Can Portrait Drawing Foster Socio-Emotional Skills?

Development and Experimental Evaluation of Evidence-Based Visual Arts Courses in the Art Museum to Foster Adolescents' Empathy and Self-Concept

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Lydia Marina Kastner, M. Sc.

aus Heilbronn

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"...it's like this. Sometimes, when you've a very long street ahead of you, you think how terribly long it is and feel sure you'll never get it swept. And then you start to hurry. You work faster and faster and every time you look up there seems to be just as much left to sweep as before, and you try even harder, and you panic, and in the end you're out of breath and have to stop – and still the street stretches away in front of you. That's not the way to do it.

You must never think of the whole street at once, understand? You must only concentrate on the next step, the next breath, the next stroke of the broom, and the next, and the next. Nothing else.

That way you enjoy your work, which is important, because then you make a good job of it. And that's how it ought to be.

And all at once, before you know it, you find you've swept the whole street clean, bit by bit. What's more, you aren't out of breath. That's important, too..."

Michael Ende, *Momo*

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"Art is not what you see but what you make others see."

Edgar Degas

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Lydia

SUMMARY

In recent years, engagement with the arts has emerged as a topic of increasing interest for politics, research, and society on both a national and international level (Scheunpflug & Prenzel, 2013; Scheunpflug et al., 2021). With regard to the visual arts, for instance, this special interest is reflected not only in a widely available infrastructure in the form of museums and exhibitions, which allow everyone access to the arts, but also in the fact that visual arts are expected to yield beneficial effects on personal development and thus are an integral part of school education systems throughout the world (Americans for the Arts, 2022; National Art Education Association, 2022). Additionally, it is claimed that visual arts engagement foster not only creative activities and participation of educated citizens in society but might also play an integral role in developing social competencies (cf. BMBF, 2015; Timm et al., 2020). Social competencies, in turn, might determine the success of social interactions (Dede, 2010) and might be related to well-being, and quality of life (Collie, 2019; Eisenberg et al., 2015; Goodman et al., 2015). Especially, the ongoing Covid-19 pandemic has highlighted the consequences of social isolation and lack of visual arts engagement, for instance, on individual well-being (Hetland & Kelley, 2022; UNESCO, 2020, 2021).

Nowadays, it is not surprising that many scientists were particularly interested in studying *what*, *when*, *how*, *where*, and *under which circumstances* positive "side effects" (in the following mentioned as transfer effects) beyond direct effects from artistic activities occur (e. g., Mozart effect, Bastian et al., 2000; Rauscher et al., 1993). However, it become apparent that finding evidence for such assumed transfer effects is rather challenging as many studies could not convincingly demonstrate their existence (e. g., Hetland & Kelley, 2022; Winner, Goldstein, et al., 2013). Winner, Goldstein, et al. (2013) could point out in their meta-analysis that most studies in this research area possess theoretical and methodological flaws (e. g., a lack of theoretically justified measures, a lack of experimental studies, and a lack of sufficiently large group sizes). As a result, this leads to the conclusion that robust and reliable studies on transfer effects regarding different art forms have only rarely been conducted so far.

For that reason, a central aspect of this dissertation is to investigate presumed transfer effects of visual arts engagement with an optimized experimental study design that avoids many of the pitfalls of previous research as reported by Winner, Goldstein, et

al. (2013). The main research question, thereby, is whether visual arts engagement can lead to socio-emotional transfer effects. In addition, the question arises how visual arts course programs must be designed and which underlying mechanisms might play a role, such as drawing activities and personal prerequisites. To answer the research questions, this dissertation developed a course program *"Emotions, Self-Concept, & Epochs – Exploring Portraits With a Digital Drawing Pencil"* consisting of three visual arts courses that differed only in their content (for an overview, Kastner et al., 2020). Two of the visual arts courses addressed socio-emotional skills, empathy, or self-concept using an instructional design, while the control course focused on historical periods. The course program was conducted over a period of three weeks at the Herzog Anton Ulrich Museum in Braunschweig. The data set underlying this dissertation for the evaluation of the course program was acquired in two collection phases. Generally, the empirical studies in this dissertation are based on data from $N = 294$ adolescents between the ages of 12 and 19, although not all data were included in all studies. Study 1 conducted an overall analysis ("general look"), examining all three visual arts courses for their specific effectiveness on socio-emotional transfer effects. In contrast, Studies 2 and 3 focused on the specific target constructs, empathy, and self-concept, separately for which transfer effects were found. In Study 2, the focus was primarily on the first target construct (empathy/emotion recognition), drawing activities and mechanisms known from the learning-by-drawing literature. Whereas in Study 3, the focus was on the second target construct (self-concept/self-complexity) and the personal prerequisites, such as personality traits.

Study 1 (*Designing Visual-Arts Education Programs for Transfer Effects: Development and Experimental Evaluation of (Digital) Drawing Courses in the Art Museum Designed to Promote Adolescents' Socio-Emotional Skills*) investigated whether transfer effects of visual arts engagement on socio-emotional skills, namely empathy and self-concept, exist. Therefore, two "psychological instructed" visual arts courses focusing on socio-emotional skills (i. e., emotion course, self-concept course) were compared to a traditional course focusing on historical periods (i. e., epoch course, not focused on socio-emotional skills). The results showed that transfer effects on socio-emotional skills could be achieved, but only when they were properly designed into the visual arts engagement. Concretely, specific effects on the emotion recognition abilities as subfacet of empathy could be found for the emotion course (i. e., measured with an animated morph task, Schönenberg et al., 2014), as well as on self-complexity, for the self-concept course (self-concept task, following McConnell, 2011), were found. However, the effect on self-complexity was moderated by adolescents' empathy. In contrast, no specific transfer effects of the epoch course on socio-emotional skills were found. In sum, this study shows that transfer effects on socio-emotional skills can occur, but only if the visual arts engagement is designed properly. To understand the socio-emotional transfer effects in detail, in two subsequent in-depth studies the underlying mechanisms and influencing factors, such as drawing activities and personal prerequisites, were analyzed.

Study 2 (*Focusing on Emotions in Digital Drawing Courses Fosters Emotion Recognition: The Influence of Drawing Tasks and Drawing Activities*) focused on the first socio-emotional target construct of empathy/emotion recognition in detail and potential influencing factors. Since specific improvements in the emotion course on emotion recognition abilities could be demonstrated, the aim of this study is to analyze drawing parameters that are known from "classical" learning-by-drawing literature as effective, such as prior knowledge about emotions, drawing quality and drawing tasks itself (e. g., Ainsworth et al., 2011; Ainsworth & Scheiter, 2021; Cook, 2006; Cromley et al., 2020). The results of this study showed that prior knowledge had no effect on drawing quality and, in turn, no effect on the emotion recognition abilities. In contrast, declarative knowledge about emotions was mediated by drawing quality. Since drawing quality could not explain the specific findings on emotion recognition abilities, a special interest of this dissertation was on the question whether emotion recognition abilities could be predicted by drawing tasks differing in their elaboration depth or by drawing patterns. For drawing tasks with deeper elaboration (i. e., intensifying, transfer, selfie drawing tasks) more correlations with the emotion recognition abilities were found than in tasks with less deep elaboration (i. e., tracing drawing task). Since these findings were only correlative in nature, a more holistic exploratory analysis was conducted based on a machine learning approach to generalize for unseen data and to have a look at the bigger picture. The aim of this approach is to go beyond individual correlations between drawing patterns and emotion recognition abilities by training a supervised machine learning algorithm to identify complex patterns of drawing behavior that can robustly predict high (or low) improvements in emotion recognition abilities when all features are considered simultaneously. Thereby, it could be shown that time pencil on tablet or pencil pressure might be able to predict course effectiveness on the acquisition of emotion recognition abilities.

Study 3 (*How and Under Which Circumstances Might Visual Arts Engagement Support Adolescents' Self-concept Development? Psychological Boundary Conditions for Socio-Emotional Transfer Effects of Visual Arts Programs*) focused on the second socio-emotional target construct, self-concept/self-complexity, and the comparison with the epoch course. The baseline model used to explain the effects on self-complexity could only explain ~25 % variance in the data. In the following, special interest was on other influencing factors that might help to explain the data variance comparing the self-concept course with the epoch course. Therefore, an exploratory machine learning approach was again used to identify the most relevant patterns from personality (as well as drawing data) to predict course outcomes on a complex self-concept. Thereby, strongest feature importance values could be found for the personality traits of agreeableness and the drawing feature altitude. Based on these exploratory findings, moderators influencing the effects on a complex self-concept could be identified. Adolescents with low levels of empathy and agreeableness benefited most in terms of building a complex self-concept from visual arts engagement, while adolescents with high levels of empathy and agreeableness could not benefit. In sum, this study provides significant insights into the relation between personality, drawing and learning in the visual arts.

Overall, this dissertation makes an important theoretical and methodological contribution to research on the transfer effects of visual arts engagement in the context of promoting socio-emotional skills. This dissertation shows using an interdisciplinary approach that the design of visual arts engagement is important to promote socio-emotional skills (e. g., empathy or self-concept). However, the results showed that socio-emotional transfer effects could only be found under certain circumstances. Therefore, an important step ist to consider the underlying mechanisms of drawing and personality traits. Lastly, this dissertation provides implications for the design of cultural education programs (also in other areas of cultural education) for museums and health psychology.

ZUSAMMENFASSUNG

In den letzten Jahren erreicht Kunst zunehmend das nationale und internationale Interesse von Politik, Forschung und Gesellschaft (Scheunpflug & Prenzel, 2013; Scheunpflug et al., 2021). In Bezug auf die bildenden Künste beispielsweise zeigt sich dieses besondere Interesse nicht nur in einer weithin verfügbaren Infrastruktur in Form von Museen und Ausstellungen, die jedermann den Zugang zu den Künsten ermöglichen, sondern auch in der Tatsache, dass von den bildenden Künsten positive Auswirkungen auf die persönliche Entwicklung erwartet werden und sie daher ein integraler Bestandteil der Schulbildungssysteme auf der ganzen Welt sind (Americans for the Arts, 2022; National Art Education Association, 2022). Darüber hinaus wird behauptet, dass die Beschäftigung mit den bildenden Künsten nicht nur kreative Aktivitäten und die Teilhabe gebildeter Bürger an der Gesellschaft fördert, sondern auch eine wesentliche Rolle bei der Entwicklung sozialer Kompetenzen spielen kann (vgl. BMBF, 2015; Timm et al., 2020). Soziale Kompetenzen wiederum könnten den Erfolg sozialer Interaktionen (Dede, 2010) und mit dem Wohlbefinden und der Lebensqualität in Zusammenhang stehen (Collie, 2019; Eisenberg et al., 2015; Goodman et al., 2015). Insbesondere die aktuelle Covid-19-Pandemie hat die Folgen sozialer Isolation und mangelnden Engagements in der bildenden Kunst für das individuelle Wohlbefinden aufgezeigt (Hetland & Kelley, 2022; UNESCO, 2020, 2021).

Heutzutage ist es nicht verwunderlich, dass viele Wissenschaftler besonders daran interessiert waren zu untersuchen, *was*, *wann*, *wie*, *wo* und *unter welchen Umständen* positive „Nebeneffekte“ (im Folgenden als Transfereffekte bezeichnet) jenseits der direkten Effekte künstlerischer Aktivitäten auftreten (z. B. Mozarteffekt, Bastian et al., 2000; Rauscher et al., 1993). Es hat sich jedoch gezeigt, dass die Suche nach Belegen für solche angenommenen Transfereffekte recht schwierig ist, da viele Studien ihre Existenz nicht überzeugend nachweisen konnten (z. B. Hetland & Kelley, 2022; Winner, Goldstein, et al., 2013). Winner, Goldstein, et al. (2013) konnten in ihrer Meta-Analyse darauf hinweisen, dass die meisten Studien in diesem Forschungsbereich theoretische und methodische Mängel aufweisen (z. B. ein Mangel an theoretisch begründeten Messgrößen, ein Mangel an experimentellen Studien und ein Mangel an ausreichend großen Gruppengrößen). Dies führt zu der Schlussfolgerung, dass robuste und zuverlässige Studien zu

Transfereffekten in Bezug auf verschiedene Kunstformen bisher nur selten durchgeführt wurden.

Ein zentraler Aspekt dieser Dissertation ist es daher, vermutete Transfereffekte der Beschäftigung mit Bildender Kunst mit einem optimierten experimentellen Studiendesign zu untersuchen, das viele der von Winner, Goldstein, et al. (2013) berichteten Fallstricke bisheriger Forschung vermeidet. Die Hauptforschungsfrage ist dabei, ob die Beschäftigung mit visueller Kunst zu sozio-emotionalen Transfereffekten führen kann. Zudem stellt sich die Frage, wie Bildender Kunst Kursprogramme gestaltet sein müssen und welche zugrundeliegenden Mechanismen eine Rolle spielen könnten, wie z. B. Zeichnen und persönliche Voraussetzungen. Um die Forschungsfragen dieser Dissertation zu beantworten, wurde ein Kursprogramm *„Emotions, Self-Concept, & Epochs - Exploring Portraits With a Digital Drawing Pencil“* entwickelt, das aus Kursen zur Bildenden Kunst besteht, die sich nur in ihren Inhalten unterscheiden (für einen Überblick, Kastner et al., 2020). Zwei der Kunstkurse beschäftigten sich mit sozio-emotionalen Kompetenzen, Empathie oder Selbstkonzept unter Verwendung eines Instruktionsdesigns, während sich der Kontrollkurs auf historische Epochen konzentrierte. Das Kursprogramm wurde über einen Zeitraum von drei Wochen im Herzog Anton Ulrich-Museum in Braunschweig durchgeführt. Der dieser Dissertation zugrunde liegende Datensatz zur Evaluation des Kursprogramms wurde in zwei Erhebungsphasen gewonnen. Generell basieren die empirischen Studien in dieser Dissertation auf Daten von $N = 294$ Jugendlichen im Alter von 12 bis 19 Jahren, wobei nicht alle Daten in alle Studien einbezogen wurden. In Studie 1 wurde eine Gesamtanalyse („general look“) durchgeführt, in der alle drei Bildungskurse auf ihre spezifische Wirksamkeit auf sozio-emotionale Transfereffekte untersucht wurden. Im Gegensatz dazu konzentrierten sich die Studien 2 und 3 auf die spezifischen Zielkonstrukte Empathie und Selbstkonzept, für die separate Transfereffekte gefunden wurden. In Studie 2 lag der Schwerpunkt in erster Linie auf dem ersten Zielkonstrukt (Empathie/Emotionserkennung) sowie auf Zeichenaktivitäten und Mechanismen, die aus der Literatur zum Lernen durch Zeichnen bekannt sind. In Studie 3 hingegen lag der Fokus auf dem zweiten Zielkonstrukt (Selbstkonzept/Selbstkomplexität) und den persönlichen Voraussetzungen, wie z. B. Persönlichkeitsmerkmalen.

Studie 1 (*Designing Visual-Arts Education Programs for Transfer Effects: Development and Experimental Evaluation of (Digital) Drawing Courses in the Art Museum Designed to Promote Adolescents' Socio-Emotional Skills*) untersuchte, ob Transfereffekte der Beschäftigung mit visueller Kunst auf sozio-emotionale Fähigkeiten, nämlich Empathie und Selbstkonzept, existieren. Dazu wurden zwei „psychologisch angeleitete“ Kunstkurse, die sich auf sozio-emotionale Fähigkeiten konzentrieren (Emotionskurs, Selbstkonzeptkurs), mit einem traditionellen Kurs verglichen, der sich auf historische Epochen konzentriert (Epochenkurs, nicht auf sozio-emotionale Fähigkeiten ausgerichtet). Die Ergebnisse zeigten, dass Transfereffekte bei den sozio-emotionalen Kompetenzen erzielt werden konnten, allerdings nur, wenn sie in die Beschäftigung mit den visuellen Künsten angemessen integriert wurden. Konkret wurden für den Emotionskurs spezifische Effekte auf die Emotionserkennungsfähigkeiten als Teilaspekt der Empathie (gemessen mit der Animated Morph Task, Schönenberg et al., 2014) sowie auf die Selbstkomplexität für den Selbstkonzeptkurs (Selbstkonzeptaufgabe, in Anlehnung an McConnell, 2011) gefunden. Allerdings wurde der Effekt auf die Selbstkomplexität durch die Empathie der Jugendlichen moderiert. Im Gegensatz dazu wurden keine spezifischen Transfereffekte des Epochenkurses auf sozio-emotionale Fähigkeiten gefunden. Zusammenfassend zeigt diese Studie, dass Transfereffekte auf sozio-emotionale Fähigkeiten auftreten können, aber nur, wenn die Beschäftigung mit visueller Kunst richtig gestaltet ist. Um die sozio-emotionalen Transfereffekte im Detail zu verstehen, wurden in zwei anschließenden Vertiefungsstudien die zugrundeliegenden Mechanismen und Einflussfaktoren, wie z. B. die zeichnerischen Aktivitäten und die persönlichen Voraus-setzungen, analysiert.

Studie 2 (*Focusing on Emotions in Digital Drawing Courses Fosters Emotion Recognition: The Influence of Drawing Tasks and Drawing Activities*) fokussierte auf das erste sozio-emotionale Zielkonstrukt der Empathie/Emotionserkennung im Detail und auf mögliche Einflussfaktoren. Da spezifische Verbesserungen des Emotionskurses auf die Emotions-erkennungsfähigkeiten nachgewiesen werden konnten, ist das Ziel dieser Studie die Analyse von Zeichenparametern, die aus der „klassischen“ Learning-by-Drawing-Literatur als wirksam bekannt sind, wie z. B. Vorwissen über Emotionen, Zeichenqualität und Zeichenaufgaben selbst (z. B. Ainsworth et al., 2011; Ainsworth & Scheiter, 2021; Cook, 2006; Cromley et al., 2020). Die Ergebnisse dieser Studie zeigten, dass das Vorwissen keinen Einfluss auf die Zeichen-qualität und damit auch nicht auf die Fähigkeit zur Emotionserkennung hatte. Im Gegensatz dazu wurde das deklarative Wissen über Emotionen durch die Zeichenqualität vermittelt. Da die Zeichenqualität die spezifischen Befunde zu den Emotionserkennungs-fähigkeiten nicht erklären konnte, lag ein besonderes Interesse dieser Dissertation auf der Frage, ob Emotionserkennungsfähigkeiten durch Zeichenaufgaben mit unterschiedlicher Elaborations-tiefe oder durch Zeichenmuster vorhergesagt werden können. Für Zeichenaufgaben mit tieferer Elaboration (z. B. Intensivierungs-, Transfer-, Selfie-Zeichenaufgaben) wurden mehr Korrelationen mit den Emotionserkennungsfähigkeiten gefunden als bei Aufgaben mit weniger tiefer Elaboration (z. B. Nachzeichenaufgabe). Da diese Ergebnisse nur korrelativer Natur waren, wurde eine ganzheitlichere explorative Analyse auf der Grundlage eines maschinellen Lernansatzes durchgeführt, um für ungesehene Daten zu verallgemeinern und einen Blick auf das Gesamtbild zu werfen. Ziel dieses Ansatzes ist es, über einzelne Korrelationen zwischen Zeichnungsmustern und Emotionserkennungsfähigkeiten hinauszugehen, indem ein überwachter maschineller Lernalgorithmus trainiert wird, um komplexe Muster des Zeichnungsverhaltens zu identifizieren, die robuste Vorhersagen über hohe (oder niedrige) Verbesserungen der Emotionserkennungsfähigkeiten ermöglichen, wenn alle Merkmale gleichzeitig berücksichtigt werden. Dabei konnte gezeigt werden, dass die Zeit, die der Stift auf dem Tablett verweilt, oder der Druck des Bleistifts in der Lage sein könnten, die Effektivität des Kurses für den Erwerb von Emotionserkennungsfähigkeiten vorherzusagen.

Studie 3 (*How and Under Which Circumstances Might Visual Arts Engagement Support Adolescents' Self-concept Development? Psychological Boundary Conditions for Socio-Emotional Transfer Effects of Visual Arts Programs*) konzentrierte sich auf das zweite sozio-emotionale Zielkonstrukt, das Selbstkonzept/Selbstkomplexität, und den Vergleich mit dem Epochenverlauf. Das zur Erklärung der Effekte auf die Selbstkomplexität verwendete Basismodell konnte nur ~25 % der Varianz in den Daten erklären. Im Folgenden galt das besondere Interesse anderen Einflussfaktoren, die zur Erklärung der Datenvarianz beim Vergleich des Selbstkonzeptkurses mit dem Epochenkurs beitragen könnten. Daher wurde erneut ein explorativer Ansatz des maschinellen Lernens verwendet, um die relevantesten Muster aus der Persönlichkeit (sowie aus den Zeichnungsdaten) zur Vorhersage von Kursergebnissen zu einem komplexen Selbstkonzept zu identifizieren. Dabei konnten die stärksten Merkmalsbedeutungswerte für die Persönlichkeitseigenschaften Verträglichkeit und das Merkmal Zeichnungshöhe gefunden werden. Auf der Grundlage dieser explorativen Befunde konnten Moderatoren identifiziert werden, die die Effekte auf das komplexe Selbstkonzept beeinflussen. Jugendliche mit niedrigem Empathie- und Verträglichkeitsniveau profitierten am meisten vom Aufbau eines komplexen Selbstkonzepts durch die Beschäftigung mit visueller Kunst, während Jugendliche mit hohem Empathie- und Verträglichkeitsniveau nicht davon profitieren konnten. Insgesamt liefert diese Studie wichtige Erkenntnisse über die Beziehung zwischen Persönlichkeit, Zeichnen und Lernen in der bildenden Kunst.

Insgesamt leistet diese Dissertation einen wichtigen theoretischen und methodischen Beitrag zur Erforschung der Transfereffekte der Beschäftigung mit bildender Kunst im Kontext der Förderung sozio-emotionaler Kompetenzen. Die Dissertation zeigt anhand eines interdisziplinären Ansatzes, dass die Gestaltung der Beschäftigung mit Bildender Kunst wichtig für die Förderung sozio-emotionaler Kompetenzen ist (z. B. Empathie oder Selbstkonzept). Die Ergebnisse zeigen jedoch, dass sozio-emotionale Transfereffekte nur unter bestimmten Bedingungen gefunden werden können. Daher ist es wichtig, die zugrunde liegenden Mechanismen von Zeichnen und Persönlichkeitsmerkmalen zu berücksichtigen. Schließlich liefert diese Dissertation Implikationen für die Gestaltung von kulturellen Bildungs-programmen (auch in anderen Bereichen der kulturellen Bildung) für Museen und die Gesundheitspsychologie.

CONTENTS

CHAPTER 1

INTRODUCTION & THEORETICAL BACKGROUND

"Silence descends without arts and culture"[1] — The Covid-19 pandemic painfully shows us the importance of social interactions and their impact on an individual's well-being (Sun et al., 2020; Tymoszuk et al., 2021). Furthermore, lockdowns and behavioral restrictions of the last two years have demonstrated the great importance of various pathways of the arts, which cover aspects as diverse as listening to and creating music, dancing, acting, watching a play in a theater, or visiting a museum (Jeanotte, 2021). This emphasizes the arts as an important medium to get in touch with other people, to pass on information, to share, express, interpret, categorize or explore personal experiences, emotions, thoughts, and identities (Konrath & Kisida, 2021; Winner, 2019). However, it is not new that the arts and the engagement in the arts are considered to enable access to essential components of human culture, personal and cultural identity, and personal development (Wilson, 2007). For instance, the enquete commission "Culture in Germany" of the German Bundestag (2007, p. 379) claimed more than ten years ago: "Through arts education, basic skills and abilities are acquired that are central to the young person's personality development, emotional stability, self-realization, and identity formation". Subsequently, representatives of cultural and arts institutions highlighted the special nature and value of the arts in our society and their essential contribution in times of crisis (e. g., United Nations Educational, Scientific and Cultural Organization (UNESCO), 2020, 2021). With regards to the visual arts, for instance, this special nature is reflected not only in a widely available infrastructure in the form of museums and exhibitions, which allow everyone entrance to the arts, but also in the fact that visual arts are an integral part of school education systems throughout the world and thus are expected to yield beneficial effects on personal development (Americans for the Arts, 2022; National Art Education Association, 2022).

[1] German Campaign *"Ohne Kunst und Kultur wird's still"*; `https://www.ohnekunstundkulturwirdsstill.de` (Last Access: 2021-03-14).

Since visual arts' effects on personal development beyond immediate direct effects, such as the acquisition of aesthetic and creative competencies or drawing skills, are assumed, empirical research on positive "side effects" of visual arts engagement that lie outside the specific subject area is growing (in the following mentioned as *transfer effects*, Knigge, 2013). Research on transfer effects, especially in Germany, received a particular boost from the famous *"Mozart Effect"* study published by Rauscher et al. (1993). This study indicated a direct relation between listening to classical music and cognitive performance. Consequently, scientists, politicians, and the public all over the world became interested in studying beneficial transfer effects not only in the field of music but also in other areas of artistic engagement, including the visual arts. As a result, numerous efforts to prove transfer effects claimed on academic outcomes, standardized test scores, or drop-out rates in schools, but also socio-emotional outcomes, like empathy, prosocial behavior or self-complexity, have been made (for an overview see Wilson, 2018; Winner, Goldstein, et al., 2013). However, it became apparent that finding empirical evidence for such assumed transfer effects is rather challenging as many studies could not convincingly demonstrate their existence. One important reason for this problem was pointed out in a meta-analysis by Winner, Goldstein, et al. (2013) on the state of evidence for presumed transfer effects for different genres of arts, stating that most studies in this research area possess theoretical and methodological flaws. As a result, this leads to the conclusion that robust and reliable studies on transfer effects regarding different art forms have only rarely been conducted so far. For that reason, a central aspect of this dissertation is to examine presumed transfer effects of visual arts engagement with an optimized study design that avoids many of the pitfalls of previous research as reported by Winner, Goldstein, et al. (2013). Specifically, this dissertation is an attempt to overcome the three main problems that characterize the current study situation, namely

- *a lack of theoretically justified measures* for transfer effects of interest (often due to a lack of basic theoretical models describing possible mechanisms underlying these transfer effects),
- *a lack of randomized experimental studies* (often correlative relations or self-selected groups are examined, which may vary in several characteristics apart from membership in an experimental group, so that no causal inferences can be drawn), and
- *a lack of sufficiently large group sizes* (which are required to ensure that effects found are beyond random variation by means of inferential statistics).

These three basic problems can be found in many studies in the literature on transfer effects and can be illustrated more concretely by an example study, such as Bastian et al. (2000). This (at least in Germany) very well-known and controversial study claimed to demonstrate positive transfer effects of primary school students' engagement with music lessons on their social competencies and intelligence. Despite its popularity, the longitudinal study was harshly criticized for severe methodological limitations regarding the three above-mentioned problems (e. g., Knigge, 2004). First, it did not use randomized experimental comparisons. Rather, it compared music-focused schools to schools without a focus on music. Students deciding to attend a school with a focus on music, of course, might differ from those attending a school without such a focus in a wide variety of ways (e. g., their personality, motivation, or socio-economic background), which could just as well form the basis of better developmental trajectories as the specific music lessons that were in the focus of the study (i. e., *self-selection effects*). Second, regarding the sample size it was highly problematic that only two control classes were included in the study. As the allocation to the two reference groups (music-focused or not) took place at class level, results cannot be validated by inferential statistics either (see also Ader, 2008; for a general overview over the statistical limitations of current studies, Kröner et al., 2021). And third, there was a severe gap between (1) the target constructs addressed in the study, namely social competencies, and intelligence, (2) the far-reaching interpretations and conclusions drawn regarding the positive transfer effects for these target constructs, and (3) the specific course contents, tasks and concrete measurements used to assess improvements regarding these constructs. For example, a decrease in antipathy (measured by the number of disliked classmates) was found in the classes with music lessons but not in those without music lessons. This decrease was interpreted as evidence for improved social competencies in classes with music lessons. However, there was no theoretical justification on how this measure related to specific social competencies in terms of underlying theoretical mechanisms and to how these mechanisms might have been influenced by music lessons. Accordingly, it has been criticized that many other processes unrelated to an increase in social competencies could have been responsible for this observation (e. g., Jäncke, 2008). For instance, students attending additional music classes might have become increasingly arrogant over time and might have tended to think they were superior to others and therefore rated themselves and their classmates less negatively. Such a process would explain the effect but does not indicate increased social competencies. Despite these theoretical caveats, Bastian and colleagues nevertheless concluded that an extension of lessons of music in schools is a sure guarantee in the prevention of aggression and violence by means of antipathy (cf. Jäncke, 2008). For a scientific justification, of course, such an exaggerated claim would require a much better theoretical and empirical understanding of the antipathy measure used and the mechanisms relating this measure to social competencies, aggression, and violence.

In the last couple of years, methodological limitations of existing transfer effect studies have been more explicitly recognized in the German and international research community on arts education, and efforts have been made to overcome these problems. This process can exemplarily be seen in numerous large funding initiatives such as

"*Förderung von Forschungsvorhaben in der Kulturellen Bildung*"[2] (engl.: "*Funding of Research Projects in Arts Education*"; Bundes Ministerium für Bildung und Forschung (engl.: Federal Ministry of Education and Research) (BMBF), 2015), and "Kultur macht stark" (engl.: "*Culture makes strong*"; BMBF, 2016), as well as "*Forschung zur Digitalisierung in der Kulturellen Bildung*" (engl.: "*Research on Digitization in Arts Education*"; BMBF, 2017). This dissertation, which has been funded by the first, aims to contribute to closing existing methodological gaps in the field of transfer effects. Beyond the methodological aspect, this dissertation also aims at generating new insights into the potential role of visual arts engagement for the development of social competencies (in the following referred to as socio-emotional skills (SES) or socio-emotional transfer (SET) effects). In particular, the question will be addressed, whether, how, and under what conditions various socio-emotional skills can be enhanced by engaging with visual arts.

For answering these questions, the Chapters of this dissertation are structured according to the following order: The theoretical background will be presented in the introduction (»Chapter 1«), which is split into three parts: First, the current state of the empirical studies on transfer effects will be reflected from a psychological perspective, especially in the field of visual arts (»Chapter 1.1«). Second, some theories and frameworks regarding transfer effects of (visual) arts engagement and their limitations will be provided in »Chapter 1.2«. Based on these theories and frameworks, »Chapter 1.3« proposes a specific theoretical framework that focuses on transfer effects of visual arts engagement and the fostering of socio-emotional skills. This framework will be used to elaborate and discuss under which circumstances it seems reasonable that socio-emotional skills could be addressed through visual arts engagement. Therefore, in »Chapter 2« the concrete visual arts education program *"Emotions, Self-Concept, & Epochs – Exploring Portraits With a Digital Drawing Pencil"* that was developed in this dissertation and forms the core of the realized studies is introduced. The course program is consisting of three courses that differ only in their content. »Chapter 3« is dedicated to the research questions addressed in the three empirical studies. This is followed by the empirical studies in »Chapters 4 - 6« that based on data from $N = 294$ adolescents between the ages of 12 and 19 years, although not all data were included in all studies. Study 1 conducted an overall analysis ("general look"), examining all three visual arts courses for their specific effectiveness on socio-emotional transfer effects in the context of an art museum (»Chapter 4«). In contrast, Studies 2 and 3 focused on the specific target constructs, empathy, and self-concept, separately for which transfer effects were found. In Study 2, the potential of specific drawing activities and mechanisms, the role of drawing quality as well as prior knowledge (known as effective parameters from the learning-by-drawing literature) were examined regarding the first target construct em-

[2]This dissertation project was funded within this funding guideline "Förderung von Forschngsvorhaben in der Kulturellen Bildung" of the German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF, funding code: 01JK1617).

pathy/emotion recognition (»Chapter 5«). Whereas Study 3 examines the constraints of supporting the socio-emotional skill of self-concept/self-complexity through a visual arts education program with a special focus on boundary conditions of personal prerequisites and personality traits (»Chapter 6«). In »Chapter 7« the findings of the empirical studies are summarized, integrated, and discussed regarding strengths and limitations. Finally, implications for research, practice, and future directions are given.

1.1 Visual Arts "Beyond Visual Art's Sake"? – Theoretical Claims and Empirical Findings on the Effects of Visual Arts Engagement

In recent years, literature on the impact of the visual arts beyond their visual "art's sake" is growing in quantity, varying in the used methods and their quality, in the learning environments, as well as in the addressed audience (e. g., Hetland & Kelley, 2022; Winner, Goldstein, et al., 2013). Although numerous efforts have been made to systematically investigate the benefits of the visual arts in national and international context, most of the literature addresses claims or hopes of non-empirical advocacies and theories (Chemi, 2015; Hetland & Kelley, 2022). However, this might be the case because representatives of arts and cultural institutions tried to find arguments why students should learn and engage with the visual arts in the school context (e. g., Heisig et al., 2020). In this Chapter, I review in detail the empirical findings on transfer effects of visual arts engagement[3]. But before the literature review is presented, a more general remark on the topic of transfer effects will be given, as well as a definition what is meant by *transfer effects* in comparison to the direct learning effects (so-called *primary effects*) in this dissertation.

From my point of view (and that of my colleagues), the primary focus and aim of visual arts engagement should be to provide every individual access to this valuable part

[3]The present dissertation focuses on visual arts engagement for the following reasons: First, the visual arts belong to the "traditional" art forms, as they are an important part of human culture and a central part of school curricula all over the world (e. g., Winner, 2019). As Sparks et al. (2015) reported in their study, music and visual arts lessons are offered in more than 90 % of the elementary and secondary schools, while dance and theater are only offered in less than 50 % of the schools (Parsad & Spiegelmann, 2012). Second, looking at the amount of research that was undertaken to analyze the effects of music lessons and/or music engagement on an individual's performance and skill development compared to visual arts, it is evident that the field of visual arts engagement is empirically lacking far behind. This can exemplarily be seen by the fact that for the field of music transfer effects have already been investigated much more than the visual arts, as studies by Rauscher et al. (1993) or Bastian et al. (2000) show. These two popular and at the same time controversial studies might be the reason why many researchers focused more frequently on transfer effects of music rather than the visual arts, either to replicate their findings or to refute them. A recent review demonstrated that 12 of 24 (quasi-) experimental studies on transfer effects of arts focused on music, compared to only a single study analyzing transfer effects of the visual arts (Schneider & Rohmann, 2021). The fact that visual arts have been severely understudied so far, qualifies them as a promising candidate to elaborate on the existence and extent of transfer effects.

of human culture and society, encourage personal growth and foster self-knowledge (cf. Sherman & Morrissey, 2017). However, the focus should not be primarily on transfer effects that might come along. It could be highly beneficial when visual arts engagement is designed in a way so that it promotes skills and competencies that go beyond the actual arts contents involved. This idea is in accordance with the so-called *arts-integrated education approach* in which the (visual) arts and at least one other discipline meets both artistic standards as well as the standards of the discipline itself (for an overview, see Burnaford et al., 2007; Casciano et al., 2019; The Kennedy Center, 2021). For instance, the John F. Kennedy Center for Performing Arts (p. 1) describes "arts integration (AI)" as "[...] an *approach* to *teaching* in which students construct and demonstrate *understanding* through *art form.* Students engage in a *creative process* that *connects* one art form and another subject area and meets *evolving objects* in both"[4]. Nevertheless, even if one agrees with this line of thought the following questions remain open: Which transfer effects of visual arts engagement can be expected under specific conditions, and how can visual arts education programs be better designed to initiate and improve specific transfer effects in terms of an arts-integrated approach?

1.1.1 Primary Versus Transfer Effects: Defining the Construct of Interest

When a new arts subject or content is being learned, learning can have subject-specific as well as general benefits (Keuchel, 2019). Two types of benefits can be distinguished, namely *primary* and *transfer effects.* First, primary effects describe the direct, subject-specific learning effects that can occur in the great diversity of artistic disciplines (e. g., music, theater, or visual arts; Hetland et al., 2013; Hogan et al., 2018; Hogan & Winner, 2019). This includes, for instance, increased musical understanding after a music lesson or increased drawing skills after participating in a visual arts course (Keuchel & Reinwand-Weiss, 2016). Second, transfer effects do not describe effects on subject-specific learning, but rather effects on skills outside a subject or key competencies of the visual arts (cf. Bamford, 2010; Winner, Goldstein, et al., 2013). These transfer effects outside of the visual arts themselves can naturally occur because of similarities or an instructional study design (see also intrinsic vs. instrumental transfer effects; McCarthy et al., 2004; Schneider & Rohmann, 2021). In the Rauscher et al. (1993) study about the Mozart effect, for instance, students who listened to classical music showed higher cognitive skills after listening. A primary effect in this case would be better recognition of the sound of a violin, any other instrument, or a tone sequence that was played in the piece listened to. General improvement in skills outside the key competencies of the arts, such as mathematical or geometrical reasoning skills or prosodic speech recognition

[4] https://www.kennedy-center.org/education/resources-for-educators/classroom-resources/articles-and-how-tos/articles/collections/arts-integration-resources/what-is-arts-integration/ (Last Access: 2022-01-26).

(quite near to recognition of tone sequences) would be signs of distant or near transfer effects.

In line with this concept of transfer effects, even broader objectives of visual arts have been formulated, such as promoting individuals' engagement with their environment and society (Emert, 2009) or developing innovative power to shape society (Nettke, 2017; see also the recommendation of the German Kultusministerkonferenz zur kulturellen Kinder- und Jugendbildung, 2007/2013). However, many authors criticize a strong focus on transfer effect expectations for not considering the intrinsic value of artistic-creative activities enough (e. g., Fink et al., 2010; Knigge, 2013; Rittelmeyer, 2012a, 2012b, 2013, 2018). Thus, the arts-integrated education approach is proposed to be an elegant solution that simultaneously focuses on the intrinsic value of the visual arts and its benefits on extracurricular learning disciplines (Bamford, 2010; Burnaford et al., 2007; Deasy, 2003; Goldberg, 2006; Grumet, 2004). In addition, understanding the psychological processes underlying primary and transfer effects is important to evaluate the broader impact of learning with the visual arts (compare underlying processes in classroom learning, Black et al., 2004; Black & Wiliam, 2010). The next section focuses on specific studies providing evidence of transfer effects, especially in the socio-emotional domain.

1.1.2 Overview of The Empirical Findings of Visual Arts Engagement on Socio-Emotional Transfer Effects – A Literature Review

Since positive transfer effects of visual arts engagement are often expected, for example from non-empirical advocacies, it is not surprising that many scientists were particularly interested in studying *what*, *when*, *how*, *where*, and *under which circumstances* transfer effects occur (Hetland & Winner, 2001; Winner, Goldstein, et al., 2013; Winner & Hetland, 2000). However, the state of research does not provide clear evidence so far. For instance, Winner, Goldstein, et al. (2013) meta-analyzed transfer effects of different art genres (music, visual arts, dancing, theater) on academic, creativity, motivational, socio-emotional, or brain outcomes. Generally, the quality of the studies was hetereogeneous in terms of their unique characteristics and context. This makes interpretation and comparability of studies or programs difficult (for more information about the theoretical and methodological problems of visual arts engagement, see »Chapter 1.1.3«, see also Ewing, 2010; Schneider & Rohmann, 2021). Just a few number of studies, for instance, are based on randomized (field) experiments or longitudinal control-group designs that allow causal conclusions regarding transfer effects. Instead most studies solely demonstrate correlational evidence which might be based on self-selection effects (see also, Konrath & Kisida, 2021). For instance, students with better prerequisites regarding socio-emotional skills might be *more* interested in participating in visual arts education programs.

In the literature review presented below, I focus only on the transfer effects of visual arts engagement on socio-emotional skills for two reasons. First, socio-emotional skills are an increasing area of interest which needs conceptual organization. Second, many institutions, educational practitioners, advocates, and policymakers have claimed the power of the arts to shape our society and consider the arts as an integral component of child development (cf. claims of the enquete commission "Culture in Germany" of the German Bundestag, 2007). But the question arises: Is there empirical evidence that visual arts are a gateway to the acquisition of socio-emotional skills? To answer this question, the literature on the effects of visual arts engagement on socio-emotional skills is reflected in the following sections. First, however, a brief definition of what is meant by socio-emotional skills in this dissertation is given.

Socio-emotional skills — sometimes also called *soft-skills* or *21st century skills* — describe important skills needed in today's social interactions, e. g., in terms of having knowledge about identifying or creating, controlling, and using emotions. Moreover, these skills are related to quality of life, success and social well-being (Collie, 2019; Eisenberg et al., 2015; Goodman et al., 2015). Because the concept of socio-emotional skills is an umbrella term, there is a larger number if research papers that has examined very different facets or sub-facets of these skills. In the pursuit of this, five important socio-emotional skills could be classified: (1) the self-awareness of own emotions (*"self-awareness"*); (2) the relationship building and maintenance ("*relationship skills*"); (3) the ability to adopt perspectives, and understand other cultures, backgrounds, and social and ethical norms ("*social awareness*"); (4) the ability to self-regulate emotions and cope with stress ("*self-management*"); and (5) the ability to make decisions and reflect on resulting outcomes and consequences ("*responsible decision making*", Casciano et al., 2019; Elias et al., 1997; Ross & Tolan, 2017). Based on the proposed facets of socio-emotional skills, the literature of visual arts engagement will be presented below. Their benefits range from effects on *emotion regulation* and *emotion recognition*, over *empathy*, *perspective taking* and *theory of mind*, to *self-concept* and *self-complexity*. These socio-emotional skills are discussed in more detail in the subsections below. Table 1 provides an overview over studies of visual arts engagement focusing on the acquisition of socio-emotional skills.

Effects of Visual Arts Engagement on Emotion Regulation and Emotion Recognition

In the context of visual arts engagement, various studies have examined the effects of visual arts on emotion regulation and emotion recognition. However, Winner, Goldstein, et al. (2013) only identified one study in their meta-analysis that addressed emotion regulation in the context of various art forms. In this study, Goldstein et al. (2012) were interested in the question of how often students in different arts classes (music, theater, visual arts) use positive or negative emotion regulation strategies. The authors, thereby, focused on the two most well-known emotion regulation strategies, namely *cognitive reappraisal* (a positive emotion regulation strategy that changes a current situation through reinterpretation or modification), and *expressive suppression* (a negative emotion regulation strategy that is used to downregulate expressions of already existing emotions, e. g. through suppressing tears; Gross, 1998, 2001, 2002, 2007). Since art forms differ in their quality to express emotions, the authors hypothesized that also the emotion regulation strategies might differ between theater, visual arts, and music classes. The results showed that students participating in theater classes in high schools used expressive suppression less frequently as an emotion regulation strategy than students in visual arts or music classes (Goldstein et al., 2012). Since the results of this study could also be due to self-selection, it is possible that individuals who participate in theater classes are less likely to use expressive suppression before course participation. To rule out such self-selection bias and to draw causal conclusions, the authors conducted a second study. In a pre-post design, the authors showed that participating in a 10-month theater class (led to a reduction of expressive suppression in elementary school students. These results suggest that theater classes might be related to less frequent use of negative emotion regulation strategies. However, students were not randomly assigned to classes, so again one must be cautious about the interpretability of the results. Nevertheless, this study shows that visual arts might not be an appropriate form of engagement to improve emotion regulation strategies.

Although, no specific effects of visual arts engagement on concrete emotion regulation strategies could be found in the study of Goldstein et al. (2012), other studies strongly focused on the aspect that drawing might allow the down-regulation of negative emotions, for example through self-expression (cf. Kramer, 2000; Waller & Gilroy, 1992). This hypothesis is in line with assumptions of art therapy research in which the engagement in the visual arts is expected to lead to catharsis or redirection (e. g., Gruber & Oepen, 2018; Sholt & Gavron, 2006). Concretely, De Petrillo and Winner (2005) considered the effects of visual arts engagement on short-term mood improvement. Therefore, the authors created a negative mood in two studies: Participants then had to draw a painting related to their feelings or copy geometrical shapes (Study 1) or solve a puzzle (Study 2). The results showed a short-term mood improvement only in the picture drawing condition, but not in the other two control conditions. In sum, these results suggest that visual arts engagement can increase the dimension of mood by catharsis or redirection, but these two dimensions could not be distinguished so far. In several follow-up studies, this basic effect of drawing on short-term mood improvement could be replicated several times. In addition, these studies tried to determine whether the effects belong to catharsis or distraction in the context of different induced emotions (Brechet et al., 2020; Dalebroux et al., 2008; Drake, 2019, 2021; Drake & Winner, 2012, 2013; Smolarski et al., 2015; Turturro & Drake, 2022). Dalebroux et al. (2008), for instance, investigated in an experimental study whether expressing (corresponding to the catharsis hypothesis) or redirecting (corresponding to the distraction hypothesis) is shown to be more effective in improving mood in the short term. After a negative mood was induced, participants should either make a drawing in which they expressed their current mood (venting condition), make a drawing in which they depicted something happy (positive emotion condition), or scan a sheet of paper for symbols (distraction condition). Results showed that venting did not contribute better to mood improvement than the distraction condition, while drawing something happy (positive emotion condition) contributed significantly to mood improvement. These results suggest that expressing feelings (in terms of catharsis) contributes less to mood improvement than redirection. Results were similarly found in the study by Smolarski et al. (2015) who used stressful life events for mood induction before assigning students to the three conditions of drawing: (1) Expressing happiness, (2) expressing current stress through drawings, or (3) coloring or tracing a line. Consistent with the study of Dalebroux et al. (2008), mood in the positive expression condition was significantly more likely to improve than in the distraction or coloring condition. Drake and Winner (2012) were in the following interested whether neutral drawings might lead to similar effects as the positive drawings. Therefore, the authors concerned the effects of neutral drawings in comparison to a venting and an only-sitting condition. They found that mood improved significantly more when engaging in visual arts (venting, neutral drawing) than in the only-sitting condition. Generally, the effects of neutral drawing were stronger than the venting condition.

These results were further replicated with children (Brechet et al., 2020; Drake & Winner, 2012). Brechet et al. (2020) examined children aged 7 and 10 years in three drawing conditions (venting, free drawing, happy drawing). Age and emotional understanding of the children were controlled for. Also, other potential influencing factors such as drawing appreciation and skills, perceived competence, and duration were measured. The children were asked to draw in any of the drawing conditions. As with the adults, there was a greater mood improvement in the free and happy drawing conditions than for venting, especially for children with intermediate emotional understanding. An important influencing factor was children's perceived competence in drawing. Besides these influencing factors, Drake and Hodge (2015) expected that also an individual's preference to different art forms might modify the findings. Therefore, the authors studied two different forms of engagement: drawing versus writing. Approximately, half of the participants were allocated randomly to their favorite activity, while the other half were allocated to their disfavored activity after inducing a negative mood. Negative affect was noted to be significantly less after drawing than after writing, regardless of the favored activity.

In addition, participants used drawing more to distract themselves and writing to express themselves. In a more recent study, James et al. (2018) studied two emotion regulation strategies (e. g., express vs. redirect) in the setting of different activities (draw, write, talk, or think). Only in drawing and thinking, redirection led to a greater positive mood compared to expression, while in all four activities redirection led to a stronger decrease of negative mood compared to expression. Based on these findings, the authors concluded that redirection is more powerful strategy to regulate emotions and improve mood, especially for thinking and drawing activities. Turturro and Drake (2022) took their current study even a step further by also examining the physiological benefits of redirection and expression in addition to the psychological benefits. After an anxiety induction, students were asked to either color a design (coloring), draw a design (redirecting), or express their thoughts and feelings in a drawing (expressing). In a pre-post design, anxiety was recorded, while respiratory sinus arrhythmia, heart rate and skin conductance were monitored throughout the testing session. The results of the study showed that anxiety could be reduced. Thereby, the heart rate decreased, the respiratory sinus arrhythmia increased in all drawing activities, regardless of the condition. However, it was found that the students asked to redirect had more fun than the students asked to express their feelings and thoughts. Thus, this current study again demonstrates that different drawing tasks can contribute to emotion regulation at psychological and physiological levels, but that, in addition, distracting drawing tasks can lead to more enjoyment.

Overall, it appears that although drawing is good to distract oneself from negative emotions, the basic hypothesis that expressive drawing has a positive effect on the regulation of negative emotions through catharsis could not be confirmed. This means, there is no reliable empirical data to justify the assumption of drawing having specific positive effects on emotion regulation strategies. Nonetheless, positive effects of visual arts engagement on mood improvement could be experimentally demonstrated. In addition, some studies on visual art have shown that extensive engagement with artistic portraits leads to less holistic and more analytical processing of emotional faces (Balas & Sinha, 2008; Zhou et al., 2012). For instance, Balas and Sinha (2008) demonstrated that no-experienced portrait drawers (i. e., novices) are more likely to misinterpret facial features than portrait drawers with experience (i. e., artists) but also that emotion recognition skills can be trained through a visual arts engagement by directing attention to relevant facial features. It can therefore be assumed that visual arts engagement is per se able to regulate emotions, and if emotions serve as content for drawing, one can additionally train emotion recognition abilities.

Effects of Visual Arts Engagement on Empathy, Perspective Taking, and Theory of Mind

Although there are great expectations that visual arts engagement can promote empathy, perspective taking and theory of mind, like the basic processes of emotion recognition and emotion regulation, the experimental evidence is similarly limited. Kou et al. (2019), for instance, analyzed four large correlational data sets on the relation between empathy/prosocial behavior and different types of arts engagement. Therefore, information on arts engagement (consuming vs. creating arts) in three arts genres (visual arts, theater, literature), prosocial traits (perspective taking, empathic concern), and prosocial behavior (e. g., donating to charity) were analyzed. Stronger correlations were found for arts consumption with prosocial behaviors (compared to prosocial traits) in comparison to arts creation. When the authors analyzed single measures of prosocial traits and arts engagement in detail, they found significant correlations between empathic concern, visual arts, and literature. It should be noted, however, that the correlations are based on cross-sectional data and do not allow causal inferences. Nevertheless, one might assume that creating visual arts (and/or literature) fosters empathy, but it is also possible that the relationship is the other way around: More empathic individuals engaged more with visual arts. Another explanation for these findings could be that the relation between visual arts and empathy is moderated or mediated by a third variable (Kou, 2018; Kou et al., 2019). As Kou et al. (2019) pointed out, visual arts and empathy could both involve emotional engagement, human connections, and imagination. Moreover, some studies showed that arts engagement and empathy even activate the same neural systems, so-called Default Mode Network (DMN) (Christensen & Gomila, 2018; Li et al., 2014; Vessel et al., 2012). To support this network idea, Bolwerk et al. (2014) showed that participants who took part in a 10-weeks visual arts program changed their DMN, while participants who only focused on cognitive evaluation of artworks showed no changes. The authors argue that these neural effects could have interesting psychological consequences, as the default mode network is related not only with understanding the emotional states of others, but also with cognitive processes related to the self, such as episodic and autobiographical memory, self-monitoring, and introspection. Accordingly, the DMN-related hypothesis about the effects of arts might also predict positive effects of visual arts engagement on prosocial behavior, perspective taking, theory of mind, and self-concept, apart from the positive effects on empathy (cf. self-concept development next section).

However, even from the neural studies that show similar brain activation patterns, there is no causal evidence for these relationships. In the few (quasi-)experimental studies that have preferred methods, comparing students participating in visual arts courses with those participating not, no positive effects on empathy/theory of mind were demonstrated. Goldstein and Winner (2012) examined the effects of different forms of arts engagement (theater, visual arts, or music) on growth in empathy and theory of mind. The authors hypothesized that theater, an art form that demands students to "step into the shoes of others" (cf. Winner, 2019), should be superior to the other two art forms. In two studies, they examined adolescents (high school students) and children (elementary school students) who received a training in either theater or other art forms (visual arts, music) for one year. Before and after the school year, students' empathy and theory of mind were recorded. As expected, significant increases in empathy could be found in both studies for participants in the theater training (but not for participants in music or visual arts training). The adolescents also showed significant gains in theory of mind (ToM). Goldstein and Winner (2012) demonstrated in this study that empathy and theory of mind are indeed modifiable through training (even long after early childhood, when these skills develop). Another key finding was that the skills can be improved through role-playing (in the context of acting/theater), but not through classical exposure to visual arts or music. However, when interpreting these results, it must be kept in mind that adolescents participated in the arts courses according to their existing interest, so the differential findings could also be attributable to self-selection effects: It might be the case that adolescents who have higher empathy skills in advance are more likely to choose theater training than other art forms because they probably have greater interest in understanding human emotions, thoughts, and actions. Nevertheless, the results of these two studies do not provide positive evidence for specific positive effects of visual arts engagement on empathy.

Beyond these two quasi-experimental studies, only two experimental studies addressing socio-emotional skills in visual arts context could be identified. Unfortunately, both studies failed to demonstrate the expected transfer effects. First, Greene et al. (2014) studied school classes which were randomized to participation (or not) in an art museum field trip. Results showed positive impact on motivational and cognitive outcomes but not on measures of perspective taking and historical empathy. Second, in a subsequent longitudinal study by Erickson et al. (2020), multiple arts-related field trips were examined (e. g., visiting a theater performance, symphony or an art museum), comparing students who took part in the three arts-related field trips with those who did not take part. Effects were again found on motivational and cognitive outcomes but not for empathy and perspective taking. A potential explanation might be that studies on visual arts engagement and empathy/perspective taking do not take important personality variables into account, although they might be crucial moderators of visual arts engagement. Since this issue might be important for the lack of positive findings on empathy, this dissertation focuses on the influence of personality traits on empathy and more generally socio-emotional skills (for more information about the influence of personality traits on socio-emotional skills, see »Chapter 1.3.2«).

Effects of Visual Arts Engagement on Self-Complexity and Self-Concept

A third well known socio-emotional skill (besides emotion recognition, emotion regulation and empathy/perspective taking/ToM), for which transfer effects have been studied in the literature, is self-concept. Some correlational studies like the study by Burton et al. (2000) showed evidence that arts-engaged students scored higher on subscales of academic self-concept than students who did not engage with the arts. The findings of Burton and colleagues are in line with the results of Catterall et al. (1999) who found that high arts-engaged children had a more positive self-concept than those with lower arts engagement. In contrast to these findings, the quasi-experimental study of Catterall and Peppler (2007) could not confirm this relation between self-concept and visual arts engagement. In a pre-post design, the authors compared elementary school students engaging in visual arts courses with those not engaging in these courses. Results showed no significantly higher gains on the global self-concept (e. g., *„I am able to do things as well as most other people"*) or the internal versus external attribution style (e. g., *„Hard work is more important than good luck"*) for students who engaged in the visual arts than for the control students. Only for self-efficacy, significant differences between the students who engaged in a visual arts course and the comparison course could be found (e. g., *„I have control over my future"*). Similarly, no connection between self-concept development and other forms of arts engagement could be established (e. g., Beales & Brook, 1990; Freeman, Sullivan, & Fulton, 2003; Warger & Kleman, 1986), although Tay et al. (2018) expected that arts engagement might lead through socialization processes to a differentiated self-concept in terms of social roles and identities. For instance, participation in the arts (e. g., visual arts, theater, music) is not only expected to enrich the individual's life through the diversification and accumulation of social roles (e. g., artist, actor, musician) but also through new networks of friends (Roberts & Donahue, 1994). Extending social roles is closely related to development of new identities and might be able to buffer stress and lead to well-being (Harrison, 2006; Thoits, 1983). Especially, for adolescents it is important to develop new identities and manage stressors because a low differentiated self-concept is associated with depression (e. g., Evans, 1994; Harrison, 2006; Tay & Diener, 2011; Tay et al., 2013).

Holochwost et al. (2021) argued that the reason why so many effects on self-concept and self-complexity could not be found is that studies on arts engagement and its expected transfer effects are too unspecific. Self-complexity and self-concept are broad constructs that encompass internal skills, self-regulation and identity formation (see also, Farrington et al., 2019). The authors suggest that it is important to take the arts genre and context/setting into account. If we do so, then it might be possible to find positive effects on self-concept. DeBettignies and Goldstein (2020), for instance, investigated the effects of improvisational theater classes (impro theater) on adolescents' self-concept in an experimental pre-posttest design. Students were randomized to impro-theater or study hall, changing after the half of the school year. Thereby, self-concept was measured with the Piers-Harris Children's Self-Concept Scale (Piers & Herzberg, 2002) at three points in time (at the start, during, and at the end of the school year). The study demonstrated a significant effect of the impro-theater classes on self-concept. However, this effect was only found for students with relatively low self-concept. The results are in accordance with other studies that also found stronger intervention effects for those with lower prerequisites (Emler, 2001; Wright, 2006). DeBettignies and Goldstein (2020), argued that the specific effects might result from cognitive constructs underlying self-concept, spontaneity, or being present in the moment (e. g., active listening, observing, emotional presence, empathy). Falk (2008, 2009), additionally, assumed that also for visual arts it should be possible to foster self-concept: Visiting an art museum should lead to processes of self-reflection and self-interpretation, and in the following to a more differentiated self-concept which encompasses social roles, physical features, and group membership. In sum, the findings on self-concept and self-complexity are heterogenous in terms of their quality, unique characteristics and definition of constructs investigated.

Conclusion

In this Chapter, I reviewed the most important empirical studies in context of visual arts engagement and the socio-emotional skills (e. g., emotion recognition/emotion regulation, empathy/perspective taking/ToM, and self-concept/self-complexity). When reviewing these findings, the question arises under which circumstances and context conditions positive transfer effects on socio-emotional skills can be found. For that reason, in the next section the problems and gaps in measuring transfer effects in visual arts will be summarized (»Chapter 1.1.3«) to subsequently derive how drawing tasks and instructions should be designed so that participants are actively “pushed” to “explore and invent”, as has been proposed by Winner, Goldstein, et al. (2013, p. 196)? Therefore, in »Chapter 1.2« general theories and frameworks of (visual) arts engagement to explain these positive transfer effects will be discussed in detail.

Table 1

Overview Over the Visual Arts Studies of Transfer Effects on Socio-Emotional Skills

Authors (year)	**Type of Study**	**Participants**	**Creation vs. Consumption**	**Duration**	**Arts-related Variable**	**Socio-emotional Variable**
Emotion Regulation/ Emotion Recognition						
Goldstein et al. (2012) (Study 1)	Correlative	Adolescents	Creation	10 months	Theater vs. visual arts vs. music [class]	↓Theater class: uses less suppression; Visual arts/Music class: no change in the use of suppression
Goldstein et al. (2012) (Study 2)	Quasi-experimental (longitudinal)	Children/Elementary school students	Creation	9/10 weeks	Theater vs. visual arts [class]	↓Theater class: uses less suppression; Visual arts class: no change in the use of suppression
De Petrillo and Winner (2005) (Study 1)	Experimental	Students	Creation	Single intervention	Art majors vs. non-art majors Drawing vs. copying geometric shapes	↑Drawing: positive effect on valence, no effect on arousal No difference beween art majors/non-art majors Copying geometric shapes: no effect on valence, arousal
De Petrillo and Winner (2005) (Study 2)	Experimental	Students	Creation	Single intervention	Art majors vs. non-art majors Drawing vs. completing a word puzzle	↑Drawing: positive effect on valence (stronger than after completing a puzzle) Completing a puzzle: no effect on arousal

Table 1
Continued

Authors (year)	**Type of Study**	**Participants**	**Creation vs. Consumption**	**Duration**	**Arts-related Variable**	**Socio-emotional Variable**
Dalebroux et al. (2008)	Experimental	Students	Creation	Single intervention	Venting vs. expressing positive emotions vs. distraction control	All conditions: Arousal remained unchanged, valence became positive Valence: positive emotion > venting > distraction control
Smolarski et al. (2015)	Experimental	Undergraduate students (20 years old)	Creation	Single intervention	Drawing to express (positive expression) vs. drawing to express current stress (venting) vs. tracing/coloring a simple line drawing (distraction control)	↑Mood improvement: in all three conditions Positive expression > venting = distraction control
Drake and Winner (2012)	Experimental	Undergraduate students (20 years old)	Creation	Single intervention	Venting vs. distraction vs. sitting (Study 1: film for mood induct., Study 2: saddest life event)	↑Mood improvement: Negative mood reduced more for distraction > venting = sitting

Table 1
Continued

Authors (year)	**Type of Study**	**Participants**	**Creation vs. Consumption**	**Duration**	**Arts-related Variable**	**Socio-emotional Variable**
Drake and Hodge (2015)	Experimental	Undergraduate students (18 years old)	Creation	Single intervention	Drawing vs. writing Preferred vs. non-preferred activity	↑Mood improvement: Negative mood reduced more after drawing than after writing independent of the preferred activity Drawing: distract, writing: express
Brechet et al. (2020)	Experimental	Children (7/10 years old)	Creation	Single intervention	Venting vs. free drawing vs. happy drawing	↑Mood improvement: Happy = free drawing < venting to improve mood
James et al. (2018)	Experimental	Undergraduate students (18 years old)	Creation	Single intervention	Expressing vs. Distracting Drawing vs. writing vs. talking vs. Thinking	↑Positively affect: distraction > expression (draw, think) ↓Negatively affect: distraction > expression (draw, write, talk, think) Distract is more effective than to express!
Turturro and Drake (2022)	Experimental	Undergraduate students (20 years old)	Creation	Single intervention	Coloring a design vs. drawing a design (distract) vs. drawing to express negative thoughts and feelings	↓All three drawing activities with no differences reduced anxiety, decreased heart rate and increased respiratory sinus arrhythmia

Table 1
Continued

Authors (year)	Type of Study	Participants	Creation vs. Consumption	Duration	Arts-related Variable	Socio-emotional Variable
Balas and Sinha (2008)	Experimental	Students	Creation	Single intervention	Face production vs. face recognition	Difference between face production and face recognition. Face Recognition is easier
Zhou et al. (2012)	(Quasi-) Experimental	Students with and without art experience	Creation	Single intervention	With vs. without arts experience should draw faces	Difference in face processing – the higher the art experience (years of arts engagement) the lower (higher) the holistic (analytic) processing
Empathy/Theory of Mind						
Goldstein and Winner (2012) (Study 1)	Quasi-experimental (longitudinal)	Children/ Elementary school students (9 years old)	Creation	10 months, 90 min/week	Theater vs. visual arts [class]	↑Theater class: Increase in self-rated empathy but no change in ToM Visual arts class: no change in empathy and ToM
Goldstein and Winner (2012) (Study 2)	Correlative	Adolescents (14 years old)	Creation	10 months	Theater vs. visual arts/music [class]	↑Theater class: Increase in empathy and ToM ↑Visual arts class: increase in empathic accuracy (but not at the same rate as the theater class)

Table 1
Continued

Authors (year)	Type of Study	Participants	Creation vs. Consumption	Duration	Arts-related Variable	Socio-emotional Variable
Kou et al. (2019)	Longitudinal, Correlational	Adults (4 American representative samples)	Creation; Consumption	~ 10 years	Average of attending art museum and making visual arts	↑Prosocial traits increase ↑Prosocial behavior increase
Bolwerk et al. (2014)	Experimental	Adult	Creation; Consumption	10 weeks	Visual arts production vs. cognitive arts evaluation	Visual arts production: changes in the neural activity Cognitive arts evaluation: no changes in the neural activity
Greene et al. (2014)	Quasi-experimental	Adolescents (9-17 years old)	Consumption	1 field trip	Museum visit vs. waiting control list	↑Historical empathy, tolerance increase ↑Students from disadvantaged backgrounds profit most from a museum field trip
Erickson et al. (2020)	Longitudinal, Experimental	Children (4/5th grade students)	Consumption	1 year	Multiple arts-based museum field trips (orchestra, theater, visual arts museum) vs. control	↑Tolerance with different opinions, condcientiousness and desire to consume arts increase ↑Field trip students received higher grade exams, are absent less often and have fewer behavioral infractions, no effect on social perspective taking, or empathy

Table 1
Continued

Authors (year)	**Type of Study**	**Participants**	**Creation vs. Consumption**	**Duration**	**Arts-related Variable**	**Socio-emotional Variable**
Self-Concept						
Burton et al. (2000)	Correlative	Children (4/5/7/8th grade students)	Creation	1 session (45 min)	High-arts group vs. low-arts group	High- arts group received higher levels on reading self-concept (sc), math sc, general school sc, and total academic sc
Catterall and Peppler (2007)	Quasi-experimental	Children (3rd grade students)	Creation	20-30 weeks	Visual arts group vs. control	= Visual arts and control differed not in their gains on self-concept, internal attribution style ↑Visual arts gained in their self-efficacy belief (control over the future, confidence) and 'originality' as subcomponent of creativity
DeBettignies and Goldstein (2020)	Experimental	Children (4/5th grade students)	Creation	1 year	Improvisational theater vs. study hall	↑self-concept: improvisational theater Stronger effects for children with relatively low self-concept
Beales and Brook (1990)	Quasi-experimental	Children 9-12th grade students)	Creation	70 hours	Theater vs. control	↑theater group: increase in social presence (self-confidence, self-control), tolerance, achievement via independence

Table 1
Continued

Authors (year)	**Type of Study**	**Participants**	**Creation vs. Consumption**	**Duration**	**Arts-related Variable**	**Socio-emotional Variable**
Freeman, Sullivan and Fulton (2003)	Quasi-experimental	Children ($3^{rd}/4^{th}$ grade students)	Creation	18 weeks	Theater vs. control	↓theater do not improve self-concept, reduce problem behavior or improve social skills
Warger and Kleman (1986)	Quasi-experimental	Children (6-10 years old)	Creation	2 weeks, 30-45 min/day	Institutionalized vs. non-institutionalized children with severe behavior disorder Theater vs. Control	↑theater group: increase in self-concept and creative expression (also in the behaviorally handicapped as well as non-behaviorally handicapped children)

1.1.3 Problems and Gaps to Measure Transfer Effects in Visual Arts

As the literature review points out, there are three central problems of previous studies investigating transfer effects of visual arts engagement, especially in the socio-emotional domain. These three problems (i. e., need for experimental comparisons, large sample sizes, and objective tasks and measurements) have great impact not only on the validity of previous publications on transfer effects, but also on the approaches chosen in this dissertation to overcome them. This leads to a situation in which many studies in fact might have missed their transfer effect targets based on general shortcomings in their study design. For this reason, these points will be discussed in detail in the following paragraphs.

Experimental Comparisons

Most studies in the field of visual arts focused on studying transfer effects in the context of already existing visual arts education programs rather than creating new ones (e. g., Kosica, 2017). Especially, in classroom-based interventions or educational research in general, it is not always feasible to randomly assign children or adolescents to different treatment groups and to fulfill the “gold standard” — an experimental study design — that allows causal conclusions (Goldstein, 2015; Schneider & Rohmann, 2021). For instance, studies investigating such preexisting courses also commonly compare course differences between control and treatment group by means of correlations. This comes along with considerable drawbacks: Pre-existing visual arts courses are often self-selected by the students due to their interest in the specific topic, whereas other students might try to avoid this specific topic because they are not interested in it (self-selection effects, e. g., Bastian et al., 2000; Curva et al., 2005; Vaughn & Winner, 2000; Winner, Goldstein, et al., 2013). As a result, the groups analyzed might differ in several characteristics and in the according studies might have failed their aim to create groups as similar as possible (Goldstein, 2015). This is problematic since previous studies have already shown that students with greater interest in a topic or subject are also significantly better in that subject compared to those without interest (Jansen et al., 2016). Nevertheless, little is known about various profiles of students who take part in such visual arts classes in general (Goldstein, 2015; but with a special focus on talented children and adolescents, see; Milbrath, 1998). For that reason, it might be beneficial to integrate experimental study designs into a visual arts education program to overcome the current limitations and get more insights into characteristics of the learner on one hand and the learning material on the other (drawing tasks, drawing techniques, learning instructions, etc.). This is necessary to draw causal conclusions from a visual arts education program.

Sample Size

A second limitation referred to in the existing studies on transfer effects of visual arts is that only relatively small sample sizes were included in the studies conducted (Ackerman, 2003; Goldstein, 2015; Kröner et al., 2021; Schneider & Rohmann, 2021). This problem should be demonstrated on the basis of Kröner et al.'s (2021) current review ($N = 245$ remaining studies after reviewing the full texts) on transfer effects of arts engagement. Since the studies were based on different research traditions, a classification of the empirical studies ($n = 111$) was made according to their research design: Quantitative ($n = 29$ total, thereof $n = 24$ peer-reviewed), qualitative ($n = 60$ total, thereof $n = 53$ peer-reviewed) and mixed research ($n = 22$, using both quantitative and qualitative methods) was considered in the review. Generally, only little intervention studies were reported. Most of these studies did not work with randomized assignment of subjects to groups (as mentioned before). Even experimental or quasi-experimental studies often fell short in their evaluation due to a lack of inferential statistical analyses for the findings and information on effect sizes. In addition, also correlation and regression analyses were rare, and structural equation models were used only in isolated cases, although the data would allow for these analyses. The opportunity to combine quantitative and qualitative approaches in the sense of mixed methods was also rarely seized, and when it was, the potential it offered was not fully exploited. For more information on the studies considered in the review see Kröner et al. (2021). In line with this, also Schneider and Rohmann (2021) reviewed that mostly small sample sizes were used in the studies. Additionally, the groups in these studies were often self-assigned by the participants.

Objective Measurements of Outcomes and Processes

A third constraint of the previous research on transfer effects of visual arts is the need of objective instruments to measure the outcomes. While cognitive transfer effects (e. g., academic achievement) are usually measured by standardized achievement test (SAT) scores (e. g., Vaughn & Winner, 2000), socio-emotional transfer effects are often measured by subjective instruments such as questionnaires or self-reports or self-developed measurements (e. g., Catterall & Peppler, 2007; Goldstein & Winner, 2012). However, it is exactly this subjective nature of the data that could partly be responsible for the limited evidence on socio-emotional transfer effects found so far: First, if everyone uses their own measuring instrument, then the comparability of studies suffers extremely. Second, questionnaires might have produced response biases (e. g., socially desirable participant, Paulhus, 2002). Also, Dang et al. (2020) found weak correlations between self-reports and behavioral measures of achievement. Third, questionnaires might not be sensitive enough to detect small improvements on socio-emotional skills (Catterall & Peppler, 2007; Goldstein et al., 2012). For this reason, it would be desirable to measure changes with more objective tasks. To do so, it is necessary to operationalize the construct of interest explicitly. More precisely, this means that it is not valid to ask people before and after course participation how well they think they can perform on different target constructs (e. g., Catterall & Peppler, 2007; Goldstein et al., 2012). In contrast to self-reports, objective measurements should be designed in such a way that the template and response cannot be influenced deliberately by the subject (Dorsch, 2021). However, it must be taken into account that measurements must be adapted to the learners' characteristics and developmental stage (i. e., age, sex, etc.).

In conclusion, it can be suggested that the neglect of these three pillars (experimental comparisons, sample size and objective measurement) could be the basis for the ambiguous state of research on transfer effects in the field of visual arts so far. As the interest of arts educators, policymakers, administrators, parents, and other stakeholders grows, more studies and research will be undertaken to investigate transfer effects of visual arts engagement on the development of socio-emotional skills (Farrington et al., 2019). In the next »Chapter 1.2«, we take another step back and review the theoretical and empirical frameworks that already exist for studying and explaining the effects of arts in general and visual arts in particular.

1.2 Theories and Frameworks of (Visual) Arts Engagement

1.2.1 What, How, and Which Transfer Effects can be Expected from Visual Arts Engagement?

The previous Chapter showed that finding experimental evidence on socio-emotional transfer effects through visual arts engagement is anything but easy, although numerous efforts have been made in a national and international context and the number of studies rising rapidly (Holochwost et al., 2021). In this Chapter, I focus on plausible theories and frameworks that try to explain why visual arts engagement might lead to (socio-emotional) transfer effects. For this reason, I present three different conceptual frameworks all trying to explain the positive effects of (visual) arts engagement with special focus on theoretical constructs, operational definitions, and underlying processes (see also »Chapter 2.3«). From a psychological point of view, there is good reason to assume that transfer effects in the socio-emotional domain can be addressed, even though it is much more important to understand *what*, *how* and *why* transfer effects occur (cf. Shim et al., 2019; Tay et al., 2018). Additionally, I consider three boundary conditions (arts genre, context/setting, and target construct) reviewed by Holochwost et al. (2021) that might delineate the benefits of the arts engagement.

Framework 1: The Role of the Arts and Humanities in Human Flourishing

Tay et al. (2018) were among the first to provide a general-integrative conceptual framework that tried to understand the psychological effects of arts engagement on human flourishing and more specifically on the development of socio-emotional skills. In this conceptual framework, the authors focused on *what* students are studying in the arts (*extensional definition*: contents/topics/subjects' matter, disciplines/courses) and *how* students are studying them (*functional analysis*: modes of engagement/activities of involvement) to address flourishing outcomes. Tay and colleagues, thereby, suggested four important mechanisms: *immersion* (physiological and psychological reactions, "flow"-experience), *embeddedness* (socio-cognitive processes underpinning learning and enriching other domains of our lives), *socialization* (degree of taking on various identities and social roles), and *reflectiveness* (self-awareness, see also Csikszentmihalyi & Csikzentmihaly, 1990; Fritz & Avsec, 2007; Tay et al., 2018). It is noteworthy that these four mechanisms are not exclusive to arts engagement but can occur in other contexts and situations as well, possibly even mediating/moderating the effects of arts engagement. However, flourishing outcomes are only illustrative and not exhaustive in nature (see Figure 1). In fact, individual (personality, preferences, skills, interests), institutional (culture, climate) and societal (the extent to which the arts are valued by society) factors should be considered during arts engagement as well but are not covered enough in this framework.

In contrast to the conceptual framework of Tay et al. (2018), Konrath and Kisida (2021) have a stronger focus on the personal and situational variables as well as the internal state of a person (emotion, cognition, arousal). Especially the interaction between facets of the internal state might enable opportunities of change in the context of visual arts engagement but this interaction has yet been studied very little (cf. Kim & Kim, 2018; Vreeland, 2006; Winner, 2019). For this reason, the *General Model of Arts Engagement* considers these internal states and influencing variables in greater detail.

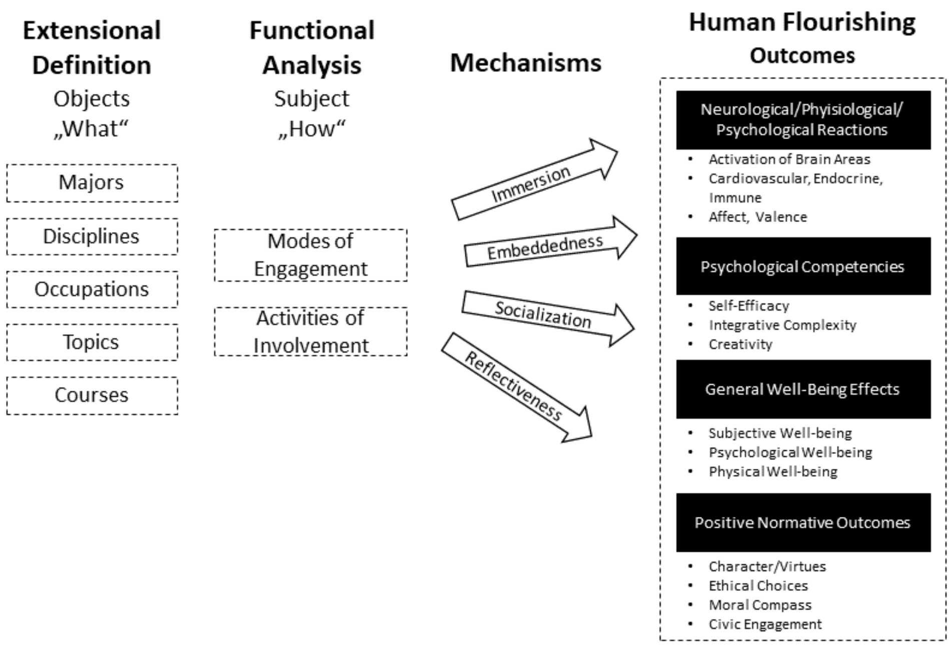
Framework 2: The General Model of (Visual) Arts Engagement

The *General Arts Engagement Model (GAEM)* (Konrath & Kisida, 2021) focuses more concretely on personal (demographic, personality, motivation, ability) and situational variables (arts genre, creation vs. consumption, content, ...) of arts engagement (see Figure 2). However, the GAEM addresses the arts in general, rather than a specific arts genre, as Ruth (2019) had already proposed for the engagement with music. The GAEM represents a special adaptation of the *General Learning Model (GLM)* (Barlett & Anderson, 2012), which classically focuses on person-environment interactions[5]. An example for one of these interactions is that individuals interpret their experiences in the context of arts engagement based on previous learning experiences. Other influencing factors might be age or the developmental stage of children and adolescents. It might also be plausible that children, adolescents, and adults process the arts differently. In

[5]The original GLM was developed to explain how and why some adolescents tend to engage in violent behavior after violent media consumption (TV, video games), while others remain completely unaffected.

Figure 1

Overview of Tay et al.'s (2018) Conceptual Framework for the Role of the Arts Engagement in Human Flourishing



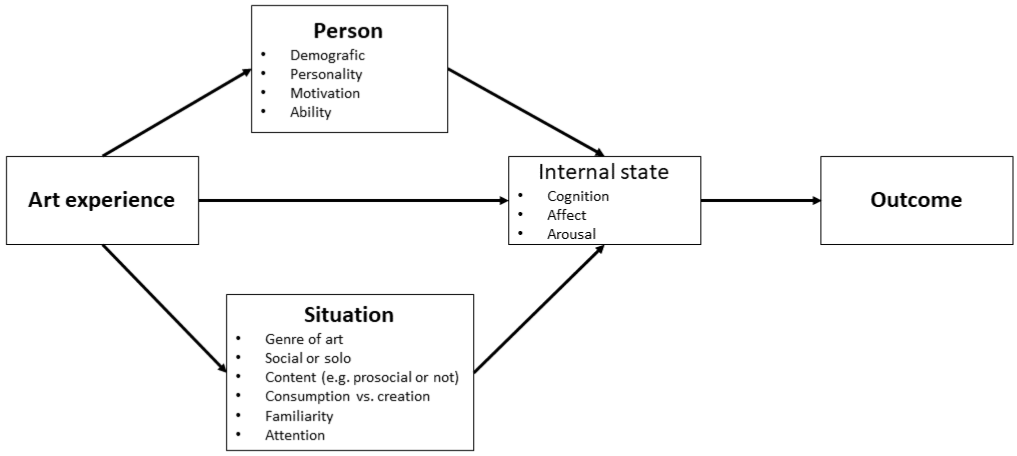
Note. Slightly adapted version of the "Conceptual Framework for the Role of the Arts and Humanities in Human Flourishing" published by Tay et al. (2018). The flourishing outcome variables are only illustrative, not exhaustive. © Tay, L., Pawelski, J. O., & Keith, M. (2018). The role of the arts and humanities in human flourishing: A conceptual model. *The Journal of Positive Psychology, 13*(3), 215—255. https://doi.org/10.1080/17439760.2017.1279207.

general, the authors hypothesize that there may be several factors that influence engagement with the arts (e. g., gender, culture, race, socio-economic status). Also, motivation and interest have a crucial influence (compare, Jansen et al., 2016). Individuals with intrinsic motivation or interest will generally be able to benefit more from engaging with the arts than those who participate only for an extrinsic reason (e. g., because they are required to do so in school classes). For this reason, Konrath and Kisida (2021) consider it useful to account for demographic differences in statistical analyses. Besides the personal variables, however, there are also several situational variables that influence arts engagement.

Konrath and Kisida (2021) expect that the arts genre in particular plays a role. For example, Goldstein and Winner (2012) assume that engagement with performing arts (theater classes) leads to stronger empathy skills and theory of mind than the engagement with visual arts or music (for an overview of the effects of visual arts on socio-emotional skills, see »Table 1«). This seems plausible as theater classes, for example, involve more empathy-related tasks (imagine the role of another person), which Winner (2019) de-

Figure 2

Overview of Konrath and Kisida's (2021) General Arts Engagement Model



Note. Adapted version of General Arts Engagement Model (GAEM) published by Konrath and Kisida (2021). Does Arts Engagement Increase Empathy and Prosocial Behavior? A Review of the Literature. In L. N. Hersey and B. Bobick, *Engagement in the City: How Arts and Culture Impact*, p. 16–47. © Copyright 2021 by The Rowman & Littlefield Publishing Group, Inc.

scribes as "stepping into the shoes of others". Therefore, some forms of arts engagement are more social than others, although the degree of social interaction can also be influenced within each arts genre, e. g., drawing alone in the art museum, at home or with classmates in the classroom. It can be assumed that more social interaction likewise leads to a greater acquisition of socio-emotional skills (cf. literature review, Konrath & Kisida, 2021). Another influencing factor is the content: Does the visual arts engagement address socio-emotional learning or are only drawing skills taught? Furthermore, there seems to be a difference between *creating* arts (sometimes specifically called *arts engagement*: drawing, making music in terms of playing an instrument, acting, or writing) vs. *arts consuming* (*arts experience*: visiting an art museum, listening to a concert, watching a theater performance/musical/opera, or reading something; Wilson, 2018). A difference between these two kinds of arts involvement (arts creation, arts consumption) can be seen in correlations with socio-emotional skills, specifically prosocial behavior (Kou, 2018; Kou et al., 2019). In these studies, consuming arts was found to be more effective than creating arts in terms of promoting prosocial behavior (Kou, 2018; Kou et al., 2019). This finding seems surprising, since generating arts should require significantly more cognitive resources than consuming arts. Regardless of whether arts are created or consumed, individuals appear to respond differently to arts depending on how familiar they are with it (Konrath & Kisida, 2021). Familiarity with arts experiences can be perceived as pleasurable, but sometimes lead to boredom or disinterest as well.

The GAEM gives a general idea of how personal and situational variables might interact in (visual) arts engagement and consequently might lead to differential findings on transfer effects. However, this framework is very generic, and no specific conclusions can be made about which activities are particularly effective. For this reason, other researcher has focused on which activities are effective (e. g., Hetland et al., 2013). Hetland et al. (2013), for instance, analyzed what exactly students learn during a visual arts engagement. They assumed that before one might to think about transfer effects, it is necessary to understand the underlying processes of visual arts engagement. None of the studies presented in the literature review of this dissertation analyzed the underlying mechanisms of visual arts engagement in detail. Hetland and colleagues argued that it is difficult to guess what is learned outside the visual arts, if we do not know what is learned within the visual arts itself. Therefore, the *studio habits of mind* were identified as a tool to classify the contents learned during visual arts classes as a theoretical foundation to explain the intrinsic value of the arts itself (see also, Winner et al., 2006). For this reason, the next subsection explains the studio habits of mind in more detail and gives insights to what is learned within the visual arts.

Framework 3: The Studio Habits of Mind

The studio habits of mind are another framework which tries to analyze the benefits of visual arts engagement. However, the main focus of Hetland et al.'s (2013) studio habits of mind was to analyze beneficial processes in dealing directly with visual arts in an arts classroom to identify the essential core of artistic activities and drawing tasks. Using qualitative ethnographic methods, the authors were able to identify eight basic cognitive and motivational studio habits of mind (cf. Hetland et al., 2013): (1) *developing craft*, (2) *engaging & persisting*, (3) *envisioning*, (4) *expressing*, (5) *observing*, (6) *reflecting*, (7) *stretching & exploring*, and (8) *understanding the art world* (compare internal state, Konrath & Kisida, 2021). Although, the studio habits of mind were originally developed for the analysis of immediate primary effects of visual arts engagement, and not for the analysis of potential transfer effects, the highly differentiated and art-specific nature of them might in fact also be helpful in the analysis of transfer effects of visual arts education programs (Burger & Winner, 2000; Hetland et al., 2013; Hogan et al., 2018; Reed et al., 2012; Winner, 2018; Winner, Goldstein, et al., 2013). Importantly, the studio habits of mind can be utilized not only to describe artistic activities but also to try to analyze the underlying processes and mechanisms of drawing and learning, particularly in the case of drawing activities involved.

In general, all eight studio habits of mind enable a deep engagement with the respective learning material. Hogan et al. (2018) themselves did not assume immediate transfer effects because they anticipated that the studio habits of mind must be learned in a visual arts context before transfer effects in other domains can be considered. Since the studio habits of mind are generic and non-specific in nature, we expect that the studio habits of mind could be trained through visual arts engagement (for an overview of the eight studio habits of mind and potentially expected transfer effects, see Table 2).

In the following the eight studio habits of mind will be introduced, and examples will be given: When students start engaging with the visual arts, they must learn how to draw a portrait by *developing crafts*. To do so, the students could study portraits of other popular artists, such as Rembrandt, in terms of *engaging and persisting* with the artist's artworks. How did Rembrandt draw his portrait? Therefore, the students need not only *observation* skills that help to extract the central features that are necessary for drawing a portrait, but also *envisioning* the portrait in terms of a mental representation and *expressing* this into a drawing. To generate a representational drawing, students need crafts. Additionally, the visual arts offer a very specific learning environment in terms of so-called studio structures that could promote learning in the arts. A central part of these studio structures is besides the *demonstration phase* in which central learning contents are conveyed to the students and the *students-at-work phase* in the context of artistic drawing tasks, the *reflection phase* in which students could present their artworks and discuss them with others. For that reason, *reflecting* as well as *stretching and exploring* describes the opportunity to present one's own artwork to others but at the same time the risk of making mistakes. The last studio habit of mind *understanding art world* describes a meta-cognitive skill to recognize artists or connections between their own artwork and a professional artwork. Generally, the studio habits of mind have nothing to do with transfer effects, but there is the possibility that certain studio habits of mind are characteristic for the visual arts or, vice versa, that their training could support their application in other areas as already shown in the cognitive transfer effects (e. g., Dolev et al., 2001; for a review, Mukunda et al., 2019). Through close observation, students in visual arts might learn to extract central features that are necessary for drawing a portrait. It might also be possible that through the visual arts engagement the students train their general ability to perceive, observe, or imagine, which are skills that are also needed in other school subjects and so these subjects can also benefit regarding transfer effects from the visual arts engagement (e. g., biology/medicine, Dolev et al., 2001).

Table 2
Winner's (2018) Studio Habits of Mind With a Short Description and a Sample Transfer Hypothesis

Studio Habit of Mind	**Brief Definition**	**Sample Transfer Hypothesis**
Develop Craft	Learn technique and care of materials.	Students understand that all areas of the curriculum involve basic rules/ principles and recognize the importance of learning these.

Table 2
Continued

Studio Habit of Mind	Brief Definition	Sample Transfer Hypothesis
Engage & Persist	Find problems that engage you and stick with them.	Students are more likely to find engaging problems in any other area of the curriculum (e.g., Winner et al., 2006).
Envision	Imagine in images what you cannot observe directly.	Students are better able to envision molecular structures in biology, chemistry, or medicine (e.g., Dolev et al., 2001; Mukunda et al., 2019).
Express	Convey meaning and personal vision.	Students develop a stronger personal voice in non-fictional writing.
Observe	Open up your eyes and look more closely than you usually do.	Students' observational skills are strengthened in biology, chemistry, or medicine (e.g., Dolev et al., 2001; Mukunda et al., 2019).
Reflect	Explain one's process (metacognition) and evaluate own and other's works.	When writing a history paper, students reflect on possible hypotheses and begin to evaluate the strength of the evidence (pros and cons).
Stretch & Explore	Take risks and learn from mistakes.	Students are more likely to try out a new way of solving a math problem.
Understand Art Worlds	Recognize that artists learn from one another; recognize connections between their own art and that in the professional art world.	Students begin to recognize links between work in a school subject area and work by professionals in the domain (Hetland et al., 2013; Winner et al., 2006).

Note. Adapted version of the studio habits of mind (p. 21) published by Winner (2018). Valuing thinking in the arts. *Creative Teaching & Learning, 8.4*, 14–23. https://static1.squarespace.com/static/5e7977706f259a3ea1d94af0/t/5e8237bef58ede602ece41f6/1585592371518/CTL+Issue+8.4_Full+Version.pdf (Last Access: 2021-03-09).

Conclusion

In sum, the three presented theoretical frameworks try to explain the effects of (visual) arts engagement through a special focus on the underlying activities and mechanisms or situational as well as personal variables. While Tay et al.'s (2018) framework focused on what, how and why (extended in Shim et al., 2019) is learned through arts engagement, Konrad and Kisida's (2021) GAEM focused much more on personal and situational variables. Hetland et al.'s (2013) studio habits of mind as the third framework analyzed the activities underlying the instructions in visual arts classrooms. However, the three frameworks allow the deduction of hypotheses on transfer effects, but they are not specific enough to explain the differential transfer effects of socio-emotional skills sufficiently. For that reason, one might ask what is missing in the frameworks to promote socio-emotional skills through (visual) arts engagement? Holochwost et al. (2021) also addressed the question of what is missing to achieve benefits on socio-emotional skills in the context of arts engagement in general and identified three factors that must be adequately defined beforehand: arts genre, context/setting, and target construct, concretely the domain of socio-emotional development. The assumption of clear definitions about the psychological target constructs such as emotion recognition is in accordance with Winner, Goldstein, et al. (2013, p. 196) who argued that participants must be "pushed" to actively "explore and invent" to socio-emotional skills. Therefore, in the following Chapter, I will combine important aspects of all three frameworks presented here into a conceptual framework under consideration of important aspects and mechanisms of the learning-by-drawing literature. Thereby, this framework takes care to define psychological target constructs adequately and address them in a theory-based design in terms of an arts-integrated approach. Based on the general idea that visual arts engagement can reliably catch socio-emotional transfer effects, if the theoretical background (arts genre, context/setting, and target construct/domain of socio-emotional development) is well defined beforehand (Holochwost et al., 2021). Otherwise, the goals of a visual arts engagement can rather easily be missed. To generate a specific framework of visual arts engagement on the acquisition of socio-emotional skills, the "classical" learning-by-drawing assumptions will be combined with the studio habits of mind, and personal and situational influencing factors.

1.3 Development of a Conceptual Framework of Visual Arts Engagement to Promote Transfer Effects on Socio-Emotional Skills (Empathy, Self-Concept)

In this Chapter, I argue that the field on visual arts engagement must go beyond broad claims about their general impact to delineate the benefits on socio-emotional skills. As it was demonstrated before, several theoretical frameworks were developed to explain the effects of (visual) arts engagement based on underlying activities, as well as personal and situational characteristics. Since the frameworks were not specific enough to explain the effects of visual arts on socio-emotional skills, the aim of this Chapter is to develop a conceptual framework based on the assumptions of the previous frameworks (Hetland et al., 2013; Konrath & Kisida, 2021; Tay et al., 2018) by integrating the approach of Holochwost et al. (2021). For Holochwost et al. (2021) three aspects seem to be important to achieve benefits on socio-emotional skills in the context of the arts engagement: (1) *arts genre*, (2) *context/setting*, and (3) *target construct/domain of socio-emotional development*. In their opinion, it is fundamental to formulate precise hypotheses and develop a differentiated *definition* of arts education programs and activities. Yet, the arts and the arts engagement are often treated as monolith, although there are differences between art forms as well as within the individual art forms (Holochwost et al., 2021). This is in line with Farrington et al. (2019) who argue in their review that one should not only consider the outcome but also the activities and mechanisms that are explicitly needed to promote socio-emotional skills:

> *"Perhaps the greatest need is for applied research that better articulates and explores the ways that specific arts practices and pedagogical strategies in different contexts lead to different social emotional competencies. Rather than asking, 'Does this arts program result in X outcomes?' researchers instead might ask 'What are the mechanisms whereby particular arts activities support the development of specific social-emotional competencies?'"*
>
> (p. 39)

That the activities and mechanisms during arts engagement might be important, is also shown in the frameworks by Tay et al. (2018) and Hetland et al. (2013). While Tay et al. (2018) focused on the general mechanisms of arts engagement independent of the arts genre, Hetland and colleagues extensively analyzed visual arts classes. Also within one arts genre, it cannot be expected that a visual arts curriculum in a school class, for instance, might lead to the same effects as strictly-specified visual arts activities via matched control-group-design (compare, Goldstein et al., 2017). Therefore, the first step in this dissertation is to define the arts genre analyzed: visual arts (see Table 4).

1.3.1 Definition of the Arts Genre: Visual Arts

Since the arts genre of *visual arts* is already set, the remaining question in this dissertation is which elements, characteristics and mechanisms of drawing can generally be used to address the target constructs or concretely to promote socio-emotional skills. In the following, an approach from "classical" learning-by-drawing research will be presented in detail, in which the focus is primarily on the transfer of learning content. This approach assumes that drawing is an effective method for knowledge acquisition if drawing tasks and learning materials are designed appropriately (e. g., Ainsworth et al., 2011; Cook, 2006; Cromley et al., 2020). Central mechanisms of learning-by-drawing, thereby, might be to slow down, to observe closely, to pay attention to the relevant details of the learning content, and to understand the underlying concepts by building mental representations (Matern & Feliciano, 2000; Quillin & Thomas, 2015). Moreover, making drawings seems to be an integral part of scientific reasoning because thoughts are expressed on paper (Ainsworth et al., 2011; Schmeck et al., 2014). Nevertheless, it is not only the *active engagement* in terms of drawing with the learning material that might stimulate content elaboration but also the ability to *reduce abstraction* by representing the contents spatially (*visual spatial reasoning*). The theoretical models used to explain the generic effects of drawing are completely domain general and not only limited to science contexts (e. g., *dual-coding theory* DCT, Paivio, 1990; *generative learning theory* GLT, Wittrock, 1992, 1994; *cognitive load theory* CLT, Sweller, 1994, 2004, 2005; *theories of multimedia learning*, Ainsworth, 2006; Mayer, 2014; Schnotz, 2014). For that reason, similar effects can be assumed for artistic drawing, even if the learning-by-drawing approach has to the best of my knowledge never been studied in the arts and humanities so far.

Moreover, Ainsworth and Scheiter (2021) were able to analyze and identify important parameters that might be effective in classical learning-by-drawing research to achieve positive learning effects which might be also important for the learning in the visual arts (see checklist, Table 3). First, the authors recommend checking whether the learning content/target constructs can be conveyed by drawing. More concretely, this means that we should ask beforehand whether the target construct could be really addressed through drawing (e. g., *"Can emotion recognition abilities be improved through drawing emotional facial expressions?"*; *"Can a differentiated self-concept be improved through the drawing of different social roles of Hercules?"*). For instance, Goldstein and Winner (2012) could demonstrate through the comparison of different arts genres (theater, visual arts) positive transfer effects of theater engagement, but not for visual arts engagement. While the theater engagement includes empathy-related tasks, the visual arts engagement does not necessarily require this and may be based solely on technical drawing skills. The authors concluded that it might also be possible to promote empathy in the visual arts engagement if empathizing with another person is encouraged. Second, it is important to know the different functions of drawing and that these can change over time. For instance, one important function of drawing is to express/externalize internal mental representations on paper. At the same time, the externalization on paper can change the internal mental representation. Third, it must be decided whether drawing can be used in the intended context/setting. For instance, in this dissertation drawing was examined in an art museum context, in which art historians explained adolescents' socio-emotional contents by using tablets and digital drawing pencils (for more information about the influencing context/setting, see »Section 1.3.2«). Additionally, the digital drawing had the advantage that not only the product — the final drawing — can be analyzed, but also the process to get there and the related underlying drawing processes. A forth influencing factor is, according to Ainsworth and Scheiter (2021), that learners must recognize the value of drawing and that especially inexperienced drawers must first lose their fear of drawing, for which sufficient explanations and exercises are necessary. Furthermore, it is important to be aware that drawing only leads to outcomes if meaningful drawings are created during the process. A central element in the creation of meaningful drawings is feedback from others (teachers, peers, or automated feedback, see also reflection phase, Hetland et al., 2013). Accordingly, sometimes learners might fail to produce coherent mental representations and external drawings. If this is the case, the checklist can be helpful in identifying problematic factors and improving future learning (see Table 3). If the checklist alone does not help to find an explanation for the failure in producing coherent mental representations and external drawings, it can also be useful to analyze the environmental conditions of the immediate or broader context of the program or experience. For this purpose, the next section explains what needs to be considered in this context.

Table 3
Mechanisms That Might Explain the Instructional Effects of Drawing

Learning by Drawing	Brief Definition
Consider whether drawing is a suitable approach	Drawing is particularly suited for tasks requiring visuospatial reasoning in two dimensions.
Ask what functions drawing will serve	Decide on the specific role(s) for drawing, note that a drawing can change its function over time and be revised to serve a new purpose.
Address the tools to be used	Practically, drawing with pen and paper is easy to implement in classrooms. If drawings are to be shared, edited by other people, or revisited as artifacts, digital drawing offers advantages.
Make the drawing activity purposeful, valuable and nonthreatening	Typically, learners are unfamiliar with drawing to learn and can be anxious. Explain why it can be useful for this purpose, and that they will not be judged on aesthetic qualities.
Make the intended audience explicit	Learners' views about whom they are drawing for influence what and how they draw. Drawings need not be meaningful to other people if simply intended as a memory cue, but they must be when intended to share understanding.

Table 3
Continued

Learning by Drawing	Brief Definition
Match assessment criteria to the function of the drawing	Depending on its function, a drawing can be evaluated for its accuracy, completeness, metarepresentational awareness, or innovative use of representational tools.
Scaffold drawing activities toward their intended purpose	Learners often need scaffolding to draw in the ways laid out by the assessment criteria. This can include training, models, partial templates, or prompts.
If possible, provide feedback on the drawing	Learners can often benefit from feedback on their drawings and be encouraged to revise them meaningfully by peers, teachers, or even automated systems. Drawings reveal misunderstandings that can become a focus for feedback and future learning.
Use drawings as artefacts in subsequent lessons	Making a drawing should not be an isolated activity. Consider how they fit in the curricula and reuse drawings as an anchor for engaging learners in further reasoning, discussion, or future learning activities when appropriate.

Note. Adapted version of the Drawing-to-Learn Checklist (p. 65) presented by Ainsworth and Scheiter (2021). Learning by drawing visual representations: Potential purposes, and practical implication. *Current Directions in Psychological Science, 30*(1), 61–67. doi: `https://www.doi.org/10.1177/0963721420979582`.

1.3.2 Definition of the Context/Setting

Besides the definition of the arts genre, it is also important to consider the role of the *context/setting* in which a program or activity occurs, such as where, for whom, by whom, and how (Holochwost et al., 2021, p. 3). According to Holochwost and colleagues, two types of context/setting can be distinguished: (1) the *immediate context of the program or experience*, and (2) the *broader context of the program or experience* (see Table 4). The (1) immediate context describes the specific institutional setting and program characteristics (i. e., frequency, duration, digital drawing) in which the program takes place, as well as the characteristics of the teacher/teaching artist (i. e., gender, experience). In contrast, the (2) broader context describes characteristics of a person and exosystem factors (i. e., peer group, school, neighborhood) are seen. In Konrath and Kisida's (2021) framework, a similar classification into situational and personal influencing factors occurs. This means that the experiences or tasks that take place in a visual arts program always depend on situational factors as well as the personal experiences of the children and adolescents (such as age, developmental stage, gender, demographics, personality traits, prior knowledge, drawing level, motivation or familiarity, Diamond & Ling, 2020; Konrath & Kisida, 2021).

However, the developmental stage and age of children and adolescents might be the most influencing personal factors. For instance, if the aim of a visual arts education program is to foster a differentiated academic self-concept, then the developmental stage of the children and adolescents must be considered. While the self-concept of young children is very broad and domain general, their self-concept starts to differentiate with increasing age, leading to altered perspectives on themselves as adolescents (Marsh & Ayotte, 2003; Marsh et al., 2018). It should be clear that preschoolers do not develop a more differentiated academic self-concept when they have *per se* no academic self-concept to enhance. This example shows that the developmental stage of a child/adolescent must fit the addressed target constructs/domain of socio-emotional skills (Holochwost et al., 2021). For this reason, it must be clear what should be promoted and at what age the skills develop. Therefore, clear definitions of the target constructs are needed, so that they can be instructed appropriately (see »Section 1.3.3«). In this dissertation two socio-emotional skills were addressed as target constructs in the context of visual arts engagement. This was done to distinguish whether the acquisition of socio-emotional skills is a general effect of drawing tasks or a specific effect that depends on the concrete content of drawing or learning (for definition of the addressed socio-emotional contents, see next section).

Furthermore, studies should not neglect to consider the interindividual differences that may result from the exosystem factors regarding their prerequisites (Holochwost et al., 2021; see also situational factors, Konrath & Kisida, 2021). It might be possible that adolescents with low socio-emotional skills in the pretest had fewer opportunities at their disposal to practice these skills and in the following also more “room for improvement” during the visual arts engagement (e. g., Brown & Sax, 2013; Greene et al., 2014; Van Heel et al., 2020). Additionally, the personality of the adolescents might be an important influencing factor during the visual arts engagement, which most studies did not take into account yet, although they might be crucial moderators or mediators and can be changed through arts engagement (Grosz et al., 2020). The personality traits (sometimes also mentioned as the “big five”) are a conceptual construct to describe human’s personality by five traits which are empirically validated (Asendorpf, 2018; Danner et al., 2019; Rammstedt & Danner, 2016): (1) *Neuroticism/emotionality* (tendency toward emotional lability, anxiety, and sadness), (2) *extraversion* (tendency toward sociability and optimism; is also seen as the opposite of introversion), (3) *openness to experience* (tendency to inquisitiveness, interest in new experiences), (4) *agreeableness* (tendency to altruism, cooperation, and compliance), and (5) *conscientiousness* (tendency to discipline, high achievement, and reliability). These five personality traits determine the personal dispositions of how a person interacts with or sees the world. In more recent studies, the "big five" have been extended to include a sixth dimension, *honesty-humility* (Lee & Ashton, 2004).

Since the personality traits might be situationally and temporally stable constructs that develop very slowly over life time, and the adolescence in contrast is a major formative period for developing socio-emotional skills (Miklikowska et al., 2011), it seems reasonable to consider personality traits in such studies. Some studies, for example, found a strong relationship between empathy and personality traits, especially agreeableness (Lee & Ashton, 2004; Mooradian et al., 2011). Additionally, others argued that the association between agreeableness, and empathy might belong to similar neurophysiological mechanisms in terms of the human mirror neuron system (Cheng et al., 2009; DeYoung, 2010). From these observations, two conclusions seem possible but are mutually exclusive: First, agreeableness and empathy are identical (Mooradian et al., 2011). Second, agreeableness is stable in later childhood and adolescence (e. g., Roberts et al., 2006), whereas empathy can also be changed by appropriate training opportunities (Goldstein & Winner, 2012). The study by Van Heel et al. (2020) might explain these contradicting conclusions from a developmental perspective by investigating adolescent's personality (i. e., agreeableness), empathy (i. e., empathic concern, perspective taking), and parent-child interactions as opportunities to train these skills. The authors found a small correlation between agreeableness and empathy (approximately $r = .30$). The results indicated a large unique variance for the adolescents. In addition, they expected that supportive parenting promotes agreeableness in adolescents, and this might in turn predict empathy. Alternatively, agreeableness might predict both empathy and supportive parenting in adolescence. In sum, the results were better in line with the second conclusion. They found no evidence for the conclusion that supportive parenting led to higher agreeableness and higher empathy over time. Only empathy predicted greater levels of perspective taking at a later point. The authors argued based on these findings that empathy results in more opportunities to train perspective taking. In addition, it was found that parental support was associated with empathy but not perspective taking which might be explained by the fact that affective/empathic responses by parents can be directly observed, whereas the cognitions are not as easy to observe, experience or imitate. Thus, the association between empathy and agreeableness is even stronger as the association between empathy and parental support, which indicates that there is not only a need to study empathy, and practice opportunities but also to consider adolescents' personality in terms of their agreeableness (compare Konrath & Kisida, 2021). It might be the case, that adolescents with lower levels of agreeableness have generally lower opportunities for practicing empathy, and also that if they have the opportunity to engage in empathy, they are less willing to do so.

However, the study by Van Heel et al. (2020) exemplarily shows that interventions in the context of visual arts engagement might be potentially promising for adolescents with lower prerequisites and that it is important to consider personality traits as context variables. It remains an open question to what degree the lack of learning experiences for empathy due to missing parental support can be compensated by other experiences focusing on empathy, e. g., in the context of visual arts engagement. In the present dissertation, the influence of personality traits, and concretely agreeableness, will be studied in more detail in »Chapter 6«.

1.3.3 Definition of the Target Constructs: Empathy and Self-Concept

Finally, there is the question of the target construct: What contents and target constructs can be promoted in the context of visual arts engagement? In recent decades, focus of interest has been on socio-emotional skills in the context of the visual arts because they are claimed as an essential part of personality development (Goleman, 1995). Socio-emotional skills in turn are not only the prerequisite for social interactions, quality of life, academic performance, but also social well-being (Bradley et al., 2012; Collie, 2019; Eisenberg et al., 2015; Goodman et al., 2015). To address socio-emotional skills in the context of visual arts engagement a theory-based design is necessary, as well as clear definitions of the target constructs, namely for *empathy* (e. g., Goldstein, 2015; Goldstein et al., 2012; Goldstein & Winner, 2012; Kou et al., 2019), and *self-concept* (e. g., Catterall, 2002; Catterall & Peppler, 2007; DeBettignies & Goldstein, 2020). These two concepts in turn belong to five overall facets of socio-emotional learning which includes *social awareness* (the ability to adopt perspectives, and understand other cultures, backgrounds, and social and ethical norms), *relationship skill* (the ability to build relationship and maintenance), *self-awareness* (awareness of one's own emotions), *self-management* (the ability to regulate one's own emotions and deal with stress), and *relationship skill* (the ability to make decisions and reflect on resulting outcomes and consequences, CASEL, 2012; Denham, 2018; Ross & Tolan, 2017). Because empathy and self-concept are again umbrella terms, a hierarchical classification and allocation of skills was made in this dissertation. These two constructs will be explained in more detail below.

Empathy and Emotion Recognition

Due to its great importance for social interactions, *empathy* represents the first socio-emotional target construct of this dissertation, which was investigated in many studies focusing on transfer effects on the socio-emotional domain as demonstrated in the literature review (e. g., Goldstein, 2015; Goldstein et al., 2012; Goldstein & Winner, 2012; Kou et al., 2019; see also »Chapter 1.1.2«. Thus, empathy can be seen as the general ability to perceive, understand and interpret situations, feelings, and thoughts of other persons correctly (Davis, 1983; Eisenberg & Fabes, 1990; Eisenberg & Strayer, 1990) on a *cognitive* ("thinking what another person is thinking") or an *emotional* or *affective* level ("feeling what another person is feeling", cf. Reniers et al., 2011). The *cognitive* *empathy* describes a variety of processes to mentally put oneself into another person's situation and thinking (sometimes also described as *perspective taking* or *theory of mind*; Goldstein & Winner, 2012). In contrast, the emotional empathy is acquired in early childhood and depends on parents' skills in feeling happiness or compassion for others (in terms of role learning, Van Heel et al., 2020). From a conceptual perspective one might expect that cognitive empathy might be a prerequisite for building *affective empathy* because empathic concern with another person requires an accurate understanding of what he/she thinks or feels. However, empirical studies have found that the opposite is the case (e. g., Van Heel et al., 2020). Concretely, the level of empathy at one point predicts the level of social perspective taken at a later point. Van Heel and colleagues explained these findings based on learning opportunities during childhood. Obviously, children will use their parents as role models regarding social perspective taking and emotional concern (Eisenberg et al., 2006). As mentioned by Holochwost et al. (2021), the child-parent interaction might also be important in developing socio-emotional skills: Children observe, experience, and practice these skills in the context with their families, and later with their peers. However, the initial learning opportunities for empathy strongly differ from social perspective taking. Children can easily observe their parents' empathic reactions and build their own empathic concern based on their role models, whereas their parents' cognitions cannot be directly observed by the children. It might be possible that the empathic concern is acquired earlier in childhood than the ability for social perspective taking. In addition, it might be the case that the early empathic concern might stimulate the general interest to engage in social perspective taking. Especially in the context of visual arts, this developmental explanation might be interesting, since we know that empathy is also a matter of training and that engaging with another person can train empathy (Goldstein & Winner, 2012; Winner, 2019). Vreeland, thereby, expected that the benefits of arts belong to imagination of other roles: "Paintings allow us to live beyond our own time and place. Each time we enter imaginatively into the life of another, it's a small step upwards in the elevation of the human race. When there is no imagination of others' lives, there is no human connection, and therefore no compassion ... Art-and literature are antidotes to that" (Vreeland, 2006; quoted from Konrath & Kisida, 2021, pp. 16-17). For that reason, it might be important that visual arts programs really "push" children forward to "explore and invent" new learning contents (Winner, Goldstein, et al., 2013, p. 196). Otherwise, the aim to foster socio-emotional skills like empathy and theory of mind can be easily missed (as demonstrated in Goldstein & Winner, 2012). In this study, the adolescents should only engage with visual arts in terms of technique training, and not empathy-related drawing tasks. To empathize with another person and interpret situations correctly, it might be also helpful to recognize the underlying emotions (Preston & Hofelich, 2012). If individuals fail to recognize emotions in a competent manner, however, it is related to dissatisfaction and difficulties in later developmental tasks (Denham, 2018; Havighurst, 1972). From clinical and non-clinical studies, it is known that directing attention to relevant parts of the face

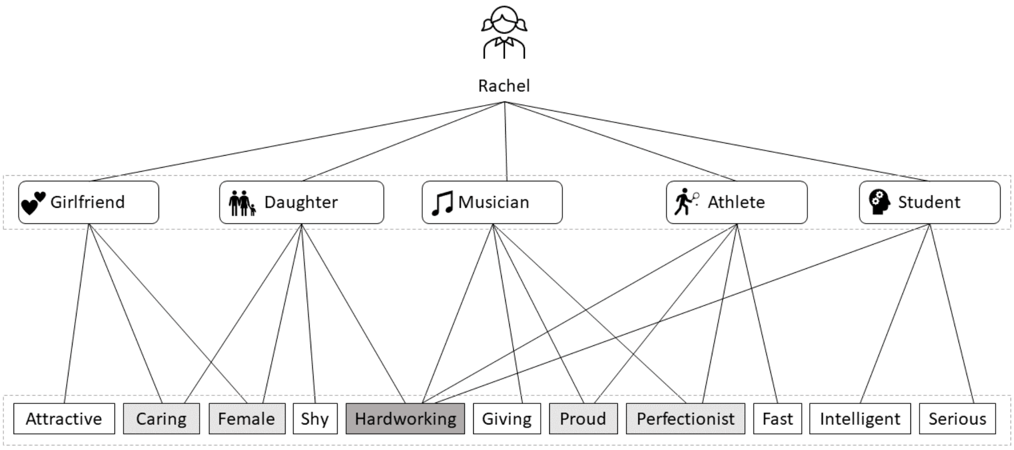
(i. e., eyes) can explicitly train the ability to recognize emotional facial expressions (e. g., in *Attention Deficit Hyperactivity Disorder (ADHD)*: Dadds et al., 2006; *autism*: Harms et al., 2010; *non-clinical studies*: Balas & Sinha, 2008; Zhou et al., 2012). Based on these findings that directing attention to relevant parts of a face lead to better emotion recognition performance, Zhou et al. (2012) showed an improved processing of faces for the artists compared to the novices. Thus, these results demonstrate that emotion recognition and empathy skills can be learned and trained through an engagement with the visual arts by directing attention to relevant facial features. However, artists might differ in several other characteristics, such as interest, motivation, etc. In sum, based on these findings it can be assumed that emotions can serve as content for drawing.

Self-Concept and Self-Complexity

The second target construct, which should be trained in the courses conducted within this dissertation, is *self-concept.* There are many different ideas and theories about how the self-concept is structured and mentally represented. Generally, the knowledge a person possesses about him- or herself (e. g., semantic traits, episodic memory) is seen as self-concept's *content*, while the way how the information about the self is organized (e. g., the number of self-aspects) is the self-concept's *structure* (Brown, 2020; McConnell, 2011). From visual arts engagement or museum visits, for instance, it is expected that the self-concept structure can be changed through personality development and stimulating self-reflection (Banz, 2008; Falk, 2008, 2009; Falk & Dierking, 2018). Moreover, Falk (2008) identified different motivations why people are visiting a museum. He demonstrated that self-reflection and self-interpretation, are important processes during a museum visit and that these processes in turn lead to better understanding of one's selves (see also Linville, 1985; Simon, 1997, 1998, 1999, 2004). Falk's findings (2008) are consistent with the idea of self-aspects: *Self-aspects*, in turn, can be seen as cognitive elements that serve to organize all the knowledge and information one has about oneself, and in their totality lead to a complex self-concept. Self-aspects, thereby, can be *physical characteristics* like being small, *social roles* like being a student, a member of a club or a friend, or *psychological characteristics* like traits, behavior, attitudes, or abilities. Thus, having many different self-aspects means that a person is extraordinarily self-complex (Linville, 1985, 1987; Woolfolk et al., 2004). Additionally, there is evidence that self-complexity is associated with success in several life areas and general well-being (Rafaeli-Mor & Steinberg, 2002). Thus, self-complexity might be a protection against negative self-evaluations and low self-esteem. If a person has several self-aspects that he or she can identify with, a defeat in one single self-aspect, such as a poor grade in math should not be generalized to other areas of the person's life or lead to depressive reactions and/or low self-esteem (Linville, 1987; Rafaeli-Mor & Brown, 1997). Figure 3 shows an example for a student, named Rachel and her self-aspects (which was already used in the self-concept course to explain students the topic of self-complexity, see Appendix

Figure 3

Hypothetical Self-Concept for a Person Named Rachel With Five Self-Aspects ("the Ovals") and Associated Adjectives



Note. Adapted figure from McConnell (2011). The multiple self-aspect framework: Self-concept representation and its implications. Rachel with her social roles and how she describes herself with adjectives. In some roles Rachel describes herself with the same adjectives. These adjectives are grey colored. McConnell (2011). *Personality and Social Psychology Review*, *15*(1), 3–27. doi: `https://doi.org/10.1177/1088868310371101`.

A). Rachel describes herself with different personal characteristics per self-aspect, e. g., hardworking, intelligent, as well as caring. Thereby, it is noteworthy that the accessibility to self-aspects depends on the social context. For example, the social context *school* might activate the self-aspect *student* and the characteristics which might be associated with this self-aspect (e. g., intelligent, serious). Simultaneously, other self-aspects such as *daughter* and the respectively associated characteristics might be activated less in the context of *school*. Additionally, some adjectives might overlap between the self-aspects: Rachel, for example, describes herself as caring. This description belongs to two self-aspects: daughter and girlfriend.

Developing a complex self-concept and describing oneself with different characteristics is an important developmental task in adolescence. A central assumption is that observing other persons and putting oneself in their shoes might help to develop a more complex self-concept representation (Eisenberg & Sulik, 2012; Myers & Hodges, 2012). Through processes such as empathy, perspective taking and theory of mind, characteristics and complexities of another person might be transferred and integrated into the own self-representation (Brown & McConnell, 2009). Including the other person into the own self means that the representation of the self and the representation of the other person overlap (Aron et al., 2004; Mashek et al., 2003). An important observation was made in the studies of Brown et al. (2009) who found that the mental representation of close others and one's own self-concept are often compatible in terms of their complexity. If the self-representation is more complex, then also the representation of the close other is more complex. Researchers argued that the own self is used as a reference for perceiving meaningful others and including them in one's self-representation regarding content and structural similarity (e. g., Davis et al., 1996). For instance, people expect that others behave as they do (e. g., Marks & Miller, 1987). Meyer et al. (2019), on the contrary, argues that perspective taking in the sense of simulation of others might change one's own self-representation to fit to the simulated person. This means that the self of the other person is used as reference. Following Meyer et al.'s (2019) argument, it might be plausible to use a complex reference and create in turn a complex self-concept. Based on these findings, one might expect that empathy-related (drawing) tasks in which the complexity of a simulated person is systematically increased lead in turn to an increase of one's own self-complexity. In sum, visual arts engagement leads to a higher self-complexity because visitors activate and reflect self-aspects during their experience in an art museum (cf. Falk, 2008). Therefore, a museum visit might be described as an activity which is closely related to one's own self-concept.

Table 4

Definitional and Contextual Parameters of the Course Program:
Emotions, Self-concept & Epochs – Exploring Portraits With a Digital Drawing Pencil

Parameter	**Course Program:** ***Emotions, Self-Concept & Epochs – Exploring Portraits With a Digital Pencil***
Differentiated Definition of Arts Education	
Domain	Visual Arts
Genre/traditions/methods (e. g., classical, modern)	Artworks from the Herzog Anton Ulrich Museum Braunschweig (Baroque/Rococo paintings)
Combinations	
• Multiple arts domains	Visual Arts/Digital Drawing encompassing empathy tasks (“stepping into the shoes of others”)
• Integrated/combined with other subjects	Socio-Emotional Learning: Empathy/Emotion Recognition, Self-Concept/Self-Complexity
Characteristics	
• Type of activity (solo/group)	Museum exhibition and digital drawings were group activities
• Mode of participation (passive/active)	Adolescents were active learners (observing, discussing, engaging, and drawing) during arts consumption and creation
Immediate Context of a Program or Experience	
Specific institutional setting (e. g., school)	The Herzog Anton Ulrich Museum:
• Setting’s arts learning profile	• Europe’s oldest art museum (since 1754 by Duke Carl I of Braunschweig-Lüneburg) • It features some 4,000 works of art spanning 3,000 years of art history

Table 4
Continued

Parameter	**Course Program:** ***Emotions, Self-Concept & Epochs – Exploring Portraits With a Digital Pencil***
	Partner Schools: • Public high schools of the district of Braunschweig • Participation during arts classes • Class 7-12
Presence/characteristics of teachers/teaching artist:	
• Personal characteristics	Teachers were museum educators/art historians.
• Training (as artist and educator)	Teachers received an initial training and course manual.
• Experience (as artist and educator)	Educator in Art Museum
• Role in institutional setting	-
Program Characteristics	
• Structural features	Adolescents were bused from their school to attend three course sessions.
• Process quality	Course session occurred during school day in the Herzog Anton Ulrich Museum. Adolescents were randomly assigned to the courses. Demonstration phase, digital drawing (tracing, intensifying, transfer, selfie), reflection/discussion, measure process data of digital drawing.
Dosage	
• Frequency of instruction	3 weeks
• Duration of activity	3 hours per week

Table 4
Continued

Parameter	**Course Program: *Emotions, Self-Concept & Epochs – Exploring Portraits With a Digital Pencil***
Broader Context of a Program or Experience	
Child characteristics	
• Age/developmental stage	12-19 years/all school types
• Gender identity	46 % (38 %) of students were identified as female (male), 16 % without gender information
Exosystem factors	
• Peer group	All students were from the district of Braunschweig.
• School	All German school types (Hauptschule, Realschule, Gesamtschule, Gymnasium).
• Neighborhood	-

Note. This table was designed for the course program "*Emotions, Self-concept & Epochs – Exploring Portraits With a Digital Drawing Pencil*" in accordance to Holochwost, S. J., Goldstein, T. R., & Palmer Wolf, D. (2021). Delineating the benefits of arts education for children's socio-emotional devlopment. *Frontiers in Psychology*, *12*(624712), 1–11. https://doi.org/10.3389/fpsyg.2021.624712.

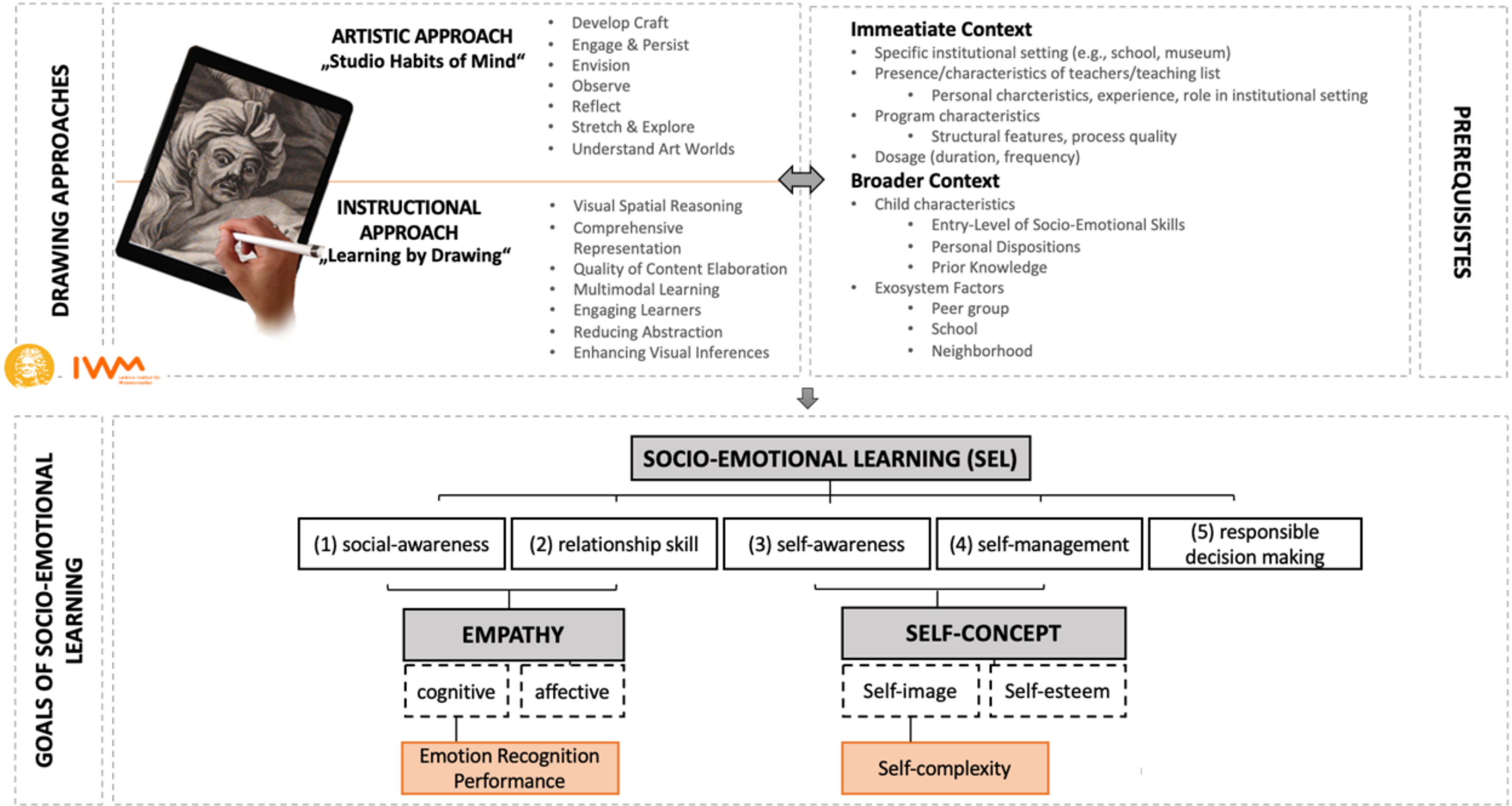
1.3.4 Conceptual Framework of Visual Arts Engagement

Based on Holochwost et al. (2021) assumptions, a specific framework for visual arts engagement can be derived to train socio-emotional skills in adolescence. Since the arts genre was already set in this dissertation, theoretical considerations and proven learning principles from the learning-by-drawing literature (referred to as *instructional approach* in the following) were used and linked to the theoretical assumptions of the studio habits of mind (referred to as *artistic approach*, »Chapter 1.2.1, Framework 3: The Studio Habits of Mind«). The two approaches have in common that they assume that visual arts, especially drawing, can promote engagement and learning if the content is adequately instructed (for a general overview over the drawing tasks instructed, see »Chapter 2«). Since the instructional approach focuses much more on the content and interactions with the learning material, the artistic approach is stronger related to the processes and interactions between teacher and students in a visual arts classroom (cf. Hetland et al., 2013). It may be particularly enriching to combine these two approaches, as not only the content but also the forms of teaching are addressed.

Thereby, important teaching processes in visual arts classrooms could be identified: (1) *Demonstration phase* in which the students learned about the specific topic, (2) *students-at-work phase* which builds the basis for designing drawing tasks regarding the instructional approach, (3) *reflection phase* in which students could critically discuss and reflect their own artwork with others. For both approaches, however, it seems to be important to choose and define socio-emotional learning contents concretely and how theses contents can be addressed in a visual arts context. (see »Chapter 1.3.3«). Based on previous studies, we expected that empathy-related drawing tasks might foster empathy or self-concept (cf. Goldstein et al., 2012). Besides the specific design of the drawing tasks also the context/setting in which the drawing took place should be considered. For instance, the visual arts classroom enables a “room” for learning through observing, discussing, exploring, and engaging with learning contents, as well as reflecting, making mistakes, and updating mental representations. However, the visual arts also enable trying new techniques when the learning environment is valuable and nonthreatening. Integrating these contextual factors (as proposed by Holochwost et al., 2021; Konrath & Kisida, 2021) might allow new insights and understanding of visual arts engagement as well as analyzing drawing data exploratively. Figure 4 provides an overview of the dissertation’s conceptual framework considering a clear definition of the socio-emotional skills by integrating the studio habits of mind and learning-by-drawing as theoretical foundation as well as the personal prerequisites of the learner.

Figure 4

Conceptual Framework for Systematizing an Arts Education Program and Underlying Mechanisms on the Development of Socio-Emotional Skills



Note. In accordance with Holochwost et al.'s (2021) a clear definition of the educational experience (e. g., visual arts, drawing approaches), the domain of socio-emotional skills (e. g., empathy, self-concept), and context variables (e. g., child characteristics, prerequisites) were considered.

CHAPTER 2

COURSE PROGRAM, METHODS, & PROCEDURE

2.1 From the Conceptual Framework to the Course Program

This Chapter gives an overview on the structure and content of the developed course program *Emotions, Self-Concept, & Epochs – Exploring Portraits With a Digital Drawing Pencil*, which forms the basis for the three empirical studies of this dissertation (»Chapters 4-6«). In addition, the operationalization in terms of drawing tasks, measurements, and questionnaires are presented in the following sections. I describe how the course program is related to the conceptual framework (»Chapter 1.3.4«). Thereby, I explain to what extent the artistic and instructional approaches influence the acquisition of socio-emotional skills with respect to prerequisites of the immediate or broader context (i. e., abilities, interest, motivation). Generally, the most important requirement of the course program was the experimental pre-post comparison. The three courses studied were completely standardized in their structure (theoretical learning phase, drawing and reflection time, and self-reference) and differed only in their content. To avoid self-selection effects, the adolescents were randomly assigned to a course after the pretest. The adolescents were not allowed to change their course. In the following, based on the two approaches (artistic, instructional) and the personal variables, a list of criteria for designing a concrete visual arts course program is proposed.

Criteria List to Design a Visual Arts Course Program:

- **Consider the personal and situational differences between subjects!**
    - To minimize situational differences, use a controlled and standardized setting. In this dissertation, a classroom setting was used in an art museum context.
    - Standardize the courses in their structure and drawing tasks. Only the concrete graphics used for drawing differ.

    - Identify personal differences using personality questionnaires (e. g., Personality Traits (HEXACO PI-R)), and prior knowledge (e. g., declarative, procedural). If it is possible, also measure the drawing process (e. g., drawing features) and drawing quality. This allows insights into potential underlying mechanisms.

- **The engagement with the learning material should be interactive and stimulating!**
    - The learning research tells you that active engagement leads to a deeper processing of the learning content (e. g., Bonwell & Eison, 1991; Freeman et al., 2014; Markant et al., 2016).
    - Keep in mind that the artistic approach based on the eight studio habits of mind assumes that active engagement with learning materials takes place in visual arts classes in terms of drawing portraits (compare students-at-work phase, Hetland et al., 2013, p. 20). Adolescents engage and persist with visual arts to acquire socio-emotional skills. However, not only the active engagement with the content and materials provided (paintbrushes, pencils, or even tablets) is crucial, but also the shared exchange with classmates, the teacher, and the museum educators. By reflecting together on a created work of visual arts, the "artist" not only gets the opportunity to express him- or herself, but also can receive feedback from others (compare critique phase, Hetland et al., 2013, p. 20). The feedback helps to critically reflect the own artwork.
    - Contemplate the instructional approach, which also assumes that active engagement with the learning material is crucial. In contrast to the artistic approach, this approach focuses less on the classroom setting itself and more on the drawing result (e. g., picture, graphic, sculpture) and if possible, the drawing process (e. g., drawing data/drawing features). The instructional approach has been largely neglected in transfer effects research. However, the underlying assumptions of the instructional approach are extremely generic, which is why it can be assumed that they could also be helpful in the acquisition of socio-emotional skills. As with the artistic approach, there is a particular focus on active engagement with the learning material. Central elements in learning-by-drawing are the formation of internal representations, which are expressed on paper or tablets. Drawing helps to break down complex learning content to the essentials and to form inferences.

- **The learning content must be specifically designed!**
    - You cannot assume that drawing *per se* promotes socio-emotional skills. In previous studies (e. g., Goldstein & Winner, 2012), no effects of visual arts on socio-emotional skills such as empathy could be found, although other

studies show that the arts use the same neural structures as the processing of empathy (e. g., Christensen & Gomila, 2018; Li et al., 2014; Vessel et al., 2012). Goldstein and Winner (2012), for instance, explain that in their studies, the students in the visual arts condition should only engage with basic drawing skills. The authors argue that engagement with visual arts should be particularly conducive to the acquisition of socio-emotional skills such as empathy when drawing tasks explicitly involve empathy elements such as "putting oneself in the shoes of another person" (Winner, 2019). Furthermore, experiencing a complex person through empathizing should lead to a more complex representation of oneself.

- **Prerequisites that the students bring with them must be taken into account!**
  - Consider individual differences between learners to understand who benefits most from visual arts. Not only personality traits, prior knowledge, demographics, but also ability level in terms of socio-emotional skills and drawing skills play an important role. Individuals with drawing skills should be able to make more realistic drawings, which results in a better drawing quality (e. g., Schmidgall, 2017; Schmidgall et al., 2019). Since personality differences could also be explicitly reflected in drawing behavior (e. g., pencil/brush pressure), the present dissertation recorded the entire drawing process using tablets and analyzed it exploratively for the first time.

In the following Section, I will give a short description of the course program, in which I used all the previously presented criteria.

2.2 The Course Program "Emotions, Self-Concept, & Epochs – Exploring Portraits With a Digital Drawing Pencil"

The core of this dissertation is the conceptual development, implementation, as well as the scientific evaluation of the course program *Emotions, Self-Concept, & Epochs – Exploring Portraits With a Digital Pencil* (Kastner et al., 2020). The course program was developed in interdisciplinary collaboration between psychologists, museum educators, art historians, and computer scientists and resulted in a course manual, which is attached in digital form in APPENDIX A[6]. The course program was designed as a 3-week courses over 9 hours (3 hours/week) and was conducted at the Herzog Anton Ulrich-Museum

[6]The manual is also available online at `https://uni-tuebingen.oerbw.de/edu-sharing/share?nodeId=7592969e-24c9-44a4-8561-dd9b7d94fdf7&token=1f8fb55fb72e9cc633d79c2c3c06e6bd` (Last Access: 2022-01-30).

(HAUM) in Braunschweig with students of Grades 7–12. The participating school classes were recruited by the head of museum education. The course program comprised three courses that differed only in their learning content. Two of the three courses focused on socio-emotional topics (empathy/emotion recognition or self-concept/self-complexity), while the third one was about an art historical topic (epochs). Within each of the three courses, the students dealt with the respective learning contents in various (drawing) work phases. The work phases were based on the three central elements of the *studio structures for learning* by (Hetland et al., 2013, p. 20): demonstration phase, students-at-work phase, and critique phase.

In the first course session, the students learned about the specific course content (*demonstration phase*). For example, the students saw authentic visual artwork being made, tools being used, or images of work made by others. The important components were *group focus* (the teacher gave an overview of the specific learning content about emotions, self-concept, or epochs), *visual emphasis* (the students were engaged and informed; information was presented visually), *immediate relevance* (the learning content was related to what students had to do), *brevity* (the students should have enough time to reflect), and *connection* (the students relate skills, attitudes, concepts, and prior knowledge; for more information see also Hetland et al., 2013, p. 21). In the two subsequent course sessions, the acquired knowledge about the respective learning contents was actively implemented in drawing tasks with increasing difficulty (*students-at-work phase*). The *students-at-work* structure is one of the most helpful structures to attend to an individual student's "zone of proximal development" (see also, Hetland et al., 2013; Vygotsky, 1978, 1984). Therefore, this structure was used in the following two course sessions. While in the second course session mainly portraits from the museum were used, in the third course session mainly self-created photos and selfies (staged as self-portraits) were used (see a detailed description of the drawing tasks and drawing activities in the following section). After each drawing task, the created drawings were analyzed, reflected upon, and discussed (*critique phase*). In addition to the Hetland et al.'s (2013) *studio structures for learning*, the educational curricula of the German states of Baden-Württemberg and Lower Saxony were also considered in the design of the course programs (cf. Baden-Württemberg Ministerium für Kultus, Jugend und Sport, 2016a, 2016b, 2016c; Behme, Buchholz, et al., 2016; Behme, Hilmes, et al., 2016; Funke et al., 2016). Table 5 gives a general overview over the course topics, contents, and activity as well as the curricular goals.

Table 5

Overview Over the Course Topics/Contents/Activity and the Curricular Goals

Topic/Content/Activity	Materials	Instructions	Curricular Goals	Related Literature
Introduction: Learn about emotions, self-concept, or epochs	PowerPoint, Art Exhibition, Paintings in the Art Museum	Provide introduction to art-based education curriculum and overview of the content (emotion, self-concept, epochs)	Understanding of the course contents, demonstrating phase	Hetland et al. (2013) Winner et al. (2013) Konrad & Kisida (2021)
Tracing Drawing Task: Draw different emotions (anger, fear), Hercules in social roles (competence-oriented, relationship-oriented) or a person in historical context (Baroque, Rococo)	Tablet, digital pencil	*Emotion Course*: “Recall the typical characteristics of the emotion “anger” [“fear”] that you learned in session 1 and draw the emotional expression with the tablet.”	*Emotion Course*: Understanding how emotions look like (specific features: eyes, eyebrow, mouth) and their function for empathy; train empathy/perspective taking/ToM, observation skills	Ainsworth & Scheiter (2021) Ainsworth et al. (2011) Cook (2006) Cromley et al. (2020) Schmidgall et al. (2019)

Table 5
Continued

Topic/Content/Activity	**Materials**	**Instructions**	**Curricular Goals**	**Related Literature**
		Self-concept Course: "Here you can see a graphic of Hercules with the "Lernaean Hydra" ["Omphale"]. Your task is to draw Hercules in such a way that his movements are clearly visible in your drawing. You only need to hint at the "Hydra" ["Omphale"]."	*Self-concept Course*: Understanding that persons can have different social roles with different characteristics from the example of Hercules (competence vs. relationship role); train empathy/perspective taking/ToM & self-complexity, observation skills	
		Epoch Course: "Draw the graphic. Focus especially on the typical features of the "Baroque period" ["Rococo period"] that you learned in Session 1."	*Epoch Course*: Understanding of specific differences between historical periods, train empathy/perspective taking/ToM, observation skills	
Intensifying/Transfer Drawing Task: Draw and intensify different emotions (anger, fear), Hercules in social roles (competence-oriented, relationship-oriented) or a person in historical context (Baroque, Rococo)	Tablet, digital pencil	*Emotion Course*: "Here you see an ambiguous emotion. Your task is to reinforce this emotion of "anger" ["fear"] in such a way that it is immediately recognizable."	see Curricular Goals of Tracing Drawing Task	Ainsworth & Scheiter (2021) Ainsworth et al. (2011) Cook (2006) Cromley et al. (2020) Schmidgall et al. (2019)

Table 5
Continued

Topic/Content/Activity	Materials	Instructions	Curricular Goals	Related Literature
		Self-concept Course: “Your task now is to use the painting of Hercules and the hind to strengthen the figure of Hercules so that his strength and power are more clearly visible in your drawing. You only need to hint at the hind.”/ ”Your task now is to change the figure of Hercules in such a way that his weakness is more clearly visible in your drawing. Omphale, on the other hand, you can draw more powerfully.” *Epoch Course*: “Here you can see a graphic of the “Baroque period” [“Rococo period”], which is not immediately clear to the “Baroque” [“Rococo”]. Your task is to change the graphic in such a way that your drawing clearly shows stylistic elements of the “Baroque” [“Rococo”]. You can change clothes, posture, environment. Important: Use colors that match the baroque style.”		

Table 5
Continued

Topic/Content/Activity	Materials	Instructions	Curricular Goals	Related Literature
Self-Refence Drawing Task: Draw different emotions based on your own selfie (anger, fear), yourself in different social role (competence- vs. relationship-oriented), or yourself as a Baroque prince/princess, Rococo gentleman/lady	Tablet, digital pencil	*Emotion Course*: "Please look into the camera with a neutral expression. Imitate the feeling "anger" ["fear"]. Your task is to reinforce this emotion of "anger" ["fear"] in such a way that it is immediately recognizable."	see Curricular Goals of Tracing Drawing Task	Ainsworth & Scheiter (2021) Ainsworth et al. (2011) Cook (2006) Cromley et al. (2020) Schmidgall et al. (2019)

Table 5
Continued

Topic/Content/Activity	**Materials**	**Instructions**	**Curricular Goals**	**Related Literature**
		Self-concept Course: [*competence-oriented role*:] "Imagine you are an excellent and talented pianist who loves playing the spinet. Music makes you happy, the big stage and concerts are your world. Change the present photo so that your role with the described characteristics is immediately recognizable. There are no limits to your imagination. You can draw a big concert hall as well as a lesson with your piano teacher. The important thing is that it is immediately recognizable that you love music."/ [*relationship-oriented role*:] "This time imagine you are to be forcibly married to a person you do not love. At the same time, you love another person, but you cannot be with him. Think about how you would feel in this situation. You can be angry, sad, or aggressive. Again, there are no limits to your imagination. Try to draw how you would feel in this situation."		

Table 5
Continued

Topic/Content/Activity	**Materials**	**Instructions**	**Curricular Goals**	**Related Literature**
		Epoch Course: "Your task is to draw the two selected photos and add appropriate period features "Baroque" ["Rococo"]. In the end, you should be able to recognize in the drawing which era you wanted to depict. Facial features need only be hinted at. Accessories, hairstyle, colors and clothing are important."		
Reflection & Discussion Discuss students' artworks in classroom	Picture on tablet	"Please reflect and write down all the elements you have worked out in the Tracing/Intensifying/Transfer Drawing Task."	Critical reflection, error correction, update mental representation	Hetland et al. (2013) Winner et al. (2013) Konrad & Kisida (2021)

2.2.1 Emotion Course

In the first course session, the students of the emotion course learned the characteristic features of the six basic emotions *happiness*, *anger*, *fear*, *surprise*, *sadness*, and *disgust* (e. g., in the emotion fear, the eyes are wide open, the mouth is distorted in fright; Ekman & Friesen, 2003). In addition, the students learned which emotions are confounded with each other and where to focus to recognize emotions quickly and accurately (e. g., the eyes are informative for differentiating fear and surprise which are both characterized through wide opened eyes). Furthermore, the students learned the importance of being able to accurately recognize the emotions of others in social situations to adapt one's own behavior to the respective situations (Ekman & Friesen, 2003). In the exhibition at the HAUM, the students had the opportunity to apply their acquired knowledge and to explore the paintings for emotional facial expressions they had emphasized visually before. The painting *„Cain slays Abel"*[7] by Gioacchino Assereto (Genoa, 1600–1644) was analyzed in the classroom setting with the educator of the museum. The students closely observed the painting, reflected critically, and discussed in detail which emotion exactly was represented in the painting.

In the second course session, the students engaged in portrait drawings. In this session, they could develop their craft through the *student-at-work phase* (Hetland et al., 2013). They applied their knowledge obtained in the first course session by working on different "empathy-based" drawing tasks related to artworks in the museum. APPENDIX B shows all artworks and drawing tasks used in my dissertation. The drawing tasks increased in difficulty, while the students had to persevere and to engage to create something visible that they had imagined mentally before. For the drawing tasks, I used a specifically designed drawing app that comprised a selection of useful digital tools for developing crafts, implementing envisioned ideas, exploring portraits, and expressing themselves. The app contained templates for the drawing tasks, allowed taking selfies as templates, included simple editing functions (e. g., undoing, or redoing strokes, zooming-in or -out, fading-in or -out), and enabled drawing of templates differing in their difficulties (tracing, intensifying, transfer, and selfie). Additionally, it was possible to record the entire process of student's drawing (for more information on the measured drawing data, see »Chapter 2.3«). In the first drawing task, the students in the emotion course were instructed to *trace* two clearly recognizable emotions, namely fear and anger, expressed in an artwork (*tracing* drawing task; see APPENDIX B, 1, 2). In the second drawing task, the students had to *intensify* the emotion presented in the artwork. Here, the presented facial expressions were ambiguous (e. g., portrait of Rembrandt whose facial expression might express fear or surprise) and should be changed to a clearly recognizable emotional expression of fear (*intensifying* drawing task; see APPENDIX B, 3, 4). In a third drawing task, students had to *transfer* a neutral graphic into an emotional

[7] `https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG490/1/` (Last Access: 2022-01-29)

one. This was the most difficult task because the same painting had to be changed into three different emotional expressions (anger, fear, sadness; *transfer* drawing task; see APPENDIX B, 5).

In the third course session, students had to draw as in the second course session, but this time students had to express themselves much more. To do so, the students had to create selfies with their tablet that were used as drawing templates. Therefore, students had to take selfies of themselves looking a little angry or fearful (~50 % of full emotional expression) and change them to a fully expressed facial expression of anger or fear (*selfie* drawing task; APPENDIX B, 10). For an overview of the topics/contents/activity and related curricular goals see Table 5.

2.2.2 Self-Concept Course

In the first course session of the self-concept course, adolescents learned about the function, structure, and development of the human nature of the self-concept. How can potentially conflicting personal characteristics be integrated into a coherent self-representation, associated to different competencies or relationships? To answer this question, students had to reflect on their personal characteristics in varying social roles they have. To engage the students with the topic of self-concept and social roles, the painting *Family Picture*[8] of Cornelis de Vos (1618–1619) was used. Students had to identify themselves with the girl sitting in front of the piano surrounded by her family and imagine the different social roles (*competence-* or *relationship-oriented*) of the girl. To identify the girl's social roles, the students had to observe the painting closely, imagine her roles (*competence-oriented* roles: pianist, *relationship-oriented* roles: daughter, sister, fiancée), reflect, and discuss together in the group.

In the second course session, students had to step into the shoes of the mythical hero Hercules depicted on two different paintings, which presented him either in a *competence-oriented* role of a strong hero fighting against the Hydra or in a *relationship-oriented* role of a lover of Omphale. Participants had to *trace* Hercules in these two roles (*competence-* or *relationship-oriented*) in the first drawing task (*tracing* drawing task; see APPENDIX B, 6, 7). In the second drawing task, students had to again step in the shoes of Hercules. However, in this drawing task, Hercules was not so clearly recognizable as hero or lover in the paintings. Thus, students had to envision and *intensify* the paintings so that Hercules would be clearly recognized as a hero (competence-oriented role) or a lover (relationship-oriented role, *intensifying* drawing task; APPENDIX B, 8, 9).

In the third course session, the students had to take selfies just as in the emotion course. Here, the *Family Picture* of de Vos was used again (*selfie* drawing task; see APPENDIX B, 10) as a life-size printed version of the painting with the girl who was

[8] `https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG_206/1/` (Last Access: 2022-01-29)

sitting in front of the piano cut out. Students had to step in the role of the girl and create a selfie of themselves as a pianist in the painting and use this painting as a template for drawing. In this *selfie* drawing task, students were instructed to imagine that they are a pianist training in a music lesson or presenting themselves in a concert hall (*competence-oriented* role) or to imagine the situation marrying someone in the portrait they do not love (*relationship-oriented* role). The focus of the drawing tasks should be on envisioning these two situations.

2.2.3 Epoch Course

In the first course session of the epoch course, students learned about art history, how portraits in different epochs looked like, and what the characteristic features of different art historical periods are. Concretely, students focused on the differences of the art historical periods of Baroque and Rococo and explored them in the exhibition. For the *Baroque* period, students analyzed the painting *Portrait of Duke Anton Ulrich of Braunschweig-Wolfenbüttel*[9] (Paris, 1680–1693) and the *Portrait of Elisabeth Charlotte d'Orléans, née Countess Palatinate near Rhine*[10] (Paris, 1716), both by Hyacinthe Rigaud. For the *Rococo* period, students analyzed the *Portrait of Maria Antonia Pessina von Branconi*[11] by Anna Rosina de Gasc (Braunschweig, 1770) and the *Portrait of Duke Carl Wilhelm Ferdinand, Hereditary Prince of Braunschweig*[12] by Pompeo Batoni Cavallino (Rom, 1767).

In the second course session, students had to draw the characteristic features of the periods of Baroque and Rococo in two drawing tasks: In the first drawing task, students had to *trace* them based on a template expressing the art historical periods (*tracing* drawing task; see APPENDIX B, 11, 12), while in the second drawing task, they received an ambiguous portrait of a scientist and a lady and had to imagine and *draw/intensify* the scientist as a Baroque prince using colors and other characteristic elements, such as heavy dark-colored curtains, or the lady as a classical Rococo princess with pastel-colored clothes and flowers (see APPENDIX B, 13, 14).

In the third course session, students in the epoch course had the opportunity to step into the shoes of a Baroque/Rococo prince or princess by using wigs and other materials and take a *selfie*. The students used these selfies as templates to envision and to draw themselves as art historic personalities. Selfies in the third course session were used to deepen the processing of the course's contents (Symons & Johnson, 1997). During the courses, students produced valuable drawing data for further analysis.

[9] https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG528/1/LOG_0000/#isil_DE-MUS-026819_opal_herzanulm_kunshe_GG528(LastAccess:2022-01-29)

[10] https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG524/1/ (Last Access: 2022-01-29)

[11] https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG630/1/LOG_0000/#isil_DE-MUS-026819_opal_herzanulm_kunshe_GG630 (Last Access: 2022-01-29)

[12] https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG676/1/LOG_0000/#isil_DE-MUS-026819_opal_herzanulm_kunshe_GG676 (Last Access: 2022-01-29)

2.3 Drawing Task and Drawing Activities

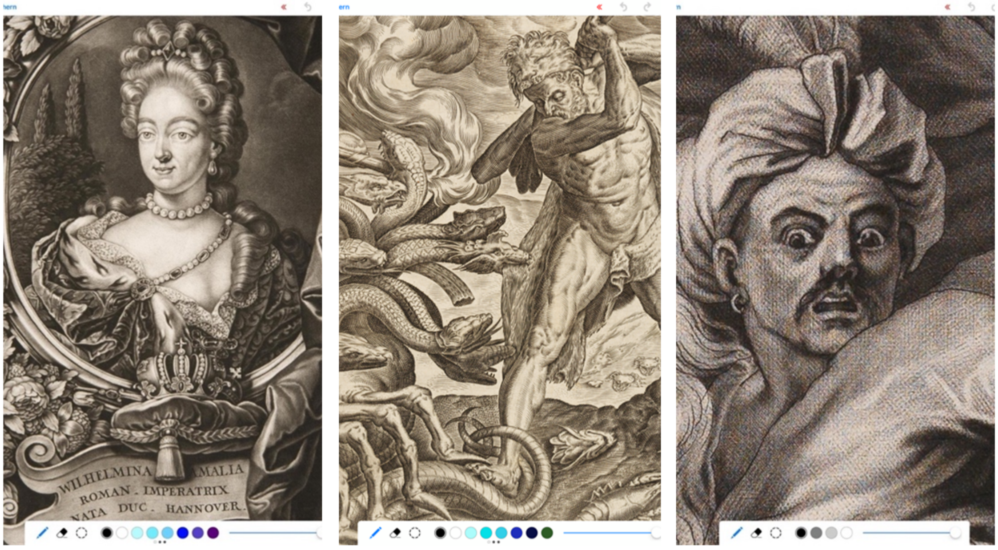
For the drawing tasks, a drawing app *Strokey: Der Schlüssel zur Zeichnung* (engl. *Strokey: The Key to Drawing*, Jaszkowic, 2018) for tablet devices (12.9" iPad Pro, 2732 × 2048 pixels 264 ppi, iOS 12.1) was used, which was specifically developed for these studies. This application allows for the use of predetermined paintings (templates), self-constructed pictures (selfies), and measuring process data during drawing (so-called drawing features), such as time pencil is on paper (*M*, *SD*, Min, Max), number of strokes, number of erased strokes, pressure (*M*, *SD*, Max), altitude (*M*, *SD*, Min, Max), number of used tools, number of used colors, number of zoom-in and zoom-out interactions, as well as the number of fade-in and fade-out interactions (see description of the drawing features measured below). At the top of the screen, students could use the function *undo* instead of an eraser, *delete* the drawing or *save* the drawing; at the bottom of the screen, several functions were contained in a toolbar (*pencil*, *eraser*, *zooms*, *fades*, *cut-and-paste*, *colors*). In the emotion course, contrary to the other two courses, students had only grayscale colors at their disposal to avoid the expression of emotions through use of colors (e. g., *red* for anger, *blue* for sadness; as we found in a pilot study; Kastner, 2017). Figure 5 shows sample pages of the three courses presented in the *Strokey* drawing app.

Overview of the drawing features registered by the drawing app for each drawing task:

- Time (in seconds) spent on tablet (time pencil is on tablet: *M*, *SD*, Min, Max).
- Number of strokes drawn (SUM).
- Number of corrections made (*erased strokes*, SUM).
- Amount of pressure exerted onto the tablet with the digital pencil (three variables):
    - Average amount of pressure exerted onto the tablet while drawing (*mean pressure*: $pressure_M$). This variable allows to identify different drawing patterns, such as drawing many thin lines with low pressure or only a few lines with strong pressure.
    - Variation in the amount of pressure exerted across different strokes (*standard deviation of the pressure*: $pressure_{SD}$).
    - Maximum pressure exerted on the tablet while drawing (*maximum pressure*: $pressure_{\mathrm{MAX}}$).
    - Minimum pressure ($pressure_{\mathrm{Min}}$) is always zero.
- Angle of the digital pencil (0-90 °) during drawing in relation to the tablet is called altitude and measured with four variables:

Figure 5

Sample Page of the Drawing Material Presented in the Strokey Drawing App in the Emotion Course (Left), Self-Concept Course (Middle), and the Epoch Course (Right)



Note. The toolbar is shown at the bottom of the page including all functions (left to right) that were available: Pencil, eraser, cut-and-paste, colors, slider (fades) and zooms (via finger gestures in the picture as usually done on touch devices), save (top left of the page), undo (one step or all steps), share, and delete (top right of the page).

- ◦ Mean angle of the digital pencil (*mean altitude*: $altitude_M$; for more information cf. Sulem et al., 2017).
- ◦ Variation in angle of the digital pencil across different strokes (*standard deviation of the altitude*: $altitude_{SD}$).
- ◦ Minimum and maximum angles of the digital pencil (*minimum altitude*: $altitude_{\mathrm{MIN}}$; *maximum altitude*: $altitude_{\mathrm{MAX}}$).

- Number of tools (eraser, cut-out function, zoom and fade functions) used for drawing (*number of used tools*, SUM).
- Number of colors used for drawing (*number of used colors*, SUM).
- Number of times zoom-in or zoom-out was used (*zoom interactions*, SUM).
- Number of times fade-out or fade-in was used (*fade interactions*, SUM).

2.4 Measurements of Empathy and Self-Concept

In this Section, an overview of the measurements and questionnaires used in the following studies is given to better understand the operationalization of the concepts reported in the three empirical studies. General remark: Almost all tasks were presented on tablets (12.9" iPad Pro, 2732 × 2048 pixels 264 ppi, iOS 12.1), except for the personality inventory (measured with the HEXACO PI-R, Lee & Ashton, 2004), which was presented in paper-pencil format.

2.4.1 The Emotion Recognition Task

One of the two target constructs considered in this dissertation is *emotion recognition* which was operationalized as a basic ability for an individual's empathy. Hereby, the more sensitive an individual is in recognizing emotions of another person, the quicker the individual can react in social situations. Since individuals differ in their perceptual sensitivity, we used a tablet-based emotion recognition task from clinical psychology (a so-called *animated morph task*, see Jusyte et al., 2017; Schönenberg et al., 2014; Schönenberg et al., 2013, Schönenberg, 2016). In this emotion recognition task, digitized color photographs of ten individuals (5 male, 5 female models) were selected as stimuli from the Radboud Face Database (Langener et al., 2010). The stimuli were adjusted for luminance and color using Adobe Photoshop CS4. In addition, the FantaMorph software (Abrosoft, Beijing, China) was used to morph neutral faces (0 % emotion intensity) into one of five basic emotions (100 % emotion intensity, fear, anger, sadness, surprise, or disgust) by 2 % incremental steps (250 ms)[13].

In total, the stimulus material consisted of 50 trials (10 models × 5 emotions) resulting in 15 minutes emotion recognition task. For keeping the repetition effects low each stimulus was presented once. For presentation and data collection, the software Presentation Version 20.0 (Neurobehavioral Systems, USA) was used. Figure 6 (A) shows an example stimulus morphing from a neutral (0 %) to an emotional facial expression (100 %). The adolescents were instructed to identify the presented emotional expression as fast as possible pressing a "stop" button. The morphed video stopped directly, the emotional expression disappeared, and the adolescents had to select the correct emotion presented in a multiple-choice manner (1:5 was correct). Figure 6 (B) shows an example trial. Thereby, two dependent variables were recorded: Accuracy (percentage of correct recognized emotions), and sensitivity (emotional intensity when a person can recognize an emotion).

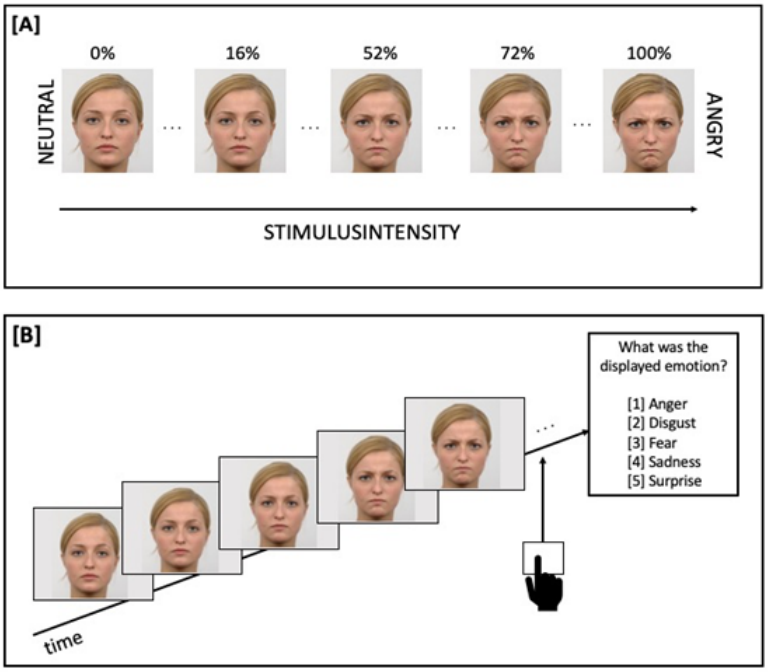
2.4.2 The Self-Complexity Task

The second social-emotional target construct that should be fostered in this dissertation is self-complexity, which represents a special subcomponent of self-concept. According to Linville's self-concept representation (1985, 1987), self-complexity is composed of multiple self-aspects and social roles that include traits, abilities, behaviors or

[13] General remark: We did not include the emotion happiness because it differs in several characteristics from the other emotions (Ekman & Friesen, 2003; Montagne et al., 2007).

Figure 6

Example Stimuli [A] and Trial Procedure [B] of the Emotion Recognition Task



Note. The emotion recognition ability was measured with two dependent variables: *accuracy* (correctly recognized emotions) and *sensitivity* (intensity when the emotion is recognized, Schönenberg et al., 2014). Stimuli presented were selected from the Radboud Face Database (Langener et al., 2010).

attitudes, but also goals, future and past selves, relationships and physical features. In general, it is very important to develop a differentiated access to their social roles and their related characteristics over time because this is related to resilience and protection against stress (Harrison, 2006; Linville, 1987). Stressful or negative life event might affect self-aspects or social roles of a person. For instance, a bad mark in English might affect a student's academic self-aspect/social role but not his or her self-aspect/social role in sports. For that reason, Linville argued that it is suitable to possess a high quantity of self-aspects, so that "only a relatively small proportion of the 'total' self is affected" (Rafaeli-Mor et al., 1999, p. 343). Contrary, if persons only have a small number of self-aspects, a stressful or negative life event might affect a huge part of the 'total' self. For instance, the bad mark in English might be generalized to the 'total' self and led to conclusion of a bad person in general. Therefore, self-complexity can be seen as the number and individual differences in self-aspects/social roles and the overlaps between the self-aspects/social roles, which Linville measured with the dimensionality statistic (H). This H-index based on a trait-sorting task in which predefined traits were sorted to self-generated variables of the self-aspect. If low doublings were used to describe oneself, this reflects high self-complexity and this in turn might have a buffering effect in stressful situations or negative life events (e. g., depression, Linville, 1987; Rafaeli-

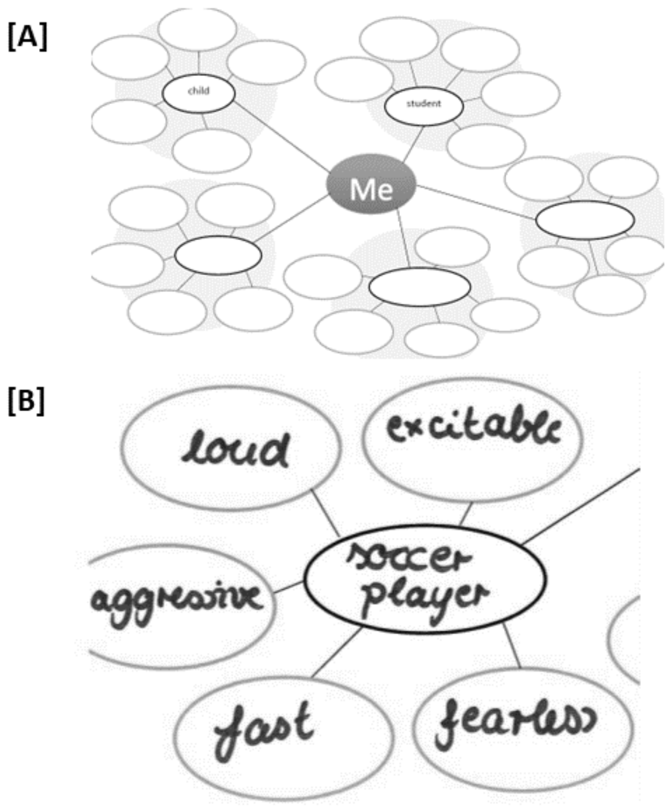
Mor & Brown, 1997). Since this self-complexity measurement is controversial in studies, some researchers argued for another instrument to measure a differentiated self-concept (Locke, 2003; Rafaeli-Mor et al., 1999). Donahue et al. (1993) developed an instrument that focused on the overlaps of self-aspects/ social roles and their integration (expressed in the self-concept differentiation index (SCD)). In the SCD the unshared variance or the absolute difference among different social roles or self-aspects is expressed (Donahue et al., 1993). Thereby, a high SCD indicates an incoherent and fragmented self-concept (Campbell et al., 2003; Diehl & Hay, 2010; Donahue et al., 1993). However, the SCD seems to be in contrast to the daily clinical experience (Pilarska & Suchańska, 2015), we prefer the self-complexity approach used by Linville (1985, 1987), which is also discussed controversial in literature. Thus, we developed our own instrument to measure self-complexity appropriately in a classroom setting, in which adolescents probably may not share their self-representation and -interpretation with others. For this reason, a paper-pencil task was developed to measure self-complexity in the graphical form of a network in this dissertation (in accordance to Linville, 1985, 1987). In this task, the adolescents' self-concept was presented with five circles designed to depict important social roles of their life. Two out of five social roles were presented in a standardized manner to all participants as they do apply to all adolescents: (1) The self-aspect "child" (as a *relationship-oriented* social role) and (2) the "student" (as a *competence-oriented* social role). The other three circles for social roles were presented in an open-response format. Adolescents could fill in self-aspects in terms of social roles and specific characteristics in relation to competence- or relationship-oriented self-aspects. Moreover, in each of the five social roles, the adolescents were allowed to describe themselves with 5 adjectives. For this, they could either make up adjectives by themselves or use those from a predetermined list that consisted of 100 adjectives (Aron et al., 1992). This list was intended to help adolescents who, on their own, had no idea how to describe themselves in different social roles. Also, the list was intended to help them think about positive and negative characteristics of themselves. In the analysis part of the studies, a score was then calculated from the number of social roles and adjectives written down to represent the complexity of the individual person's self-concept (for more information about the score calculated, see »Chapter 4« and »Chapter 6«). In this regard, a higher score represents a more differentiated self-concept. Figure 7 (A) shows the self-concept represented as a network in this task and (B) an example of an adolescent with a competence-oriented role describing him- or herself with adjectives.

2.4.3 Self-Reported Questionnaires

Empathy

Empathy was measured in this dissertation with a subjective questionnaire, the so-called *Toronto Empathy Questionnaire (TEQ)* (Spreng et al., 2009). This questionnaire

Figure 7
Example Stimuli [A] and Trial Procedure [B] of the Self-Complexity Task



Note. The self-complexity of a person was measured with a task consisting of circles to describe him- or herself with different adjectives. 25 attributes in 5 roles had to be filled in with their own words or by using a predetermined list (Aron et al., 1992). (B) An example for one self-aspect of a person.
McConnell (2011). The multiple self-aspect framework: Self-concept representation and its implications. *Personality and Social Psychology Review*, *15*(1), 3–27. doi: `https://www.doi.org/10.1177/1088868310371101` © Copyright: Sagepub.

was used for measuring a person's self-reported empathy with 16 items. Adolescents were asked to indicate on a 5-point Likert scale, 1 (*never*) to 5 (*always*), how often this statement applies to them (e. g., example item: *"I can tell when others are sad even when they do not say anything"*). A high sum score stands for a strongly developed ability to put oneself in another person's shoes.

Knowledge Tests about Emotions, Self-Concept, and Epochs

In addition to the measures of social-emotional skills of emotion recognition and self-complexity, I also recorded adolescents' explicit declarative knowledge before and after participation in one of the three courses. In general, adolescents were expected to experience knowledge gains in all three courses depending on the course content. Adolescents answered questions in multiple-choice format with four alternative answers.

Only one answer was correct. Example item for the emotion course: *"How many basic emotions exist?"*, answer options: "a) *4*, b) *6*, c) *8*, or d) *10 basic emotions*", correct answer: "b) *6 basic emotions*"; example item for epoch course: *"The style of what era can be seen as a countermovement to the Baroque?"*, answer options: "a) *Classicism*, b) *Renaissance*, c) *Rococo*, d) *Romanticism*", correct answer: "c) *Rococo*"; example item for self-concept course: *"Which roles are likely to show the greatest overlap in self-concept, i. e., are most similar?"*, answer options: "a) *Girlfriend–Student*, b) *Girlfriend–Daughter*, c) *Daughter–Student*, d) *Athlete–Daughter*", correct answer: "b) *Girlfriend–Daughter*". The tasks of the explicit knowledge tests were tested in advance regarding their difficulty in a pilot test on a student sample, whereby all items had a similar difficulty. All declarative questionnaires used in this dissertation are presented in APPENDIX C.

Control Measurements (Verbal Intelligence, HEXACO PI-R)

In this dissertation, two control measurements were used: A questionnaire which measures a) verbal intelligence, or b) personality traits. Since the self-complexity task might depend on individual's vocabulary, we used the German Wortschatz Test [engl. verbal intelligence test] (WST) Schmidt & Metzler, 1992) consisting of 40 items to measure individuals' verbal intelligence. Each item consisted of one real word (target) and five non-words (distractors). The adolescents had to identify the target under the distractors. If the adolescents did not know any of the words, they should indicate *"I don't know"*. The task had no time limit. Example item: *"Which of these words is a real German word?"*, answer options: "[1] *Renek*, [2] *Skerk*, [3] *Erenk*, [4] *Kern*, [5] *Nerk*, [6] *Lersk*, [7] *do not know*", correct answer: "[4] *Kern*".

Additionally, personal characteristics of the person were measured by using the 100-items questionnaire HEXACO PI-R (Lee & Ashton, 2004) on the six dimensions of *honesty-humility*, *emotionality*, *extraversion*, *agreeableness*, *conscientiousness* and *openness to experiences*. Adolescents could (dis)agree on a 5-point Likert scale, 1 (*strongly disagree*) to 5 (*strongly approve*). Example item: *"I often check my work several times to find all the mistakes."* The HEXACO PI-R is also necessary as, on the one hand, it allows subjects to access their own emotions and personality in a differentiated way, and on the other hand, it serves as a control measure to address our research question regarding the moderating influence of personality traits.

CHAPTER 3

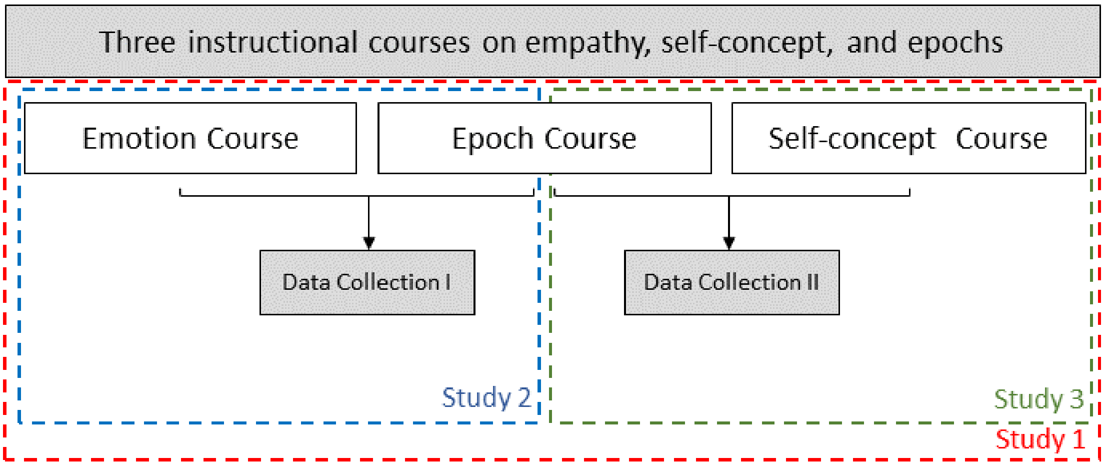
OVERVIEW OF THE RESEARCH QUESTIONS & EMPIRICAL STUDIES

3.1 Aim of This Dissertation and Research Questions

The aim of the present dissertation is to provide new insights into transfer effect research in the context of socio-emotional skills by designing and evaluating a visual arts education program in terms of three instructional courses in an art museum context. Two of these courses instructionally focused on socio-emotional skills in terms of either empathy or self-concept, whereas the third course did not focus on socio-emotional skills (i. e., control condition), but rather on a classical arts topic in terms of different historical art periods (see »Chapter 2« for a detailed description of the developed courses). An experimental study design was used in a randomized controlled field trial in an art museum (i. e., the HAUM, in Braunschweig, Germany, `https://3landesmuseen-braunschweig.de/herzog-anton-ulrich-museum`). It was assumed that art museums as the HAUM are able to create a special learning environment, which promote the acquisition of socio-emotional skills (Gerjets & Schwan, 2020; Schwan & Dutz, 2020). Thus, this dissertation does not simply address the question of which transfer effects "occur naturally" when engaging with visual arts, but rather realizes promising first steps in terms of "designing" specific transfer effects into visual arts education programs by implementing different instructional focuses (Farrington et al., 2019; Holochwost et al., 2021). Based on the theoretical foundation presented in »Chapter 1.1« and »Chapter 1.2« and the derived conceptual framework that explains why visual arts could have positive "side effects" on socio-emotional skills (»Chapter 1.3«), I combine generic characteristics of visual arts engagement (e. g., studio habits of mind) with an instructional focus on the acquisition of socio-emotional skills. The studio habits of mind (e. g., closely observing, engaging, envisioning, reflecting) with their motivational aspect map perfectly onto the cognitive aspects of "learning-by-drawing" to foster deeper

Figure 8

Overview of the Three Empirical Studies Presented in the Three Manuscripts



understanding of underlying socio-emotional contents (Fiorella & Mayer, 2016; Mayer & Fiorella, 2014).

This resulted in two main Research Question (RQ), which were investigated in three empirical studies:

RQ1: Does specific visual arts engagement lead to differential transfer effects on socio-emotional skills when the courses are designed properly?

RQ2: How and under which circumstances might visual arts engagement support adolescents' development of socio-emotional skills? More concretely, what role do the drawing tasks (measured as drawing features), and the personal prerequisites (prior knowledge, personality traits) play in influencing transfer effects on socio-emotional skills?

In this dissertation, three empirical studies aimed to answer these two general research questions. Figure 8 gives an overview of the three empirical studies that were conducted in two data collection phases. In total, three visual arts courses were developed, each focusing on one topic: the first course addressed socio-emotional skills in terms of empathy/emotion recognition, the second course addressed socio-emotional skills in terms of self-concept/self-complexity, and the third course addressed different historical periods (epoch course, control course; cf. »Chapter 2«). Study 1 (Figure 8, red) investigated the specificity of transfer effects on socio-emotional skills by comparing all three courses. To examine the specificity of the courses, I compared the two specific courses targeting socio-emotional skills (empathy/emotion recognition and self-concept/self-complexity) with a control course on historical periods. If the content is not crucial, then positive effects on socio-emotional skills should be found in all courses independent of the course content. Contrary, if the content is responsible for the specific effects, differences should be found in the two courses targeting socio-emotional skills compared to the control course. More concretely, then the emotion course should lead to specific effects on empathy/emotion recognition, while the self-concept course should lead to specific effects in terms of adolescents' self-concept/self-complexity. Study 2 (Figure 8, blue) and Study 3 (Figure 8, green) were in depth-analyses of one of the specific courses and the control course that focused on the drawing tasks and the underlying processes such as drawing activities, and drawing quality as well as personal prerequisites that learners bring to the learning situation (personality traits, baseline socio-emotional skills, prior knowledge). It was expected that these drawing activities might influence the strength of the hypothesized effects.

3.2 Overview of the Empirical Studies

Study 1 (*Designing Visual-Arts Education Programs for Transfer Effects: Development and Experimental Evaluation of (Digital) Drawing Courses in the Art Museum Designed to Promote Adolescents' Socio-Emotional Skills*[14]) represents an experimental overall study examining the specificity of transfer effects on socio-emotional skills (empathy/self-concept) considering the three visual arts courses in experimental comparison ($N = 294$ adolescents, $M_{\text{age}} = 15.02$ years, $SD_{\text{age}} = 1.75$ years; Range: 12-19 years). This study design aimed to draw causal inferences about cause-and-effect directions of transfer effects, avoided self-selection effects by randomly assigning students to courses, and carefully ensured that the study groups were large enough to yield meaningful results. Specific course effects were evident in the two tasks measuring the socio-emotional skills empathy (animated morph task, Jusyte et al., 2017; Schönenberg et al., 2014; Schönenberg et al., 2013, Schönenberg, 2016) and for self-concept (self-concept task, McConnell, 2011; Linville, 1985). In sum, this study contributes to answering RQ1 about how specific transfer effects in the context of learning socio-emotional skills occur and provides evidence that socio-emotional skills can be trained specifically, but only if the art courses are properly designed.

Study 2 (*Focusing on Emotions in Digital Drawing Courses Fosters Emotion Recognition: The Influence of Drawing Tasks and Drawing Activities*[15]) focused in-depth on the positive transfer effects of the emotion course on the acquisition of emotion

[14]Kastner, L., Umbach, N., Jusyte, A., Cervera-Torres, S., Ruiz-Fernández, S., Nommensen, S., & Gerjets, P. (2021). Designing visual-arts education programs for transfer effects: Development and experimental evaluation of (digital) drawing courses in the art museum designed to promote adolescents' socio-emotional skills. *Frontiers in Psychology, 11*(603984), 1–22. doi: `https://doi.org/10.3389/fpsyg.2020.603984`

[15]Kastner, L., Brucker, B., Mock, P., Jusyte, A., Ruiz-Fernández, S., Nommensen, S., Thiel, A., & Gerjets, P. (Under Review). Focusing on emotions in digital drawing courses fosters emotion recognition: The influence of drawing tasks and drawing activities. *Computers in Human Behavior Reports.*

recognition abilities (found in Study 1). More concretely, the present study examined potential influencing factors (e. g., prior knowledge, drawing quality, elaboration depth of the drawing tasks, and drawing features logged with the deployed tablet drawing app) in terms of their predictive value on the course effectiveness in the emotion course ($n_{\mathrm{emo}} = 47$ adolescents, $M_{\mathrm{age}} = 14.26$ years, $SD_{\mathrm{age}} = 1.72$ years; Range: 12-18 years). Since, to the best of our knowledge, previous studies in visual arts engagement did not collect drawing data during the mental elaboration of artistic drawing tasks (instead only the final drawing was analyzed), this study provides new insights that neither prior knowledge nor drawing quality did explain the positive effects of the emotion course on emotion recognition abilities. However, the drawing features (i. e., time pencil on tablet, pressure) were associated with positive course outcomes and indicated differences between the drawing tasks regarding their elaboration depth. In sum, the study indicates that the use of appropriate drawing tasks and the engagement in suitable drawing activities are crucial factors to elicit transfer effects on emotion recognition abilities.

Study 3 (*How and Under Which Circumstances Might Visual Arts Engagement Support Adolescents' Self-concept Development? Psychological Boundary Conditions for Socio-Emotional Transfer Effects of Visual Arts Programs*[16]) focused on the influencing factors of drawing activities, and personal factors on adolescents' self-concept development. In Study 1, we found specific effects of the self-concept course in the self-complexity task. However, this effect was moderated through empathy in terms that only students with low empathy skills benefited from the course. Since our basic model was only able to explain $\mathrm{R}^2 = 25.41\,\%$ (adjusted $\mathrm{R}^2 = 21.93\,\%$), we expected that other factors might play a role, such as drawing activities and personality traits. For that reason, Study 3 aimed at providing new insights into influencing factors for the development of self-concept by addressing the question of whether the personality of a person predicts learning outcomes in terms of self-complexity. A particular highlight of Study 3 was the machine learning approach we used to predict personality traits based on drawing data.

[16]Kastner, L., Brucker, B., Mock, P., Jusyte, A., Ruiz-Fernández, S., Nommensen, S., Thiel, A., & Gerjets, P. (Under Review). How and under which circumstances might visual arts engagement support adolescents' self-concept development? Psychological boundary conditions for socio-emotional transfer effects of visual arts programs. *PLOS ONE*.


HERZOG ANTON ULRICH MUSEUM
What is ...
art
psychology
emotion
transfer effects
self-concept

CHAPTER 4

STUDY 1: SPECIFICITY OF TRANSFER EFFECTS IN VISUAL ARTS EDUCATION PROGRAMS

The content of the following Chapter[17] is a replication of the paper originally published in *Frontiers in Psychology, Health Psychology, Research Topic "The Psychological and Physiological Benefits of the Arts"*. The proportional contribution to the manuscript is presented in the subsequent table.

Nr.	Accepted publication yes/no	List of authors	Position of candidate in list of authors	Scientific ideas by the candidate (%)	Data generation by the candidate (%)	Analysis and Interpretation by the candidate (%)	Paper writing done by the candidate (%)
1	yes	Lydia Kastner Nora Umbach Aiste Jusyte Sergio Cervera-Torres Susana Ruiz-Fernández Sven Nommensen Peter Gerjets	1	60	95	80	80

[17] Kastner, L., Umbach, N., Jusyte, A., Cervera-Torres, S., Ruiz-Fernández, S., Nommensen, S., & Gerjets, P. (2021). Designing visual-arts education programs for transfer effects: Development and experimental evaluation of (digital) drawing courses in the art museum designed to promote adolescents' socio-emotional skills. *Frontiers in Psychology*, *11*(603984), 1–22. doi: https://doi.org/10.3389/fpsyg.2020.603984

Authors:	Lydia Kastner, Nora Umbach Aiste Jusyte, Sergio Cervera-Torres, Susana Ruiz Fernández, Sven Nommensen, Peter Gerjets
Titel of paper:	Designing Visual-Arts Education Programs For Transfer Effects: Development And Experimental Evaluation Of (Digital) Drawing Courses In The Art Museum Designed To Promote Adolescents' Socio-Emotional Skills
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Abstract

An active engagement with arts in general and visual arts in particular has been hypothesized to yield beneficial effects beyond arts itself. So-called cognitive and socio-emotional "transfer" effects into other domains have been claimed. However, the empirical basis of these hopes is limited. This is partly due to a lack of experimental comparisons, theory-based designs, and objective measurements in the literature on transfer effects of arts education. Therefore, the aim of the present study was to design and experimentally investigate a theory-based visual-arts education program for adolescents aged between 12 and 19 years ($M_{\text{age}} = 15.02$, $SD_{\text{age}} = 1.75$). The program was delivered in a museum context in three sessions and was expected to yield specific and objectively measurable transfer effects. To conduct a randomized field trial, three strictly parallelized and standardized art courses were developed, all of which addressed the topic of portrait drawing. The courses mainly differed regarding their instructional focus, which was either on periods of art history, on the facial expression of emotions, or on the self-perception of a person in the context of different social roles. In the first and more "traditional" course portrait drawing was used to better understand how portraits looked like in former centuries. The two other courses were designed in a way that the artistic engagement in portrait drawing was interwoven with practicing socio-emotional skills, namely empathy and emotion recognition in one course and understanding complex self-concept structures in the other. We expected positive socio-emotional transfer effects in the two "psychological" courses. We used an animated morph task to measure emotion recognition performance and a self-concept task to measure the self-complexity of participants before and after all three courses. Results indicate that an instructional focus on drawing the facial expressions of emotions yields specific improvements in emotion recognition, whereas drawing persons in different social roles yields a higher level of self-complexity in the self-concept task. In contrast, no significant effects on socio-emotional skills were found in the course focusing on art history. Therefore, our study provides causal evidence that visual-arts programs situated in an art-museum context can advance socio-emotional skills, when designed properly.

Keywords: arts education, visual arts, art museum, transfer effect, socio-emotional skills, empathy, self-concept, randomized field trials

4.1 Introduction

4.1.1 Cognitive and Socio-Emotional Transfer Effects of Visual-Arts Education

It has been hypothesized for decades that an active engagement with the arts in general and the visual arts in particular might yield a plethora of beneficial effects, within and even beyond the arts itself (Baker, 2012; Bowen et al., 2013; Catterall et al., 2012; Winner, Goldstein, et al., 2013). Therefore, arts education in schools and museums or other institutions is not only expected to promote so-called *"primary effects"* of arts education in terms of cultural participation or the development of receptive and productive competencies in various aesthetic and artistic forms of expression (Keuchel, 2019). Rather, beyond these intrinsic values of art for art's sake, engagement with the arts is also seen as a potential means to achieve broader positive "side effects" that are usually labeled as *"transfer effects"* (Knigge, 2013). These hypothesized transfer effects comprise cognitive side effects regarding general academic achievement and intelligence development (Bastian et al., 2000) but also more specific abilities such as problem-solving, critical thinking, memory, or spatial and geometrical thinking (Winner, Goldstein, et al., 2013). Moreover, beyond these cognitive aspects expected transfer effects also cover creativity outcomes, motivational benefits, or even improvements in socio-emotional skills (Watson et al., 2019; Winner, Goldstein, et al., 2013). Based on these expectations, arts education has been seen by many as a valuable contribution to the development of several overarching and domain-general skills or competencies usually referred to as "*21st-century skills*" (Dede, 2010). This argument was used not only to stress the relevance of school subjects such as visual arts or music, but also to underline the importance of extracurricular cultural institutions such as art museums (Aspin, 2000; Savva, 2013; Schönau, 2012).

However, the empirical basis towards broad beneficial effects caused by an active engagement with art in general and visual arts in particular is severely limited. For instance, it has been argued in a meta-study by Winner, Goldstein, et al. (2013) that substantial empirical research with regard to transfer effects of an engagement with the visual arts (and many other art forms) is largely missing. According to Winner, Goldstein, et al. (2013), studies on this topic are not only quite rare and ambiguous in their results but also rather unsatisfactory in terms of their methodological and theoretical validity. Most importantly, only a small proportion of the available studies are based on randomized experimental designs, which would be required for a causal attribution of transfer effects to visual arts engagement. The authors claim that reliable causal evidence for positive cognitive side effects of visual-arts education has been found only in one case, namely with regard to *observational skills*. It could be demonstrated experimentally that inspecting artwork also improves the quality of observing scientific images within a medical (Dolev et al., 2001) or a biological context (Tishman et al., 1999).

All other cases in the domain of cognitive "side effects" of visual-arts education seem to be less clear. For instance, there is correlational evidence that visual-arts education is related to *geometric and spatial reasoning skills* (Spelke, 2008; Walker et al., 2011). Moreover, a causal link between visual arts engagement and geometric or spatial reasoning skills is theoretically quite plausible. However, a meta-analysis of 30 quasi-experimental studies on this relation yielded no significant effect (Haanstra, 1996). Moreover, the respective longitudinal evidence is also weak since no relation between the development of drawing and of geometric reasoning skills over time could be demonstrated (Winner, Goldsmith, et al., 2013). Thus, the correlational evidence found might not represent a causal link but rather a self-selection effect in which students with better spatial reasoning skills might more often decide to engage in visual-arts education programs.

Other examples of disappointed expectations with regard to hypothesized cognitive "side effects" of visual-arts education are findings showing that engagement in visual arts (in contrast to other art forms such as theater or dance) did not stimulate *creativity* or *problem-solving skills* (Catterall & Peppler, 2007). Winner, Goldstein, et al. (2013) interpret these findings as showing that "there is no reason to think that arts education will make children more creative unless the arts are taught in a way that really pushes children to explore and invent" (p. 196). In sum, the evidence for transfer effects of visual-arts engagement on generic cognitive skills is limited, which might partially go back to the issue that this engagement is often not tailored towards specific and intended transfer effects.

When it comes to hypothesized transfer effects besides the cognitive domain, the empirical situation seems to be difficult as well. There is little reliable experimental evidence for socio-emotional transfer effects of visual-arts education. Instead, there is mostly correlational or quasi-experimental evidence prone to self-selection effects. This applies to the relation between visual arts engagement and a better development of the self-concept (Catterall & Peppler, 2007), a better regulation of emotions (Goldstein et al., 2012) or an increase in empathy with other persons (Goldstein & Winner, 2012). Moreover, the few experimental studies on socio-emotional transfer effects of visual-arts education usually fail to demonstrate the expected effects. For example, in the experimental studies by Greene et al. (2015); Greene et al. (2014) matched school classes were randomly assigned to either participate or not participate in an art-museum field trip. While some effects were detected regarding cognitive and motivational outcomes, no effects of this experimental manipulation were found on empathy measures or social perspective taking. In a follow-up longitudinal experimental study on multiple arts-based field trips by Erickson et al. (2020), control students were compared to students who attended three different art field trips, visiting an art museum, a live theater performance and a symphony. Again, effects were found towards cognitive and motivational outcomes, but no effects were found on empathy measures or social perspective taking.

According to Winner, Goldstein, et al. (2013) this lack of socio-emotional outcomes of standard visual-arts education is theoretically not very surprising. Visual-arts education usually does not involve imagining oneself in unknown roles and situations, expressing strong emotions, or stepping in the shoes of other persons (other than, for instance, theater education for which socio-emotional effects have been demonstrated empirically). Therefore, one might argue that there is no reason to expect that visual-arts education will make children per se more competent with regard to socio-emotional skills unless the arts are taught in a way that really pushes children to explore their own self-concept, to express strong emotions or to empathize with other persons' perspectives and feelings. When these aspects are not a pivotal part of a visual-arts education program, this program might just not provide sufficient opportunities for improving these socio-emotional skills. In other words, an artistic engagement that does not teach, practice, presuppose or reflect a particular skill or competence will probably make no substantial contributions to its development and improvement.

Based on similar assumptions, Hetland et al. (2013) started to systematically observe which activities might constitute pivotal ingredients of high quality visual-arts classrooms. From these observations they derived a list of expectations regarding potential transfer effects of visual-arts education. As a result, they came up with eight cognitive and motivational skills that seemed to be fundamental to any artistic engagement in the field of visual arts and to any program for visual-arts education. They described these skills as "*studio habits of mind*" and conceptualized them as crucial mental processes in creating visual artworks. Taking into account the crucial role of these skills for visual-arts education, the authors considered them to be the theoretically most plausible candidates for general transfer effects that might be improved by an active engagement with visual arts. These skills are (1) *developing crafts*, (2) *engaging and persevering*, (3) *envisioning something*, (4) *expressing oneself*, (5) *observing closely*, (6) *reflecting*, (7) *exploring*, and (8) *understanding artistic worlds*. It is noticeable, though, that socio-emotional skills such as the ones mentioned above (self-concept development, emotion regulation, empathy) are not included in this list of studio habits of mind. These skills seem not to be at the core of what is usually being taught in visual-arts classrooms and therefore might have a smaller chance of being practiced during art making than other skills that are considered studio habits of mind. This could explain why corresponding transfer effects on socio-emotional skills have not yet been demonstrated for "standard" visual-arts programs.

A seemingly lower importance of socio-emotional skills for visual arts programs, however, does not rule out the possibility to develop specific programs with an additional socio-emotional focus. For instance, visual-arts engagements could be tailored in such a way that they strongly stimulate participants to image themselves in unknown roles and situations, to express strong emotions, or to step into the shoes of other persons just as it has been demonstrated for other forms of art engagement that yield socio-emotional transfer effects such as theater education (Winner, Goldstein, et al., 2013). Under these circumstances, it might even be possible that conveying socio-emotional skills in a visual-arts context is particularly effective due to the studio habits of mind involved. A specific artistic assignment focusing on socio-emotional contents could be more intense when studio habits of mind, such as precise observation, engagement, imagination, reflection, etc. are involved compared to assignments using other art forms like music or dance without them. Consequently, synergies between the generic characteristics of visual-arts engagement in the sense of studio habits of mind and the more specific contents of an artistic assignment designed to address socio-emotional skills might occur. This could result in supporting the understanding and skill development in this area thereby evoking socio-emotional transfer effects. Similar synergistic arguments have been raised for drawing as a generative learning tool in other domains (Fiorella & Mayer, 2016; Mayer & Fiorella, 2014). Therefore, the idea pursued in this paper is to use the habits of mind, which are specific for both the understanding and making of art and to combine them with artistic contents of socio-emotional nature. We assume that this allows for the first time to establish an experimental benefit for visual-arts programs by the specific habits of mind, in which they can evoke socio-emotional transfer effects. The prospects of this idea will be investigated in the study reported in this paper.

4.1.2 Methodological Boundary Conditions for Testing Transfer Effects in Arts Education

For testing socio-emotional transfer effects of specifically designed visual-arts programs, three important methodological boundary conditions can be derived from shortcomings of the existing literature on transfer effects in arts education. These boundary conditions are related to experimental comparisons, theory-based designs, and objective measurements.

Experimental Comparisons

First, most studies in the field of transfer effects investigate art-education programs that have already been implemented and attended by (self-selected) participants. Usually, either (1) correlative relationships between outcomes and participation (or not) in a program are analyzed or (2) differences in outcomes are examined in form of quasi-experimental comparisons of two programs. However, due to self-selection, persons participating in either program may differ in various other characteristics than group membership. Therefore, no causal conclusions can be derived from group membership alone, as any of these other (confounding) differences might be responsible for differences in outcomes. Moreover, when comparing quasi-experimentally two programs that differ not only with regard to a variable of theoretical interest (e. g., artistic approach), any other difference between these programs in terms of structures, contents or instructors might also be responsible for potential differential effects. Accordingly, to derive causal conclusions on transfer effects of visual-arts education programs, randomized experimental comparisons between specific programs are necessary, that should only differ with regard to characteristics of theoretical interest. Therefore, we implemented a randomized field trial with a randomization of school classes at the student level. Students visited an art museum to participate in one of two simultaneously conducted visual-arts courses. The courses were designed for maximum equivalence except for characteristics of theoretical interest. This approach avoids the detrimental confounds and self-selection effects mentioned above. Since students are obliged to join their class, also differential attrition effects (i. e., dropouts in experimental groups) over the course of the program can be controlled. From an experimental view, studying courses in an art museum (instead of a school context) has the advantage that it allows the implementation of highly controlled courses which are run by identical persons in identical rooms for all classes and across all experimental groups. Thus, it avoids important confounders regarding the courses, the self-selection of participants, and the characteristics of particular school classes (e. g., school type or school district). Since this setting requires a between-subject design (i. e., each student participates only in one of two parallel courses), sufficient group sizes are important to ensure substantial statistical power to identify small effects that may be expectable from the literature on transfer effects of visual-arts education.

Theory-Based Designs

A second methodological limitation of the existing literature on transfer effects of visual-arts education might be more theoretical. In particular, the fact that this literature has generated only little reliable evidence to support transfer effects might not alone go back to the abovementioned flaws of study designs. Instead, there may also be more fundamental flaws regarding the theoretical reasoning pertaining to the design of visual-arts programs and the choices of dependent measures in this research. From a psychological perspective, it would be considered important to base the design of visual-art programs aiming at specific transfer effects on a deep theoretical understanding of the targeted core constructs. If, for example, transfer effects on target constructs such as empathy are intended, the underlying theories of psychological mechanisms and preconditions should be well understood by the program designers. Otherwise, a lack of theoretical understanding might prevent them from designing effective programs. Moreover, also the development and/or selection of measurement instruments that are suitable for demonstrating transfer effects on target core constructs might require theoretical in-depth knowledge. Thus, if an art program is intended, for instance, as an intervention to support participants' empathy or to improve the complexity of their own self-concept (both of which were aims in our study), the design of the respective programs and measures needs to be based on three theoretical pillars: (1) Sound psychological models and measures of empathy and self-complexity, (2) theoretical insights on how these skills can be conveyed and trained, and (3) theoretical knowledge about potentially important personal preconditions that might moderate the effectiveness of interventions. If art programs which aim at the empirical demonstration of specific transfer effects are not based on these important theoretical pillars they may easily fail to achieve these goals. Accordingly, in the current study we considered it not to be sufficient to start with a rather superficial conception of socio-emotional skills, such as empathy or self-complexity, when designing a visual-arts program that is supposed to support the development of these skills. Similarly, we assumed that the development of measurement instruments that are suitable to validly assess skill levels and skill developments with regard to specific constructs would require precise theoretical models of the target skills adressed.

Objective Measurements

A third methodological limitation for testing socio-emotional transfer effects of specifically designed visual-arts programs might be to strive for more objective measurements. Whereas cognitive transfer effects of visual-arts education (for instance, effects on spatial and geometric reasoning, problem solving or observational skills) are usually assessed by means of objective performance measures, socio-emotional transfer effects are usually assessed more subjectively. For instance, questionnaire data or self reports rather than performance measures are typically used to assess constructs such as self-concept or empathy. Relying on subjective data, however, might be one of the reasons why existing studies have not yielded strong evidence for socio-emotional transfer effects of visual-arts education, yet. For instance, questionnaire data might not be as sensitive as necessary to track small changes with regard to specific aspects of socio-emotional skills resulting from a visual-arts program. Additionally, it is well known that the correlation between objective skills and subjective reports on them might be rather weak (Dang et al., 2020). Thus, if assessements of outcomes could be based on objectively measurable aspects of socio-emotional skills, there might be a better chance to track the skill development trajectory during a visual-arts program. To be more concrete, if a visual-arts program that is intended to support participants' empathy or to improve the complexity of their own self-concept is to be evaluated, it might not be the best approach to ask them before and after the program about their deemed ability in perceiving and understanding the emotions of others or in different roles and situations. Nevertheless, this is basically the approach taken by many studies in the field (e. g., Catterall & Peppler, 2007; Goldstein et al., 2012). A better approach would possibly be to obtain their ability to perceive and understand the emotions of others in an objective test or to assess the complexity of their self-concept based on concrete self-descriptions in the context of different roles and situation. These performance measures, as opposed to self-reports, would better allow to directly assess how good participants' emotion perceptions are and how differentiated their self-representation is. Therefore, objective measures might not only be more sensitive to track skill developments but also more valid in measuring the constructs of interest than measures asking for the subjective impressions of participants. Accordingly, we deployed objective measures to evaluate two theory-based art programs, designed to either support participants' skills of perceiving emotional states in others based on their facial expressions (which is an important subcomponent of empathy; cf. Besel & Yuille, 2010), or their ability to perceive themselves in different roles and situations (which is at the core of self-complexity; Linville, 1985; Woolfolk et al., 2004).

4.1.3 Target Constructs for Transfer effects: Empathy and Self-concept Development

In the literature it has been hypothesized, but not yet demonstrated empirically, that visual-arts education might have beneficial transfer effects on the development of the self-concept (Catterall & Peppler, 2007), the regulation of emotions (Goldstein et al., 2012), or the ability to experience empathy with other people (Goldstein & Winner, 2012). Based on our previous theoretical considerations, it seems indeed plausible that visual-arts programs could be designed in a way to comprise artistic assignments, which motivate children to empathize with other persons' perspectives and feelings, or to elaborate on a multi-faceted self-concept. It is less clear, from our perspective, how a visual-arts engagement might be deployed to stimulate reappraisal processes in order to change one's own strong negative emotions. Based on these intuitions, we focused on constructs related to empathy and self-concept development in our study.

Empathy

Empathy, conceived in a very broad way, can be understood as the general ability to perceive the situations, thoughts, and feelings of other individuals correctly. Empathy can be seen as a main factor influencing individuals' well-being and relationship quality but also as a requirement for good communication skills and understanding of other people's perspectives and emotions (Ioannidou & Konstantikaki, 2008). It has been argued that engaging in empathy tasks (i. e., trying to empathize with another person) not only requires but also promotes empathy in the sense that practicing empathy reinforces it, which might be a good precondition for designing a visual-arts program that is intended to support empathic skills (Winner, 2019). Two levels of empathy have been distinguished, namely cognitive and emotional empathy. Cognitive empathy refers to the cognitive ability to recognize the mental and emotional situation of another person, i. e., to correctly assess what another person feels or thinks. Emotional or affective empathy (that builds on cognitive empathy) is characterized as the ability of a person to empathize with another person's emotional experiences (e. g., feeling pity or compassion, but also the happiness of another person).

It has to be noted that previous studies hypothesizing (but not demonstrating empirically, yet) that visual-arts education might have beneficial effects on empathy (Goldstein & Winner, 2012) used standard empathy questionnaires, which assess the extent to which a child shows an emotional reaction to another's emotional situation, as dependent measures. These measurements, however, do not distinguish between the abilities to perceive and to share others' emotions. From a theoretical perspective, it is more plausible that suitable visual-arts education programs, focusing on an artistic engagement with emotional expressions, will mainly support students' cognitive empathy in the first step. This ability to correctly recognize other peoples' emotions is a key element of competent social behavior in many everyday situations (Ekman & Friesen, 2003) and develops crucially during adolescence (Olderbak et al., 2018). Moreover, it is a main precondition for (but not the same as) sharing other peoples' emotions (cf. Besel & Yuille, 2010). We assume that studio habits of mind such as expressing (one's own or others' emotions) in authentic drawings, observing (social and emotional behaviors), and reflecting on them might be practices that are closely related to cognitive empathy. They require but also promote and thereby reinforce this skill. We hypothesize that particularly cognitive empathy might benefit from visual-arts engagements which deploy studio habits of mind to address issues of emotion expression. To test this idea more directly, we decided to measure emotion recognition performance as an objective outcome measure of a visual-arts education program instead of using empathy questionnaires comprising cognitive and affective aspects of the construct.

Among other things, bodily and particularly facial expressions of emotions are used as central cues for emotion recognition. It has be shown that difficulties in recognizing emotions on the basis of facial expressions are related to clinical disorders of social behavior such as autism (Harms et al., 2010). However, it has also been shown that the emotional recognition performance can be improved in a targeted manner by means of instructions, for example by directing attention to the parts of the face that are relevant for emotion recognition. This has, for instance, been demonstrated in clinical studies on autism (Harms et al., 2010) or schizophrenia (Silver et al., 2004). For non-clinical populations it has also been demonstrated that an intensive drawing engagement with portraits leads to a more analytical and less holistic — and thereby improved — processing of faces (Zhou et al., 2012). Balas and Sinha (2008) found similar results. They argued that people without artistic portrait drawing experience seem to be more prone than experienced portrait drawers to misrepresent important facial features. These findings provide first evidence for the assumption that applying studio habits of mind such as closely observing, envisioning, or reflecting may indeed lead to better, more detailed, and less distorted representations of facial features. In the design of one of our visual-arts education programs, which was intended to support adolescents' cognitive empathy, we have taken up this assumption about the beneficial role of the studio habits of mind for improving the processing and detailed representation of faces. Here, the idea was to promote cognitive empathy as a basic precondition of empathic behavior by means of an artistic engagement with portrait drawings focusing on emotion expression.

Self-Concept Development

The self-concept can be understood as a collection of all potentially accessible beliefs that a person holds about him- or herself (Aronson et al., 2008). The self-concept has been described as a multidimensional construct consisting of many different facets that develop over time. In previous studies hypothesizing that visual-arts education might have beneficial effects on the development of the self-concept (Catterall & Peppler, 2007) the focus was mainly on ability beliefs, self-efficacy beliefs and beliefs about the causes of personal success and failure. Thus, the questionnaire data obtained in this research may have mainly tapped into very general competence beliefs. One might ask, however, why the engagement in visual-arts education should be expected to improve one's general competence beliefs. If, at all, one might expect improvements with regard to more specific and art-related competence beliefs addressing abilities to envision, create, design and finally even produce artistic results. It remains unclear, however, why improvements with regard to these beliefs (that have not been measured) should generalize to other domains.

An alternative and from our theoretical perspective more plausible artistic approach to self-concept development would be to focus on the complexity of the self-concept: First, it can be assumed that an artistic engagement in the visual arts might be useful to explore and elaborate a multi-facetted view of other persons' self-perception in their diverse social roles and situations, for instance, by means of drawing portraits of persons in diverse roles and situations. This engagement might be conceived as a high-level empathy task requiring not only the basic perception of isolated feelings of others but also a deeper imagination of their self-perceptions in different and potentially conflicting roles and situations. Such a task might, in a second step, stimulate a more complex and differentiated scheme for person perception that might, eventually, also transfer to the perception of one's own person in different roles and situations. The core idea would be — just as the perception of one's own emotions might provide a basis for the perception of the emotions of others — that a more differentiated approach to the exploration of other persons' self-concept might eventually apply when considering the characteristics of one's own person in different roles and situations. Therefore, we would argue that a visual-arts education program, even if it does not improve one's general competence beliefs, still might be suitable to support self-concept development in terms of a better differentiation of the self-concept.

To work out this idea in greater detail, we can refer to McConnell's Multi-Self-Aspect Framework (2011) . There the self-concept consists of a network of self-aspects such as social roles and the associated attributes of one's own person, which can vary in their accessibility. The differentiation of the self-concept can be described in this model as a nuanced access to characteristics of one's own person in the context of various social roles. For example, in the school-context, the role of a student with the corresponding characteristics of one's own person might be more easily accessible than the role of a daughter or son that might be associated with a different set of personal characteristics. Possessing a differentiated self-concept along this line of thought has also been described as self-complexity (Linville, 1985, 1987; Woolfolk et al., 2004). Being able to perceive many facets of one's self in a differentiated way has also been claimed to be a fundamental process for the maintenance of general well-being and thus for success in various areas of life (Rafaeli-Mor & Steinberg, 2002). To possess a complex self-concept might prevent a person facing a failure in one area of life, e. g., a bad mark in mathematics, to also draw negative conclusions with regard to other areas of life, eventually leading to a general negative self-evaluation as a person. Hence, a complex self-concept has also been postulated as a protection against clinical disorders such as depressive reactions (Linville, 1987; Rafaeli-Mor & Brown, 1997). We have taken up these theoretical considerations and empirical findings in the design of our second visual-arts education programs, which was intended to support adolescents' self-concept development. Here, the idea was to promote self-complexity by using an artistic engagement with portrait drawings that requires imagining how another person's self-perception might look like in different and conflicting roles and situations. The students should focus on the different characteristics of their personality in different roles and situations to develop a complex self-representation which might eventually also transfer to one's own self-perception.

4.1.4 The Present Study

In the present study we investigate, in an art-museum context at the Herzog Anton Ulrich-Museum (HAUM) in Braunschweig, Germany, whether the engagement with a tailor-made visual-arts program can yield positive transfer effects on specific socio-emotional skills. Furthermore, we explore how these effects might depend on the design of the program and on the personal preconditions of participants. We focus on empathy (in the sense of emotion perception) and on self-concept development (in the sense of self-complexity) as socio-emotional target constructs for transfer effects. We also designed two visual-arts programs, each intended to contribute to the development of one of these target constructs. In designing the programs, we used not only the museum pedagogical course concepts deployed in traditional art courses at the HAUM but also approaches and methods from instructional psychology on how to teach, practice, and reflect particular skills or competencies in order to contribute to their development and improvement. Most importantly, we also tried to embed as many studio habits of mind as possible in the visual-arts education programs due to the abovementioned theoretical considerations on their amplifying potential when dealing with content domains in the mode of artistic drawing. With regard to the overall content domain of the course programs (portrait drawing), additional expertise from art history and art pedagogy were deployed to guide many design decisions.

For experimental comparison, three standardized art courses were developed, which mainly differed in their instructional focus but were otherwise held strictly parallel. All courses conveyed knowledge on drawing portraits and comprised artistic portrait-drawing experiences related to artworks in the museum as well as to selfies taken by the participants. Each course lasted nine hours and took place at the HAUM over a period of three weeks (one session per week). All participants of the courses were provided with a tablet computer and a drawing app specifically designed for the courses to ensure the availability of support tools allowing to explore novel digital forms of artistic expression.

We introduced a different instructional focus for each of the three courses as experimental variation. One course explicitly addressed the intended socio-emotional transfer effects of correctly perceiving subtle emotional expressions in faces as a basic skill involved in empathy. In this "emotion course", portrait drawing was used to provide experiences with the perception and interpretation of one's own and others' emotions based on facial expressions. All six basic emotions were addressed in the course with a focus on the two socially most important basic emotions anger and fear, which were targeted in the drawing assignments. We expected that participants' abilities to interpret subtle emotional expressions in faces (in particular with regard to the emotions anger and fear) would improve due to course participation. A second course focused on a different target for transfer effects of visual-arts education, namely self-concept complexity. In this "self-concept course", portrait drawing was used to explore artistically in detail how a person might experience themself differently in the context of diverse social roles the person is involved in. We expected that participants' abilities to provide a differentiated representation of their own self-concept structure with regard to how they experience themselves differently in diverse social roles (i. e., self-complexity) would improve due to course participation. A third and more conventional course was used as a baseline control group. It focused on characteristics of portrait drawings in different periods of art history, e. g., hair accessories or clothing styles in the Baroque versus Rococo period. In this "epoch course", no psychological contents or constructs were addressed, and portrait drawing was mainly used to explore the artistic expression in portraits of different periods of art history.

The data collection for the study reported in this paper took place as a part of a larger study comprising two phases of data collection with two cohorts of students. In the first data collection phase, the emotion course and the epoch course were offered simultaneously to individual school classes at the HAUM, which allowed for randomization at the student level. In the second data collection phase, the self-concept course and the epoch course were offered simultaneously to a different set of school classes with randomization at the student level. The participating school classes were split, and students were randomly assigned to one of the two courses in each data collection. To ensure randomization and to avoid self-selection effects, the students were not allowed to switch their courses. Students participated in only one course of the two courses offered in each data collection phases. In both data collection phases, we used a pre- and posttest-design in which the students had to complete emotion-recognition and self-concept tasks before and after participating in the course program. These are the two tasks that will be examined more closely in the present study.

In addition to these measures, process data and questionnaire data on personal characteristics were obtained as part of the larger study for later analyses on relations between drawing processes and personal characteristics. At the process data level, the students' drawing data (time pencil on paper, number of (erase) strokes, pressure (*M*, *SD*), altitude (*M*, *SD*) number of used tools/colors, number of zoom-in and fade-out interactions) were recorded as they completed the drawing tasks. With regard to personal characteristics, we additionally measured the students' empathy skills by means of questionnaires (*Toronto Empathy Questionnaire*, TEQ, Spreng et al. 2009; *Toronto Alexithymia Questionnaire*, TAS, Bagby et al., 1994a,b; *Questionnaire on Perception of Others/Fragebogen zur Wahrnehmung der Emotionen anderer*, FWEA, Lischetzke, 1999) and the *Multifaceted Empathy Test* (MET, Foell et al., 2018). Moreover, *personality traits* (HEXACO PI-R, Lee & Ashton, 2004; Moshagen et al., 2014), verbal intelligence using a *vocabulary test* (WST, Schmidt & Metzler, 1992), and clinical characteristics measured with questionnaires such as the *Inventory of Callous Unemotional Traits* (ICU, Ciucci et al., 2013; Essau et al., 2006), and the *Autism Questionnaire* (AQ, Baron-Cohen et al., 2009) were assessed. We also tested students' knowledge about emotions, epochs, and the self-concept. However, the knowledge test about the self-concept was only included in the second data collection phase so that knowledge-test data does not exist for all three courses. Therefore, we have not included knowledge-test data in the current study. From the abovementioned set of additional process data and data on personal characteristics, in the current study only the TEQ data on empathy skills will be included as a potential moderator variable in the statistical analyses. The following hypotheses will be tested in the current study:

> Hypothesis 1 (*Specificity Hypothesis*): Programs designed specifically for one particular socio-emotional transfer effect (e. g., on the recognition of other persons' emotions) are hypothesized to improve this skill but not necessarily closely related skills (e. g., the complexity of one's self-concept).

In both courses designed for transfer effects in this study, participants engage in portrait drawings in the context of imagining the situation of another person and empathizing with this person. Nevertheless, we do expect differential effects due to the focus on different contents of the empathizing during portrait drawing, namely the emotion recognition versus the self-perception in diverse social roles. Due to these differences, the courses provided differential opportunities to engage with specific socio-emotional skills that are expected to influence the course outcomes. Accordingly, we would not expect substantial effects of the emotion course on self-complexity or of the self-concept course on the ability to interpret subtle emotional expressions. Based on this reasoning, we can also derive a second (null-)hypothesis with regard to the epoch course, in which students were also drawing portraits and studying faces of others and themselves intensively, but without an instructional focus on socio-emotional contents:

> Hypothesis 2 (*Instructional Focus Hypothesis*): We do not expect transfer effects on socio-emotional skills for the epoch course used as baseline control group due to a lack of instructional focus on these skills and a corresponding lack of opportunities to engage with these skills.

Thirdly, based on theoretical considerations put forward in section "Empathy" we assume that entry-levels of socio-emotional skills might moderate the effectiveness of the two visual-arts education programs designed for socio-emotional transfer effects. In both courses, students are strongly encouraged to empathize with the person they focus on in their portrait drawings. In particular, the artistic drawing assignments in both "psychological" courses were designed as opportunities to imagine other persons' perspectives and feelings. For instance, students were asked in the emotion course to interpret the emotional expression in an artwork and to render the same expression even stronger in their own drawing. Or they were asked in self-concept course to imagine how a person in an artwork perceives herself in a particular role and situation and to express this self-perception by means of drawing. We assume that engaging in this type of empathy tasks does not only require but also promotes empathy in the sense that practicing empathy improves empathy. Therefore, we expected that students with lower empathic skills may benefit more from the course programs due to two reasons: (1) Lower-empathy students might have experienced less opportunities so far to engage in specific activities focusing on empathy meaning that the opportunities provided by the "psychological" courses might play a bigger role for them than for participants with higher empathy levels. (2) Lower-empathy students might have more room for improvement left with regard to relevant skills and thus may yield a steeper learning curve. Hence, we assumed that a generic measure of how well participants already perform in different types of empathy-relevant situations (as measured by the TEQ as a standard compound questionnaire measure of empathy) might provide a potential moderator of course effects:

> Hypothesis 3 (*Entry-level Hypothesis*): Participants with lower empathetic skills may particularly benefit from courses addressing socio emotional skills such as emotion recognition or self-complexity.

4.2 Methods

4.2.1 Participants

A total of 294 adolescents of grades 7 to 12 of all school types located in the city of Braunschweig (central Germany) participated in the present study. The study was approved by the local ethics committee and by the regional council of Braunschweig (Germany). Participating classes were recruited by the head of the museum pedagogy of the HAUM in Braunschweig. The final sample was composed of 137 girls, 112 boys and 45 adolescents without gender information aged between 12-19 years ($M_{\text{age}} = 15.02$, $SD_{\text{age}} = 1.75$). Within each class, the adolescents were randomly assigned to one of two parallel courses. We conducted two phases of data collection with two cohorts of students (for more information, cf. section “The Present Study”). In a first data collection phase, the emotion course was offered in parallel to the epoch course, while in a second data collection phase, the self-concept course was offered in parallel to the epoch course. The baseline control group was oversampled by offering the epoch course in both collection phases to increase the statistical power of subsequent analyses (in particular with regard to the (null-)hypothesis 2 that there are no transfer effects in the baseline course) and, thus, to obtain more conclusive results.

4.2.2 Design, Procedure, and Course Program

To study differential effects of the courses as well as changes over time on socio-emotional skills, pre- and post-measurements were collected before and after the experimental intervention. Transfer effects were measured with two tasks (for details cf. section “Stimuli and Apparatus”): (1) an *animated morph task* to measure individuals emotion recognition performance (Schönenberg et al., 2013), and (2) a *self-concept task* based on a graphical form to measure the complexity of their self-concept (Aron et al., 1992). Before the study was conducted and the course started, all adolescents, as well as their parents, had to read and sign a form of consent. Adolescents who did not receive permission from their parents to participate in the study still had the opportunity to take part in the course program without data collection. The courses were conducted by two museum pedagogues of the HAUM who had previously been trained by means of a course manual (Kastner et al., 2020). In the course manual, all three course sessions of the three different courses were specified in detail. The museum pedagogues took turns in conducting the different courses to avoid confounds due to course-teacher effects. They were not aware of the hypotheses investigated in the study. Moreover, they did not collect the pre- and posttest measures. These measures were obtained by the experimenter in the class setting while the museum pedagogues were sitting in front of the class. The course programs of the three different courses are described in detail in the following paragraphs to make clear, how the different course contents have been interwoven with the eight studio habits of mind, namely (1) *developing crafts*, (2) *engaging and persevering*, (3) *envisioning something*, (4) *expressing oneself*, (5) *observing closely*, (6) *reflecting*, (7) *exploring*, and (8) *understanding artistic worlds*.

In a first course session, (1) declarative knowledge with regard to the respective course contents was conveyed, (2) accurate observation was trained, and (3) the course contents were illustrated and exemplified with artworks from the museum's collection (analogue to the *Demonstration-Phase* described by Hetland et al., 2013; Hogan et al., 2018). In the art exhibition, adolescents' understanding of artistic worlds could be stimulated and they could deepen their acquired knowledge by exploring and discussing artworks that fit to their respective course theme. Here, the focus was on studio habits such as observation and reflection. At the end of the first course session, in each course two worksheets were handed out as homework, which required students to rehearse course contents and to apply these contents to another piece of art.

To be more concrete, in the emotion course, students first learned about characteristic features observable in facial expressions of the six individual basic emotions *happiness*, *anger*, *sadness*, *fear*, *surprise*, and *disgust* (e. g., when anger is expressed, the eyebrows tighten, and the gaze is rigidly focused straight ahead). Moreover, they reflected on why it is important to be able to recognize non-verbal facial expressions of emotions quickly and reliably in social situations. Afterwards the adolescents had the opportunity to identify basic emotions in different paintings in the exhibition. For instance, they were asked to explore the painting "Cain slays Abel"[18] by Gioacchino Assereto (Genoa, 1600–1644). The painting should be closely observed, reflected critically, and discussed in detail with regard to which emotional expressions are displayed exactly.

In the self-concept course, students first learned about the structure, function, and development of the human self-concept and about how to integrate within a coherent representation of the self potentially conflicting personal characteristics associated to different competence-oriented or relationship-oriented roles. Moreover, students were asked to reflect on their own personal characteristics in different situations and on important social roles they take in their lives. We used the painting "Family Picture"[19] of Cornelis de Vos (1618–1619) from the HAUM exhibition to get students engaged with the topic of self-complexity in an authentic art context. Students were asked to identify themselves with a girl sitting in front of a piano in the center of the painting, looking towards the observer while being surrounded by her family. Students were instructed to detect, reflect and discuss the different roles the girl might potentially take in her daily life, such as *pianist* (because she is sitting in front of the piano), *daughter* (because it is a family portrait and her parents are also depicted), *sister* (because the whole family is depicted in this portrait, or *fiancée* (because she is wearing a ring) who is supposed to

[18] https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG490/1/

[19] https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG_206/1/

marry somebody she might love or not. The focus of this exploration was to consider how different she might perceive herself in the different roles.

In the epoch course, students were first given a general art historic introduction to portrait drawings from different centuries and learned about the stylistic characteristics of different art epochs. Subsequently, students focused more specifically on the differences between portraits from the Baroque and Rococo periods and had the opportunity to study two typical examples for each of the two periods in the HAUM exhibition. For the Baroque period we selected two portraits painted by Hyacinthe Rigaud, namely the “Portrait of Duke Anton Ulrich of Braunschweig-Wolfenbüttel”[20] (Paris, 1680–1693) and the “Portrait of Elisabeth Charlotte d’Orléans, née Countess Palatinate near Rhine”[21] (Paris, 1716). For the Rococo period, students explored the “Portrait of Maria Antonia Pessina by Branconi”[22] by Anna Rosina de Gasc (Braunschweig, 1770) and the “Portrait of Duke Carl Wilhelm Ferdinand, Hereditary Prince of Braunschweig”[23] by Pompeo Batoni Cavallino (Rom, 1767).

In the second course session, the adolescents engaged in portrait drawing by themselves. Here, they could develop their crafts and actively apply the knowledge obtained in the first session on the specific course content by working on various drawing assignments that where related to artworks in the museum. All artworks and assignments used are schematically presented in Figure 9 for all courses. The Appendix contains the names of the portraits used for drawing. The assignments were presented in a sequence of increasing difficulty and growing demands for creative problem solving. Thus, they required students to engage and persevere to create something visible they had envisioned before.

For all drawing assignments a drawing app on a tablet computer was provided that was specifically designed for these assignments. The app comprised a selection of useful digital tools we considered helpful for supporting participants in engaging in their artistic projects, developing crafts, implementing the ideas they envision, exploring different design possibilities and expressing themselves. It contained the artworks for the drawing assignments as templates, allowed for taking selfies as templates for drawing, comprised simple editing functions (e. g., undoing, or redoing strokes), enabled tracing of the templates with different intensities as well as zooming of templates in order to support the drawing of details. Additionally, the app allowed to record and replay the entire drawing process, which could be used at the end of the course session for students’ presentation and discussion of how their own drawings were developed.

[20] https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG528/1/LOG_0000/#isil_DE-MUS-026819_opal_herzanulm_kunshe_GG528

[21] https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG524/1/

[22] https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG630/1/LOG_0000/#isil_DE-MUS-026819_opal_herzanulm_kunshe_GG630

[23] https://kulturerbe.niedersachsen.de/objekt/isil_DE-MUS-026819_opal_herzanulm_kunshe_GG676/1/LOG_0000/#isil_DE-MUS-026819_opal_herzanulm_kunshe_GG676

In a first step, in the emotion course, artworks characterized by strong emotional facial expressions had first to be *reproduced* by students who were asked to focus on drawing the crucial characteristics in the artwork that revealed the emotions expressed. Students received two portraits with clearly recognizable emotions, namely fear and anger, and were asked to trace these portraits in the first step (Figure 9, *tracing* drawing task, 1, 2). In a second step, the emotionality of two portraits had to be *intensified* by means of drawing. Here, the adolescents received an ambiguous facial expression (e. g., a Rembrandt portrait whose facial expression might show surprise or fear). The students were asked to envision and draw this portrait in a way that it displays a clearly recognizable emotional expression of fear (Figure 9, *intensifying* drawing task, 3, 4). Finally, there was another task (Figure 9, *transfer* drawing task, 5) in which the students were given a neutral painting that they should envision and draw in a way that it displays different emotions (anger, fear and as a transfer assignment the emotion sadness).

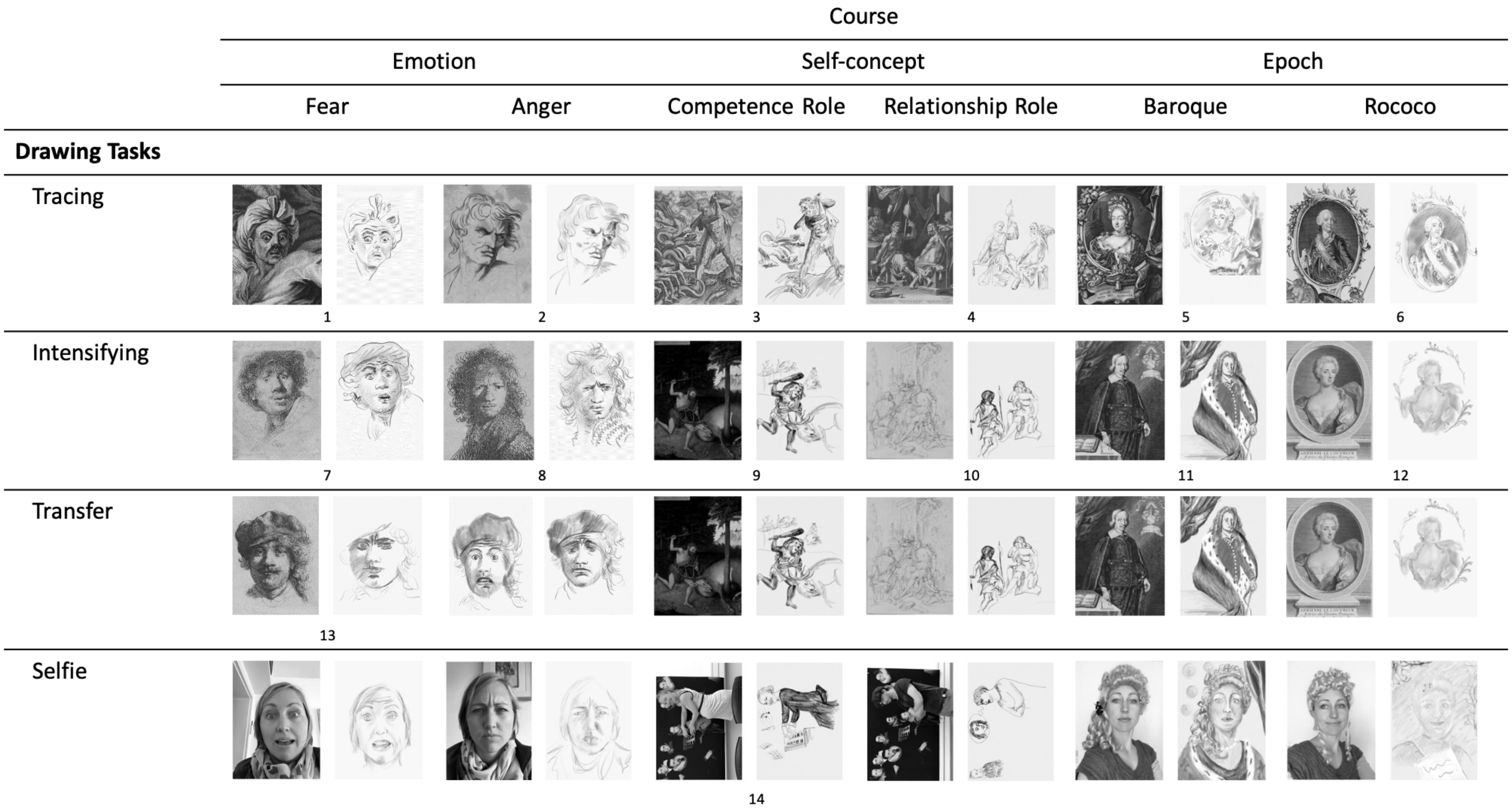
In the self-concept course, students were first provided with two paintings of the mythical figure Hercules showing the figure either in a "competence-oriented" role as a strong and invincible hero fighting against the Hydra or in a "relationship-oriented" role as a vulnerable lover dominated by Omphale (Figure 9, *tracing* drawing task, 6, 7). They were asked to trace these paintings with a focus on the characteristic features showing how different Hercules might perceive himself in these two conflicting roles. Subsequently, students again received two pictures showing Hercules either in a competence- or relationship-oriented role. However, here Hercules was less clearly recognizable as a hero or lover in these paintings. The task of the students was to envision and draw these pictures of Hercules in a way that he would be clearly recognizable as a hero in the competence-oriented role or as a lover in the relationship-oriented role (Figure 9, *intensifying* drawing task, 8, 9).

In the epoch course, students first received two characteristic portraits from the Baroque and Rococo periods and were also asked to trace them, focusing on the characteristic features of the particular epoch (Figure 9, *tracing* drawing task, 11, 12). Secondly, students received an ambiguous portrait of a scientist and a lady. The task of the students was to envision and draw the scientist as a baroque prince by using colors and characteristic elements, e. g., dark-colored heavy curtains, or the lady as a classical rococo lady (e. g., with flowers, pastel-colored clothes, etc.; Figure 9, *intensifying drawing task*, 13, 14).

In the third session of the course, the focus was again on drawing processes. This time, however, participants were stronger stimulated to express themselves by drawing portraits based on their own selfies. The selfies were created with the tablet computer and could be used as drawing templates. Depending on the content of the course, the selfies were used for staging an emotional situation, a role conflict, or a period of art history. In the emotion course, the students were asked to take a selfie of themselves looking a little sad or a little angry and to create portrait drawings out of these selfies that display the fully developed expressions of the emotions, “anger” and “fear”. In the self-concept course, we used the “Family Picture” of de Vos again (Figure 9, *selfie* drawing task, 10). We printed a life-size version of the painting and cut out the central figure sitting at the piano. Students could place themselves behind the cut-out area to create a selfie of themselves as the pianist in the painting. They were asked to use the selfie as a template for a drawing in which they envisioned themselves in a competence-oriented role such as a pianist in a concert hall or in a music lesson. In a second relationship-oriented assignment, students should use the selfie to envision themselves in the situation that they were supposed to marry someone in the portrait they do not love. The focus of the drawing assignments was on envisioning how they would look and feel in these two situations. In the epoch course, the students had the opportunity to use wigs to stage themselves as persons of the Baroque or Rococo period. They used the selfies taken with these wigs as templates for envisioning and drawing themselves as historic personalities. The self-reference introduced in the third course session by staging one’s own person was assumed to deepen the processing of the courses’ contents (Symons & Johnson, 1997). As in the second course session, the drawing phase ended with a mutual presentation and reflection on participants’ own drawings. Following the third course session, the adolescents filled in the posttest.

Figure 9

Overview Over the Pictures Used in the Visual-arts Education Program for Drawing



Note. The *intensifying* drawing task and the *selfie* drawing task based on the same portraits in the epoch course and self-concept course.

4.2.3 Stimuli and Apparatus

Animated Morph Task

Digitized color photographs of five male and five female models displaying affective facial expressions of five basic emotions (anger, sadness, fear, surprise, and disgust) were selected from the Radboud Face Database (Langener et al., 2010, Figure 10). Differences in the stimulus material in color and luminance were adjusted by using Adobe Photoshop CS4. The stimulus intensity was systematically modified by blending neutral expressions (0 %) into full emotional one's (100 %) in 51 unique levels (2 % incremental steps, each step was presented for 250 ms) using a morphing procedure (FantaMorph Software, Abrosoft, Bejing, China). The stimulus material consisted of 50 trials (10 models × 5 emotions). Each stimulus was presented only once per test to minimize repetition effects. Students needed approximately 36 s on average to classify a stimulus into one of the five basic emotions (15 min for the whole task). For stimulus presentation, data collection and data decryption, we used the Presentation software version 20.0 (Neurobehavioral Systems, USA) on a tablet screen (12,9” iPad Pro, 2732 × 2048 Pixel 264 ppi, iOS 12.1).

Self-Concept Task

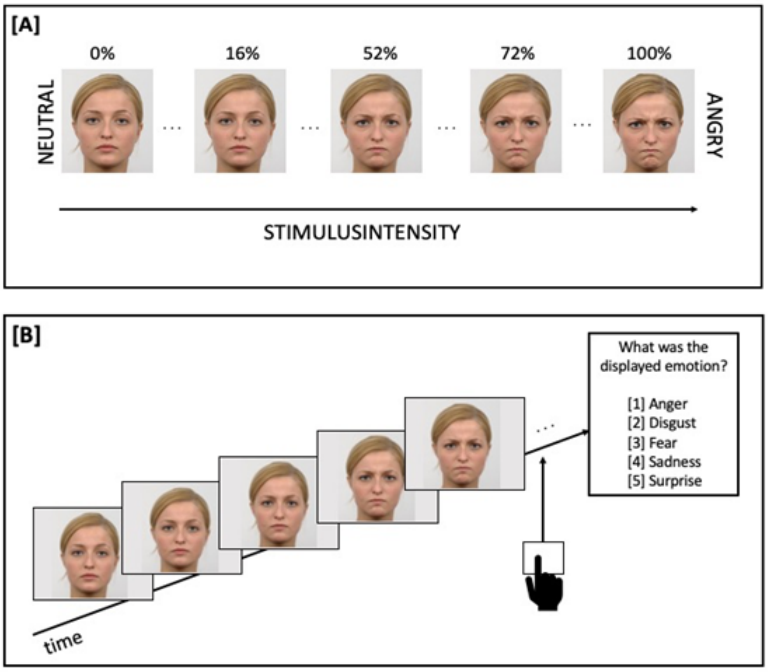
Based on Linville (1985) self-complexity measure, we developed a graphical task in paper-pencil format to measure the complexity and structure of participants' self-concept. In this task, students had to use a graphical form with five big circles to note down three important roles in their lives in addition to the two roles child and student that were already filled in two of the circles. Furthermore, they had to use adjectives to characterize themselves in each of the five roles by writing these adjectives into smaller circles surrounding the bigger circles containing the roles. Five adjectives could be filled into the five smaller circles surrounding each role. Students could either select adjectives from a prepared list of 100 adjectives (Aron et al., 1992) or generate adjectives by themselves. The prepared list of adjectives was designed to represent a wide range of characteristics that persons use to think about themselves and included both positive and negative characteristics. The number of roles and adjectives written down were used to calculate a measure of self-complexity. Figure 11 shows the task (A) and an example of an adolescent (B).

Control Variables

To test Hypothesis 3 related to individual differences between participants with regard to their general ability to cognitively and affectively empathize with others, we included the *Toronto Empathy Questionnaire* (TEQ, Spreng et al., 2009) in this study.

Figure 10

Example of the Stimuli Used in the Animated Morph Task (A) and Trial Procedure (B) Used in the Animated Morph Task



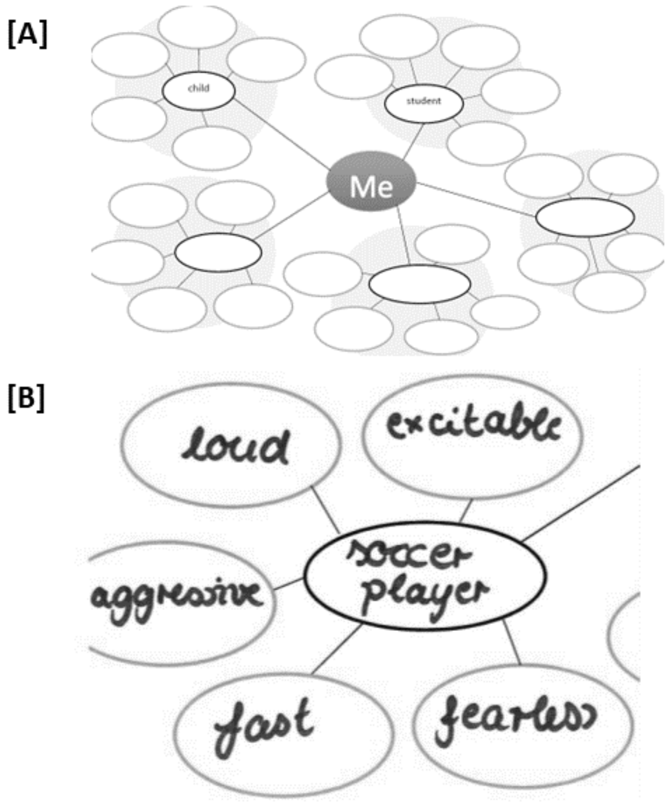
Note. Stimuli were selected from the Radboud Face Database (Langener et al., 2010). In the animated morph task (Schönenberg et al., 2014) two variables were measured: emotion intensity until participants responded (i. e., participants sensitivity) and the accuracy of emotion recognition (percentage of correct recognized emotions) was measured.

The TEQ is a self-reporting questionnaire that provides a standard compound measure comprising different aspects of empathy. A high cumulative score in the TEQ indicates highly developed abilities to empathize with the thoughts and feelings of others. In addition to the TEQ, we obtained demographic data on participants preconditions with regard to age, media usage, art interest, art mark, visits to art exhibitions, drawing skills, drawing as a hobby, and photography as a hobby.

4.2.4 Analytic Approach

Data analyses were performed using the lme4 package (Bates et al., 2012) in the free software R (R-Core-Team, 2020). For the animated morph task, we analyzed accuracy (i. e., percent correct) and sensitivity (i. e., emotion intensity required until participants responded) as two dependent variables. We used linear mixed-effect models with random intercepts for participants and random slopes for emotion for each participant to investigate the effects of course and emotion on the dependent variables. Within the five emotions presented in the task, we distinguished between drawn emotions (anger, fear) and not-drawn emotions (surprise, disgust, sadness) to examine how specific the

Figure 11
Form Used for the Self-concept Task (A) and an Example for one Self-aspect of a Person (B)



Note. This task was developed in style of McConnell (2011). The multiple self-aspect framework: Self-concept representation and its implications. *Personality and Social Psychology Review*, *15*(1), 3–27. doi: 10.1177/1088868310371101 © Copyright: Sagepub.

effects of drawing are. As course effects might depend on participants who already developed empathic skills (Hypothesis 3), we included participants' pretest TEQ score as well as their age and their initial emotion recognition performance in the pretest before participating in the course program as covariates in the models.

For the self-concept task, we also derived two dependent variables as indicators for self-complexity: the number of unique adjectives (without repetition) used for self-description and the number of self-generated adjectives, both divided by the number of roles elaborated on in the graphical form. Therefore, we calculated the average number of adjectives per role (APR) (cf. Equation (1)), separately for self-generated adjectives only and for all adjectives used including those from Aron et al. (1992) list. The rationale for these measures was as follows: Depending on how many of the five roles were elaborated on in the graphical form, students could fill in a maximum of 25 adjectives (i. e., 5 adjectives per role). If identical adjectives were used in the description of several roles this would reduce the overall number of unique adjectives used (indicating lower levels of self-complexity). Additionally, if students would not just pick adjectives out of the preselected list of possible adjectives but felt that they would need more specific adjectives to describe a specific role adequately, this was counted as indicating higher levels of self-complexity. Since no within factors were included in the models for the self-concept task, we calculated a multiple regression model with the categorical predictors course and TEQ and age and pretest as metric covariates.

$$APR = \frac{Number\ of\ adjectives}{Number\ of\ roles} \tag{1}$$

4.3 Results

Data and analysis scripts for all reported results can be found in the supplemental material. For the analyses in this paper, 224 data sets with complete pre- and post-measurements were included for the animated morph task and 209 data sets could be used for the self-concept task. A table with number of participating students for each experimental condition and time point can be found in the supplements (Table S1.1).

4.3.1 Demographic Data

To test whether the experimental groups differ with regard to their demographic data (age, media usage, art interest, art mark, visits to art exhibitions, drawing skills, drawing as a hobby, and photography as a hobby) and their pretest scores (for accuracy, sensitivity, APR and self-generated adjectives per role (APR_{self})) separate analyses of variance were conducted. Table 6 shows the means and standard deviations for all variables. Results indicate no differences between the courses, except for age and the pretest scores in the animated morph task with regard to accuracy as well as to sensitivity. Students in the emotion course were younger on average than the ones in the other two courses, $F(2{,}244) = 10.85$, $MSE = 30.87$, $p < .001$, partial $\eta^2 = 0.08$, and had a lower emotion recognition performance in the pretest, $F = 4.89$, $MSE = 0.25$, $p = .008$, partial $\eta^2 = .01$, while also being less sensitive in the pretest, $F = 6.28$, $MSE = 924.23$, $p = .002$, partial $\eta^2 = .01$ (all other results for the demographic variables can be found in Table S1.2 in the supplements). It has been shown that emotion recognition performance is associated with age (Tonk et al., 2007) and this can also be seen in our data. The correlation between age and the percentage of correctly recognized emotions in the pretest was significant, $r = .13$, $t(1033) = 4.34$, $p < .001$, 95 %-CI = [.07, .19]. For sensitivity, however, no significant correlation with age was found, $r = -.03$, $t(1043) = -1.04$, $p = .297$, 95 %-CI = [-.09, .02]. Based on these results, age and pretest scores were used as covariates in all analyses.

Table 6
Means and Standard Deviations for Sociodemographic Variables and Pretest Scores for all Dependent Variables for Each Experimental Condition

	Course					
	Epoch		Emotion		Self-concept	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age	15.15	1.80	14.27	1.68	15.64	1.41
Media usage	2.88	1.71	3.06	1.71	2.82	1.64
Art interest	2.62	1.15	2.54	1.16	2.63	1.12
[1 very low, 2 low, 3 intermediates, 4 frequently, 5 always]						
Art mark	2.21	0.93	2.33	1.13	2.04	0.79
[1 very good, 2 good, 3 satisfactory, 4 sufficient, 5 poor]						
Art exhibition	1.87	0.80	1.88	0.59	1.86	0.72
[1 never, 2 1-3 times, 3 3-6 times, >6 times]						
Drawing skills	2.98	1.21	2.82	1.25	2.96	1.24
[1 very good, 2 good, 3 satisfactory, 4 sufficient, 5 poor]						
Drawing hobby	1.88	0.97	1.99	1.05	1.73	0.84
[1 rarely or never, 2 sometimes, 3 sometimes, 4 frequently]						
Photography hobby	2.40	0.91	2.30	0.97	2.32	0.97
[1 rarely or never, 2 sometimes, 3 sometimes, 4 frequently]						
$\text{Accuracy}_{\text{Pretest}}$	76.25	22.90	71.72	23.94	77.75	21.35
$\text{Sensitivity}_{\text{Pretest}}$	60.78	11.94	63.83	11.56	60.69	13.11
$\text{APR}_{\text{Pretest}}$	3.38	1.11	3.61	0.93	3.48	1.15
$\text{APRself}_{\text{Pretest}}$	0.76	0.67	0.82	0.72	0.72	0.55

4.3.2 Animated Morph Task

Data Preparation for Analysis

As described in the methods section, we were interested in two variables: (1) the accuracy in terms of the percentage of correctly recognized emotional facial expression, and (2) the mean emotion intensity required by participants for the correctly recognized emotional facial expression (i. e., sensitivity). Five emotional facial expressions (angry, sad, fearful, disgusted, and surprised) of 10 individuals at two points in time (pre, post) had to be recognized in the animated morph task. We defined separate exclusion criteria for the *Accuracy* and the *Sensitivity Analysis*. For both analyses, we used a data driven approach for defining exclusion criteria based on the frequency distribution of reactions per emotion intensity (Figure 12). Generally, two behavioral patterns were interpreted to indicate that the instruction to recognize emotions as quickly and accurately as possible was not complied with: (1) Students waiting until the emotional expression was fully developed (100 % emotion intensity) before providing a judgment, and (2) students trying to complete the task as quickly as possible without working on the task conscientiously thereby completely sacrificing accuracy. Figure 12 shows these two behavioral patterns as accumulations between 0 and 16 % emotion intensity and at 100 % emotion intensity.

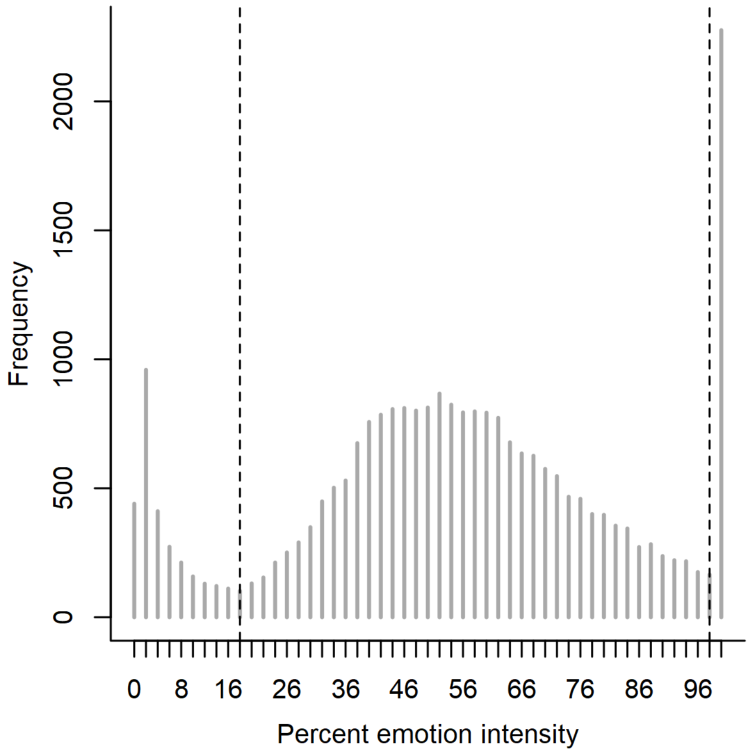
For the accuracy analysis all trials in which participants responded without caring for accuracy (emotion intensity $< 18\,\%$) were excluded. As a result, 11 % of the trials were excluded from the analysis. These trials had an average accuracy at chance level for all courses (about 20 % correctly solved trials with five possible answering alternatives, Supplements Table S1.3). Trials in which participants waited up to 100 % of emotional facial expression were not excluded in the accuracy analysis, although it can be assumed — based on the distribution of emotion intensities required — that the adolescents actually did recognize the emotion before it was fully developed. However, for the accuracy analysis it is most important to have the information whether or not an emotion was recognized correctly and that can be answered even when the exact intensity required for this decision is not known. At the aggregated levels of the percentage of correctly solved trials per emotion, only average values were included in the analysis that were based on at least five valid trials out of the 10 trials presented per emotion per test.

For the sensitivity analysis, only correct answers were included in the analysis. The exclusion criterion was slightly different than for accuracy. As before, trials in which participants responded without caring for accuracy (emotion intensity $< 18\,\%$) were excluded. In contrast to the accuracy analysis, however, we also excluded those trials in the sensitivity analysis in which participants waited up to 100 % of emotional facial expression before they reacted. Figure 12 shows this pattern as a massive accumulation at 100 % emotion intensity. The rationale for this exclusion is again that it can be assumed — based on the distribution of emotion intensities required — that the adolescents actually did recognize the emotion before it was fully developed — but did not stop the morphing. Therefore, these data contain no information with regard to the sensitivity in these cases, which is, however, crucial for a sensitivity analysis.

In sum, the reason for excluding these 100 % intensity trials in the sensitivity analysis but not in the accuracy analysis relates to the meaningfulness of the information obtained: On the one hand, we do know whether these trials were answered correctly or not and this information can be meaningfully used as an indicator for the performance distribution with regard to accuracy, but on the other hand, we do not have any information about the sensitivity required for emotion detection when the morphing was only stopped after the 100 % emotion intensity was displayed before judgements were provided. The mean sensitivity for these excluded judgments was between 5.01 and 7.80 % for the different courses (see Table S1.3 in the supplements). Accordingly, 20 % of the data points had to be excluded from the sensitivity analysis due to 100 % values. One student had to be excluded from the data analyses entirely as he reacted in all trials when the emotional intensity of 100 % was reached. For all other students, only individual trials were excluded.

Figure 12

Frequency Distribution of Students' Overall Response Behavior as a Function of Emotion Intensity (0–100 %) With Exclusion Criteria



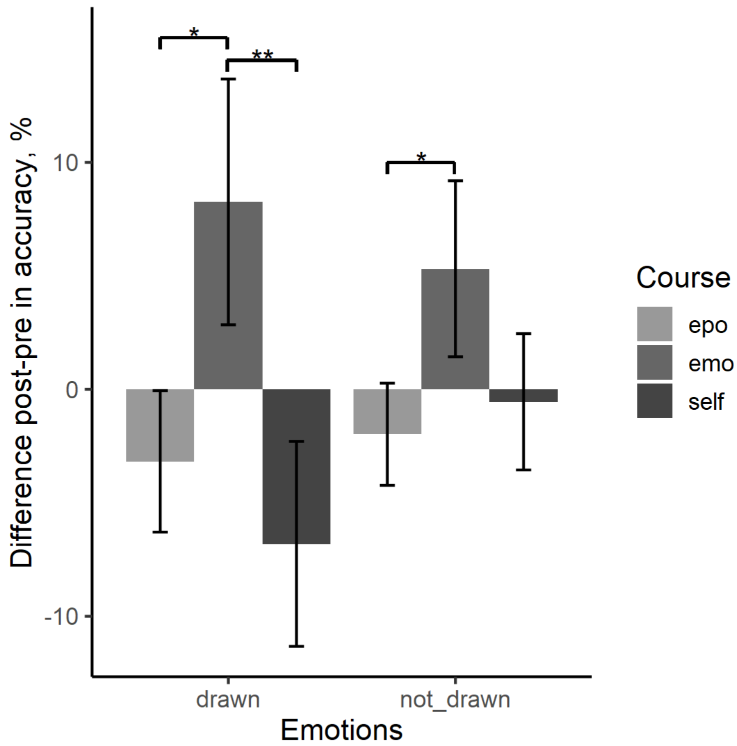
Note. In the accuracy analysis only trials with an emotion intensity < 18 % were excluded from the analysis. In the sensitivity analysis trials with an emotion intensity < 18 % and > 98 % were excluded from data analysis.

Accuracy Analysis

As described in the analytic approach, we used linear mixed-effects models to study specific course effects on emotion recognition performance. We included age and pretest score as covariates in the analyses. TEQ was considered as a discrete variable with high vs. low empathy (via median split). Type of emotion (drawn vs. not-drawn) was introduced as a fixed within participant factor. Change scores ($y_{post} - y_{pre}$) were used as dependent variable. Figure 13 shows change scores for the three courses separately for drawn (anger, fear) and not-drawn emotions (surprise, disgust, sadness). The accuracy performance differed depending on the course participated in. The emotion course was the only course where significant positive effects for the accuracy performance were found. Table 7 shows the estimated parameters for the fixed and random effects of the model described above and their 95 % confidence intervals for the change in accuracy from pre- to posttest as a dependent variable. Emotion drawn and the epoch course were defined as reference categories. The results show significant effects for emotion, course, age and pretest. There was no significant interaction between emotion and course. For

Figure 13

Mean Change Scores for the Drawn Emotions (Anger, Fear) and the Not-drawn Emotions (Disgust, Sadness, Surprise)



Note. The mean change scores for accuracy are calculated from $P(\text{correct})_{\text{post}} - P(\text{correct})_{\text{pre}}$; epo = epoch course, emo = emotion course, self = self-concept course. Error bars represent the standard error of the mean.

the drawn emotions, post-hoc tests showed significant differences between the emotion course and the epoch course, $t(204) = 3.04$, $p = .017$, as well as the self-concept course, $t(208) = -3.62$, $p = .003$. For the not-drawn emotion, only a significant difference between the emotion and the epoch course could be found, $t(210) = 2.66$, $p = .050$. The difference to the self-concept course was not significant, $t(211) = -2.20$, $p = .158$. There was no effect of high versus low TEQ nor an interaction between TEQ and course. Overall, these results indicate specific effects of the emotion course on the emotion recognition performance as measured by recognition accuracy in the animated morph task.

Sensitivity Analysis

For the sensitivity analysis linear mixed-effects models were conducted as for the accuracy analysis. Results show significant effects for emotion and pretest (cf. Table 8). Both, the emotion course, and the self-concept course, do not differ significantly from the epoch course. This pattern was confirmed by post-hoc tests which showed no significant differences between the courses for drawn and not-drawn emotions. Only

Table 7
Estimated Parameters for the Fixed Effects for the Change of Accuracy Over Time

Fixed Effects				
	Estimates	Std. error	t-value	95 %-CI
Intercept	9.86	7.44	1.32	[–4.84, 24.51]
Emotion	**7.18**	**1.91**	**3.76**	**[3.39, 10.94]**
Course (emo vs. epo)	**7.79**	**3.87**	**2.01**	**[0.17, 15.41]**
Course (self vs. epo)	− 3.61	3.31	− 1.09	[–10.12, 2.94]
TEQ	− 3.23	2.07	− 1.56	[–7.43, 0.89]
Age	**0.99**	**0.46**	**2.16**	**[0.09, 1.89]**
Pretest	**–38.84**	**3.07**	**–12.67**	**[–44.95, –32.74]**
Emotion × Course (emo)	− 3.19	3.33	− 0.96	[–9.76, 3.38]
Emotion × Course (self)	3.83	3.28	1.17	[–2.62, 10.30]
TEQ × Course (emo)	3.14	3.88	0.81	[–4.50, 10.83]
TEQ × Course (self)	− 0.07	3.73	− 0.02	[–7.45, 7.37]
Random effects				
	Variance	Std. Dev.	Corr	
Participant (Intercept)	92.93	9.64		
Participant (Emotion)	60.52	7.78	− 0.82	
Residual	323.57	17.99		

Note. $N = 196$ adolescents. Emo, emotion course; epo, epoch course; self, self-concept course. Significant parameter estimates are marked bold.

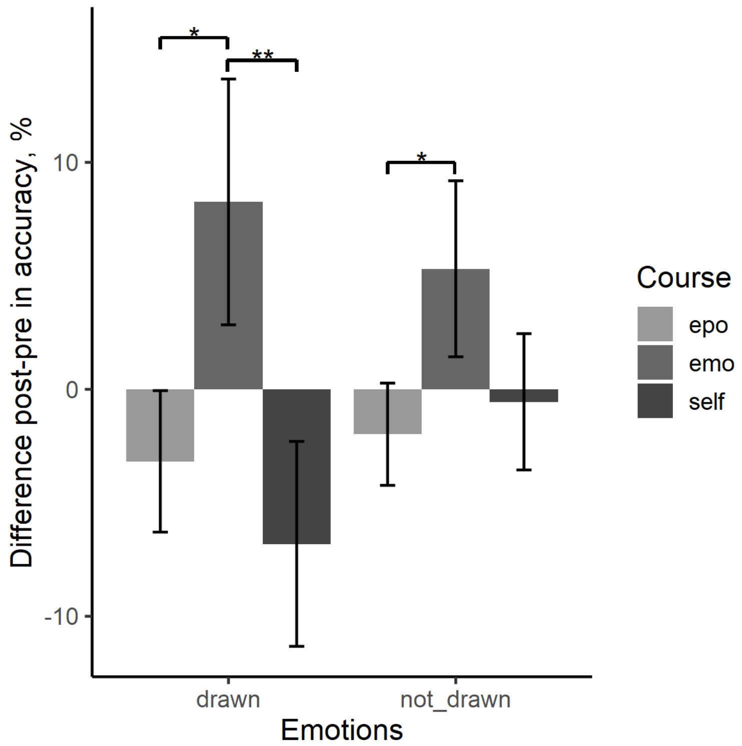
within the courses significant differences could be found between drawn and not-drawn emotions ($t(200) = –4.03$, $p = .001$ for the epoch course, $t(201) = –3.89$, $p = .001$ for the emotion course, and $t(195) = –3.80$, $p = .001$ for the self-concept course) which reflects the significant effect for emotion. All students were more sensitive after participating in one of the three courses. Subjects which had a low pretest score had a higher change from pre- to posttest. There was no effect of high versus low TEQ nor an interaction between TEQ and course. Figure 14 shows the change scores for emotion intensity students need for correct emotion recognition for the three courses separately for drawn (anger, fear) and not-drawn emotions (surprise, disgust, sadness).

4.3.3 Self-Concept Task

In the next step we analyzed whether specific effects of the self-concept course could be found with regard to the self-concept task used to assess the self-complexity of participants. To measure adolescents' self-complexity, we calculated two variables: the number of adjectives per role (APR and the number of APR_{self}). Self-generated adjectives refer to adjectives that were not on the list with adjectives provided for students (see methods section). Change scores ($y_{post} - y_{pre}$) were used as dependent variables. Two participants were excluded from the analysis because they displayed a behavior on the

Figure 14

Mean Change Scores for the Drawn (Anger, Fear) and the Not-drawn Emotions (Disgust, Sadness, Surprise)



Note. The mean change scores for sensitivity are calculated from $\text{Sensitivity}_{\text{post}} - \text{Sensitivity}_{\text{pre}}$; epo = epoch course, emo = emotion course, self = self-concept course. Error bars represent the standard error of the mean.

task that indicated a complete lack of motivation and compliance, such as filling in the adjective "normal" in all five circles for all five roles in the graphical form. As for the animated morph task, we included age and pretest score as covariates in the analyses. Course and TEQ were introduced as discrete variables as before. For the self-concept task there were no random factors involved, therefore multiple regression models were conducted on the dependent variables.

The results show that there were no effects of course, TEQ or age on the change scores for the number of APR. Results are therefore not reported here but can be seen in the supplements Table S1.4 and reproduced with the analyses scripts in the supplements. Results for the APR_{self} showed a significant main effect of the course and a significant interaction between course and TEQ, indicating that participants benefited most from the self-concept course and that this was particularly the case for low TEQ students (cf. Table 9). Moreover, we found a significant main effect for the number of self-generated adjectives in the pretest (cf. Table 9): Students with low pretest scores had a higher change score from pre- to posttest for APR_{self}. Figure 15 displays the change scores for the number of APR_{self}.

Table 8
Estimated Parameters for Change Over Time for Sensitivity

Fixed Effects				
	Estimates	Std. error	t-value	95 %-CI
Intercept	**31.72**	**6.22**	**5.10**	**[19.51, 44.05]**
Emotion	**-3.12**	**0.77**	**-4.04**	**[-4.64, -1.60]**
Course (emo vs. epo)	1.51	2.72	0.56	[-3.84, 6.88]
Course (self vs. epo)	−2.05	2.30	−0.89	[-6.58, 2.49]
TEQ	0.01	1.72	0.01	[-3.39, 3.42]
Age	0.31	0.38	0.83	[-0.43, 1.05]
Pretest	**-0.68**	**0.03**	**-20.81**	**[-0.74, -0.61]**
Emotion × Course (emo)	−1.29	1.36	−0.95	[-3.95, 1.38]
Emotion × Course (self)	−1.20	1.36	0.88	[-3.88, 1.48]
TEQ × Course (emo)	0.76	3.15	0.24	[-5.46, 6.97]
TEQ × Course (self)	1.35	3.12	0.43	[-4.79, 7.49]
Random effects				
	Variance	Std. Dev.	Corr	
Participant (Intercept)	72.80	8.53		
Participant (Emotion)	0.75	0.87	−1.00	
Residual	67.29	8.20		

$N = 206$ adolescents. Emo = emotion course, epo = epoch course, self = self-concept course. Significant parameter estimates are marked bold.

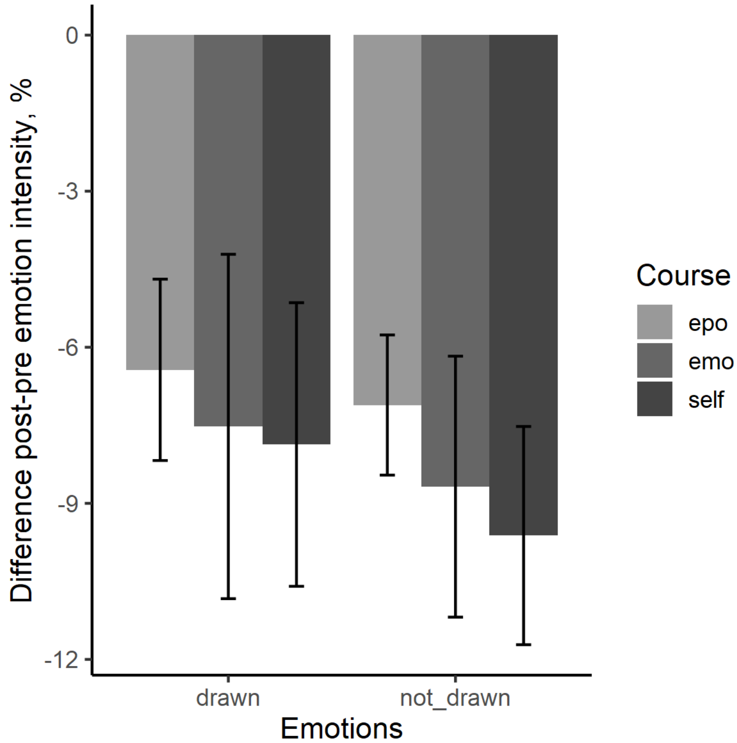
4.3.4 Test of Hypotheses

In this study we examined three hypotheses: (1) In the *Specificity Hypothesis* (Hypothesis 1), we assumed that the emotion course should lead to specific improvements with regard to emotion recognition performance, whereas the self-concept course should lead to specific improvements with regard to self-complexity. (2) In the *Instructional Focus Hypothesis* (Hypothesis 2), we assumed that the epoch course, which was used as a control group for the emotion and self-concept course, respectively, should neither yield positive effects on emotion recognition performance nor on self-complexity due to its lack of instructional focus on these constructs. (3) In the *Entry-level Hypothesis* (Hypothesis 3), we assumed that particularly participants with lower entry-levels of empathic skills prior to participating in the course might benefit more from courses addressing socio-emotional skills such as emotion recognition or self-complexity as compared to adolescents with already better-developed socio-emotional skills.

Hypotheses 1 and 2 could be basically confirmed in our analyses. For the emotion course, course specific effects could be found for emotion recognition accuracy, whereas an unspecific positive effect on sensitivity could be found for all courses. For the self-concept task course-specific effects could also be found for the self-generated adjectives used to describe important roles taken by students. In line with Hypothesis 3, we also

Figure 15

Mean Change Scores for the Number of Self-generated Adjectives per Role (APR_{self})



Note. The mean change scores for APR are calculated from self-generated $APR_{post} - APR_{pre}$, epo = epoch course, emo = emotion course, self = self-concept course, high and low values on the Toronto Empathy Questionnaire (TEQ). Error bars represent the standard error of the mean.

found that the TEQ had as moderating role for the latter variable. Persons with lower TEQ values self-generated more adjectives per role after than before the course, which was not the case for persons with higher empathic skills. This moderating effect of empathy was, however, only found for the self-concept course. We did not find any influence of prior empathy on emotion recognition performance in the animated morph task. Therefore, Hypothesis 3 could be partially confirmed for the self-complexity but not for emotion recognition.

4.4 Discussion

Previous research on (socio-emotional) transfer effects of visual-arts education programs can be characterized by three methodological shortcomings: There is a lack of (1) experimental comparisons, of (2) theory-based program designs, and of (3) objective measurement methods for outcomes. The aim of the present study was therefore to design and experimentally investigate theory-based visual-arts education programs from which specific and objectively measurable transfer effects are be expected due to a com-

Table 9
Estimated Parameters for Change Over Time for Self-generated Adjectives per Role (APR_{self})

	Estimates	Std. error	t-value	p-value
Intercept	**0.83**	**0.38**	**2.21**	**0.028**
Course (emo vs. epo)	0.01	0.13	0.05	0.964
Course (self vs. epo)	**0.32**	**0.15**	**2.13**	**0.034**
TEQ	0.20	0.11	1.79	0.076
Age	−0.04	0.02	−1.50	0.137
Pretest	**-0.49**	**0.06**	**-7.72**	**< 0.001**
TEQ (high) × Course (emo)	0.04	0.21	0.21	0.834
TEQ (high) × Course (self)	**-0.46**	**0.20**	**-2.26**	**0.027**
Residual standard error	0.56			
R^2	0.28			

$N = 198$ adolescents. Emo = emotion course, epo = epoch course, self = self-concept course. Significant parameter estimates are marked bold.

bination of *generic characteristics* of visual-arts engagement (e. g., a strong involvement with studio habits of minds) and *specific characteristics* of the programs with regard to methods used and contents addresses (e. g., empathy or self-complexity). We aimed at answering the following central research questions: (1) Are specifically designed visual-arts courses suitable for promoting socio-emotional transfer effects? (2) Are transfer effects course-specific or general in nature? (3) What role do personal preconditions with respect to socio-emotional skills play for course effectiveness?

4.4.1 Specific Effects of the Visual-arts Courses on Empathy and Self-concept Development

With regard to the research question of whether specifically designed visual-arts education programs can promote socio-emotional transfer effects, we found encouraging results for both the emotion course and the self-concept course. For both courses beneficial outcomes could be demonstrated that were not found for the epoch course used as experimental control. In accordance with the *Specificity Hypothesis*, results showed significant improvements in the percentage of correctly recognized emotional facial expressions (accuracy) only in the emotion course. Surprisingly, however, this specific effect was limited to the accuracy measure but was not found for the sensitivity measure, which improved in all three courses from pre- to posttest. Various explanations for this generally improved sensitivity in all three courses are possible. First, a *familiarity effect* may have occurred, since participants already had seen the depicted facial emotional expressions in the pretest (Bornstein & D'Agostino, 1992; Zajonc, 1968). Although each emotional facial expression was presented only once per test, this single exposure might have been sufficient for students to enable them recognizing an emotion faster on the second encounter. Clinical studies using this animated morph task (Schönenberg et al., 2014) have also demonstrated that it takes only a small number of repetitions to yield this type of *familiarity effects*. Second, a *general learning effect* with regard to analyzing facial expression might have occurred due to the study of visual arts. For instance, Hetland et al. (2013) argue that the ability to observe precisely is trained through the studio habits of mind practiced during an engagement with visual arts. Better observation may have led to faster responses in the animated morph task. A third possible explanation might be given by assuming a decay in motivation leading to a faster response for all students in the posttest as compared to the pretest. Since the posttest was administered at the very end of the third course session, it might be possible that the adolescents were exhausted and wanted to finish the tasks as quickly as possible, thereby changing their criterion for speed-accuracy trade-offs. This might also explain why student's accuracy in the epoch course and the self-concept course dropped from pre- to post-test despite an increased familiarity with the stimuli. It has to be noted however, that in the emotion course the increase in sensitivity was accompanied by an increase in accuracy, which seems to contradict exhaustion and motivational problems as potential causes of faster responses in the posttest.

Looking at the beneficial accuracy (and sensitivity) effects on emotion recognition performance within the emotion course more closely, it is interesting to note that the improvements in accuracy were found for both, drawn emotions (anger, fear) and not-drawn emotions (surprise, sadness, disgust), regardless of their individual difficulty (Montagne et al., 2007). This finding is consistent with studies in clinical psychology showing that an implicit (Schönenberg et al., 2014) or explicit (Combs et al., 2008; Dadds et al., 2012; Dadds et al., 2006) direction of attention on relevant facial features might lead to improved emotion recognition performance. This suggests that the emotion course itself might have focused participants' attention on facial features relevant for emotion recognition, thereby leading to an improvement in accuracy even for emotions that are not elaborated in detail in terms of being subject to the drawing assignments (although descriptively the accuracy changes seem to be more pronounced for the drawn emotions).

With regard to the second target construct investigated (self-concept development in terms of self-complexity), we were interested in whether a specific visual-arts course might be helpful to perceive one's own person more differentiated in diverse social roles. As for the emotion course, a specific effect of the self-concept course on self-complexity was found. This effect was moderated by the individual's general empathic skills that were obtained by means of a subjective questionnaire measure in the pretest (TEQ). As expected in the *Entry-level Hypothesis*, we found that adolescents with lower empathic skills seemed to benefit more from participation in the self-concept course than those with higher empathy scores. In particular, participants in the self-concept course with lower initial empathy scores generated more adjectives per role after course participation as compared to the pretest, which was not the case for students in the other courses. It has to be noted, however, that the newly developed measurement instrument for self-complexity might have underestimated the effect of the intervention due to ceiling effects: In the task used to measure self-complexity, we had already provided adolescents with two roles (student and child) and left only three roles for open response. Many of the adolescents had therefore already filled in the maximum number of roles and adjectives during the pretest, which is why these participants could not achieve any observable increases in the posttest.

Since we focused on self-concept development (in the sense of self-complexity) and empathy (in the sense of emotion recognition) as socio-emotional target constructs for transfer effects, we designed two "psychological" visual-arts programs, that we compared with each other but also with a control course focusing on periods of art history. Beyond the specific transfer effect of each of the two interventions, we found — in line with the *Instructional Focus Hypothesis* — that there were no specific effects of the epoch course on socio-emotional skills, such as emotion recognition or self-complexity. Thus, in sum, our three research questions can be answered as follows: (1) Specifically instructed art courses are suited (and required) for the promotion of socio-emotional skills, such as empathy or self-concept development. (2) Transfer effects are "course-specific" and not generic in nature. Therefore, specific transfer effects can only be expected if a course is designed properly for the target construct in question. (3) Socio-emotional preconditions of participants, such as general empathy, might play a role as moderators for socio-emotional transfer effects and can influence the effectiveness of an intervention. These results are based on experimental randomization and objective measurements and can, therefore, claim to provide rather strong empirical evidence as compared to other studies on transfer effects of arts education programs. Moreover, the results highlight the important role of specific psychological theories and models for a successful design of arts education programs intended to yield socio-emotional transfer effects Since only a few studies exist that successfully demonstrate transfer effects of arts education programs on socio-emotional skills in the literature to date, and since only a few of these address the issue with robust methodological approaches (Winner, 2019), we believe that an expansion of the scientific approach outlined in this paper might provide a promising avenue for the further development of the research field.

4.4.2 Role of Studio Habits of Mind for Transfer Effects

An important issue might be raised with regard to the "mixture" of the art-related and psychology-related ingredients we designed into the two "psychological" course programs. On the one hand, these courses are based on psychological theories and models of the socio-emotional skills targeted and on approaches and methods from instructional psychology on how to teach, practice, and reflect a particular skill or competence in order to enhance it. Focusing on these aspects, one might suspect that these courses are basically psychological empathy and self-concept courses embedded in a visual arts paradigm, rather than visual arts courses per se. On the other hand, however, our courses are based on the on museum pedagogical course concepts deployed in traditional art courses at the HAUM and they were further strongly enriched by engaging students in practicing different studio habits of mind, which can be considered to be quite specific for an involvement with visual arts. We worked with authentic pieces of art in an exhibition context and required students to closely observe, envision and create expressive drawings, to persist in these activities over the course of several weeks, thereby developing their crafts and their understanding of artistic worlds. Moreover, our course program comprised three central elements described by Hetland et al. (2013): First, a "*Demonstration-Phase/Knowledge-Acquisition-Phase*" was conducted in which central course contents were conveyed to the adolescents. Subsequent to acquiring a basic knowledge in each course, adolescents were given the opportunity to apply their knowledge in a "*Students-at-Work-Phase*" in the context of artistic drawing assignments that increased in their demands for crafts and creativity. Lastly, finished drawings were presented and discussed together in a "*Reflection-Phase*" in each course. Therefore, we would consider the course programs as a genuine and interdisciplinary mixture of authentic visual-arts engagements and psychological elaborations on the course contents. Probably, typical arts teachers conducting these course programs might notice an atypical strong psychological component integrated in the programs, but nevertheless they might still consider them to be "real" arts courses due to the equally strong art-typical elements. Moreover, we obviously would not doubt the general value and importance of the traditional "arts for art's sake" perspective of most visual arts classes. Rather, the present study is intended to provide an answer to the question of why in many studies on visual-arts programs no effects "beyond art's sake" could be found, for instance in the socio-emotional domains covered in this study that are not genuinely attached to the studio habits of mind. Therefore, our study can be seen as a proof of concept that visual-arts programs can be tailored as authentic contexts that allow for achieving positive transfer effects even in the socio-emotional domain — when properly designed.

As one important caveat, however, it has to be noted that our study does not yet allow to draw strong conclusions as to which of the elements integrated in the overall course program were crucial for the positive effects obtained. First, students were always asked both, to study and to draw portraits. Therefore, we cannot distinguish from our current data how relevant these two components were individually for the outcomes obtained. In particular, we don't know yet how important the creative aspects of the drawing tasks such as intensifying, and selfie-drawing were for course success. Second, we do not know for sure by now whether similar course effects could be found when students would engage in studying and drawing non-artistic portraits based on photos form magazines or yearbooks, for instance. In other words, we have not tested directly for the role of the authentic art context yet. However, we are convinced that studying and drawing photos from a magazine might not lead to the same improvements on socio-emotional skills as looking at and engaging with visual art, due to the uniqueness of the engagement with visual art beyond just looking at a photo. Third, we do not know how important the authentic art museum context might have been for the course effects. However, based on research on the perception of authentic objects in museums and exhibitions we can assume that the museum context might play and important role in the acquisition of knowledge. Schwan and Dutz (2020), for example, were able to show that museum visitors dealing with authentic objects develop more situational interest and give them a stronger impression of being in touch with the historical periods of the exhibition.

Therefore, future studies should focus more closely on the individual course elements and their influence on the development of socio-emotional skills due to visual-arts programs. In other words, elements such as the drawing assignments (including specific aspects such as the self-reference due to selfie-drawing), or the reflection phases should be studied in isolation regarding their overall contribution to socio-emotional learning. Similarly, the different studio habits of mind-elements comprised in the course programs might be validated individually with regard to their contribution to the overall effectiveness of the intervention.

4.4.3 Implications for Clinical and Health Research

With regard to the scope of the current study it has to be noted that we recruited an average sample of healthy adolescents as participants. Thus, we do not know, yet, whether our interventions have the potential to be also helpful for students at risk with regard to their socio-emotional skills, which would require testing the intervention in clinical populations. However, we used clinical paradigms to measure effects on emotion recognition (Jusyte et al., 2017) and self-complexity (Linville, 1985, 1987; Woolfolk et al., 2004). This suggests that there might be interesting synergy effects between clinical research and experimental research on the effects of engaging in visual arts. It might well be that our course programs, with its specific transfer effects, is particularly well suited to be applied in important clinical areas. For instance, Schönenberg et al. (2014) could show that a subtle training (sensitivity to emotional expressions training (SEE training)) that implicitly directed attention to important regions of emotional faces (with slowly fading out the intensity levels of the presented expressions over the course of training sessions) was suitable to improve perceptual insensitivities to facial affect found in a group of incarcerated violent offenders. As our emotion course also yielded strong improvements in emotion recognition performance, it would be interesting to test the effectiveness of the intervention in a similar way in clinical studies.

Moreover, the approach of art therapy also indicates that visual-arts programs might be helpful in clinical disorders associated with impaired emotion recognition (e. g., autism, Durrani, 2019) or with a rigid and non-adaptive self-concept, characterized by a low ability to take another person's perspective concerning a situation (Semrud-Clikeman, 2007). Unsurprisingly, many health programs in general address the promotion of the two socio-emotional skills addressed by our interventions with the aim to produce significant and lasting changes in psychopathology (Spence, 2003). Therefore, we think that the research approach used in the present study could be extended to also explore causal effects of art therapy in greater detail. In addition, visual-arts education programs might not only be valuable to support and augment therapies for clinical conditions but also help in the prevention of clinical disorders.

Supplemental Material to Study 1

Table S1.1
Number of Students for Each Experimental Course and Time Point

	Course				
Dataset Morphing					
	Epoch	Emotion	Self-Concept	NA	Total
Pretest	129	63	60	11	263
Posttest	127	66	53	0	246
Pre- & Posttest	118	55	51	0	224
At Least One	138	74	62	11	285
Dataset Self-Concept					
	Epoch	Emotion	Self-Concept	NA	Total
Pretest	123	55	58	5	241
Posttest	120	53	55	0	228
Pre- & Posttest	112	47	50	0	209
At Least One	131	61	63	5	260

Table S1.2
Results for ANOVAs for Demographic Variables Testing for Differences Between Experimental Conditions

	MSE	*F*	*df1*	*df2*	*p*	η^2
Age	30.87	10.85	2	244	< 0.001	0.082
Media Usage	1.02	0.35	2	246	0.703	0.003
Art Interest	0.17	0.13	2	246	0.878	0.001
Art Mark	1.31	1.42	2	246	0.244	0.011
Art Exhibition	0.01	0.02	2	246	0.983	< 0.001
Drawing Skills	0.61	0.41	2	246	0.666	0.003
Drawing Hobby	0.98	1.05	2	246	0.351	0.008
Photography Hobby	0.29	0.33	2	246	0.719	0.002

Table S1.3

Means and Standard Deviations for Accuracy for Excluded Trials for the Animated Morphing task for Each Experimental Condition

	Course					
	Epoch		Emotion		Self-Concept	
	M	*SD*	*M*	*SD*	*M*	*SD*
Accucary	19.26	39.45	19.72	39.81	19.73	39.84
Sensitivity	5.01	4.81	5.80	4.98	7.80	5.08

Table S1.4

Estimated Parameters for Change Over Time for APR

	Estimates	Std. error	*t*-value	*p*-value
Intercept	**2.18**	**0.63**	**3.46**	**< 0.001**
Course (emo vs. epo)	− 0.22	0.21	− 1.07	0.288
Course (self vs. epo)	0.25	0.25	0.99	0.324
TEQ	0.00	0.19	0.00	0.999
Age	− 0.02	0.04	− 0.50	0.616
Pretest	**−0.60**	**0.06**	**−9.34**	**< 0.001**
TEQ (high) × Course (emo)	0.39	0.35	1.10	0.272
TEQ (high) × Course (self)	− 0.11	0.34	− 0.31	0.756
Residual Standard Error	0.94			
R^2	0.32			

$N = 198$ adolescents. Emo = emotion course, epo = epoch course, self = self-concept course. Significant parameter estimates are marked bold.

CHAPTER 5

STUDY 2: INFLUENCING FACTORS ON EMPATHY IN A VISUAL ARTS EDUCATION PROGRAM

The content of the following Chapter was submitted at the Journal *Computers in Human Behavior Reports*. The proportional contributions to the manuscript are presented in the subsequent table. This article may not exactly replicate the final version published in the journal. It is not the copy of the record.

Nr.	Accepted publication yes/no	List of authors	Position of candidate in list of authors	Scientific ideas by the candidate (%)	Data generation by the candidate (%)	Analysis and Interpretation by the candidate (%)	Paper writing done by the candidate (%)
2	no	Lydia Kastner Birgit Brucker Philipp Mock Aiste Jusyte Susana Ruiz-Fernández Sven Nommensen Ansgar Thiel Peter Gerjets	1	70	95	70	75

Authors:	Lydia Kastner, Birgit Brucker, Philipp Mock, Aiste Jusyte, Susana Ruiz Fernández, Sven Nommensen, Ansgar Thiel, Peter Gerjets
Titel of paper:	Focusing On Emotions In Digital Drawing Courses Fosters Emotions Recognition: The Influence Of Drawing Tasks and Drawing Activities
Status in publication process:	Submitted, Under Review

Abstract

Engagement in visual arts is expected to be beneficial beyond the arts, for example by supporting cognitive or socio-emotional skills (so-called transfer effects). Research on learning-by-drawing in the context of science education consistently showed that drawing helps students (e. g., for slowing down, paying attention to details, and understanding complex contents and concepts). However, empirical evidence for these claims on socio-emotional skills during drawing is limited as experimental study designs, objective skill assessments, and process measurements are mostly lacking. A previous experimental study was able to demonstrate such specific transfer effects of three properly designed drawing courses (focusing on emotions, self-concept, or historical periods) in an art museum context on socio-emotional skills. However, only the emotion-related drawing course (but not the other two drawing courses) yielded socio-emotional transfer effects on emotion recognition abilities because it intertwined engagement in portrait drawing with practicing these abilities. In addition, the present study investigated potential influencing factors (e. g., prior knowledge, drawing quality, elaboration depth of the drawing tasks, and process features logged with the deployed tablet drawing app) in terms of their predictive value on the effectiveness of the course. The results of the present study showed that neither prior knowledge nor drawing quality did explain the positive effects of the emotion course on emotion recognition abilities. However, process data revealed specific drawing patterns (e. g., time pencil on paper, altitude) associated with positive course outcomes. Using thes patterns within a machine learning approach to train classifiers for predicting the top versus bottom 40 % of participants concerning their gains in emotion recognition abilities yields up to 65 % correct classifications. In sum, these findings indicate that the use of appropriate drawing tasks and the engagement in suitable drawing activities are crucial factors to elicit transfer effects on socio-emotional skills.

Keywords: instructional design, visual arts courses, art museum, digital drawing, socio-emotional transfer effects, emotion recognition, process data, machine learning

5.1 Introduction

Ever since our ancestors — tens of thousands of years ago — produced their prehistoric cave paintings, visual arts have played a pivotal role for mankind. This is because engaging in visual arts allows mankind to pass information from one generation to another and share and express personal experiences, emotions, thoughts, and identities (Winner, 2019). However, creating a realistic representation of something by drawing is anything but easy. It involves a substantial investment of time and effort in processes of exploration, close observation of objects, reflection, and elaboration (Bustle, 2004; Hetland et al., 2013; Hogan et al., 2018; Matthews, 2003). Drawing has been described as the creation of a two-dimensional representation of an imagined or "real" experience by using different materials and techniques (Gingsborg, 2003; Ramm, 2005). In order to illustrate an experience graphically, the individual must reduce its complexity and represent its essential components by means of strokes and shadings. This requires a high degree of perceptual abstraction, cognitive elaboration, and skilled motor performance (Tyler & Likova, 2012). If these requirements are met visual arts have also been hypothesized to be useful for acquiring a wide range of cognitive and socio-emotional skills (for an overview, see Winner, Goldstein, et al., 2013). Such hypothesized "extra" outcomes of visual arts beyond creating something beautiful or expressing one's personality are referred to as "transfer effects" (Knigge, 2013; Winner, Goldstein, et al., 2013). In an experimental study, Kastner et al. (2021) demonstrated such specific transfer effects of properly designed visual arts courses in an art museum context on socio-emotional skills. Kastner et al. (2021) compared in a three-group design an emotion course, a self-concept course, and an epoch course. Results of their study demonstrated specific course effects for both the emotion and self-concept courses compared to the epoch course on emotion recognition and on self-complexity respectively. The present paper will extend these findings by analyzing in detail whether and how these positive effects are influenced by personal prerequisites and drawing processes. In particular, we will investigate how the positive effects of artistic drawing on the acquisition of socio-emotional skills in terms of emotion recognition abilities might depend on (1) the personal prerequisites in terms of prior knowledge and drawing skills that individuals bring to the drawing situation, (2) the appropriate design of the drawing tasks, and (3) the detailed characteristics of the drawing processes themselves.

5.1.1 "Learning-by-Drawing" in the Context of Visual Arts

The assumption that drawing can lead to a deeper understanding of the learning content is not new. However, the important role that drawing can play for helping students in slowing down, paying attention to detail, and understanding complex content and concepts has been demonstrated mainly in the context of science education (Matern & Feliciano, 2000; Quillin & Thomas, 2015). In this literature, it is usually referred to as *drawing-to-learn* or *learning-by-drawing* (Ainsworth et al., 2011; Ainsworth & Scheiter, 2021; Cook, 2006; Cromley et al., 2020). Research in this field has shown growing experimental evidence for the beneficial effects of learner-generated drawings on knowledge acquisition and has highlighted the importance of appropriately designed drawing tasks to effectively support learning (Fiorella & Mayer, 2016; Leutner & Schmeck, 2014; Van Meter et al., 2006; Van Meter & Firetto, 2013). The beneficial effects of drawing have been attributed to a more accurate and multimodal mental representation of the depicted learning content (Ainsworth et al., 2011; Van Meter & Firetto, 2013). For such a superior mental representation, however, the quality of the drawings generated in terms of their precision seems to play a crucial role as well (Scheiter et al., 2017).

Generating high-quality drawings is assumed to require sufficient and conscious declarative prior knowledge about the learning content (Fiorella & Zhang, 2018), which is also strongly related to the learning outcome (Scheiter et al., 2017; Schmidgall et al., 2019; Schwamborn et al., 2010). However, in the context of socio-emotional skills (e. g., emotion recognition), not only declarative prior knowledge (which can be described as explicit knowledge that the learner is able to verbalize), but also unconscious perceptual-procedural prior knowledge might be very important. This procedural prior knowledge describes knowledge that is automatically represented in a mental representation (Aronson et al., 2008). Kastner et al. (2021) showed first promising evidence that procedural knowledge in terms of emotion recognition abilities can be enhanced by properly designed drawing tasks. These findings imply that not only declarative but also procedural prior knowledge might play a crucial role during learning about emotional expressions.

Besides these findings, previous studies on learning-by-drawing have not considered the potential of visual arts engagement for learning in contexts other than science, nor its role in transfer effects on socio-emotional skills. However, based on the classical learning-by-drawing literature, it can be assumed that an artistic elaboration of specific learning content (e. g., emotion recognition skills as example of socio-emotional contents) by means of drawing might stimulate content elaboration and clarification in a similar way to non-artistic drawing. This is particularly plausible as the theoretical models used to explain the potential benefits of learning-by-drawing are completely domain-general and not tied to specific contents such as science (e. g., theories of multimedia learning, Ainsworth, 2006; Mayer, 2014; dual-coding theory, Paivio, 1990; Schnotz, 2014; cognitive load theory, Sweller, 1994; Sweller, 2005; generative learning theory, Wittrock, 1992; Wittrock, 1994). All these models attribute drawing effects to an active selection, organization, and integration of verbal information (e. g., thoughts) and visuospatial information (e. g., self-generated graphical representations) into a multimodal but coherent mental representation. The forced integration of verbal and visuospatial representations postulated by these theories might be the foundation for potential cognitive as well as socio-emotional benefits of drawing (Cox & Rowlands, 2010; Van Meter & Garner, 2005). For instance, it can be assumed that reflecting and elaborating on a variety of contents, particularly if these contents are visuospatial in nature, can be enhanced by means of drawing activities. This might result in finding more elaborated knowledge structures and a deeper understanding of these contents irrespective of their specific nature.

As already mentioned above, the design of the drawing tasks might have an important impact on learning outcomes as they might vary in how deep a learner engages in the to-be-learned contents. For instance, drawing tasks that foster deeper elaboration or involve personal pronouns should lead to more profound learning (e. g., personalization principle, Mayer, 2005; Mayer & Fiorella, 2014; Schrader et al., 2018). With the advent of digitalization, devices such as tablets allow for digital drawing and therefore also recording of the entire drawing activities in terms of process features (e. g., time pencil on tablet, fading, or zooming). This seems highly potential, since it is often criticized in the "classical" learning-by-drawing literature that one rarely gets an insight into the underlying drawing process, except for the "final product". However, previous studies in the learning-by-drawing literature have, to the best of our knowledge, never collected explicit drawing data in terms of different drawing tasks varying in their elaboration depth. Moreover, tablets contain features that encourage learners to have greater fun and interaction with the drawing task (Lorenzo & López, 2015) and might help to reduce anxiety that some participants experience in the context of art classes (Hourcade et al., 2013). For example, using the zoom function to have a closer look on drawing details or generating self-captured images using the camera function might promote active learning and sustained interest in the learning content. Thus, we assume that drawing with tablets constitute a major strength to address potential cognitive and socio-emotional benefits of drawing.

5.1.2 Potential Cognitive and Socio-Emotional Benefits of Drawing

As the abovementioned learning-by-drawing literature (Ainsworth et al., 2011; Ainsworth & Scheiter, 2021; Cook, 2006; Cromley et al., 2020) does not directly formulate hypotheses about the benefits of visual arts, we combine their assumptions with established models describing processes of visual arts engagement to derive empirically testable hypotheses. One such popular model is the *studio habits of mind* framework based on a seminal study by Hetland et al. (2013). They investigated mechanisms and effects involved in visual arts engagement through over hundred hours of high-school classroom observation. Hetland and colleagues defined eight cognitive and motivational skills that seemed to be fundamental to every artistic engagement in the visual arts, namely (i) *developing crafts*, (ii) *engaging and persevering*, (iii) *envisioning something*, (iv) *expressing oneself*, (v) *observing closely*, (vi) *reflecting*, (vii) *exploring*, and (viii) *understanding art world*. These studio habits of mind were meant to serve as a conceptual structure to better understand student-teacher interactions in the context of visual arts. It turned out that learners who applied and were exposed to all studio habits of mind in their visual arts classes, either consciously or unconsciously, eventually yielded better perceptual abilities, a better understanding and critical analysis of the content dealt with during their visual arts engagement. It must be noted, though, that Hetland et al. (2013) did not consider these effects as transfer effects. Rather, in their view these effects pertain to the actual goals of visual arts engagement itself (i. e., primary effects), whereas transfer effects are by-products of visual arts engagement (e. g., better observational skills). Nevertheless, even though the studio habits of mind were originally developed for the analysis of immediate "primary effects" of visual arts courses, it might also be helpful to apply it to the field of transfer effects research due to its highly differentiated and art-specific nature. Most importantly, the studio habits of mind do not stop at describing the surface characteristics of central activities that take place in the visual arts classroom (regardless of whether their effects are seen as primary or transfer effects) but tries to analyze the underlying mechanisms and processes on a more abstract level, thereby resembling the cognitive models referred to in the learning-by-drawing literature.

Given the analysis of Hetland et al. (2013), it is not surprising that causal effects of visual arts engagement on cognitive skills (more precisely: *observational skills*) could already be demonstrated experimentally. For instance, it has been shown that an attentive inspection of artwork leads to improved observational skills in both a medical (Dolev et al., 2001) and a biological science context (Tishman et al., 1999). In addition, Zhou et al. (2012) showed that students with more experience with drawing faces exhibit a superior (i. e., more analytic and at the same time less holistic) approach to general face processing than students with less experience. Zhou et al. (2012) hypothesized that this effect may be inherently caused by the drawing experience because drawing faces might enable a person to better break down and analyze the individual parts of a face. Similarly, Balas and Sinha (2008) found that individuals with greater experience in portrait drawing were better at selecting the relevant features (e. g., eyes, forehead, mouth) of a facial expression as compared to inexperienced drawers. These findings are perfectly in line with the characteristics of artistic drawing listed in the studio habits of mind, such as closely observing, engaging, expressing, envisioning, reflecting, etc. Thus, these studio habits of mind seem to promote a deeper cognitive engagement not only with scientific topics but also with contents potentially related to socio-emotional skills, such as characteristics of human faces. They might consequently support a deeper understanding of certain (socio-emotional) themes and related skill development (Fiorella & Mayer, 2016; Mayer & Fiorella, 2014). Accordingly, Kastner et al. (2021) demonstrated that a specifically designed visual arts course, that focused on teaching the generic characteristics of visual arts engagement (e. g., studio habits of mind) and addressing concrete socio-emotional content, such as facial expression of emotions (a crucial component of empathy) by drawing emotional portraits, resulted in specific socio-emotional transfer effects (i. e., positive effects on procedural emotion recognition abilities). The present paper focuses on the question whether these positive effects on emotion recognition abilities on the one hand are influenced by learners' prerequisites in terms of their prior knowledge and their drawing skills and on the other hand depend on the drawing activities incorporated in this course (varying in their elaboration depth) as well as the different process features of the drawing activities (e. g., time pencil on tablet, fading, or zooming).

5.1.3 Emotion Recognition Ability as a Target Construct for Transfer Effects of Visual Arts

Recognizing and interpreting the emotions of others correctly is an important aspect of socially competent behavior in everyday life (Ekman & Friesen, 2003; Izard et al., 2001) that is directly related to successful communication (Haynes & Avery, 1979), and perspective taking or empathy (Ioannidou & Konstantikaki, 2008). Problems with adequately recognizing the emotions of others or empathizing with them are often found in clinical disorders (e. g., attention deficit hyperactivity disorder, ADHD, Da Fonesca et al., 2008; Demirci & Erdogan, 2016; or autism, Harms et al., 2010; Tehrani-Doost et al., 2017). In line with the evidence from clinical programs (as well as from non-clinical drawing studies, cf. Balas & Sinha, 2008; Zhou et al., 2012) that emotion recognition abilities can be trained by directing attention to relevant facial features (Combs et al., 2008; Dadds et al., 2006; Schönenberg et al., 2014), Kastner et al. (2021) showed that a visual arts course focusing on drawing emotional facial expressions is a promising method to enhance emotion recognition abilities. In this previous study (Kastner et al., 2021) four drawing tasks were implemented (besides other instructional tasks) in the visual arts course focusing on drawing emotional portraits. These drawing tasks systematically increased in difficulty (cf. description of the drawing tasks in the methods section). Firstly, in a *tracing* drawing task participants had to trace portraits with a focus on the most important aspects for recognizing the depicted emotion. Secondly, in an *intensifying* drawing task participants had to draw out portraits that showed emotions in an ambiguous manner in a way that a certain emotion will become clearly recognizable. Thirdly, in a *transfer* drawing task participants had to draw out portraits that show neutral expressions in a way that a certain emotion will become clearly recognizable. Finally, in a *selfie* drawing task participants had to draw out pictures of themselves looking a little "angry" or "fearful" in a way that the emotion will become clearly recognizable. These four drawing tasks allowed for incorporating different aspects of the studio habits of mind framework (Hetland et al., 2013) because the following mechanism could be considered as important to develop such an effective intervention:

- Envisioning (cf. envisioning something in Hetland et al., 2013) of successful drawings by constructing a mental representation of specific emotional facial expressions in the intensifying, transfer, and selfie drawing tasks.
- Illustrative expression of one's own emotions (cf. expressing oneself in Hetland et al., 2013) or that of others by means of drawing in the selfie drawing task.

- Close observation (cf. observing closely in Hetland et al., 2013) of characteristic features of each emotion (e. g., in- and downward contracted eyebrows in anger resulting in a vertical wrinkle on the forehead) in all drawing tasks, particularly in the tracing drawing task with fully pronounced emotions.
- Reflection, exploration, and understanding (cf. reflecting, exploring, and understanding in Hetland et al., 2013) about the success of drawing specific emotional expressions during the construction of mental representations and actual drawings of specific emotional facial expressions particularly in the intensifying, transfer, and selfie tasks.

Investigating which underlying components of the drawing intervention (i. e., drawing tasks and the assessed process features of the drawing activities) account for the beneficial effects of the emotion course (cf. Kastner et al., 2021) is at heart of the current paper which will be explained in more detail in the next section.

5.1.4 The Present Study

The present study aims at identifying the components associated with drawing that might account for the positive effects of the emotion course on emotion recognition abilities (cf. Kastner et al., 2021). We measured these abilities by utilizing in a pre-post-design a commonly used paradigm from clinical psychology (Schönenberg et al., 2016). This paradigm gives us information about the procedural knowledge in terms of: (a) how correctly individuals recognize different emotions (*accuracy*), and (b) what intensity of emotional facial expression is needed to detect an emotion correctly (*sensitivity*). In our previous study (Kastner et al., 2021), specific effects were found on *accuracy gains* ($\text{accuracy}_{\text{post}} - \text{accuracy}_{\text{pre}}$) in the emotion course. The present study aims at identifying the underlying variables associated with drawing that explain these positive results (in terms of accuracy gains) in the emotion course by taking into account variables that are known as effective parameters from the classical learning-by-drawing literature: type and extent of participants' prior knowledge, drawing quality, drawing tasks as well as drawing process parameters, such as for example time pencil on paper or fade interactions.

According to previous studies, it is known that generating accurate drawings requires sufficient prior knowledge with regard to the content to be learned (Fiorella & Zhang, 2018). Moreover, several studies have demonstrated a strong relationship between precision of drawing and learning outcomes (Scheiter et al., 2017; Schmidgall et al., 2019; Schwamborn et al., 2010). Since previous studies only focused on the impact of declarative prior knowledge and not procedural prior knowledge, we additionally analyzed the effects of both kinds of prior knowledge on learning outcomes in terms of accuracy gains in emotion recognition abilities. Thus, for drawing quality (*Drawing Quality* Hypothesis, see Table 10), we hypothesize that adolescents' declarative prior knowledge about the emotional facial expressions as well as their procedural prior knowledge is positively related to their drawing quality (in the tasks incorporated in the course) and to their accuracy gains (Hypothesis 1a and 1b). More specifically, we expect that beneficial effects of the emotion course on accuracy gains will be stronger for participants with higher declarative as well as procedural prior knowledge (due to better quality of their drawings). Concretely, we expect that declarative as well as procedural prior knowledge predicts accuracy gains and that including drawing quality as a mediator in these models yields significant indirect paths (Hypothesis 1c).

Previous studies in visual arts have, to the best of our knowledge, never collected explicit process measures to investigate drawing processes during the mental elaboration of an artistic assignment. In the current study, we tried to push the field forward in this respect by collecting fine-grained drawing data during all artistic assignments. We collected these data for an extensive exploratory correlational analysis on the role the drawing tasks themselves play for the higher accuracy gains in the emotion course. The emotion course comprised four drawing tasks: tracing, intensifying, transfer, and selfie drawing tasks (cf. description of the drawing tasks in the methods section) that differed regarding the types of elaboration required. For instance, on the one hand we administered tasks that required mainly the generation of a drawing by means of recognizing and tracing important aspects without a deeper elaboration. These tasks require mainly close observation and engagement. On the other hand, there were also tasks that required intensifying some aspects of a drawing or applying course content to a drawing by means of transfer. Here, a more in-depth elaboration in terms of envisioning and reflecting elements of a drawing was required beyond close observation and engagement. Using tablets allowed us to collect specific real-time process data in terms of drawing features. Regarding the drawing process measures collected, we hypothesized that features of the drawing process such as drawing time, number of strokes, variability in the pressure and altitude of the pen, and so forth might be able to indicate appropriate drawing activities for specific tasks and therefore might explain the positive effect of the emotion course on accuracy gains. Moreover, based on previous studies on drawing (Schmidgall et al., 2019), we also derived two alternative hypotheses. For instance, if merely the generation of a drawing is the main contributing factor to positive drawing effects, then we would expect that the accuracy gains in the emotion course might be correlated in a similar way with drawing features for all four drawing tasks, irrespective of the depth of elaboration they require (Hypothesis 2a: *Generation Hypothesis*). However, if the accuracy gains depend mainly on the elaboration depth provided by envisioning and reflecting elements in drawings, then drawing tasks with stronger elaboration depth (e. g., intensifying and transfer drawing tasks) should yield more and/or stronger correlations between drawing features indicating appropriate approaches and accuracy gains than less elaborative drawing tasks such as the tracing drawing task (Hypothesis 2b: *Elaboration Depth Hypothesis*, see Table 10).

Another important factor for deeper elaboration that might be highly relevant in a visual arts context is self-reference (e. g., personalization principle, Mayer, 2005; Mayer & Fiorella, 2014; Schrader et al., 2018). Therefore, we used a selfie drawing task involving self-expression to establish a strong self-reference of the emotional content. We hypothesize that the drawing task involving selfies might be suitable to stimulate deeper elaboration such that this drawing task might be crucial for the beneficial effect of the emotion course. If this is the case, more and/or stronger correlations between drawing features indicating appropriate approaches and accuracy gains should result for this selfie drawing task than for the drawing tasks with less self-reference (e. g., intensifying, transfer, and tracing drawing task; Hypothesis 3a: *Self-Reference Hypothesis*). However, self-reference in terms of drawing one's own face and body might turn out to be rather distracting regarding the emotional course content, particularly for adolescents, which could result in the opposite pattern. In this case, we would alternatively not expect more and/or stronger but rather less and/or weaker correlations between drawing features and accuracy gains for the selfie drawing task than for drawing tasks with less self-reference (Hypothesis 3b: *Distraction Hypothesis*, see Table 10).

Beyond these correlation analyses, we are also interested in a last explorative step to investigate in a more holistic and integrative way how useful and specific the drawing features obtained might be for predicting course outcomes in terms of accuracy gains. Therefore, we used a machine learning approach to evaluate the overall predictive value of the drawing features for accuracy gains beyond individual correlations. More specifically, we trained several classifiers using data from all four drawing tasks of the emotion course to investigate whether there are holistic behavioral patterns in the process data recorded during the drawing tasks that are specific for either high or low accuracy gains (pre-post differences). To achieve the goal of putting our findings into practice, one obvious field of application of the developed emotion drawing course is an adaptive learning application that analyzes a user's behavior to maximize learning success. The drawing data of a person can be obtained on the fly and the analysis can be performed directly on the device. However, the drawing tasks (which possibly also influence drawing behavior) then must be adjusted accordingly to match a user's individual learning needs. Ideally, we are able to train models that can predict how socio-emotional transfer effects can be fostered (in terms of which drawing tasks users perform and how they might be instructed to draw) from recorded drawing features without having to rely on other personal data and/or pretest scores of the respective users. For this to work, however, we must make sure that our findings generalize across different drawing tasks and different persons, such that a drawing feature model that is trained on data from a sample of previous users can also be applied for new users who never interacted with the system before. Given the result pattern, that adolescents in the emotion course in fact benefit from the appropriately designed drawing tasks purposely involving emotional faces (Kastner et al., 2021), yields the expectation that training the models with data from the use of this

Table 10
Overview of the Hypotheses Tested in the Present Study

Hypothesis 1 *Drawing Quality Hypothesis*	a) Correlation between prior knowledge and drawing quality > 0 b) Correlations between prior knowledge and learning outcomes (accuracy gains) > 0 c) Drawing quality mediates the correlation between prior knowledge and accuracy gains
Hypothesis 2 (a) *Generation* vs. (b) *Elaboration Depth Hypothesis*	a) Correlations (drawing features, accuracy gains): Intensifying drawing task = Transfer drawing task = Tracing drawing task b) Correlations (drawing features, accuracy gains): Intensifying drawing task = Transfer drawing task > Tracing drawing task
Hypothesis 3 (a) *Self-Reference* vs. (b) *Distraction Hypothesis*	a) Correlations (drawing features, accuracy gains): Selfie drawing task > Intensifying drawing task = Transfer drawing task = Tracing drawing task b) Correlations (drawing features, accuracy gains): Selfie drawing task < Intensifying drawing task = Transfer drawing task = Tracing drawing task

emotion course should allow the identification of predictive drawing patterns that can be exploited to achieve high classification precisions regarding high versus low accuracy gains. If this automatic classification of high and low learning gains based on the actual drawing behavior (in terms of drawing features) of a user is possible in an actual drawing context this could consequently be used to improve visual arts training as well as drawing apps in the future. Table 10 summarizes all hypotheses investigated in the current study.

5.2 Methods

5.2.1 Data Collection and Procedure

The data analyzed in the present paper were collected in the context of a larger study conducted in an art museum. In this study, we investigated specific transfer effects of three visual arts courses on different socio-emotional skills (Kastner et al., 2021). These three courses comprised the emotion course that is in the focus of the current paper together with a self-concept course and an epoch course. While the self-concept course was designed to support adolescents in developing a more complex self-concept, the epoch course focused on historical periods as a control condition. The three courses were offered within two data collection phases, in which two independent cohorts of participants were investigated. In both collection phases, the simultaneous offering of two courses for each participating school class enabled a randomization at the student-level.

In the first phase, participating school classes were randomly divided into two groups that were assigned to either the emotion or the epoch course, whereas in the second phase they were randomly assigned to the self-concept or the epoch course. However, in the second data collection phase, one more class was resampled for the comparison of the emotion and the epoch course. To avoid biases due to self-selection effects about the different courses (a main problem in previous studies) participants were not allowed to switch their randomly assigned courses. The courses were conducted by two museum educators, who were trained based on a detailed course manual (Kastner et al., 2020). Each of the three courses consisted of three course sessions, with each session lasting three hours. In Session 1, participants mainly acquired declarative knowledge on the course topic. In Sessions 2 and 3, the participants used this knowledge when drawing portraits and self-portraits on a tablet. In the following only the emotion course and its tasks are described in detail.

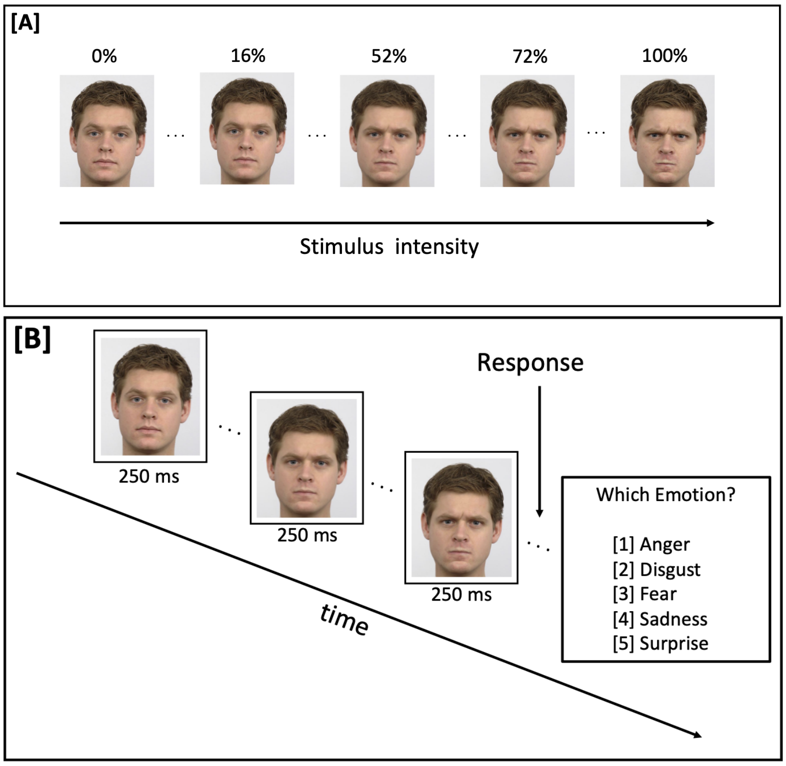
5.2.2 Materials

Emotion Recognition Task

To measure changes in the emotion recognition abilities over time we used a clinical paradigm before and after the course (Schönenberg et al., 2013). Measuring these abilities already beforehand not only allowed us to investigate individual learning gains as a dependent variable but we were also able to use the pre-scores of it as indicator of participants' procedural prior knowledge. To measure emotion recognition abilities, we presented standardized videos (based on digitalized color photographs) of five female and five male models selected from the Radboud Face Database (Langener et al., 2010) that slowly changed from neutral facial expressions (0 % emotional intensity) into full emotional expressions (100 % emotional intensity). The videos were created with the FantaMorph Software (Version 5.4.7; Abrosoft, Bejing, China) and consisted of 51 unique intensity levels (2 % incremental steps, each step was presented for 250 ms in a video) of the five emotions (anger, fear, sadness, disgust, surprise) for each of the 10 models. Each stimulus was presented only once in the pretest and once in the posttest in a randomized order to keep repetition effects low (Schönenberg et al., 2014). The emotion recognition task was presented on a tablet (Apple iPad Pro with a 12.9" integrated touchscreen). For stimulus presentation, data collection, and data decryption, the software Presentation (Version 20.0; Neurobehavioral Systems, USA) was used. Figure 16(A) shows a stimulus example developing from a neutral face (0 % emotional intensity) to a full emotion (i. e., anger, 100 % emotional intensity). Participants were instructed to press a button as quickly as they were able to identify the emotion. When they pressed the button, the video stopped immediately, the face disappeared, and in a multiple-choice manner the participants had to decide via a button press which one of the five emotions they had seen (Figure 16(B)). On average, the whole task took about 15 min.

Figure 16

(A) Example-Stimuli With Changing Emotion Intensity (Langener et al., 2010) and (B) Timeline for one Trial Used in the Emotion Recognition Task (Schönenberg et al., 2016)



Note. This figure of the emotion recognition task was already published in "Kulturelle Bildung. Theroretische Perspektiven, methodologische Herausforderungen und empirische Befunde" [Cultural Education: Theoretical perspectives, methodological difficulties, and empirical findings] by C. Timm, J. Costa, C. Kühn, & A. Scheunpflug, 2020, Waxmann, p. 231–246. doi: `https://doi.org/10.31244/9783830991502`. The stimuli presented in the emotion recognition task were selected from the Radboud Face Database (Langener et al., 2010).

Declarative Prior Knowledge

In addition to measuring procedural prior knowledge (in terms of participants' emotion recognition abilities that were assessed beforehand) we investigated individual differences between participants about their baseline abilities by recording their declarative prior knowledge about emotions. This test comprised 28 multiple-choice questions with four alternative answers, one of which was correct. An example item was "*Which emotional facial expression results in horizontal wrinkles on the forehead*? (a) *anger*, (b) *fear*, (c) *sadness*, (d) *disgust*", with the correct answer being "(b) *fear*".

5.2.3 Tablet Drawing, Drawing Quality, and Drawing Tasks

A central element of the emotion course is artistic drawing, which participants had to perform as digital drawing tasks on tablets. Each tablet was accompanied by a digital drawing pencil (Apple Pencil) that registers all drawing activities. An important advantage of digital drawing is the possibility to record process data during drawing. In the learning-by-drawing literature, it is often criticized that one rarely gets an insight into the underlying processes of drawing, often having access to only the “final product” of the drawing process. The use of tablets allows for recording the entire drawing process. Moreover, drawing on the tablet has been shown to be more fun than drawing on paper (Lorenzo & López, 2015), and additionally it might help to reduce anxiety that some participants experience in the context of art classes (see also, Hourcade et al., 2013). At the beginning of the course, each participant received a tablet (12.9” Apple iPad Pro) on which all drawing tasks, and measurements were presented. The drawing tasks were implemented within an iOS drawing application that has been developed for the purpose of this study (Strokey; Jaszkowic, 2018). Strokey allows for the presentation of predetermined pictures (templates) for drawing tasks as well as for the use of self-constructed pictures (selfies) as materials for drawing tasks (see Figure 17 for screenshots of the Strokey app). At the bottom of the screen, Strokey provides a toolbar containing several functions that participants could use while drawing or editing their drawings, including the selection of different pencils and colors, an eraser, zoom (enlarge/reduce elements of the drawing template), fade (hide the drawing template), and a cut-and-paste function. At the top margin of the page, participants could also use an undo function (instead of using the eraser). In total, during drawing and editing processes the following drawing features were continuously registered by the app for each drawing task:

- Time (in seconds) spent (*time pencil is on tablet*: *M*, *SD*, Min, Max).
- Number of strokes drawn (SUM).
- Number of corrections made (*erased strokes*, SUM).
- Amount of pressure exerted onto the tablet with the digital pencil (three variables):
    - Average amount of pressure exerted onto the tablet while drawing (*mean pressure*: $pressure_M$). This variable allows to identify different drawing patterns, such as drawing many thin lines with low pressure or only a few lines with strong pressure.
    - Variation in the amount of pressure exerted across different strokes (*standard deviation of the pressure*: $pressure_{SD}$).
    - Maximum pressure exerted on the tablet while drawing (*maximum pressure*: $pressure_{\text{MAX}}$). Minimum pressure is always zero

- Angle of the digital pencil (0-90 °) during drawing in relation to the tablet is called altitude and measured with four variables:
  - Mean angle of the digital pencil (*mean altitude*: *altitude*$_M$; for more information cf. Likforman-Sulem et al., 2017).
  - Variation in angle of the digital pencil across different strokes (*standard deviation of the altitude*: *altitude*$_{SD}$).
  - Minimum and maximum angles of the digital pencil (*minimum altitude*: *altitude*$_{\mathrm{MIN}}$; *maximum altitude*: *altitude*$_{\mathrm{MAX}}$).
- Number of tools (*eraser*, *cut-out function*, *zoom* and *fade functions*, SUM) used for drawing (*number of used tools*).
- Number of colors used for drawing (*number of used colors*, SUM).
- Number of times zoom-in or zoom-out was used (*zoom interactions*, SUM).
- Number of times fade-out or fade-in was used (*fade interactions*, SUM).

In the emotion course, participants used graphite pencils of different shades of gray (gray, dark gray, black, and white, see Figure 17 for an example page of the drawing material). This was done to prevent participants from conveying emotions through the selection of colors (as shown in a preliminary study; Kastner, 2017) instead of working out the facial expressions of emotion as taught in the course.

Drawing Quality

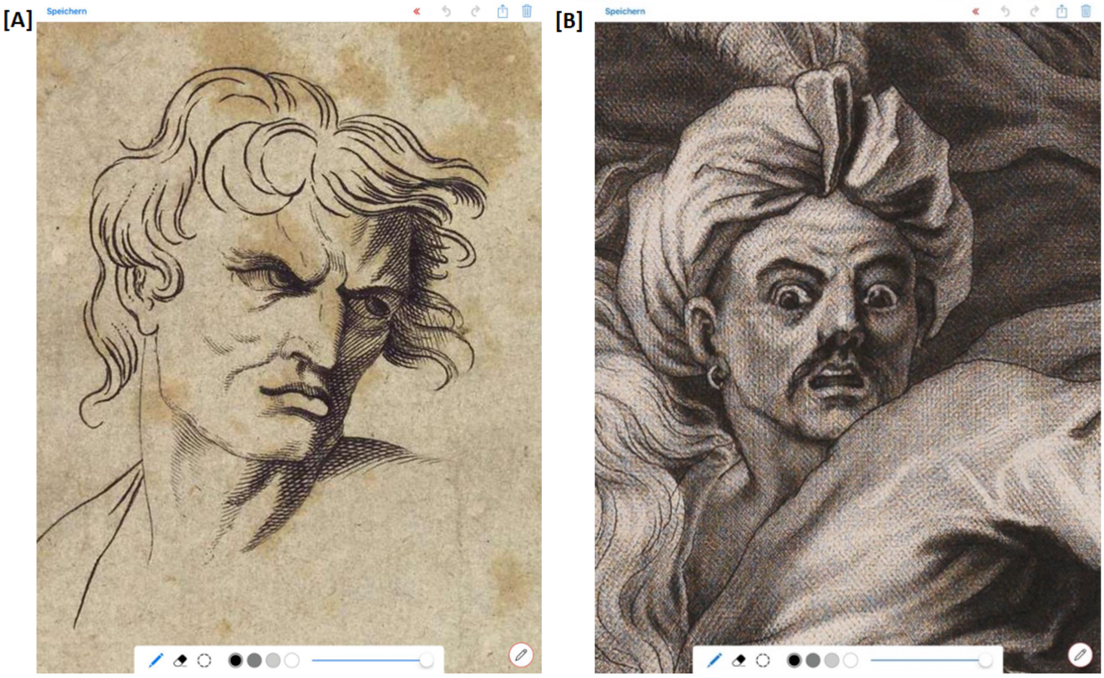
The drawing quality was evaluated for the emotion course with up to four points per emotion, considering whether the participants correctly drew the relevant emotional facial characteristics in the areas of forehead, eyebrows, eyes, and mouth. For the emotion anger, these four points were fulfilled if the adolescents drew the eyebrows pulled together, a vertical wrinkle between the eyebrows became visible on the forehead, the gaze was rigidly directed straight ahead, and the mouth was drawn either pinched together or wide open (screaming, see Figure 17(A) for anger). The emotion fear received four points if the adolescents drew horizontal wrinkles on the forehead, raised eyebrows, wide open eyes, and fear-distorted open mouth (as Figure 17(B) shows). For each of the four drawn areas, the adolescents received one point, so that a maximum of four points could be achieved per emotion, which were converted into percentages respectively (max. 100 % for each emotion).

Drawing Task

The drawing tasks used in this study started quite simple and systematically increased in difficulty to make participants feel confident about drawing on the tablet.

Figure 17

Sample Page of the Drawing Materials Presented in the Strokey Drawing App in the Emotion Course for [A] Anger[a] and [B] Fear[b]



Note. The toolbar is shown at the bottom of the page including all functions that were available (left to right): pencil, eraser, cut and paste, colors, and fade-out/in via pencil on the scroll bar. Also zoom-in/out was possible via finger gestures in the picture. Additional functions at the top of the page from left to right included save (speichern; top left), undo (one step or all steps), redo, share, and delete (top right of the page).
[a]G. Stein: *Representation of different emotional states.* Copperplate Engraving, Wolfenbüttel, Herzog August Bibliothek, Germany.
[b]Johann Elias Ridinger: *Asia.* Mezzotint, Braunschweig, Herzog Anton Ulrich-Museum, Germany.

Figure 18 provides an overview of all drawing tasks used in the emotion course. Before participants started with their actual drawing tasks, they were provided with a practice drawing task in which they could test the various options provided by the tablet (e. g., zooming or erasing). Subsequently to this short familiarization phase, the participants started with the easiest drawing task, *tracing*. This task was administered because it required mainly the generation of a drawing by means of recognizing and tracing important aspects (close observation and engagement) without a deeper elaboration. More concretely, participants in the tracing drawing task should draw two portraits displaying the emotions of "anger" and "fear". Participants had to trace these portraits with a focus on those aspects of the face that were most important for the recognition of the respective emotion (see Figure 18a, b). In the subsequent, more difficult drawing task, *intensifying*, participants were given an ambiguous portrait. Here, a more in-depth elaboration in terms of envisioning and reflecting elements of a drawing was required beyond close observation and engagement. In the emotion course, this meant that the emotion depicted was not as clearly identifiable as before (i. e., it could contain elements of fear or surprise, or elements of anger, sadness, or disgust). The participants' task was to manipulate the portrait by means of drawing in such a way that it would be clearly recognizable which emotion was shown in the graphic (in this case the target emotions fear and anger, see Figure 18c, d). There was also an even more difficult drawing task: *transfer*. In the transfer drawing task, participants had to draw facial expressions of emotions (fear and anger) based on a neutral emotional portrait of a person (Rembrandt: Self-portrait with beret. Etching and hand coloring, 1630, Braunschweig, Herzog Anton Ulrich-Museum, Germany; see Figure 18e). In the final drawing task, *selfie*, participants in the emotion course were asked to take a selfie of themselves looking a little "angry" or "fearful" (with approximately 50 % emotion intensity) and then to draw out the facial expression of the full emotions based on these selfies. As aforementioned, the main idea of the *selfie* drawing task was to create a deeper understanding of the learning material through self-reference (Mayer, 2005; Mayer & Fiorella, 2014; Schrader et al., 2018).

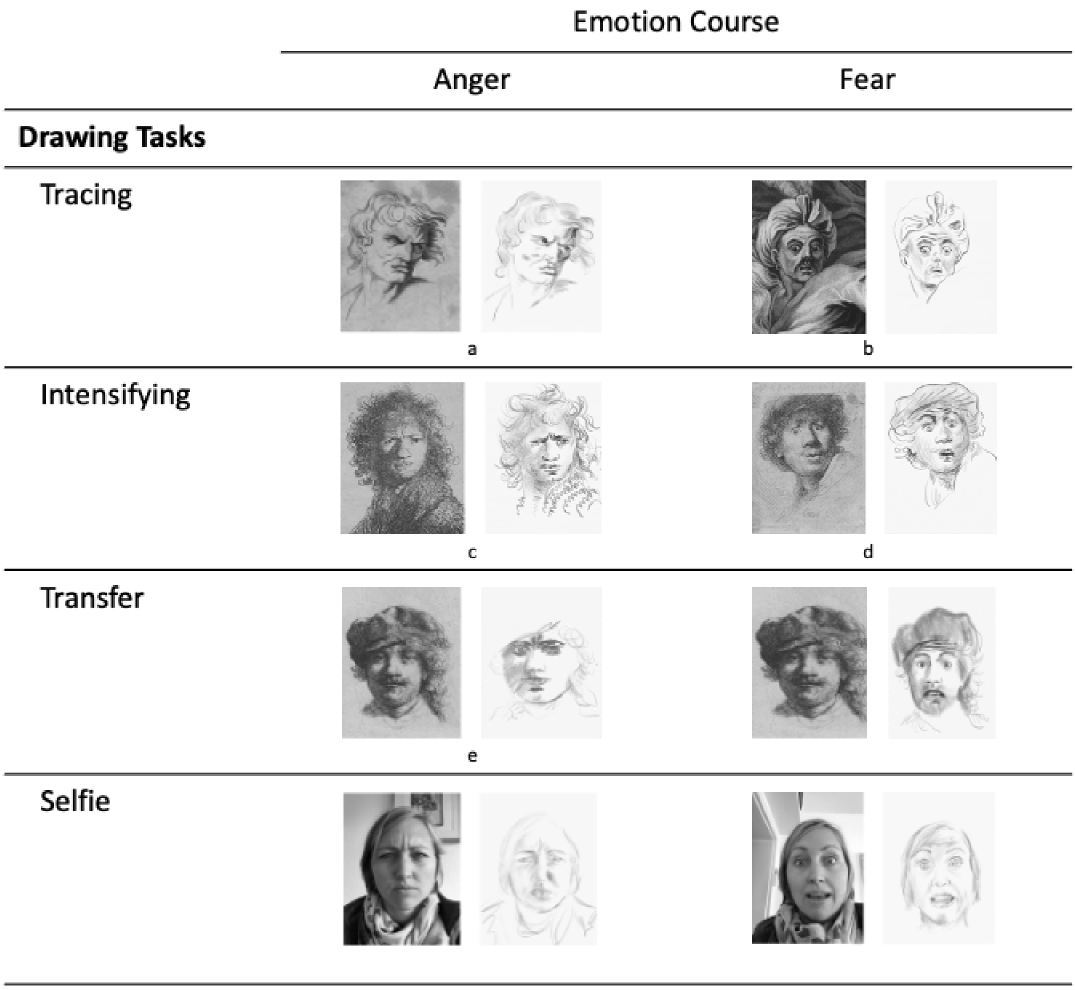
5.2.4 Analytic Approach

Data analyses were performed using the free software R (Version 4.0.3; R-Core-Team, 2020). In the emotion recognition task, we focused on the accuracy gains (pre-post comparison of percentage correctly recognized emotions), since Kastner and colleagues found specific effects on accuracy gains (Kastner et al., 2021). In the analyses, we included only participants who had completed both the pre- and posttest as well as the respective drawing tasks. Additionally, in a data-driven approach trials in the emotion recognition task with sensitivity $< 16\,\%$ or $> 98\,\%$ were not used and only participants who completed five or more pre- and posttest trials were included (for more information on the inclusion/exclusion criteria, see Kastner et al., 2021). To investigate the role of drawing activities on accuracy gains in greater detail and because in the emotion recognition task five emotions were used from which only two were drawn in all four drawing tasks, we distinguished the gains into two subsets: namely *drawn* emotions (anger, fear) versus *not-drawn* emotions (surprise, disgust, sadness).

Because the previous study (Kastner et al., 2021) found positive effects of the emotion course on emotion recognition abilities, we investigated in this paper how this effect can be explained based on additional data. From previous studies, it is known that generating accurate drawings requires sufficient declarative prior knowledge about the learning content itself and that drawing quality predicts learning outcomes (Schleinschok et al., 2017; Schmidgall et al., 2019). However, because Kastner et al. (2021) found effects on emotion recognition abilities, we were interested in the question whether the amount of declarative as well as procedural prior knowledge in terms of emotion recognition abilities that participants already possessed before taking the course influences accuracy gains. We addressed this by testing the influence of declarative and procedural

Figure 18

Overview Over the Drawing Tasks Used in the Emotion Course



[a]G. Stein: *Representation of different emotional states.* Copperplate Engraving, Wolfenbüttel, Herzog August Bibliothek, Germany.
[b]Johann Elias Ridinger: *Asia.* Mezzotint, Braunschweig, Herzog Anton Ulrich-Museum, Germany.
[c]Rembrandt: *Self-portrait with wrinkled forehead.* Etching, 1630, Braunschweig, Herzog Anton Ulrich-Museum, Germany.
[d]Rembrandt: *Self-portrait with cap, big eyes, and open mouth.* Etching and drypoint, 1630, Braunschweig, Herzog Anton Ulrich-Museum, Germany.
[e]Rembrandt: *Self-portrait with beret.* Etching and hand coloring, 1630, Braunschweig, Herzog Anton Ulrich-Museum, Germany.

prior knowledge on accuracy gains and additionally investigating the mediating role of drawing quality.

Besides that, we checked whether specific drawing activities (separately for the four drawing tasks) would be related to stronger accuracy gains. In particular, we analyzed parameters that addressed either the *drawing process* itself (e. g., time of pencil on tablet, number of strokes, number of erased strokes, pressure, altitude) or the *editing process*

(e. g., number of used colors, number of used tools, number of zoom interactions, number of fade interactions). Finally, to improve the generalizability of our correlational analyses, we used machine learning to predict high or low levels of accuracy gains. Therefore, we implemented a random forest classifier (Breiman, 2001; Ho, 1995) using Matlab (Version 7.11.2; Thompson & Shure, 1995) with the top and bottom 40 % of pre-post differences for drawn emotions) as class labels.

5.3 Results

5.3.1 Demographic Data

In the present study, we analyzed data from 47 adolescents (25 females, 22 males) who participated in all three course sessions of the emotion course (of the previous study, 11) and met our exclusion criteria (cf. methods section). Participants were aged between 12–18 years ($M_{\text{age}} = 14.26$, $SD_{\text{age}} = 1.71$) and in Grades 7 to 11 of secondary, comprehensive, and grammar schools in the school district of Braunschweig (central Germany). Before the study was conducted, all adolescents and their parents had to read and agree with a consent form. The study followed the guidelines for good scientific practice at the University of Tübingen (Germany) and the regional council of Braunschweig (Germany) and was approved by the local ethics committee.

5.3.2 The Potential Impact of Drawing Quality on Emotion Recognition Performance (*“Drawing Quality” Hypothesis*)

We expected (1) that students' declarative and procedural prior knowledge might be positively related to their drawing quality. Moreover, we expected (2) that drawing quality would be related to accuracy gains, particularly in the drawn emotions. Whereas there was no correlation between declarative prior knowledge with accuracy gains, $r(47) = -0.09$, $t(72) = -0.75$, $p = .457$ (all correlations can be found in Table 11), we found a significant correlation between procedural prior knowledge (accuracy pretest) and accuracy gains in procedural emotion recognition abilities, $r(47) = -0.45$, $t(72) = -4.23$, $p < .001$. However, this correlation was negative indicating that participants with lower pretest scores of emotion recognition abilities (procedural prior knowledge) particularly benefitted from the emotion course in terms of higher accuracy gains. Moreover, whereas we found a significant correlation between declarative prior knowledge and drawing quality, $r(47) = 0.26$, $t(92) = 2.60$, $p = .011$, there was no such significant correlation between procedural prior knowledge (accuracy pretest) and drawing quality, $r(47) = 0.17$, $t(84) = 1.58$, $p = .117$ (Hypothesis 1a). Furthermore, we did not find a significant correlation between drawing quality and the accuracy gains in emotion recognition abilities, $r(47) = -0.08$, $t(72) = -0.65$, $p = .515$ (Hypothesis 1c). This pattern of results does not speak in favor of Hypothesis 1 (“*Drawing Quality*” *Hypothesis*).

Table 11

Means, Standard Deviations, and Correlations for Drawing Quality, Procedural Prior Knowledge (Accuracy Pretest), Accuracy Gains, Declarative Prior Knowledge About Emotions and Declarative Knowledge About Emotions After Course Participation (Posttest)

	M	*SD*	1	2	3	4
Drawing quality	32.45	12.61				
Procedural prior knowledge (accuracy pretest)	60.89	25.54	0.17			
Accuracy gains	7.68	24.74	−0.08	-0.45^{***}		
Declarative prior knowledge$_{\text{emo}}$	51.44	14.18	0.26^{*}	0.22^{*}	−0.09	
Declarative knowledge$_{\text{emo}}$ posttest[a]	54.86	15.52	0.39^{***}	0.27^{*}	0.04	0.51^{***}

Note. $N = 47$ participants. The values of all variables (1-4) are given in percent (%). Emo = emotion course.
[a]Declarative knowledge about emotions after course participation (posttest).
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Actually, prior research postulated this connection particularly for drawing quality on declarative learning outcomes (Schmidgall et al., 2019). This prompted us to exploratively extend our correlational analyses with regard to declarative learning outcomes. Both declarative as well as procedural prior knowledge correlated significantly with the declarative knowledge posttest, (declarative: $r(47) = 0.51$, $t(92) = 5.63$, $p < .001$; procedural: $r(47) = 0.27$, $t(84) = 2.58$, $p = .012$). Moreover, we found in addition to the aforementioned significant correlation between declarative prior knowledge and drawing quality, $r(47) = 0.26$, $t(92) = 2.60$, $p = .011$, also a significant correlation between drawing quality and the declarative knowledge posttest, $r(47) = 0.39$, $t(92) = 4.08$, $p < .001$. In sum, the declarative knowledge posttest seems to be dependent on declarative (probably via a mediation of drawing quality) as well as procedural prior knowledge, whereas the procedural emotion recognition abilities did only depend on procedural prior knowledge but was in contrast to our Hypothesis 1 not affected by drawing quality.

To investigate the relations between drawing quality, declarative prior knowledge, procedural prior knowledge, and learning in terms of (procedural) accuracy gains and declarative knowledge in the posttest in greater detail, we used simple mediation analyses. In a first step (A), we analyzed whether declarative and procedural prior knowledge predicts accuracy gains and whether this direct path is mediated by drawing quality. Figure 19 shows the mediation analyses with the direct path from declarative prior knowledge (lower model) and procedural prior knowledge (accuracy pretest; upper model) to accuracy gains and the indirect paths with drawing quality as a potential mediator. For declarative prior knowledge, we found no significant direct effect on accuracy gains (c’ = –0.12, $p = .578$). Drawing quality was predicted by declarative prior knowledge (a = 0.35, $p = .001$), but drawing quality did not influence accuracy gains (b = -0.10,

$p = .677$). For procedural prior knowledge (accuracy pretest) we found a significant direct effect on accuracy gains (c' = –43.53, $p < .001$). However, when entering drawing quality as mediator into the model, accuracy pretest did not predict the drawing quality significantly (a = 10.47, $p = .075$), and in turn drawing quality did not influence the accuracy gains (b = 0.03, $p = .893$). Therefore, Hypothesis 1 addressing the impact of drawing quality on accuracy gains could not be confirmed.

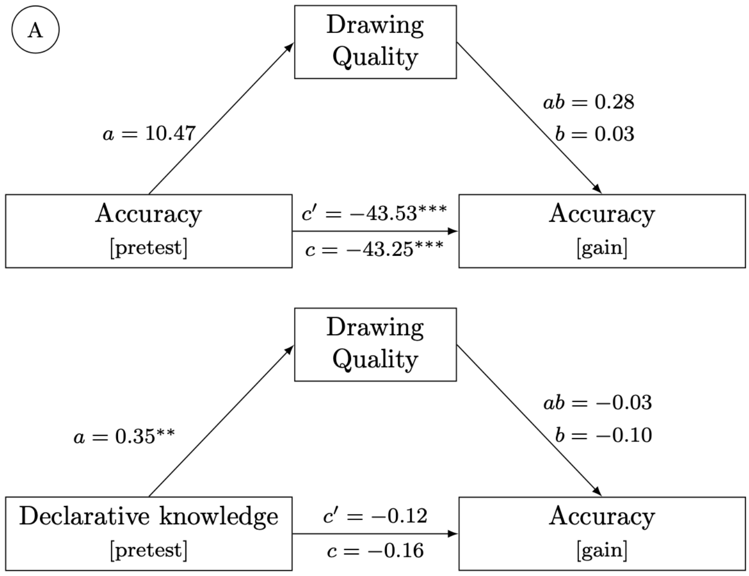
To further explore the role of drawing quality for learning outcomes in the emotion course, we exploratively analyzed in a second step (B) whether the declarative knowledge after course participation (posttest) can be predicted by declarative and procedural prior knowledge and whether these effects are mediated by drawing quality as indicated by previous learning-by-drawing literature (Ainsworth et al., 2011; Ainsworth & Scheiter, 2021; Cook, 2006; Cromley et al., 2020). We conducted the same analyses as for accuracy gains for the declarative knowledge about emotions after course participation (posttest). Figure 20 shows the mediation analyses with the direct path of declarative prior knowledge (lower model) and procedural prior knowledge (accuracy pretest, upper model) on the declarative knowledge posttest and drawing quality as a potential mediator (indirect path). In these analyses we found for declarative prior knowledge a significant direct effect on the declarative knowledge posttest (c' = 0.47, $p < .001$), as well as an indirect effect (ab = 0.08, $p = .043$): Declarative prior knowledge predicts drawing quality (a = 0.23, $p = .009$), and this in turn influences the declarative knowledge posttest (b = 0.34, $p = .001$). For procedural prior knowledge (accuracy pretest) we also found a direct effect the declarative posttest (c' = 13.01, $p = .032$). While drawing quality was not predicted by procedural prior knowledge (accuracy pretest, a = 8.51, $p = .109$), drawing quality had as aforementioned a significant influence on the declarative posttest (b = 0.44, $p < .001$). Thus, we did not find an indirect mediated effect of procedural prior knowledge (accuracy pretest) via drawing quality on declarative posttest. In sum, these findings point in the direction that drawing quality might in this content domain also be an important mediator for declarative learning, but that drawing quality is not relevant when it comes to the application of this knowledge in terms of (procedural) emotion recognition performance. Thus, these findings cannot explain the positive effect of the emotion drawing course on accuracy gains in emotion recognition abilities (Kastner et al., 2021). Therefore, we further addressed differences between the drawing tasks as well as the process features of the drawing activities.

5.3.3 How Drawing Tasks Influence Emotion Recognition Abilities (*"Generation" vs. "Elaboration Depth" Hypothesis*)

Hypothesis 2 is related to the drawing features underlying the *drawing process* (time pencil on tablet [*M*, *SD*, Min, Max], number of strokes [SUM], number of erased strokes [SUM], pressure [*M*, *SD*, Max], and altitude [*M*, *SD*, Min, Max]) or the *editing process*

Figure 19

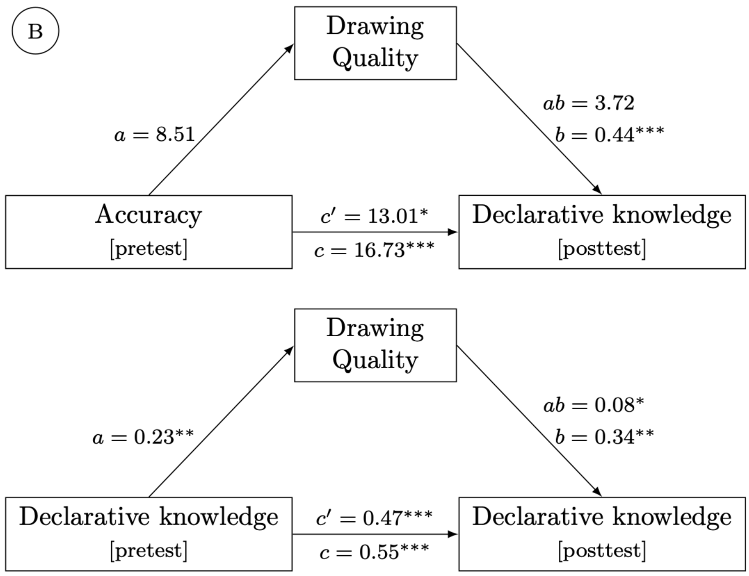
Mediation Analysis of the Direct and Indirect Effects of Procedural Prior Knowledge (Accuracy Pretest, Upper Model) and Declarative Prior Knowledge (Lower Model) on Accuracy Gains With Drawing Quality as a Potential Mediator



Note. $^{**}p < .01$. $^{***}p < .001$.

Figure 20

Mediation Analysis of the Direct and Indirect Effects of Procedural Prior Knowledge (Accuracy Pretest, Upper Model) and Declarative Prior Knowledge (Lower Model) on Declarative Knowledge About Emotions After Course Participation (Posttest) with Drawing Quality as a Potential Mediator



Note. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

(number of used colors [SUM], number of used tools [SUM], number of zoom interactions [SUM], and number of fade interactions [SUM]). The drawing features specified for describing drawing and editing processes were calculated using interactions averaged per image. To account for differences between the images per task (one for anger and one for fear), we used normalized differences from the respective per image means instead of absolute values. During scoring and evaluating the drawing quality, we detected differences between the two drawn emotions (anger, fear) in the drawing features used by participants (see Figure 21 showing drawings of three participants [1, 2, 3] for anger and fear). Although both emotions are negative with regard to their valence, anger is more activating, whereas fear is more deactivating. The examples in Figure 21 demonstrate that participants use the drawing features very differently for the two emotions: for anger more pressure and bold strokes were used, whereas for fear more fine lines and less pressure were used. These differences might not influence the drawing quality itself, but if participants use high pressure in one image and low pressure in the other, then potential correlations might cancel each other out. Because the two emotions also differ strongly in their social function (Marsh, Adams, et al., 2005; Marsh, Ambady, et al., 2005), we decided to analyze the correlations between the drawing features and accuracy gains separately for the two drawn emotions and the drawing tasks (cf. Table 12). In line with the literature (Schönenberg et al., 2016) fear had lower accuracy gains, which suggest that fear is more difficult to identify than anger.

We hypothesized that the drawing features might be in general (i. e., for all drawing tasks and both drawn emotions) related to the accuracy gains found in the emotion course as they might indicate appropriate drawing activities during the generative process (*Generation Hypothesis*). Alternatively, gains for the two drawn emotions might be more strongly related to the drawing features from more elaborative drawing tasks (i. e., intensifying and transfer drawing tasks) as these tasks require engagement in cognitive processes of deeper elaboration so that appropriate drawing activities in these tasks are more productive than in less elaborative drawing tasks (e. g., tracing drawing task; *Elaboration Depth Hypothesis*). To investigate which of these two alternative hypotheses is valid, we firstly analyzed the relation between the drawing features and accuracy gains for the drawn emotions in terms of correlations (see Table 12 for an overview; the full correlation matrices can be found in the supplementary materials, Tables S2.1–S2.8). Additionally, we analyzed how many correlations between accuracy gains and the drawing features could be found for the different drawing tasks and in which direction. We compared the correlations for tracing (for both emotions anger and fear) on the one hand and for the more elaborative intensifying and transfer drawing tasks (again for both emotions) on the other hand (cf. Table 12). We expected that if the generation of a drawing is the main contributing factor for positive transfer effects of drawing, then we should find similar correlation patterns between drawing features and accuracy gains for all drawing tasks irrespective of their elaboration depth (Hypothesis 2a). Alternatively, if drawing effects depend on the depth of processing stimulated by drawing, then the intensifying and the transfer drawing tasks should yield stronger patterns of correlation between process measures and accuracy gains than the tracing drawing task (Hypothesis 2b).

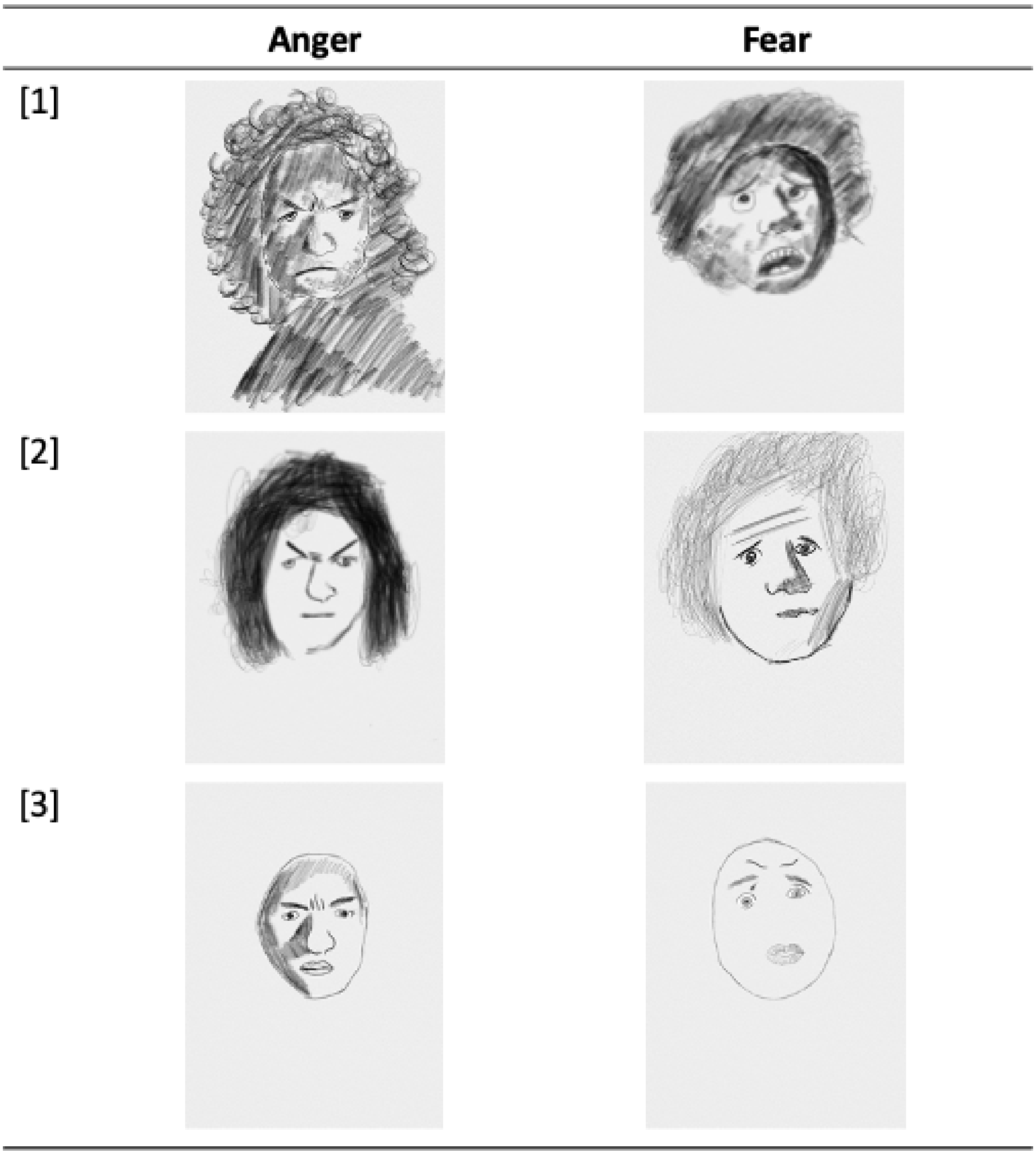
The descriptive analyses showed in accordance with the *Elaboration Depth Hypothesis* (Hypothesis 2b) that there were more correlations in the drawing tasks that require deeper processing (three correlations for intensifying and one correlation for transfer) than in the tracing drawing task (one correlation, see Table 12). However, the correlation patterns differed not only in the number of correlations found for the different tasks, but also for the different emotions as well as their respective directions. Of course, since we only analyzed the overall pattern of correlations, we can only evaluate Hypothesis 2 in a descriptive manner: We found more significant correlations between drawing features and accuracy gains in the intensifying drawing tasks, which required deeper elaboration processes as compared to the tracing drawing task (three versus one correlations). However, we did not find more significant correlations between the transfer drawing task, which theoretically also required deeper elaboration processes as compared to the tracing drawing task (one versus one correlation). This pattern is despite that it is rather weak, more in line with the assumption that appropriate drawing activities matter more in the more elaborative drawing tasks than in the just generative drawing task. Moreover, the correlations of drawing features with accuracy gains depended on which of the two emotions was drawn. For anger, we found (in sum over the four drawing tasks) six correlations between accuracy gains and drawing features (e. g., with time pencil on tablet$_M$, altitude$_{\text{MIN}}$, and number of fade interactions). For fear, we found three correlations between the accuracy gains and drawing features (e. g., with time pencil on tablet$_M$). Interestingly, the correlations indicated that appropriate drawing activities seem to substantially differ for the two emotions anger and fear. For instance, time pencil on tablets seems to be appropriate when drawing fear but not appropriate (or even detrimental) when drawing anger as indicated by positive versus negative correlations of this drawing feature with accuracy gains respectively for the two different emotions.

5.3.4 Is Self-Reference Beneficial or Distracting for Emotion Recognition Performance? (*"Self-Reference" Hypothesis* vs. *"Distraction" Hypothesis*)

Hypothesis 3a postulates that drawing selfies might stimulate self-reference effects resulting in a deeper elaboration of emotional facial expressions. Based on this assumption, participants are expected to benefit from drawing selfies. On the contrary, according to the alternative Hypothesis 3b, selfies might also turn out to be rather distracting in nature for adolescents, so that no deeper processing of emotional facial expressions and consequently no stronger improvements in emotion recognition abilities in terms of accuracy gains can be expected. As with Hypothesis 2, we can evaluate these assumptions in

Figure 21

Drawings of Anger and Fear in the Intensifying Drawing Task by Three Participants



only a descriptive manner based on the overall pattern of correlations without being able to infer causality. Based on Hypothesis 3a we would expect that engaging in appropriate drawing activities in the selfie drawing task should improve accuracy gains in an even stronger way than the intensifying and the transfer drawing tasks, whereas according to Hypothesis 3b we would not expect drawing selfies to be strongly correlated to the resulting and already shown socio-emotional transfer effects (Kastner et al., 2021).

The pattern of correlations found for the selfie drawing task is more in line with Hypothesis 3a than with Hypothesis 3b: Most importantly, in accordance with the *Self-Reference Hypothesis* (Hypothesis 3a) there is a higher number of correlations between drawing features and accuracy gains in the selfie drawing tasks (seven correlations, Table

12) than in the drawing tasks that require deeper processing (three correlations for intensifying and one correlation for transfer). Thus, self-reference seems to lead to deeper elaboration of emotional facial expressions instead of distracting adolescents from the emotional contents. Because the selfie drawing task can be also classified as an elaborative drawing task in line with the intensifying and the transfer drawing task this result pattern also speaks in favor of Hypothesis 2b that these elaborative drawing tasks (selfie, intensifying, transfer) are more strongly related to course outcomes than the merely reproductive tracing drawing task (seven, three, and one versus one correlation(s) respectively). However as mentioned above, the main challenge of addressing Hypothesis 2 and 3 by looking at the correlations between drawing features and accuracy gains, is that correlations do not provide information about causality. Moreover, the correlations also differed between the two analyzed emotions anger and fear. To get more robust results and gain additional insights, we used an exploratory machine learning approach to predict emotion recognition performance (in terms of accuracy gains) from the drawing data.

Table 12

Correlations Between the Drawn Emotions Anger and Fear and the Process Variables for the Four Drawing Tasks

	Tracing Drawing		**Intensifying Drawing Task**		**Transfer Drawing Task**		**Selfie Drawing Task**	
Accuracy gains								
	Anger	*Fear*	*Anger*	*Fear*	*Anger*	*Fear*	*Anger*	*Fear*
Time pencil on tablet$_{\text{Mean}}$	0.46*	0.08	0.10	0.20	0.16	0.12	0.54**	0.50*
Time pencil on tablet$_{SD}$	0.26	−0.06	−0.15	−0.05	0.05	0.02	0.52**	0.41*
Time pencil on tablet$_{\text{Min}}$	0.03	0.14	0.27	0.03	−0.29	0.33	0.48*	0.19
Time pencil on tablet$_{\text{Max}}$	0.10	−0.22	−0.24	−0.27	−0.19	0.13	0.27	0.16
Number of strokes$_{\text{SUM}}$	−0.29	0.05	0.09	0.01	−0.28	0.1	−0.21	−0.30
Number of erased strokes$_{\text{SUM}}$	0.11	0.07	−0.33	−0.03	0.17	0.17	0.10	−0.02
Pressure$_{\text{Mean}}$	−0.05	0.11	0.12	−0.01	0.11	−0.06	0.57**	0.34
Pressure$_{SD}$	−0.38	0.00	−0.22	−0.30	−0.24	−0.21	0.29	0.17
Pressure$_{\text{Max}}$	−0.13	0.02	−0.02	−0.02	−0.03	0.12	0.25	0.16
Altitude$_{\text{Mean}}$	−0.14	0.17	−0.06	−0.06	−0.17	−0.03	0.12	0.00
Altitude$_{SD}$	−0.32	−0.35	−0.47*	−0.48*	−0.45*	−0.29	−0.37	−0.04
Altitude$_{\text{Min}}$	0.19	0.38	0.45*	0.15	0.15	0.27	0.43*	0.40
Altitude$_{\text{Max}}$	−0.32	0.05	−0.23	−0.36	−0.01	−0.17	0.17	0.15
Number of used colors$_{\text{SUM}}$	0.05	0.05	−0.04	0.27	0.09	0.06	−0.07	0.03
Number of used tools$_{\text{SUM}}$	0.15	−0.22	0.17	0.18	0.21	0.13	0.39	−0.09
Zoom interactions$_{\text{SUM}}$	0.03	−0.03	0.06	0.18	0.01	0.03	0.02	−0.11
Fade interactions$_{\text{SUM}}$	−0.09	−0.18	−0.13	−0.06	−0.12	−0.13	−0.07	0.10

Note. $N = 33$ participants in each drawing task (with exception of the selfie drawing task: $N = 32$). * $p < .05$. $^{**}p < .01$. $^{***}p < .001$.

5.3.5 Exploratory Analysis: A Machine Learning Approach to Predict Emotion Recognition Performance From Drawing Data

In addition to analyzing the recorded process measures separately with regard to their relation to accuracy gains, we conducted a more holistic exploratory analysis based on a machine learning approach to assess the ability of the used models to generalize for unseen data. Although we found in the correlational analyzes differences between the drawing features for different drawing tasks and different emotions, we now want to have a look at the bigger picture and investigate which patterns are robust across multiple tasks and hold sufficient predictive power to support a practically relevant machine learning model. The basic idea of this approach is to go beyond individual correlations between drawing features and accuracy gains in emotion recognition performance by training a supervised machine learning algorithm to identify complex patterns of drawing behavior that can robustly predict high (or low) improvements in emotion recognition performance. This approach allows to quantify the importance of different drawing features when all features are considered simultaneously. Our goal is to train models that can predict socio-emotional transfer effects (in terms of accuracy gains) from recorded process data without having to rely on other personal data and/or pretest scores. From a more applied perspective, a model which would be able to reliably predict such effects from ongoing drawing patterns alone could, for instance, be used for designing adaptive drawing environments that change drawing tasks or provide specific advice depending on the way a user approaches the drawing tasks or interacts with the visual interface elements.

For the analysis, we implemented a random forests classifier (Breiman, 2001; Ho, 1995) using Matlab (Thompson & Shure, 1995) with high and low pre-post differences for drawn emotions as class labels. Random forests are an ensemble learning method which uses a multitude of weak learners (in this case decision trees) to create a strong combined predictor. We opted for this method since random forests allow for interpretable models, are robust to the inclusion of irrelevant features, and can be trained with a comparatively low number of data points. We used a grid search approach to find the number of decision trees in the ensemble that yielded the best trade-off between model complexity and performance. The models were then evaluated using ten-fold cross validation (using a common 80/10/10 split for training, validation, and test sets). This process was repeated ten times for each classification task. The reported classification errors are the means of all iterations. As for the partitioning of the pre-post differences into high and low classes, we opted for a data split using the top and bottom 40 % of data points. This ensures that the two classes are well separable due to the resulting margin between the binarized class labels without losing too many data points (i. e., 20 % of the available samples) for model generation.

Drawing features were calculated using interactions averaged per image. To account for differences between images, we again used normalized differences. Although we found differences in the drawing features between *tracing*, *intensifying*, *transfer*, and *selfie* drawing tasks, we used process data from all images of the corresponding emotion regardless of the task as separate data points for a comprehensive model. Naturally, the variance introduced by this heterogeneity of the tasks is detrimental for classification precision. Nevertheless, this is necessary for two reasons: 1) It increases the number of data points per model, thus increasing robustness across multiple evaluation runs. 2) Using data from different tasks for a holistic model emulates the general conditions of the envisioned application scenario of an adaptive drawing environment that provides feedback across multiple tasks. Task differences can also be offset by using differences to the respective task means as features which effectively removes some of the between-task variability.

To train our models, we deployed the same drawing features for the machine learning approach that we already reported in the correlation analyses. Using data from a total of 316 data points (data from *tracing*, *transfer*, and *selfie* drawing tasks), mean classification precision was 65.44 % for accuracy gains. We found that a large percentage of the classification errors were due to the high variances in the training data. Therefore, gradually increasing the number of training samples used for training a model yielded more stable hyperparameters across multiple runs on the one hand, and lower generalization errors on the other hand. We expect classification of accuracy gains to improve with additional data, especially because the above results were generated with unified data across heterogeneous tasks (*tracing*, *transfer*, *intensifying*, and *selfie* drawing tasks) with potential task differences being prone to having a pronounced negative impact on overall classification precision. Although our current database does not allow for classification precision that could be considered sufficient for an immediate application in an adaptive drawing app, we anticipate that a significantly larger set of recorded drawing data might well enable such applications.

Since our correlational analyses suggest that appropriate drawing activities for improving the emotion recognition abilities for anger and fear might differ substantially, we assumed that models trained to predict gains in anger and fear recognition separately should outperform the combined models reported so far. Following this line of reasoning, we also trained two separate models for anger and fear to predict high versus low accuracy gains. We found that accuracy gains classification benefited from the separate predictions of the two emotions: The classification precision using only fear recognition trials improved by 9.82 % (75.26 % mean classification precision as compared to 65.44 % for combined models). The classification precision for anger improved by 5.11 % (70.55 % mean classification precision). It should also be noted that these results could be achieved with a significantly smaller dataset since only images of the corresponding emotions were incorporated. These findings confirm that effects on recognizing anger and fear should be investigated separately.

We can further dissect our findings and investigate the nature of the underlying drawing patterns by inspecting the isolated impact that individual drawing features have on classification precision. To do so, we calculated feature importance ratings using random permutations of feature values and measuring the resulting degradation of classification precision. As most features of certain feature groups (e. g., pressure- or altitude-related features) are highly correlated, we permuted feature groups instead of single features, such that unpermuted similar features would not counterbalance the permutations. As feature groups we defined *Timing* (time pencil on tablet [*M*, *SD*, Min, and Max] of time on tablet per stroke), *Number of Strokes* (number of strokes [SUM], number of erased strokes [SUM]), *Pressure* [*M*, *SD*, and Max], *Altitude* [*M*, *SD*, Min, and Max], *Used Tools* (number of used colors [SUM] and tools [SUM]), and *Zooms & Fades* (number of zoom [SUM] and fade interactions [SUM]). Feature importance values for the anger and fear classification models above can be found in Table 13. As feature importance values were calculated by subtracting classification errors of the unaltered models from those with permuted feature values, a value of zero means that the performance was not degraded and thus the feature group did not contribute to the classification at all. The higher the importance value, the more the respective model relied on a feature group (with the upper bound being the original classification precision or, in practice, the original classification precision minus chance level). A negative value means that a feature group was even detrimental to model performance. Table 13 shows that the anger and fear models have some major differences regarding the features they rely on most heavily for classification. In particular, the accuracy gains models diverge for anger and fear: the highest feature importance value for anger are the *Timing* related features with 9.06 with all other features being below 2, whereas *Pressure* is by far the most important feature group for fear with a value of 10.11. These differences between anger and fear models suggest that even though we were able to find robust patterns across tasks that enable classification of high and low gains for unseen data, the drawn emotion is a pivotal factor for what these patterns look like on a feature level.

Summarizing our machine learning analyses, we could show that drawing data contain enough predictive power to classify accuracy gains well above chance level on unseen data. Classification of accuracy gains based on the different emotions in terms of distinct anger and fear trials exceed 70 % mean classification precision (70.55 % and 75.26 % respectively). Thus, we do consider our models to be already fit for immediate application with the present database even though practical implementations in an adaptive drawing environment would certainly require substantially larger numbers of data points. Nevertheless, our analyses revealed patterns in drawing that are robust across multiple tasks. In general, models trained with specific drawn emotions outperform aggregated models, which is in line with exploratory results of our correlative analyses. On the

Table 13
Feature Importance Values for Different Classification Models (Higher Means More Important for Classification Precision)

	Emotion	
Feature group	Anger	Fear
Timing	9.06	1.58
Number of Strokes	1.94	-0.21
Pressure	1.83	10.11
Altitude	0.06	0.16
Used Tools	0.11	1.42
Zooms & Fades	-0.11	2.79

drawing feature level, we found diverging patterns for anger and fear models: Timing appears to be of particular importance for classifying anger, whereas pressure appears to be of particular importance for classifying fear. The differences between anger and fear models furthermore confirm that drawing features are affected by the subject matter of a drawing task and our results suggest that it is advisable to model different themes separately.

5.4 Discussion

In this study, we investigated how the positive effects of artistic drawing in an emotion course (Kastner et al., 2021) on emotion recognition abilities might depend on the personal prerequisites in terms of prior knowledge and drawing skills that individuals bring to the drawing situation, appropriately designed drawing tasks and the detailed characteristics of the drawing processes (drawing features) in an art museum context. More specifically, we addressed three central hypotheses which focused on (1) the influence of drawing quality, (2) the role of generation versus elaboration depth in drawing, and (3) the role of self-reference versus distraction when drawing portraits based on selfies. For developing appropriate drawing tasks, we combined ideas from the learning-by-drawing literature (Ainsworth et al., 2011; Ainsworth & Scheiter, 2021; Cook, 2006; Cromley et al., 2020) with art-specific mechanisms elaborated in the studio habits of mind framework (Hetland et al., 2013). Both approaches specify important motivational and cognitive aspects of drawing that were used to develop an integrated digital portrait drawing course specifically focusing on emotions at the art museum in a randomized field trial. Furthermore, we implemented a machine learning approach to predict emotion recognition performance from drawing data.

5.4.1 How is Drawing Quality Related to Transfer Effects?

With regard to Hypothesis 1 (*Drawing Quality Hypothesis*) addressing the issue of whether drawing quality might have an impact on individual's emotion recognition abilities, the learning-by-drawing literature suggests that a sufficient level of declarative prior knowledge might be crucial for the resulting drawing quality, which, in turn, might be predictive for (declarative) learning outcomes (Fiorella & Mayer, 2016; Leutner & Schmeck, 2014; Van Meter et al., 2006; Van Meter & Firetto, 2013). The theoretical rationale behind these relations is that declarative prior knowledge has a decisive influence on the active selection, organization, and integration of verbal and visuospatial information, and is thus a critical component in the creation of a coherent mental representation of learning contents (Ainsworth, 2006; Mayer & Fiorella, 2012; Paivio, 1990; Schnotz, 2014; Sweller, 1994; Sweller, 2005; Wittrock, 1992, 1994). Such a coherent representation will, in turn, be required to create high-quality drawings that can be seen as externalizations of this mental representation and allow for further elaboration and refinement. We extended this reasoning by both investigating in addition procedural prior knowledge as well as accuracy gains in emotion recognition abilities as indicator of procedural learning outcomes. These extensions were necessary due to the overall goal of testing possible explanations of the previously found positive socio-emotional transfer effects of the emotion course on emotion recognition abilities (Kastner et al., 2021). Accordingly, we assumed that adolescents' declarative as well as procedural prior knowledge on emotional facial expressions might be positively linked to the quality of their emotional portrait drawings. We additionally investigated whether the drawing quality is linked to the accuracy gains in emotion recognition abilities as indicator of procedural knowledge. Moreover, we exploratively analyzed this regarding the performance in a declarative knowledge posttest.

In line with previous literature (Mayer, 2005; Mayer & Fiorella, 2014; Schrader et al., 2018; Van Meter & Firetto, 2013), we found a significant relationship between declarative prior knowledge and drawing quality (Hypothesis 1a), which could be interpreted as partly supporting the *Drawing Quality Hypothesis*. However, procedural prior knowledge was not related to drawing quality (speaking against Hypothesis 1a). Moreover, drawing quality was not related to accuracy gains in emotion recognition abilities and there was no mediating role of drawing quality on emotion recognition abilities (speaking against Hypothesis 1c). This is not surprising, as declarative prior knowledge was not directly related to accuracy gains in emotion recognition performance, whereas accuracy gains depended (negatively) on procedural prior knowledge (speaking against Hypothesis 1b). This negative correlation indicated that adolescents with lower pretest levels of emotion recognition abilities (i. e., their procedural prior knowledge) particularly benefitted from the emotion course in terms of higher accuracy gains. This might be the case due to individuals' lower entry levels in accuracy pretests generally might have "more room for improvement" and therefore a better chance of an increased performance in the posttest. Moreover, practicing the analysis of emotional faces in the course might help to alleviate a potential lack of procedural knowledge that might underlie lower entry levels in emotion recognition abilities. Finally, we conducted an exploratory analysis for the effects of declarative as well as procedural prior knowledge on the declarative knowledge about emotions after the course showing that both declarative as well as procedural prior knowledge are positively related to declarative learning outcomes. However, only the effect of declarative prior knowledge on declarative learning outcomes is (partly) mediated by drawing quality. This is completely in line with the findings of the learning-by-drawing literature obtained for declarative knowledge in science domains and could be shown likewise in this socio-emotional domain.

Taken together, these results suggest that the emotion recognition task and the declarative knowledge posttest about emotions measure two rather different kinds of knowledge. Whereas the emotion recognition task addresses the objective abilities to correctly recognize an emotional facial expression in practice (procedural knowledge related to a perceptual skill), the posttest questionnaire about emotions measures the explicit and verbal knowledge about characteristic elements of the facial expression of emotions (declarative knowledge; for an overview of the two kinds of knowledge, see ten Berge & van Hezewijk, 1999). The results indicate that appropriate drawings based on already existing and accurate declarative internal representations can help to further develop this declarative knowledge about emotions (e. g., knowing how the facial expression of the emotion anger explicitly looks) but has no effect on the procedural skill of recognizing emotions correctly (Ainsworth & Scheiter, 2021; Scheiter et al., 2017; Schmidgall et al., 2019). This distinction between declarative and procedural knowledge about faces is in line with other research findings on portrait drawing and face processing. For example, a typical error in portrait drawing is to place the eyes too high on the face, which is commonly referred to as the squashed skull effect (Edwards, 1999). Even trained portrait artists must explicitly learn to divide the face into the correct proportions (Balas & Sinha, 2008). Accordingly, inexperienced drawers who do not know the rules of drawing a face correctly usually produce rather poor portrait drawings, although they might perform well on facial recognition tasks addressing the same facial characteristics they got wrong in their drawings. This is in accordance with our findings that the quality of adolescents' drawings was relatively low, although the adolescents achieved good results in the emotion recognition task. This might also explain the lacking correlation between drawing quality and accuracy gains found in our study (Balas et al., 2018).

5.4.2 How is Drawing Process Itself Related to Transfer Effects?

As we found that the quality of the drawings crafted in the emotion course was not correlated to the resulting transfer effects in terms of accuracy gains (Hypothesis 1) we went one step further to investigate the drawing processes themselves over time. In particular, we analyzed numerous aspects of participants' drawing and editing processes with regard to how they correlate with the resulting transfer effects. Our rationale for this analysis was that correlations between drawing features such as the number and timing of strokes or the variance in pressure or altitude on the one hand and course effects on the other hand might indicate that these drawing processes are important for course outcomes. In other words, if the drawing tasks are important ingredients of the courses that are at least partially responsible for the resulting accuracy gains and if engaging in appropriate drawing activities during these tasks is relevant for rendering the drawing tasks effective in promoting the envisioned transfer effects, then substantial correlations between numerous characteristics of the drawing process and the resulting transfer effects are to be expected. If, on the other hand, the drawing processes are not crucial for the course effects, then variations in how these drawing tasks are accomplished should not matter much for course outcomes so that no strong correlations between drawing characteristics and course outcomes are to be expected. Therefore, to test Hypothesis 2 we analyzed the number of substantial correlations that could be identified for the different drawing tasks. In a first step, we tested Hypothesis 2a (*Generation Hypothesis*) claiming that the mere generation of a drawing irrespective of the associated elaboration depth (incorporated in the respective drawing tasks) might support the envisioned transfer effects because the generation of a drawing always involves close observation and engagement, which might be crucial aspects for the learning contents of the emotion course. An alternative Hypothesis 2b (*Elaboration Depth Hypothesis*) claims that only drawing tasks with a high level of elaboration depth provided by envisioning and reflecting elements in drawings might support the envisioned transfer effects. If Hypothesis 2b is true, then drawing features in the intensifying and transfer (and the selfie) drawing tasks should show strong correlations with course outcomes because these tasks require high levels of envisioning and reflection. Whereas in the intensifying drawing task the adolescents were asked to convert faces that displayed an emotion (about 50 % emotional intensity) into a full emotion (100 % emotional intensity), in the transfer drawing task the adolescents were given a neutral face (0 % emotional intensity) that was then to be converted into an emotional one (best case outlook 100 % emotional intensity). If, however, Hypothesis 2a is true, then the number of substantial correlations should not differ between these two tasks and the tracing drawing task, which does require close observation and engagement but no deeper processes of elaboration.

Our descriptive results are more in line with the *Elaboration Depth Hypothesis* in that we could identify more correlations of accuracy gains and drawing features in the intensifying drawing task (as well as in the selfie drawing task, see also below, but not in the transfer drawing task) as compared to the tracing drawing task. Therefore, it seems that the details of the drawing activities participants engaged in are substantially more important in the more elaborative drawing tasks than in the easier tracing drawing task. It must be noted that the transfer drawing task failed to show more correlations than the tracing drawing task. This might be the case because participants did not develop a deeper engagement in this transfer drawing task because it might have been too difficult for participants to throw a bridge from a neutral picture with 0 % emotional intensity to a full emotion with at best 100 % emotion intensity (cf. the overall quality of adolescents' drawings).

We conducted the same type of analysis with the selfie drawing task that involves even stronger self-reference elements than the other drawing tasks. Here, we wanted to test whether the self-reference of a drawing task influences the role of the drawing patterns for the resulting course outcome (Hypothesis 3). We hypothesized either that self-reference could lead to a deeper elaboration of emotional facial expressions (Hypothesis 3a; *Self-Reference Hypothesis*) or that drawing selfies might turn out to be rather distracting for adolescents so that they do not stimulate a deeper processing of emotional facial expressions (Hypothesis 3b; *Distraction Hypothesis*). In the former case but not in the latter case selfie drawing might be important for the course effects on emotion recognition abilities, which we tried to detect by analyzing the correlations between course effects and characteristics of the selfie drawing process. The pattern of correlations found for the selfie drawing task is rather more in line with Hypothesis 3a than Hypothesis 3b. We found seven-fold more correlations for the selfie drawing than in the tracing drawing task. For both emotions, anger and fear, longer times of pencil on paper were positively correlated with accuracy gains. Therefore, generating drawings based on one's own face seem to be an appropriate task to train emotion recognition abilities. The longer participants engaged with their own facial emotional expressions during the visual arts course in terms of selfies, the better might be their emotion recognition abilities. This finding is in accordance with the personalization principle (Mayer, 2005, 2014) in which a deeper processing is stimulated by words that establish a reference to one's own person. Although, the studies substantiating the personalization principle according refer to a verbal and not a visual self-reference, we could demonstrate the self-reference effect by means of selfies. Contrary, it cannot be assumed that selfies have a high potential to distract participants from the focus of the course on emotional facial expressions as participants' attention might have been caught by other facial aspects (e. g., by pimples, hair, etc., which are not related to emotion recognition). At this point, however, it should be emphasized again that the data are correlational in nature and, therefore, do not necessarily indicate causality. Thus, the interpretations that we offer should only be seen as possible theoretical explanations of the correlational pattern obtained.

5.4.3 Do Process Data Hold Predictive Power Regarding Accuracy Gains?

Going beyond the analysis of single correlations between drawing features and accuracy gains, we also conducted an exploratory analysis based on a machine learning approach to address the overall potential of using interaction patterns associated with improvements in emotion recognition for the prediction of course outcomes. We trained random forest classifiers with drawing features from the emotion course. Using all drawn images as separate trials with all 17 features from the correlational analyses, we trained models for the classification of the upper versus the lower 40 % of participants in terms of their accuracy gains in emotion recognition abilities. In line with our correlational analyses, we found that classifications on the emotion course data can be improved by modelling the gains for the two drawn emotions anger and fear separately due to their distinctive correlations with drawing features. This approach yielded classification precision of over 70 % for both emotions about their accuracy gains. Thus, the course effects for emotion recognition abilities of fear and anger are definitively reflected by distinguishable interaction patterns.

In sum, results show that it is possible to predict the accuracy gains in the emotion course based on drawing features obtained in this course to a considerable degree (approximately 70 % correct classification). This result is interesting not only regarding the theoretical issues addressed in this study, but potentially also for future practical applications, such as adaptive drawing environments that provide feedback about the appropriateness of certain drawing activities in the context of specific course programs. Inspecting the feature importance values of the above-mentioned specific models in greater detail yielded, that features related to timing as well as pressure appear to hold the most predictive power for anger and fear respectively. The machine learning results indicate that the different models for the classification of anger and fear recognition do rely on different types of drawing features. These results should be considered together with the results from the correlational analyses, as they together provide information about (a) which drawing features might be particularly suited to predict accuracy gains, (b) in which direction these features might predict accuracy gains, and (c) for which of the individual drawing tasks these relations might be most pronounced. Moreover, adding a machine learning approach to correlational analyses also helps to avoid overfitting and helps to examine the robustness of the relations found due to the implementation of cross-validation procedures.

5.4.4 Strengths and Future Directions

In this study we investigated potential influencing factors that might account for the positive effects of a visual arts course focusing on emotions on the acquisition of socio-emotional skills, particularly emotion recognition abilities, in an art museum context. Our results provided correlational evidence for the important role of the drawing tasks that were embedded in this emotion course. However, there are of course certain limitations of our study that need to be addressed by future research. First, the specific effects of the emotion course were compound effects of the complete three sessions of the course that lasted for 9 hours in total. Therefore, it remains unclear which individual or combined elements of the emotion course might have led to the specific effects of the course that we found for socio-emotional skills such as emotion recognition. In particular, we have only indirect evidence for the role of the artistic drawing activities embedded in the course. For instance, although we know that specific drawing features such as patterns of pen usage (e. g., pressure, timing) were highly correlated with course outcomes and could be used for robust outcome predictions based on machine learning algorithms, we have no conclusive evidence for a causal relationship between the different drawing tasks and drawing activities on the one hand and the accuracy gains on the other. This is due to the fact that although causal relations imply correlations, the opposite is not true. For instance, we know from the mediation analysis we conducted that drawing quality is only related to declarative pre- and posttests as a mediator between these two tests and is not related to accuracy gains, neither in terms of accuracy pretest nor in terms of accuracy gains. Therefore, a causal role of accuracy pretest for drawing quality as well as a causal role of drawing quality for accuracy gains can be ruled out due to a lack of correlation. On the other hand, a causal link from declarative prior knowledge via drawing quality to the declarative knowledge posttest remains a plausible interpretation of the correlations but cannot be proven by correlations alone. Rather, this would require experimental manipulations of declarative prior knowledge and drawing quality. Therefore, for exploring the causal roles of drawing tasks in greater detail, future studies should experimentally manipulate them based on the findings obtained in this study. For instance, we would expect that a course that replaces drawing activities with less active practices (e. g., analyzing the emotions in art works) would also be less effective than a course with drawing activities. Moreover, we would expect from our results that a course comprising drawing activities with more relevant *studio habits of mind* involved (e. g., *intensifying* drawing tasks) should be more effective than a course comprising only simpler drawing activities (e. g., *tracing* drawing task). Even more subtle, we would expect that instructing participants to adopt drawing activities that are in line with drawing features predictive for high levels of accuracy gains for specific emotions should be more effective than instructing them to adopt “the wrong” drawing activities for these emotions. In the context of these studies, also the effects for not-drawn emotions should be investigated more closely as it is still unclear whether our effect for not-drawn emotion can be interpreted as a transfer effect of the drawn emotions to the not-drawn emotions or whether the individual declarative prior knowledge about emotions was already sufficient to achieve an improvement in the not-drawn emotions.

Second, we do not know for sure whether similar course effects would be found when students engage in studying and drawing non-artistic portraits based on photos form magazines or yearbooks, for instance. In other words, we have not tested directly for the role of the authentic art context yet. However, it might well be that studying and drawing photos from a magazine does not lead to the same improvements to emotion recognition abilities as engaging with visual arts, due to the uniqueness of the engagement with visual arts beyond just looking at a photo. Similarly, we do not know how important the authentic art museum context might have been for the course effects. Based on research on the perception of authentic objects in museums and exhibitions we can assume that the museum context might play an important role in the acquisition of knowledge (Schwan & Dutz, 2020). However, the role of the authentic art and museum contexts remains an issue for future experimental investigations.

Third, to further extend the machine learning approach used in this study to analyze drawing activities in greater detail, larger data sets would be required so that also predictive patterns for specific drawing tasks and/or subgroups of participants could be analyzed. Due to sample-size restrictions, we had to collapse drawing features across all drawing activities in our study in order to generate enough data points for training the prediction models. This procedure, however, might have led to substantial noise in the data, reducing classification precisions. Larger sample sizes would allow for training more fine-grained models that might achieve even higher classification precision than the approximately 70 % that we demonstrated in this study.

Finally, future research should also address long-term effects of the type of "psychologically informed" visual arts programs that we exemplarily investigated in this study. On the one hand, it might be the case that course effects on the accuracy gains in emotion recognition abilities are not very long lasting following the drawing practice because they might rely on a short-term activation of mental representations of the facial expressions of emotions due to drawing emotional faces. On the other hand, however, long-term effects might be even stronger due to retrieval practice with regard to mental representations constructed during the course in the days and weeks after the course. Therefore, studies with delayed testing of course effects should be conducted in the future to clarify these issues. In this context, it would also be useful to obtain additional dependent variables indicating emotion recognition performance beyond accuracies in the emotion recognition task alone. For instance, more realistic tasks could be administered that involve the correct recognition of subtle facial expressions of emotions in situations that are closer to everyday contexts (e. g., interpreting film scenes).

5.4.5 Conclusions

In the present study, we investigated potential influencing factors that might account for the positive effects of a visual arts course focusing on emotions on the acquisition of socio-emotional skills in an art museum context. An in-depth exploratory analysis identified important variables that modulated this effect at the individual and drawing feature level. These modulating variables are helpful (1) to better understand the socio-emotional learning processes taking place during the visual arts course, (2) to identify important prerequisites of drawers in terms of prior knowledge, and (3) to derive implications on how effective visual arts courses and appropriate drawing tasks should be further designed to foster participants' socio-emotional skills. We assessed the robustness and generalizability of our findings by training supervised machine learning models, which were cross-validated by evaluating them on novel data points. This machine learning approach revealed which drawing pattern turned out to be essential and reliable in generalizable statistical models. Identifying effective drawing tasks and drawing features might allow for future designs of visual arts programs that are particularly promising to promote socio-emotional transfer effects. Our results indicate that drawing tasks with a deeper processing depth, such as the intensifying drawing tasks or tasks with self-reference are particularly helpful for these transfer effects whereas the effects of shallow tasks such as tracing might have detrimental effects on socio-emotional learning outcomes. Additionally, drawing features such as timing as well as pressure might be involved in course effectiveness. Thus, this study makes a first promising step in analyzing drawing features in the context of socio-emotional learning, but further investigations are necessary to validate these conclusions.

Supplementary Material to Study 2

Table S2.1

Correlation Table for the Tracing Drawing Task: Influence of the Drawing Features on the Accuracy Gains of the Emotion Anger

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Accuracy Gain																			
2. Accuracy Pretest	0.37																		
3. Accuracy Posttest	−0.49*	0.55**																	
4. Time Pencil on Tablet$_{Mean}$	−0.17	0.23	0.46*																
5. Time Pencil on Tablet$_{SD}$	−0.08	0.28	0.26	0.80***															
6. Time Pencil on Tablet$_{Min}$	−0.06	0.17	0.03	0.32	0.26														
7. Time Pencil on Tablet$_{Max}$	0.11	0.36	0.10	0.46**	0.85***	0.23													
8. Number of Strokes$_{SUM}$	0.27	0.03	−0.29	−0.73***	−0.56***	−0.31	−0.15												
9. No. of Erased Strokes$_{SUM}$	0.08	0.03	0.11	0.36*	0.18	−0.02	0.03	−0.31											
10. Pressure$_{Mean}$	−0.17	−0.12	−0.05	0.21	0.14	−0.13	−0.09	−0.29	−0.28										
11. Pressure$_{SD}$	0.04	−0.14	−0.38	0.13	0.05	−0.18	−0.10	−0.08	−0.38*	0.79***									
12. Pressure$_{Max}$	−0.15	−0.29	−0.13	0.02	−0.03	−0.25	−0.14	−0.01	−0.31	0.71***	0.76***								
13. Altitude$_{Mean}$	0.14	0.00	−0.14	−0.10	0.22	0.03	0.32	−0.05	−0.14	0.26	0.01	0.08							
14. Altitude$_{SD}$	−0.09	−0.30	−0.32	−0.03	−0.10	0.18	−0.06	−0.01	0.23	−0.30	0.00	−0.23	−0.22						
15. Altitude$_{Min}$	0.21	0.34	0.19	0.15	0.36*	−0.01	0.36*	−0.19	−0.05	0.40*	0.01	0.11	0.80***	−0.62***					
16. Altitude$_{Max}$	0.17	−0.34	−0.32	−0.07	0.03	−0.09	0.14	−0.02	0.42*	−0.26	−0.20	−0.16	0.29	0.56***	−0.03				
17. Number of Used Colors$_{SUM}$	0.14	0.09	0.05	0.04	0.10	−0.30	0.16	0.04	−0.12	0.11	0.20	0.16	0.10	0.12	0.09	0.16			
18. Number of Used Tools$_{SUM}$	0.27	0.18	0.15	0.28	0.19	−0.08	0.14	−0.09	0.53**	−0.21	−0.19	−0.27	0.11	−0.08	0.18	0.14	0.05		
19. Zoom Interactions$_{SUM}$	−0.05	−0.19	0.03	−0.20	−0.19	−0.11	−0.19	0.06	−0.13	−0.11	−0.05	−0.04	0.06	0.09	−0.12	0.02	0.17	−0.04	
20. Fade Interactions$_{SUM}$	−0.16	−0.38	−0.09	−0.17	−0.14	−0.06	−0.13	0.02	−0.09	−0.23	−0.23	−0.19	0.13	0.27	−0.10	0.21	−0.03	−0.10	0.04

Note. $N = 33$ participants in each drawing task.
$^{\dagger}p < 0.1$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table S2.2

Correlation Table for the Tracing Drawing Task: Influence of the Drawing Features on the Accuracy Gains of the Emotion Fear

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Accuracy Gain																			
2. Accuracy Pretest	0.37																		
3. Accuracy Posttest	−0.49*	0.55**																	
4. Time Pencil on Tablet$_{\mathrm{Mean}}$	−0.03	−0.03	0.08																
5. Time Pencil on Tablet$_{\mathrm{SD}}$	0.09	−0.03	−0.06	0.89***															
6. Time Pencil on Tablet$_{\mathrm{Min}}$	−0.03	0.13	0.14	0.19	0.18														
7. Time Pencil on Tablet$_{\mathrm{Max}}$	0.20	0.01	−0.22	0.50**	0.76***	0.01													
8. Number of Strokes$_{\mathrm{SUM}}$	0.08	0.15	0.05	−0.77***	−0.80***	−0.18	−0.43*												
9. No. of Erased Strokes$_{\mathrm{SUM}}$	−0.13	−0.03	0.07	0.16	0.18	0.19	0.05	−0.23											
10. Pressure$_{\mathrm{Mean}}$	−0.19	0.02	0.11	0.18	0.11	−0.17	0.15	−0.12	0.07										
11. Pressure$_{\mathrm{SD}}$	−0.12	0.05	0.00	−0.02	0.02	−0.31	0.31	−0.02	−0.17	0.83***									
12. Pressure$_{\mathrm{Max}}$	−0.14	−0.02	0.02	0.08	0.12	−0.27	0.29	−0.02	0.03	0.87***	0.85***								
13. Altitude$_{\mathrm{Mean}}$	0.05	0.23	0.17	−0.18	−0.16	0.20	0.05	0.25	0.05	0.39*	0.24	0.36*							
14. Altitude$_{\mathrm{SD}}$	0.04	−0.24	−0.35	−0.12	−0.06	−0.24	0.09	−0.04	−0.15	−0.31	0.01	−0.19	−0.33						
15. Altitude$_{\mathrm{Min}}$	−0.01	0.35	0.38	0.10	0.09	0.47**	0.08	0.10	0.12	0.30	0.07	0.22	0.73***	−0.60***					
16. Altitude$_{\mathrm{Max}}$	−0.03	−0.09	0.05	−0.15	−0.24	−0.04	−0.14	0.02	0.04	0.06	0.06	0.01	0.34	0.48**	0.10				
17. Number of Used Colors$_{\mathrm{SUM}}$	0.03	−0.10	0.05	−0.04	−0.28	0.17	−0.35	0.14	0.08	−0.04	−0.11	−0.14	0.12	0.13	0.02	0.29			
18. Number of Used Tools$_{\mathrm{SUM}}$	−0.10	−0.37	−0.22	0.26	0.21	0.26	−0.03	−0.29	0.70***	−0.01	−0.19	0.04	−0.17	−0.02	−0.16	−0.05	0.16		
19. Zoom Interactions$_{\mathrm{SUM}}$	−0.09	−0.16	−0.03	0.07	−0.08	−0.15	−0.14	−0.12	0.01	−0.06	−0.10	−0.12	0.01	0.19	−0.33	0.07	0.27	0.17	
20. Fade Interactions$_{\mathrm{SUM}}$	−0.17	−0.35	−0.18	−0.07	−0.27	−0.15	−0.40*	0.08	0.03	0.06	−0.03	−0.03	−0.21	0.11	−0.07	0.19	0.30	0.06	0.10

Note. $N = 33$ participants in each drawing task.
$^{\dagger}p < 0.1$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table S2.3

Correlation Table for the Intensifying Drawing Task: Influence of the Drawing Features on the Accuracy Gains of the Emotion Anger

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Accuracy Gain																			
2. Accuracy Pretest	0.37																		
3. Accuracy Posttest	−0.49*	0.55**																	
4. Time Pencil on Tablet$_{\mathrm{Mean}}$	−0.12	−0.04	0.10																
5. Time Pencil on Tablet$_{\mathrm{SD}}$	−0.08	0.02	−0.15	0.73***															
6. Time Pencil on Tablet$_{\mathrm{Min}}$	−0.02	0.18	0.27	0.18	0.04														
7. Time Pencil on Tablet$_{\mathrm{Max}}$	0.00	0.11	−0.24	0.20	0.78***	−0.13													
8. Number of Strokes$_{\mathrm{SUM}}$	0.05	0.17	0.09	−0.68***	−0.57***	−0.27	−0.21												
9. No. of Erased Strokes$_{\mathrm{SUM}}$	0.36*	−0.14	−0.33	0.01	−0.06	−0.22	−0.10	0.13											
10. Pressure$_{\mathrm{Mean}}$	−0.24	−0.10	0.12	0.21	0.05	0.01	−0.14	−0.22	0.02										
11. Pressure$_{\mathrm{SD}}$	−0.21	−0.20	−0.22	−0.04	0.02	−0.21	0.06	0.02	−0.14	0.71***									
12. Pressure$_{\mathrm{Max}}$	−0.16	−0.06	−0.02	−0.18	−0.15	−0.15	−0.10	0.27	−0.02	0.67***	0.82***								
13. Altitude$_{\mathrm{Mean}}$	0.23	−0.07	−0.06	−0.30	−0.44*	0.02	−0.37*	0.30	0.41*	0.15	−0.09	0.04							
14. Altitude$_{\mathrm{SD}}$	0.16	−0.41*	−0.47*	−0.22	−0.11	−0.21	0.02	0.09	0.34	−0.31	−0.06	−0.15	0.03						
15. Altitude$_{\mathrm{Min}}$	−0.07	0.31	0.45*	0.12	−0.03	0.11	−0.11	−0.03	−0.10	0.42*	0.09	0.14	0.43*	−0.68***					
16. Altitude$_{\mathrm{Max}}$	0.09	−0.38	−0.23	−0.16	−0.19	−0.26	−0.12	0.27	0.42*	−0.12	−0.04	−0.02	0.32	0.74***	−0.27				
17. Number of Used Colors$_{\mathrm{SUM}}$	0.15	0.05	−0.04	−0.27	−0.22	−0.31	0.03	0.37*	0.32	−0.05	0.14	0.19	0.16	0.15	0.04	0.17			
18. Number of Used Tools$_{\mathrm{SUM}}$	0.09	−0.02	0.17	−0.01	−0.16	−0.14	−0.14	0.28	0.49**	−0.13	−0.29	−0.10	0.2	0.13	−0.05	0.34	0.37*		
19. Zoom Interactions$_{\mathrm{SUM}}$	−0.08	−0.14	0.06	−0.28	−0.27	0.20	−0.22	0.04	−0.21	−0.20	−0.22	−0.18	0.07	0.15	−0.04	0.13	−0.12	0.16	
20. Fade Interactions$_{\mathrm{SUM}}$	0.01	−0.11	−0.13	−0.51**	−0.38*	−0.05	−0.18	0.43*	0.39*	−0.27	−0.23	−0.10	0.08	0.25	−0.40*	0.12	0.28	0.36*	0.04

Note. $N = 33$ participants in each drawing task.
† $p < 0.1$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table S2.4

Correlation Table for the Intensifying Drawing Task: Influence of the Drawing Features on the Accuracy Gains of the Emotion Fear

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Accuracy Gain																			
2. Accuracy Pretest	0.37																		
3. Accuracy Posttest	-0.49^{*}	0.55^{**}																	
4. Time Pencil on Tablet$_{\text{Mean}}$	−0.31	−0.08	0.20																
5. Time Pencil on Tablet$_{\text{SD}}$	−0.19	−0.12	−0.05	0.82^{***}															
6. Time Pencil on Tablet$_{\text{Min}}$	−0.33	−0.29	0.03	0.37^{*}	0.11														
7. Time Pencil on Tablet$_{\text{Max}}$	0.03	−0.06	−0.27	0.29	0.71^{***}	−0.13													
8. Number of Strokes$_{\text{SUM}}$	0.13	0.22	0.01	-0.74^{***}	-0.70^{***}	−0.22	−0.29												
9. No. of Erased Strokes$_{\text{SUM}}$	0.09	−0.05	−0.03	−0.04	0.03	−0.17	0.07	−0.14											
10. Pressure$_{\text{Mean}}$	−0.32	−0.18	−0.01	0.34	0.36^{*}	−0.01	0.24	−0.21	0.06										
11. Pressure$_{\text{SD}}$	−0.14	−0.19	−0.30	−0.07	0.09	−0.24	0.24	0.16	−0.07	0.68^{***}									
12. Pressure$_{\text{Max}}$	−0.20	−0.17	−0.02	−0.13	−0.05	−0.28	0.04	0.21	−0.10	0.54^{**}	0.78^{***}								
13. Altitude$_{\text{Mean}}$	0.03	−0.12	−0.06	−0.10	−0.26	0.35	−0.28	0.08	0.09	0.24	−0.08	−0.08							
14. Altitude$_{\text{SD}}$	0.20	−0.20	-0.48^{*}	−0.23	−0.02	−0.17	0.35	0.22	−0.06	−0.15	0.36^{*}	0.11	−0.05						
15. Altitude$_{\text{Min}}$	−0.10	0.09	0.15	0.30	0.13	0.45^{*}	−0.15	−0.31	−0.06	0.30	−0.20	−0.15	0.57^{***}	-0.65^{***}					
16. Altitude$_{\text{Max}}$	0.21	−0.13	−0.36	−0.06	0.02	−0.07	0.19	0.17	−0.03	0.14	0.22	0.06	0.48^{**}	0.63^{***}	−0.03				
17. Number of Used Colors$_{\text{SUM}}$	−0.01	0.20	0.27	−0.15	−0.17	−0.09	−0.14	−0.04	0.11	0.19	0.14	0.04	0.26	0.02	0.12	0.08			
18. Number of Used Tools$_{\text{SUM}}$	−0.07	0.02	0.18	0.07	0.12	−0.25	0.15	−0.11	0.28	0.21	0.09	−0.03	0.08	0.01	−0.06	0.06	0.21		
19. Zoom Interactions$_{\text{SUM}}$	0.00	−0.09	0.18	−0.19	−0.22	0.00	−0.31	0.04	−0.01	−0.10	−0.10	0.13	0.05	−0.03	−0.11	−0.03	0.24	−0.05	
20. Fade Interactions$_{\text{SUM}}$	0.26	0.17	−0.06	−0.27	−0.21	−0.33	0.01	0.26	0.38^{*}	−0.16	0.09	0.07	−0.06	0.35^{*}	-0.43^{*}	0.16	0.19	−0.03	0.09

Note. $N = 33$ participants in each drawing task.
$^{\dagger}p < 0.1$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table S2.5

Correlation Table for the Transfer Drawing Task: Influence of the Drawing Features on the Accuracy Gains of the Emotion Anger

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Accuracy Gain																			
2. Accuracy Pretest	0.37																		
3. Accuracy Posttest	-0.49^{*}	0.55^{**}																	
4. Time Pencil on Tablet$_{\text{Mean}}$	−0.07	−0.05	0.16																
5. Time Pencil on Tablet$_{\text{SD}}$	−0.03	−0.07	0.05	0.86^{***}															
6. Time Pencil on Tablet$_{\text{Min}}$	0.08	−0.28	−0.29	0.29	0.22														
7. Time Pencil on Tablet$_{\text{Max}}$	0.17	0.06	−0.19	0.16	0.55^{**}	−0.11													
8. Number of Strokes$_{\text{SUM}}$	0.14	0.08	−0.28	-0.74^{***}	-0.66^{***}	−0.29	0.04												
9. No. of Erased Strokes$_{\text{SUM}}$	−0.04	0.09	0.17	0.23	0.20	−0.02	0.09	−0.12											
10. Pressure$_{\text{Mean}}$	−0.35	−0.17	0.11	0.38^{*}	0.21	−0.10	−0.17	−0.29	0.17										
11. Pressure$_{\text{SD}}$	−0.20	−0.25	−0.24	0.14	0.01	−0.16	−0.07	0.11	0.00	0.66^{***}									
12. Pressure$_{\text{Max}}$	−0.28	−0.10	−0.03	−0.01	−0.06	0.00	−0.1	0.17	0.05	0.55^{**}	0.78^{***}								
13. Altitude$_{\text{Mean}}$	0.03	−0.19	−0.17	−0.19	−0.28	0.15	−0.32	0.08	0.10	0.25	0.03	0.14							
14. Altitude$_{\text{SD}}$	0.20	-0.45^{*}	-0.45^{*}	−0.16	−0.21	0.22	−0.16	0.20	−0.14	−0.27	0.21	0.09	−0.02						
15. Altitude$_{\text{Min}}$	−0.21	0.02	0.15	0.41^{*}	0.39^{*}	0.07	0.07	-0.40^{*}	0.21	0.54^{**}	−0.02	0.08	0.44^{*}	-0.71^{***}					
16. Altitude$_{\text{Max}}$	0.05	−0.30	−0.01	−0.04	−0.13	−0.01	−0.13	−0.02	0.24	0.10	0.14	0.13	0.38^{*}	0.49^{**}	−0.22				
17. Number of Used Colors$_{\text{SUM}}$	0.07	0.03	0.09	−0.11	−0.06	−0.25	0.21	0.24	−0.19	−0.08	0.23	0.32	−0.09	0.37^{*}	-0.38^{*}	0.35^{*}			
18. Number of Used Tools$_{\text{SUM}}$	0.01	0.03	0.21	0.19	0.06	−0.03	−0.14	−0.12	0.52^{**}	0.04	0.14	0.03	0.09	0.20	−0.06	0.17	0.04		
19. Zoom Interactions$_{\text{SUM}}$	−0.07	−0.13	0.01	−0.06	−0.18	−0.14	−0.16	−0.05	−0.10	0.02	0.07	0.14	0.09	0.18	−0.15	0.30	0.31	0.02	
20. Fade Interactions$_{\text{SUM}}$	−0.05	−0.26	−0.12	−0.28	−0.13	0.09	0.19	0.21	0.16	−0.15	0.02	0.02	−0.01	0.50^{**}	-0.44^{*}	0.40^{*}	0.30	0.18	0.06

Note. $N = 33$ participants in each drawing task.
$^{\dagger}p < 0.1$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table S2.6

Correlation Table for the Transfer Drawing Task: Influence of the Drawing Features on the Accuracy Gains of the Emotion Fear

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Accuracy Gain																			
2. Accuracy Pretest	0.37																		
3. Accuracy Posttest	-0.49^{*}	0.55^{**}																	
4. Time Pencil on Tablet$_{\mathrm{Mean}}$	0.03	0.04	0.12																
5. Time Pencil on Tablet$_{\mathrm{SD}}$	0.09	0.07	0.02	0.83^{***}															
6. Time Pencil on Tablet$_{\mathrm{Min}}$	−0.14	0.31	0.33	0.26	0.17														
7. Time Pencil on Tablet$_{\mathrm{Max}}$	0.14	0.26	0.13	0.35	0.73^{***}	−0.07													
8. Number of Strokes$_{\mathrm{SUM}}$	0.01	0.17	0.10	-0.74^{***}	-0.59^{***}	-0.43^{*}	−0.07												
9. No. of Erased Strokes$_{\mathrm{SUM}}$	−0.12	0.06	0.17	0.20	0.05	0.12	−0.12	−0.29											
10. Pressure$_{\mathrm{Mean}}$	−0.14	−0.19	−0.06	0.11	−0.05	0.12	−0.28	−0.30	0.54^{**}										
11. Pressure$_{\mathrm{SD}}$	−0.20	−0.19	−0.21	−0.16	−0.19	0.06	−0.28	−0.03	0.30	0.79^{***}									
12. Pressure$_{\mathrm{Max}}$	−0.28	0.00	0.12	−0.17	−0.25	0.17	-0.35^{*}	0.14	0.24	0.63^{***}	0.82^{***}								
13. Altitude$_{\mathrm{Mean}}$	0.03	−0.16	−0.03	−0.15	−0.24	−0.07	−0.26	0.09	0.29	0.47^{**}	0.23	0.21							
14. Altitude$_{\mathrm{SD}}$	0.08	−0.22	−0.29	−0.27	−0.24	−0.13	−0.20	0.36^{*}	−0.10	−0.12	−0.02	−0.10	0.25						
15. Altitude$_{\mathrm{Min}}$	−0.07	0.09	0.27	0.24	0.13	0.23	0.05	-0.40^{*}	0.20	0.37^{*}	0.12	0.14	0.23	-0.61^{***}					
16. Altitude$_{\mathrm{Max}}$	−0.04	−0.32	−0.17	−0.04	−0.23	−0.31	−0.27	0.16	0.19	0.22	0.05	−0.07	0.58^{***}	0.59^{***}	−0.10				
17. Number of Used Colors$_{\mathrm{SUM}}$	0.01	−0.04	0.06	-0.36^{*}	-0.39^{*}	−0.04	−0.26	0.23	−0.01	0.05	0.11	0.22	0.11	−0.10	−0.04	−0.02			
18. Number of Used Tools$_{\mathrm{SUM}}$	−0.08	0.04	0.13	0.04	−0.12	0.08	−0.21	−0.10	0.31	0.27	0.07	−0.02	0.33	0.04	0.23	0.25	0.15		
19. Zoom Interactions$_{\mathrm{SUM}}$	−0.12	−0.15	0.03	−0.16	−0.17	−0.10	−0.21	0.02	−0.13	−0.02	−0.03	0.12	0.12	0.21	−0.29	0.07	0.17	0.00	
20. Fade Interactions$_{\mathrm{SUM}}$	−0.14	−0.38	−0.13	−0.02	−0.10	-0.42^{*}	−0.08	0.02	0.22	0.04	−0.03	−0.04	0.15	0.09	0.21	0.24	0.07	0.15	−0.12

Note. $N = 33$ participants in each drawing task.
$^{\dagger}p < 0.1$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table S2.7

Correlation Table for the Selfie Drawing Task: Influence of the Drawing Features on the Accuracy Gains of the Emotion Anger

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Accuracy Gain																			
2. Accuracy Pretest	0.40																		
3. Accuracy Posttest	−0.47*	0.53**																	
4. Time Pencil on Tablet$_{\mathrm{Mean}}$	−0.26	0.29	0.54**																
5. Time Pencil on Tablet$_{\mathrm{SD}}$	−0.29	0.26	0.52**	0.92***															
6. Time Pencil on Tablet$_{\mathrm{Min}}$	−0.35	0.09	0.48*	0.43*	0.31														
7. Time Pencil on Tablet$_{\mathrm{Max}}$	−0.26	0.02	0.27	0.62***	0.82***	−0.01													
8. Number of Strokes$_{\mathrm{SUM}}$	0.00	−0.20	−0.21	−0.67***	−0.63***	−0.49**	−0.30												
9. No. of Erased Strokes$_{\mathrm{SUM}}$	0.03	0.01	0.10	−0.06	0.00	0.28	0.04	−0.18											
10. Pressure$_{\mathrm{Mean}}$	−0.32	0.21	0.57**	0.30	0.30	0.62***	0.10	−0.32	0.23										
11. Pressure$_{\mathrm{SD}}$	−0.04	0.21	0.29	0.04	0.13	0.31	0.08	−0.23	0.26	0.77***									
12. Pressure$_{\mathrm{Max}}$	−0.17	0.02	0.25	−0.19	−0.17	0.35	−0.14	0.12	0.19	0.69***	0.81***								
13. Altitude$_{\mathrm{Mean}}$	−0.04	−0.04	0.12	−0.24	−0.29	0.17	−0.18	0.26	0.27	0.28	0.11	0.29							
14. Altitude$_{\mathrm{SD}}$	0.26	0.12	−0.37	−0.15	−0.12	−0.31	0.02	−0.11	−0.22	−0.23	0.05	−0.16	−0.01						
15. Altitude$_{\mathrm{Min}}$	−0.23	0.01	0.43*	0.07	0.05	0.39*	−0.01	0.02	0.35	0.46*	0.11	0.31	0.53**	−0.62***					
16. Altitude$_{\mathrm{Max}}$	0.05	0.21	0.17	0.09	0.06	−0.01	0.23	0.09	0.13	−0.01	−0.07	−0.08	0.62***	0.40*	0.21				
17. Number of Used Colors$_{\mathrm{SUM}}$	0.21	0.04	−0.07	−0.19	−0.12	−0.14	−0.01	0.05	0.00	−0.05	0.03	0.01	0.18	0.19	0.07	0.18			
18. Number of Used Tools$_{\mathrm{SUM}}$	0.02	0.15	0.39	0.12	0.13	0.07	0.07	0.06	0.09	0.39*	0.37*	0.40*	0.14	−0.14	0.14	0.02	−0.06		
19. Zoom Interactions$_{\mathrm{SUM}}$	−0.32	−0.29	0.02	−0.16	−0.13	−0.18	−0.09	0.12	−0.17	−0.16	−0.17	−0.15	−0.03	0.11	−0.01	0.05	−0.06	0.09	
20. Fade Interactions$_{\mathrm{SUM}}$	−0.27	−0.45*	−0.07	0.05	0.11	0.11	0.29	0.00	0.12	0.00	0.00	−0.08	0.04	0.10	−0.18	0.20	−0.04	−0.09	0.40*

Note. $N = 32$ participants in each drawing task.
$^{\dagger}p < 0.1$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table S2.8

Correlation Table for the Selfie Drawing Task: Influence of the Drawing Features on the Accuracy Gains of the Emotion Fear

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Accuracy Gain																			
2. Accuracy Pretest	0.40																		
3. Accuracy Posttest	-0.47^{*}	0.53^{**}																	
4. Time Pencil on $\text{Tablet}_{\text{Mean}}$	-0.22	0.24	0.50^{*}																
5. Time Pencil on $\text{Tablet}_{\text{SD}}$	-0.30	0.12	0.41^{*}	0.88^{***}															
6. Time Pencil on $\text{Tablet}_{\text{Min}}$	0.10	0.01	0.19	-0.14	-0.17														
7. Time Pencil on $\text{Tablet}_{\text{Max}}$	-0.33	-0.10	0.16	0.47^{**}	0.78^{***}	-0.25													
8. Number of $\text{Strokes}_{\text{SUM}}$	0.18	-0.09	-0.30	-0.67^{***}	-0.62^{***}	-0.14	-0.32												
9. No. of Erased $\text{Strokes}_{\text{SUM}}$	0.14	0.04	-0.02	0.06	0.10	-0.22	0.25	-0.06											
10. $\text{Pressure}_{\text{Mean}}$	-0.13	0.16	0.34	0.17	0.11	0.16	-0.01	-0.29	-0.05										
11. $\text{Pressure}_{\text{SD}}$	0.02	0.16	0.17	0.16	0.13	0.04	0.00	-0.26	-0.1	0.93^{***}									
12. $\text{Pressure}_{\text{Max}}$	-0.01	0.03	0.16	-0.06	-0.12	0.08	-0.16	-0.02	-0.02	0.74^{***}	0.80^{***}								
13. $\text{Altitude}_{\text{Mean}}$	0.11	0.05	0.00	-0.29	-0.3	0.28	-0.07	0.07	0.28	0.38^{*}	0.31	0.44^{*}							
14. $\text{Altitude}_{\text{SD}}$	-0.08	0.02	-0.04	0.18	0.20	-0.33	0.23	-0.05	0.08	-0.13	-0.03	-0.04	0.09						
15. $\text{Altitude}_{\text{Min}}$	0.01	0.07	0.40	-0.10	-0.12	0.60^{***}	-0.24	-0.09	-0.09	0.32	0.24	0.42^{*}	0.35	-0.55^{**}					
16. $\text{Altitude}_{\text{Max}}$	-0.06	0.01	0.15	0.11	0.09	-0.17	0.16	0.22	0.28	-0.14	-0.12	0.03	0.28	0.70^{***}	-0.35				
17. Number of Used $\text{Colors}_{\text{SUM}}$	-0.05	-0.14	0.03	-0.04	0.10	0.35	0.01	-0.01	0.20	0.00	0.03	0.09	0.25	-0.07	0.33	0.16			
18. Number of Used $\text{Tools}_{\text{SUM}}$	0.38^{*}	0.27	-0.09	0.17	0.05	-0.02	-0.06	0.26	0.25	-0.01	0.02	-0.10	-0.09	-0.03	-0.24	0.29	0.04		
19. Zoom $\text{Interactions}_{\text{SUM}}$	-0.33	-0.34	-0.11	-0.19	-0.09	0.19	-0.08	0.05	-0.24	-0.27	-0.28	-0.43^{*}	-0.32	-0.01	-0.01	-0.23	0.15	-0.22	
20. Fade $\text{Interactions}_{\text{SUM}}$	-0.37^{*}	-0.35	0.10	0.07	0.12	-0.18	0.35	-0.07	0.25	-0.15	-0.23	-0.13	-0.09	0.18	-0.13	0.17	-0.31	-0.26	0.11

Note. $N = 32$ participants in each drawing task.
$^{\dagger}p < 0.1$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

CHAPTER 6

STUDY 3: INFLUENCING FACTORS ON SELF-CONCEPT IN A VISUAL ARTS EDUCATION PROGRAM

The content of the following Chapter is prepared for the submission at *PLOS ONE*. The proportional contributions to the manuscript are presented in the subsequent table. This article may not exactly replicate the final version published in the journal. It is not the copy of the record.

Nr.	Accepted publication yes/no	List of authors	Position of candidate in list of authors	Scientific ideas by the candidate (%)	Data generation by the candidate (%)	Analysis and Interpretation by the candidate (%)	Paper writing done by the candidate (%)
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Authors:	Lydia Kastner, Birgit Brucker, Philipp Mock, Aiste Jusyte, Susana Ruiz Fernández, Sven Nommensen, Ansgar Thiel, Peter Gerjets
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Abstract

Beneficial effects of visual arts engagement have been claimed for the development of personal and cultural identity, such as adolescents' self-concept. The present study focuses on how and under which circumstances such benefits might occur. In an experimental study design, two standardized visual arts courses which only differ in their focus on two specific contents were studied. Adolescents had to deal in empathy-based drawing tasks either with the topic of self-concept (self-concept course, treatment) or historical periods (epoch course, control). In the self-concept course, the adolescents were asked to imagine and draw the mythological figure of Hercules in different social roles such as a strong hero, while adolescents in the epoch course should imagine social roles of a prince/princess of the Rococo or Baroque period. To measure adolescents' self-concept development about self-complexity, adolescents should describe themselves (in a pre-post design) with different pregiven or self-generated adjectives in social roles. As dependent variables, we analyzed the proportion of self-generated adjectives per role as well as the duplicates (i. e., using the same adjective for describing different roles). A high complex self-concept was characterized by using many different self-generated adjectives and less duplicates, whereas a less complex self-concept was characterized by using only less self-generated adjectives and a relatively high number of duplicates. Since various factors might influence the effects on self-complexity, a machine learning approach was used to identify important features that might act as potential moderators (e. g., personal prerequisites, drawing features).

Moderation analyzes showed respectively, that the self-concept course particularly increased self-complexity for adolescents who have combined problematic personal prerequisites (in terms of low empathy AND low agreeableness) AND who additionally drew in a certain way. More precisely, less empathic, and low agreeable adolescents described themselves in the self-concept course with more self-generated adjectives per role if they used low tilt during drawing. In contrast, no increase was found if either one or both personal prerequisites (empathy, agreeableness) were highly developed. Results and implications of these moderators on self-complexity are discussed.

Keywords: Visual arts, digital drawing, self-complexity, instructional design, machine learning

6.1 Introduction

6.1.1 Socio-Emotional Transfer Effects of Visual Arts Engagement: Expectations Too High Meet Research Standards Too Low?

Engagement with visual arts is thought by many to be tightly related to personal development and cultural identity. Accordingly, there are high expectations regarding beneficial effects of visual arts engagement beyond the mere acquisition of artistic, creative, and aesthetic competencies. These expectations are also reflected in official claims such as from the enquete commission "Culture in Germany" of the German Bundestag: "*Through arts education, basic skills and abilities are acquired that are central to the young person's personality development, emotional stability, self-realization, and identity formation*" (translated from Deutscher Bundestag 2007, p. 379). Interestingly, all these postulated positive effects of visual arts engagement are not directly related to specific contents of the visual arts themselves but address socio-emotional domains instead and are therefore usually characterized as SET effects. SET effects are a key aspect of what art museums and their visitors as well as art teachers and their students expect to emerge from a visual arts engagement.

For instance, visitors of an art museum do not see the museum merely as a place for recreation or self-directed learning, but also as a place that is helpful for the reflection and development of their own identity (Banz, 2008; Falk & Dierking, 2018). When Falk (2008) interviewed more than 100 art museum visitors, he found that all of their different motivations for the museum visit were related to visitors' identity. Based on these findings, Falk assumed that most art museum visitors engage in processes of self-reflection and self-interpretation in the sense of Linville (1985, 1987) or Simon (1997, 1998, 1999, 2004), thereby developing a better self-understanding. In Simon's model, self-interpretation is based on a set of "self-aspects", which are defined as cognitive elements used to process and organize all information that we possess about our "self" and which in their entirety provide us with a differentiated self-concept. Self-aspects can be physical features such as being tall, but also social roles such as being the father of a son, or group memberships such as being a scientist, or psychological characteristics such as traits, abilities, behaviors, or attitudes. According to Falk (2008) art museum visitors activate, reflect, and elaborate important self-aspects during their visits thereby contributing to the development of their own unique personal identity. Therefore, visiting an art museum might per se be described as an activity that is closely related to one's own identity and self-concept.

Similar to art museum experiences, also classroom lessons in visual arts are seen as highly relevant for students' personal development and cultural identity. This is reflected in the educational standards that elaborate on the aims of visual arts engagement in schools. For instance, these standards postulate that students in the visual arts classroom will not only be provided with opportunities to develop their artistic, visual, and creative skills but also with chances to develop their communicative and social skills, thus contributing to a comprehensive development of their personality (e. g., Hessisches Kultusministerium, 2011). Thus, there seems to be a broad consent in art museums, schools and the public that visual arts engagement is vital not only for its own sake but also due to its significant SET effects.

However, the expected beneficial SET effects of visual arts engagement have not been clearly demonstrated yet. Winner, Goldstein, et al. (2013) concluded in their meta-study on transfer effects that theoretically and methodologically sound studies addressing SET effects of visual arts engagement are rare in the research literature and that available demonstrations of these SET effects are usually not unambiguous and therefore highly disputed among scientists. Based on these conclusions, the rather high expectations regarding SET effects of visual arts engagement should be contrasted with rather low research standards in this field. For example, only a small proportion of the available studies are based on randomized experimental or longitudinal control-group designs, which would be required to justify causal interpretations regarding SET effects. And these "causal" studies oftentimes do not yield the expected transfer effects. Most studies demonstrating transfer effects, on the other hand, provide only correlational evidence, showing that participation in a visual arts program is somehow related to specific socio-emotional outcomes. However, this correlational evidence might easily be based on self-selection effects, for instance, because students with better socio-emotional entry skills or prerequisites for the development of these skills decide more often to engage in visual arts education programs than students with worse skills or prerequisites. Accordingly, there is very little convincing and reliable experimental evidence for SET effects of visual arts engagement in the research literature — even for the most prominently claimed effects of visual arts engagement, namely (1) a better *regulation of emotions* (Goldstein et al., 2012), (2) an *increase in empathy* with other people (Goldstein & Winner, 2012), or (3) an improved *development of the self-concept* (Catterall & Peppler, 2007). To overcome such limitations, the aim of this paper is to experimentally investigate a visual arts program that is designed to causally elicit specific SET effects during artworks creation. Moreover, as participants differ in their prerequisites as well as in their levels of engagement in the drawing tasks, a digital drawing procedure on tablets is used that allows to support and measure students' drawing processes, which we consider to be potential moderators for the envisioned SET effects. However, before we describe the details of this visual arts program, we will review the available evidence for SET effects of visual arts engagement in the research literature to extract potential boundary conditions and constraints for these effects that we need to consider in our program development.

Effects of Visual Arts Engagement on Emotion Regulation?

In their comprehensive meta-study, Winner, Goldstein, et al. (2013) identified only one paper addressing the quantitative effects of visual arts engagement on emotion regulation strategies. In this paper, Goldstein et al. (2012) investigated the two most important emotion regulation strategies, namely *cognitive reappraisal* and *expressive suppression* in two studies (Gross, 1998). While cognitive reappraisal is considered as a positive strategy because it focuses on changing the way a situation is interpreted in order to change the emotional impact of that situation (Gross, 2002); expressive suppression, in contrast, is considered as a less positive strategy to regulate emotions as it might impair long-term health and well-being for both children and adults when used too frequently (e. g., Gross, 1998, 2001, 2002, 2007). Goldstein et al. (2012) investigated in two studies whether individuals involved in different kinds of arts classes differ regarding their use of these emotion regulation strategies. They hypothesized that the expression of emotions is valued more in some arts forms (e. g., acting) than in others (e. g., visual arts or music). In line with this reasoning, they showed in their first study that adolescents majoring in acting at high school used the suppression strategy less than adolescents majoring in other arts forms, such as visual arts or music. These findings might be explained by hypothesizing a positive SET effect of acting, with acting training lessening the tendency to use expressive suppression. However, these findings could also go back to a selection bias, with individuals majoring in acting being those who are already more extraverted and therefore tend not to use expressive suppression. To rule out such a bias and to provide better evidence for a causal relationship, the authors assessed expressive suppression in a second study with a pre–posttest design. This second study showed that engaging for 10 months in acting classes (but not in visual arts classes) reduced elementary school children's use of expressive suppression. This suggests that experience with acting may indeed improve the use of emotion regulation strategies. However, as students were still not randomly assigned to the two training conditions in this study, one must be cautious to impute causality to acting training. Nevertheless, the paper shows quite convincingly that visual arts engagement (in contrast to acting training) might not be appropriate to improve emotion regulation strategies.

Besides studying arts effects on emotion regulation strategies directly, some experimental research has also addressed the hypothesis that drawing might allow to regulate negative emotions due to the discharge of negative feelings by means of self-expression, which could not be supported empirically. However, this hypothesis is a key assumption underlying contemporary practices of arts therapy where arts making is considered to be therapeutic due to catharsis or redirection (e. g., Kramer, 2000). De Petrillo and Winner (2005), for instance, were the first to examine experimentally whether visual arts making can lead to short-term mood improvement.

They used a negative mood induction procedure and then asked participants to either draw a picture based on their feelings (venting condition), copy simple geometric shapes (distraction control condition 1), or complete a word puzzle (distraction control condition 2). It turned out that those who drew a picture improved their mood more than participants in the control conditions. This seemed to be a promising first result. In a follow-up study, Dalebroux et al. (2008) again investigated the effects of creating a drawing expressing their current mood (venting condition), creating a drawing depicting something happy (positive emotion condition), or scanning a sheet for specific symbols (distraction control condition). It turned out that venting was not better for short-term mood repair than the distraction control task, whereas the positive emotion condition was superior in improving mood (Dalebroux et al., 2008). These results imply that attending to and venting negative feelings through visual arts making is less effective in terms of mood improvement than turning away from a negative mood to something more positive. These findings were conceptually replicated several times (e. g., Drake, 2019, 2021; Drake et al., 2011; Drake & Winner, 2012, 2013; Genuth & Drake, 2021; Turturro & Drake, 2022). Although the overall evidence is compelling that drawing might be a good medium of self-distraction from negative emotions, the basic hypothesis that expressive drawing has a positive effect to regulate negative emotions through catharsis could not be supported. Hence, there is no reliable empirical data available to justify the idea that drawing either has positive effects on the use of emotion regulation strategies or on the ability to cope with negative emotions due to self-expression. Rather, the only positive contribution found for drawing is an indirect effect in that it can be successfully used as a distraction from negative mood.

Effects of Visual Arts Engagement on Empathy?

There is indeed evidence for a relation between visual arts and empathy. Generally, empathy can be understood as the general ability to perceive situations, thoughts, and feelings of other people correctly (*cognitive empathy*, also described as *social perspective taking* or *theory of mind*), and do so with compassion (*emotional* or *affective empathy*, also described as *empathic concern*, e. g., feeling the sadness but also the happiness of another person, Ioannidou & Konstantikaki, 2008; Reniers et al., 2011). As engaging in empathy does not only require empathic skills but also reinforces it, one might argue that empathy is a matter of training (Van Heel et al., 2020; Winner, 2019). From a conceptual perspective, it could be expected that cognitive empathy is a developmental precursor of emotional empathy as compassion with another person's emotional experiences seems to require an accurate assessment of what another person thinks or feels. However, longitudinal studies provide empirical evidence that the opposite is true (Van Heel et al., 2020). At a within-person level, higher empathic concern at one timepoint predicts higher levels of social perspective taking at a later timepoint, whereas the reciprocal association does not exist. Van Heel and colleagues argued that this direction of causality might go back to the nature of empathic learning opportunities during childhood: Obviously, children will use their parents as the first modeling examples regarding, both, emotional concern and perspective taking (Eisenberg et al., 2006). They experience, observe, and practice these skills in their parent-child relation. However, there is an important difference between the initial learning for empathy versus social perspective taking. Whereas children can easily observe the empathic responses by their parents and use them as social role models for empathy, the parental cognitions cannot easily be observed. Therefore, the ability for empathy might be acquired earlier in childhood than the ability for social perspective taking (Van Heel et al., 2020). In addition, developing empathy might stimulate children's interest to engage in social perspective taking. This explanation is particularly interesting in the context of visual arts engagement as it can be used to explain some of the findings obtained for the relation between arts engagement on the one hand and emotional empathy or social perspective taking/ToM on the other hand.

For instance, Kou et al. (2019) analyzed correlational data from four large datasets containing information on arts engagement (creation vs. consumption) in three artistic genres (visual arts, performing arts, and literature), as well as on prosocial traits (e. g., empathic concern, perspective taking, and principle of care) or prosocial behaviors (e. g., charitable donations). Interestingly, a significant correlation between empathic concern and creation in visual arts and literature was found. Perspective taking, however, was only significantly correlated with creation of literature but not visual arts. This pattern of significant correlations between visual arts and emotional empathy (but not cognitive empathy) would be rather difficult to explain when assuming that cognitive empathy is a prerequisite for emotional empathy, but it is in line with the reversed developmental perspective provided by Van Heel et al. (2020). However, although arts engagement and emotional empathy are highly correlated, these correlations rely on cross-sectional analyses so that no strong causal conclusions can be drawn from them in both possible causal directions. Beyond a strict causal relationship, Kou et al. (2019) hypothesized that both might involve increased human connections, emotional engagement, or exercising imagination. This idea might also find some evidence on a more basic level, as there seem to be some overlaps in neural structures, in particular in terms that the arts and empathy are processed in same brain regions in terms of the so-called DMN(Li et al., 2014; Vessel et al., 2012). Based on this idea of a shared neural network, Bolwerk et al. (2014) could even show that the participation in a 10-weeks visual arts creation course changed the functional interplay of the DMN, which was not the case for a 10-weeks control course focusing on the mere cognitive evaluation of visual artworks. The authors argue that these neural effects of visual arts creation might have far reaching psychological consequences. In particular, the DMN is not only associated with the comprehension of emotional states and intentions of others but also with cognitive processes related to the self of a person, such as episodic and autobiographic memory, introspection, self-monitoring, and prospection. Accordingly, when assuming that beneficial effects of visual arts creation are based on neural influence regarding the functional interplay of the DMN, one might also expect other beneficial effects of visual arts engagement beyond empathy, for instance improvements of processes related to the self (cf. next section). Thus, visual arts creation might be a good medium in general for practicing empathy or thinking about oneself due to the inherent DMN activation. However, beyond the suitability of the medium also the specificity of the message (the social content of the drawing task) might be important. For instance, we found in an overall analysis of a larger data set (part of which will be analyzed in this paper in much greater detail) using a three-group experimental pre-posttest design that SET effects can be demonstrated when they were specifically addressed by the content of the artistic engagement (Kastner et al., 2021).In that comparison we contrasted a course without socio-emotional content (epoch course, control) with two courses focusing on socio-emotional contents (emotion course, self-concept course, treatment) regarding the specificity of the course outcomes. We found as expected specific SET effects of the emotion course on emotion recognition abilities and the self-concept course on self-concept structure, whereas no SET effects could be shown for the epoch (control) course. These results, thus, provided first experimental evidence that SET effects can be addressed within the context of visual arts programs if these contents are appropriately integrated into the programs. However, it remains an open issue which personal prerequisites or behaviors might constrain or enlarge these effects (which is the focus of the current paper). Our findings on the important role of contents in visual arts engagements are also in accordance with Goldstein and Winner (2012) quasi-experimental findings on differential SET effects of acting, visual arts, and music. The authors hypothesized a superiority of acting for stimulating empathic skills since acting is an activity in which a person explicitly needs to step into the shoes of others. Thus, practicing empathy is the core content of the arts engagement in acting. Accordingly, in both studies, those receiving acting training (but not those receiving a training in other arts forms) showed significant SET effects on emotional empathy and theory of mind. These findings demonstrate in the first place that emotional empathy and theory of mind seem to be malleable by means of training — even long past the early childhood when these skills emerge. More importantly, they also suggest that both capacities are significantly enhanced by role-playing but unfortunately not by engaging with the visual arts or with music — potentially because they were not designed as contents into these art engagements. However, when interpreting these findings, it must be considered that both studies are only quasi-experimental since group-assignments were based on the participant's preexisting interests. For that reason, it might again be possible that the differential effects of arts engagement are biased by self-selection effects. But even when taking this caveat into account, the findings by Goldstein and Winner (2012) do not provide any positive evidence for specific positive effects of visual arts engagement on emotional or cognitive empathy, presumably because these engagements might not have set the instructional focus as specifically as Kastner et al. (2021) did.

Effects of Visual Arts Engagement on Self-Concept Development?

The development of the self-concept is a third prominent socio-emotional domain (besides emotion regulation and empathy) for which transfer effects of visual arts engagement have been claimed in the literature. Here the focus is on global aspects of the self-concept (e. g., "*I am able to do things as well as most other people*") and not on the specific structure of the self-concept or on its specific contents. Some correlational studies have been reported that children exposed to multi-arts education scored higher on some subscales of the academic self-concept than those not exposed to the arts (e. g., Burton et al., 2000). In Burton et al.'s study, self-concept was measured by means of questions about how much they value themselves, their abilities, or achievements. Similarly, Catterall et al. (1999) collected longitudinal data yielding that children with high general arts engagement had a more positive academic self-concept than those with a lower general arts engagement. However, more controlled quasi-experimental comparisons of students with versus without visual arts instructions were not able to confirm a causal relation between visual arts engagement and self-concept development. For instance, Catterall and Peppler (2007) analyzed elementary school students who participated in visual arts courses and compared these to students from the same schools who did not participate in these courses. In this quasi-experimental study, no significantly higher gains were found for the visual arts students than for the control students regarding global self-concept or regarding the internal versus external attribution of success (e. g., "*Hard work is more important than good luck*"). Only for a subscale measuring self-efficacy (e. g., "*I have control over my future*"), higher gains were found for students in the visual arts course. A similar lack of convincing evidence for overall arts effects on self-concept development has also been found for other arts forms besides the visual arts. For instance, several experiments addressing the effects of theater on self-concept yielded no effect (e. g., Beales & Brook, 1990; Freeman, Sullivan, & R., 2003; Warger & Kleman, 1986). Also, a meta-analysis by Conrad and Asher (2000) failed to find any effect of theater on the self-concept development of elementary school students.

6.1.2 Why are There no Convincing Demonstrations of SET Effects of Visual Arts Engagement yet?

As reviewed in the three previous sections, there are basically no convincing demonstrations of causal SET effects of visual arts engagement in the domains of emotion regulation, empathy, or self-concept development yet, at least when these engagements are not intentionally designed to focus on SET effects as their content domains (cf. Kastner et al., 2021). According to Holochwost et al. (2021) this situation might be mainly due to the fact that existing empirical studies are often not specific enough in terms of delineating the effects of (1) particular forms of arts education, offered in (2) certain contexts, on (3) specific domains of children's socio-emotional development. In the following three sections we will elaborate on these three issues to establish a much more specific than usual visual arts intervention for stimulating very specific SET effects. The resulting intervention will then be investigated in an experimental study.

Forms of Arts Education: What are the Strengths of Visual Arts Engagement?

Arts engagement in general is not a monolithic block of activities but rather a diverse range of artistic practices with differential potentials for general transfer effects. Based on this assumption Hetland et al. (2013) developed the so-called *studio habits of mind* approach for the visual arts by systematically observing and categorizing the activities constituting pivotal ingredients of high quality standard visual arts classrooms. Studio habits of mind have been analyzed not only for the visual arts but also for other arts forms such as music (Hogan & Winner, 2019) or theater (Goldstein & Young, 2019). For the visual arts, Hetland et al. (2013) came up with eight cognitive and motivational skills that seemed to be fundamental to any artistic engagement in this form of arts education. They described these skills as “studio habits of mind” and conceptualized them as crucial mental processes in creating visual artworks. Based on the important role of these skills for visual arts engagement, the authors considered them to be the theoretically most plausible candidates for general transfer effects. These skills are (1) *developing crafts*, (2) *engaging and persevering*, (3) *envisioning something*, (4) *expressing oneself*, (5) *observing closely*, (6) *reflecting*, (7) *exploring*, and (8) *understanding artistic worlds*. When considering this list, it is obvious that socio-emotional skills such as the ones mentioned above are not included in the studio habits of mind. Accordingly, these skills seem not to be at the core of what is usually being taught in standard visual arts classrooms and therefore might have a smaller chance of being practiced during arts making than the skills at the core of visual arts engagement.

Therefore, a lack of socio-emotional outcomes of standard visual arts engagement is theoretically not very surprising as visual arts engagement usually does not focus on practicing socio-emotional skills (Winner, Goldstein, et al., 2013). Standard visual arts engagement does simply not *per se* involve perspective taking or empathic concern by stepping into the shoes of other persons or imagining oneself in unknown roles and situations (other than, for instance, theater education). It also does not address necessarily the reappraisal of strong negative emotions. Therefore, visual arts engagement will usually not provide a strong context for practicing skills that are tightly related to self-concept development, empathy, or emotion regulation. Accordingly, one might argue that there is no theoretical reason to expect that visual arts engagement will make children *per se* more competent regarding socio-emotional skills.

This implies that visual arts programs will only be able to yield causal SET effects when they are designed to do so by focusing on contents of the arts engagement that allow for embedding opportunities to practice socio-emotional skills. The generic strength of visual arts engagement in terms of the studio habits of mind involved might be very helpful to deeply process these contents but they must be primarily used to really push students to focus on socio-emotional contents and skills. When these aspects are not a pivotal part of a visual arts engagement, no sufficient opportunities for improving these socio-emotional skills will be provided. In other words, the visual arts might not allow *per se* for SET effects, but rather working on socio-emotional contents in the medium of visual arts with a high level of engagement might do so. Therefore, in the present study we will rely on a visual arts program that was specifically designed for practicing socio-emotional skills during creating artworks (cf. Kastner et al., 2021). Moreover, as this program is based on digital drawing on tablets, we will also be able to analyze participants' levels of engagement in the drawing tasks that we consider to be a core variable for the program's success according to the line of reasoning above (as we could demonstrate for the emotion course in Kastner et al., 2022, Submitted for Publication).

Context of Arts Education: What to Deliver Where and to Whom?

Besides specifically designing visual arts programs to stimulate very specific SET effects (i. e., adding a specific content focus), the context in which arts engagement takes place might be another important aspect for the elicitation of SET effects. According to Holochwost et al. (2021) crucial aspects of the context might be the *characteristics of a program*, the *institutional setting*, and the *characteristics of the individuals* that either provide a program (e. g., teachers) or participate in it (e. g., students). As already mentioned in the previous section, the content focus of a program might be a key component for eliciting SET effects due to the lack of socio-emotional skill practicing in standard visual arts education. Developing a socio-emotionally focused program was therefore of primary importance for our own study (for details see below).

Second, the setting in which the program takes place might be a relevant variable. Visual arts education for adolescents will be typically provided by schools and art museums. In our own study we choose a museum setting for delivering the program, mostly because it is easier in a museum context to confront students with unexpected and novel information and situations, which is known in creativity research to support flexible and creative thinking (Sassenberg et al., 2021). Moreover, there is evidence from visitor research that visiting an art museum stimulates processes of self-reflection and self-interpretation, which might help to keep students engaged in the arts tasks and therefore support eliciting SET effects (Falk, 2008, 2009).

Third, regarding students' characteristics, theoretically almost any factor could influence the potential of an arts engagement for yielding SET effects (Holochwost et al., 2021). But particularly students' personal prerequisites regarding their socio-emotional skills might play an important role as moderators of visual arts effects on socio-emotional outcomes. However, these prerequisites are rarely considered in research on SET effects so far. As an exception, there is some research indicating that visual arts performances might help students to improve their self-concept — but only when the students possess a relatively low level of self-concept initially. For instance, DeBettignies and Goldstein (2020) found beneficial effects of improvisational theater on the self-concept development. In their study, elementary school students aged 8 to 11 participated in an experimental, repeated-measures control-group design and were randomly assigned to improvisational theater classes or study hall, switching halfway through the academic year. Self-concept was tested three times (at the beginning, before the semester switch, and at the end). The results showed a significant positive effect of improvisational theater classes on self-concept, but only for those students who began with a relatively lower level of self-concept. Similarly, theater interventions in five different classes and found substantial improvements in self-concept only for students with relatively lower entry levels of self-concept. These findings are consistent with Emler's (2001) proposal that interventions addressing the self might in general work best for individuals with a relative deficiency in a relevant socio-emotional skill.

The same reasoning might apply to programs intended to foster children's empathic skills, which might be deeply rooted in their personality structure as an important prerequisite. For instance, there is overwhelming conceptual and correlational evidence that one of the "big five"/"HEXACO PI-R" personality traits, namely agreeableness, plays a key role in the development of empathy during childhood (e. g., Lee & Park, 2020; Mooradian et al., 2011; Song & Shi, 2017). According to Mooradian et al. (2011), there is a tight conceptual relation between agreeableness and empathy since agreeableness describes a prosocial and communal orientation toward others that includes facets such as altruism, tender-mindedness, trust, and modesty. They point out that the adjective lists used to measure agreeableness even include person descriptors that explicitly point to empathy such as "caring" or "empathic" (cf. Goldberg, 1990). Accordingly, Graziano et al. (2007) also found empirically that empathy was substantially related to agreeableness even when gender, social desirability, and the remaining big five constructs (i. e., openness to experience, conscientiousness, extraversion, neuroticism) were controlled for, whereas empathic concern was not significantly associated with the remaining four personality traits of the big five model (Costa & McCrae, 1992; Danner et al., 2019). This strong correlation between empathy and agreeableness has been demonstrated repeatedly (e. g., Lee & Park, 2020; Mooradian et al., 2011; Song & Shi, 2017). In line with this substantial empirical overlap, it has also been argued that both agreeableness and empathy are related to similar neurophysiological mechanisms including the human mirror neuron system (Cheng et al., 2009; DeYoung, 2010). Therefore, lower entry levels of empathy and agreeableness might be important moderators of intervention programs aiming at stimulating empathic skills.

Some evidence for this assumption can be found in the developmental literature. Here, it has been claimed that supportive parenting might foster agreeableness in adolescents, which in turn might predict empathy (Schofield et al., 2012). However, when these three factors were investigated simultaneously in a longitudinal study with adolescents (Van Heel et al., 2020), a different picture emerged. The transactional relations between the three variables were better in line with the idea that agreeableness predicts both supportive parenting and empathy in adolescence: More agreeable children might receive more parental support and therefore experience more opportunities to learn and train empathic skills while observing empathic concern and perspective taking from their parents. Interestingly, there was even an association between parental support and empathy when agreeableness was controlled for. And there was a unidirectional link between empathic concern and perspective taking in the future, probably because empathic concern motivates children to engage in perspective taking. Thus, Van Heel et al. (2020) found two different pathways to empathy, namely personality (agreeableness) and parental support (opportunities to observe and practice empathy). The essence of this story might be that opportunities and motivation for practicing empathy are the core issues: Adolescents with lower levels of agreeableness might (1) generally experience less empathic responses by their parents and thus have less opportunities for observing and practicing empathy, nevertheless (2) when they are provided with such opportunities, they might benefit from them in terms of developing their empathic skills.

In an intervention context, this might imply that particularly those adolescents that (1) have lower levels of agreeableness and additionally (2) have lower levels of experiences with opportunities to develop empathic concern and perspective taking and (3) thus have developed only lower levels of empathic skills might be the ones that would benefit the most from forced opportunities for practicing empathy — at least if they are (4) really engaging themselves in these opportunities. For instance, a suitable arts engagement that would stimulate this group of students to actively engage in empathy over a longer period might constitute a substantial learning experience with measurable SET effects, whereas for a group with higher entry levels of agreeableness and empathy such an intervention might not provide a training opportunity that substantially goes beyond what they have already experienced. Accordingly, there might be no strong argument why highly agreeable adolescents who probably have been provided with sufficient learning opportunities for empathy due to parental support should benefit from another round of opportunities to practice empathy in the context of a visual arts engagement. Therefore, there might be levels of escalation with regard to the potential SET effects of visual arts programs designed to support empathy. First, they might only work for students with lower entry levels of empathy that can still benefit from training. Second, they might even better work when low empathy levels go back to low levels of agreeableness and thereby a potential lack of training opportunities. Third, it might only work well for low agreeable and low empathy students if one can motivate them to really engage in practicing empathy (and they might not be strongly motivated by themselves). If a combination of these three factors *entry level*, *personality*, and *engagement* can be achieved, the chances of eliciting relevant SET effects should be best.

Domains of Children's Socio-Emotional Development: What SET Effects to aim at?

According to Holochwost et al. (2021), when developing visual arts programs for practicing socio-emotional skills in the context of creating artworks it will be of pivotal importance that these programs are intentionally designed around specific and well-designed target constructs that (1) come with a plausible theory of change and fit the developmental stage of the child, that (2) link activities and tasks to specific domains of children's socio-emotional development, and that (3) allow for adequate measurements for identifying changes.

In line with these constraints, the visual arts program investigated in this paper addresses a specific target construct, namely the complexity of the self-concept structure (i. e., self-complexity), a construct that is on the one hand related to adolescents' general self-concept development but on the other hand also to their abilities for perspective taking and empathy. Self-complexity strongly develops during adolescents due to role differentiation. Of course, even young children have a self-concept, but it is still very broad and general (Holochwost et al., 2021). With increasing age, the self-concept becomes more nuanced. For instance, in middle childhood children distinguish their academic and their athletic self-concept. By adolescence, individuals see themselves differently in contexts such as different academic subjects (Marsh & Ayotte, 2003; Marsh et al., 2018). Visitor research in art museum indicates that arts might be a context that spontaneously invites self-reflection and self-interpretation, and thus stimulates engaging in a better understanding of one's self and one's different self-aspects in the sense of Linville (1985, 1987) and Simon (1997, 1998, 1999, 2004). Moreover, it could be shown that visual arts engagement and specifically the creation of visual arts deploys and develops neural structures that are not only responsible for processing visual arts but also for cognitive processes related to the self of a person, such as episodic and autobiographic memory, introspection, self-monitoring, and prospection and for processes related to empathy in the sense of the comprehension of emotional states and intentions of others (Bolwerk et al., 2014; Li et al., 2014; Vessel et al., 2012). Therefore, self-complexity might be a much better target construct to be addressed by visual arts programs than global self-concept development as investigated by Burton et al. (2000), Catterall et al. (1999) or Catterall and Peppler (2007). As Winner, Goldstein, et al. (2013) put it, there is no theoretical reason why arts engagement, leading to a gain of competencies in a specific arts form, should improve general self-concept more than gaining competencies in any other (academic) subject matter. Moreover, global self-concept is a broad construct which is hard to address specifically (see critics of Holochwost et al., 2021). On the contrary, there is a theoretical reason that arts engagement should lead to more elaborated and nuanced processing of self-related information thereby fostering self-complexity, which is a much narrower construct.

According to Linville (1985, 1987), self-complexity can be defined by the number and overlaps of multiple self-aspects that might include social roles and relationships or future and past selves together with the traits, abilities, behaviors, or other attributes characterizing them. Linville argued that high levels of self-complexity might be beneficial and protective particularly in the case of negative life events because "*only a relatively small proportion of the 'total' self is affected*" by these events (Rafaeli-Mor et al., 1999, p. 343). If persons, however, possess only a small number of self-aspects, a stressor might affect a greater proportion of the 'total' self.

In designing a visual arts program intended to increase adolescents' level of self-complexity, the pivotal challenge is to link specific artistic activities and tasks to this specific domain of children's socio-emotional development. Based on the literature review above pointing to a principal overlap between arts engagement and empathic processing (Bolwerk et al., 2014; Kou et al., 2019), we decided to develop an empathy-based approach to self-complexity. That is, rather than asking adolescents to represent in the context of a visual arts project their own multiple self-aspects and their commonalities and differences — which might be quite annoying for this age group — we asked them to imagine the multiple and partially conflicting self-aspects of figures depicted in artworks and to express their imagination artistically. Here we relied on the idea that this empathic task might enrich the imagined self-complexity of the target person represented in the artwork and that this increased complexity level would be reflected in adolescents own self-representation. In other words, wie tried to combine the effects on self-reflection that have been demonstrated for art museum visits with the theater-like empathy effects of stepping in someone else's shoes in detail by means of an artistic perspective taking (e. g., Goldstein & Winner, 2012).

On a theoretical level, the assumed connection between the complexity of the self-representation and the complexity of representations of other persons can be justified by several findings from basic cognitive and social psychology: For instance, according to the simulation theory of mindreading, individuals use multiple aspects of themselves as a starting point for understanding other people. That is, people draw on what they know about themselves — their personal experiences, preferences, traits, and beliefs — to make inferences about others (Allport, 1924; Camerer et al., 1989; Nickerson, 1999; Ross et al., 1977). Research on this simulation strategy of mindreading has focused on the consequences of this strategy for understanding *others*. However, there is also recent work showing that simulating others influences self-knowledge, with trait and memory measures becoming similar to a "simulated other" after adopting their perspective (Meyer et al., 2019). Brown et al. (2009) demonstrated that the alignment of self- and other-representation does not only take place at the trait level but also affects the complexity of the representations. They used a perspective-taking task that has been found to increase the overlap between the cognitive representation of another person and oneself by increasing the number of traits seen as descriptive of both oneself and the other person (e. g., Davis et al., 1996; Galinsky & Moskowitz, 2000) and found that this task also increased the correspondence between participants' self-complexity and perceived complexity of the person whose perspective was taken.

Based on this reasoning, we developed an empathy-based visual arts program in which we asked adolescents to intensively work on artworks showing persons either in conflicting social roles or with conflicting self-aspects, whereby we focused on conflicts between competence- and relationship-oriented social roles (cf. methods sections »*Empathy-Based Drawing Tasks Related to Self-Concept and Historical Periods*« for the concrete operationalization of social roles). The idea of this self-concept course was to stimulate perspective taking and the construction of an other-representation of high complexity. We used the studio habits of mind for the visual arts to stimulate an intensive engagement with the course topic presupposing that a specific artistic task or activity focusing on socio-emotional contents such as self-complexity might be more intense when habits such as precise observation, engagement, imagination, reflection, etc. are involved. We assumed that synergies between the generic characteristics of visual arts engagement in the sense of studio habits of mind and the more specific contents of an artistic task that is actively designed to address self-complexity might occur. Therefore, we considered not only students' personal prerequisites in terms of their entry levels of empathy or agreeableness as important moderators but also measured their engagement in drawing processes (on tablets) when working on the artistic empathy tasks as an important mediator of SET effects. In an experimental study, we compared the self-concept course to a structurally complete equivalent standard visual arts course focusing on arts history (epoch course).

6.1.3 Research Questions

In the present study, we were interested in studying SET effects of specifically designed visual arts courses that deploy studio habits of mind to engage with socio-emotional contents in an experimental field trial (cf. Hetland et al., 2013). Based on the idea that self-complexity can be changed through a deliberately designed visual arts training, we focused in the present paper on the comparison of two three-weeks lasting visual arts courses taking place in the Herzog Anton Ulrich Museum in Braunschweig (HAUM, cf. Kastner et al., 2021). The courses focused either on conflicting social roles and self-aspects (self-concept course, treatment) or on historical periods (epoch course, control) and belong to a larger data set in which additionally a third course focusing on emotion recognition abilities was studied. In the overall analysis of this data set (Kastner et al., 2021), we compared all three visual arts courses to analyze the specificity of the SET effects, while in the present analysis we focus on the question of whether a combination of additional potential influencing factors might be responsible for the effects on self-complexity found in Kastner et al. (2021), namely *personal prerequisites* in terms of both *entry level skills* regarding *empathy* and *personality* traits in terms of agreeableness as well as *engagement*. These factors might be important to achieve large SET effects on self-complexity from a visual arts engagement. A similar delineation of course effects has been conducted for the emotion course and its SET effects on emotion recognition performance in Kastner et al. (2022, Submitted for Publication). In this paper we will focus on testing three hypotheses:

First, in line with the overall analysis (Kastner et al., 2021), we hypothesized higher gains on self-complexity (pre-post comparison) in the self-concept course as compared to the epoch course (Hypothesis 1, *Specificity Hypothesis*). We will test this assumption by a reanalysis of Kastner et al. (2021) with two instead of three courses.

Second, we hypothesized that visual arts engagement that stimulates students over a longer period to actively engage in empathic perspective taking regarding a person yielding conflicting social roles or conflicting self-aspects might work best when specific personal prerequisites are given. More concretely, we assume that it would mainly constitute a substantial learning experience for students with low entry level skills regarding empathy, which go together with low levels of agreeableness (associated with lower chances for opportunities to practice empathy across childhood). Providing opportunities to practice empathy in the context of a visual arts engagement that requires the construction of a highly complex other-representation might be most fruitful in terms of increasing one’s own self-complexity for this group of participants. Therefore, we expected that participants with low agreeableness and low initial empathy skills should benefit most from our visual arts program. In contrast, students with higher levels of agreeableness and high initial empathy skills might not benefit much from such a learning opportunity that might not substantially go beyond what they have already experienced across childhood (Hypothesis 2, *Personal Prerequisites Hypothesis*).

Third, this SET effect might only occur to a substantial degree if students deeply engage in practicing empathy during the drawing assignments in the visual arts program (Hypothesis 3, *Engagement Hypothesis*). Therefore, we implemented three drawing tasks as key components of the course. These drawing tasks focused on elaborating different and conflicting social roles or self-aspects and differed in their elaboration depth and in incorporating different aspects of the studio habits of mind (Hetland et al., 2013; for more detailed description of the drawing tasks, cf. methods section): First, we focused on *envisioning*, *closely observing of* and *expressing* different social roles and self-aspects by means of using postures, gestures, etc. to work out an elaborated visual other-representation. Second, we stimulated *reflecting*, *exploring*, and *understanding* different social roles and self-aspects of a person depicted in an artwork by assigning tracing, intensifying and selfie drawing tasks. During the drawing process using tablets, drawing features were collected as real-time process data potentially reflecting students’ levels of engagement in these tasks (e. g., number of strokes, drawing time, pressure, and tilt of the pen).

In sum, we expect that the chances to elicit relevant SET effects might be best under a specific constellation of *personal prerequisites* (in terms of entry level skills regarding empathy and personality traits in terms of agreeableness) and *engagement*.

6.2 Methods

6.2.1 Participants, Design and Procedure

Data from a total of 134 adolescents (74 females, 1 without gender information; $M_{\text{age}} = 15.86$, $SD_{\text{age}} = 1.27$; Range: 13–19 years) of Grades 8 to 11 of all school types in the district of Braunschweig (central Germany) were analyzed. Before the study was conducted, the adolescents and their parents gave written consent. Moreover, the study was approved by the local ethics committee of the University of Tübingen and fulfilled the guidelines of the regional council of Braunschweig. The data reported here is part of a larger study, in which in total three visual arts courses were compared with regard to the specificity of their SET effects (Kastner et al., 2021). In the present study, we analyze the process and outcome measures of the self-concept course and the epoch course in greater detail in a between subject design with pre-posttest measurement. Substantially, we extend the analyses reported by Kastner et al. (2021) with regard to possible important moderating factors for SET effects on self-complexity (cf. moderating factors on emotion recognition Kastner et al., 2022, Submitted for Publication). Potential moderating factors might be person's personality traits such as agreeableness on the one hand and detailed characteristics of the drawing process on the other hand. While the self-concept course aimed at stimulating a differentiated view of one's own self in terms of self-complexity, the epoch course was designed to convey competencies required to discriminate artworks from different historical periods by analyzing visual details (for more information about the course programs, cf. Kastner et al., 2020; Kastner et al., 2021). Two art educators were trained with a detailed manual (Kastner et al., 2020) and conducted the courses that were offered in two data collection phases. In both data collection phases, we studied two independent cohorts of participants randomly assigned at student-level (1st data collection phase: emotion course vs. epoch course; 2nd data collection phase: self-concept course vs. epoch course). Due to self-selection effects, participants were not allowed to switch their randomly assigned courses. In the final sample analyzed here, we oversampled the control course (epoch course: $n_{\text{epo}} = 84$) as compared to the intervention (self-concept course: $n_{\text{self}} = 50$) to increase the power of our statistical analyses.

6.2.2 Tasks and Questionnaires

Self-Complexity Task

Based on Linville (1985, 1987) concept of self-complexity, we developed a novel paper-pencil task for this study to capture participants' structural self-representation. Self-complexity describes the number and overlaps of self-aspects, which Linville measured with the so-called dimensionality statistic (H). This H-index is generated by a trait-sorting task in which participants are instructed to sort a set of trait words into meaningful categories or groups, such that each group consists of those traits that are descriptive of the participant in some aspect of his or her life. The choice of categories is therefore idiosyncratic as is everyone's sorting of the traits into these categories. An individual's H score is then computed based on the number of groups and the overlap of traits across these groups. A larger number of groups and a lower overlap of traits across these groups reflect higher levels of self-complexity (e. g., depression, Linville, 1987; Rafaeli-Mor & Brown, 1997). This unitary self-complexity measure, however, has been discussed quite controversially in the literature with some researchers recommending to use alternative measures of self-complexity, particularly because in the H score the number of self-aspects and the overlap in their characterizations is mixed up (Locke, 2003; Rafaeli-Mor et al., 1999). For instance, Rafaeli-Mor et al. (1999) proposed to come up with measures that particularly reflect the degree of distinctiveness or overlap among self-aspects.

Based on these discussions and on two more specific arguments in the context of our study we developed our own variant of the self-complexity task: First, as we focused on conflicts between competence- and relationship-oriented social roles in our self-concept course we wanted to ensure that both types of roles would be present in participants grouping. Therefore, we asked participants first to characterize themselves in their role as a student and in their role as a child. Second, as we had to administer the self-complexity task in a group setting with a fixed amount of available time, we aimed at a more standardized task procedure than usual. In previous research, Pilarska and Suchańska (2015) found that in the standard sorting task paradigm participants self-descriptions contained five self-aspects on average with a mean value of three adjectives per self-aspect. However, there was a large variation in how many self-aspects were introduced by participants, ranging from one to twelve self-aspects. We aimed at reducing this variation for our standardized group setting by asking participants to characterize themselves in five social roles that are important in their lives (i. e., student, child, and three additional social roles). Thus, in line with Rafaeli-Mor et al. (1999) we focused not so much on the number of self-aspects provided by participants but on the overlap between the characterizations of these self-aspects. In particular, we asked participants to produce more adjectives than they would spontaneously provide on average according to Pilarska and Suchańska (2015) in order to increase the probability of adjectives being used in more than one role in case that these social roles are not that much differentiated. We standardized the number of traits (i. e., adjectives) that we asked for as a characterization of each social role (i. e., self-aspect) by instructing participants to provide five adjectives for each social role (i. e., 25 adjectives in total to characterize all 5 social roles).

In our self-complexity task, we presented students with a network form with themselves ("me") in the center, surrounded by 5 circles in which they were asked to fill-in significant self-aspects or social roles from their lives (child, student, and three others) and to characterize themselves in these roles with five adjectives each (see Figure 22[A] for the form and Figure 22[B] for an example of how the form was used by a participant). To find appropriate adjectives, participants had the option to choose adjectives from a given list of 100 common adjectives for person descriptions (Aron et al., 1992) or to self-generate "new" adjectives that were not entailed in the list.

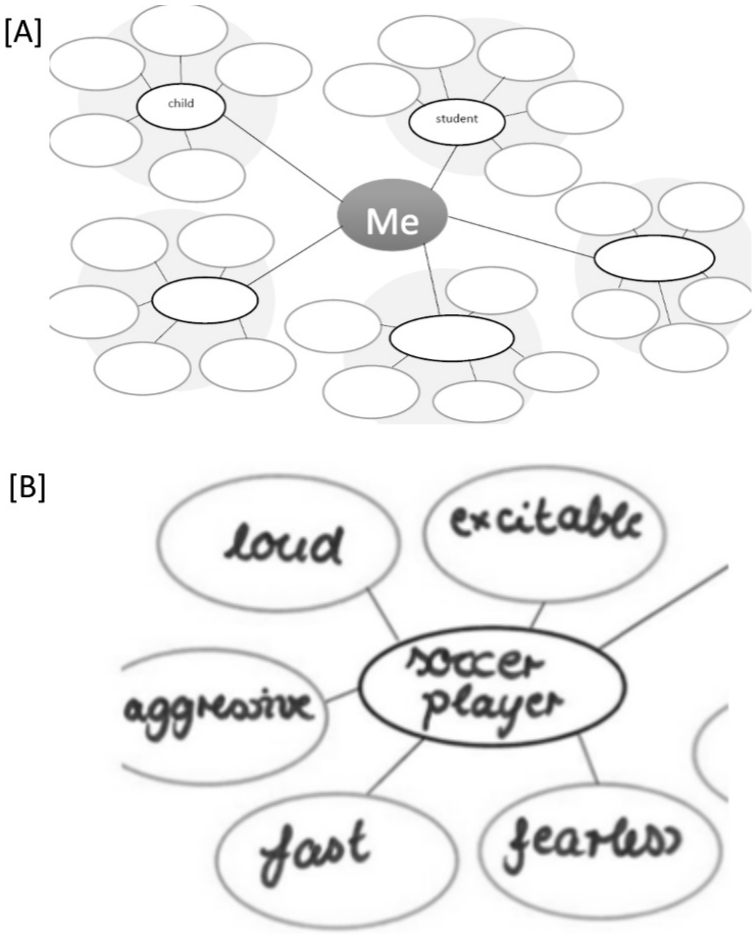
To determine participants' self-complexity, we calculated two metrics as dependent variable (DV). First, it might be the case that participants used the same adjectives in multiple social roles, and this in turn reduced the number of used adjectives in total indicating lower self-complexity. Accordingly, we counted the *number of duplicate adjectives* used for self-characterization in the five social roles as DV1. This measure should particularly reflect the degree of distinctiveness or overlap among self-aspects in line with Rafaeli-Mor et al. (1999). Second, we were interested in the proportion of self-generated adjectives among the five adjectives we asked for per self-aspect or social role (DV2, without duplicates, $\mathrm{APR}_{\mathrm{self}}$). This measure was intended to quantify the originality and precision of the self-descriptions. The idea was that if participants would use adjectives that were not contained in the list with 100 common adjectives for person descriptions this would reflect that their own self-perceptions in different roles are more precise or less stereotypical than if they would only use adjectives from the list. Thus, we assumed that when using self-generated adjectives for characterizing important roles in one's life participants would indicate a more differentiated and complex self-concept than when using only adjectives from a given list[24]. Since some participants ($n_{\mathrm{pre}} = 24$, i. e. 17.91 %; $n_{\mathrm{pre}} = 28$, i. e. 20.90 %) did characterize themselves by less than five social roles we used the following standardization procedure to calculate the hypothetical number of self-generated adjectives per five roles ($\mathrm{APR}_{\mathrm{self}}$, cf. Equation (2)) as DV2 in this paper:

$$APR_{self} = \frac{\text{"Number of self-generated Adjectives (without duplications)"}}{\text{"Number of Roles"}} \times 5 \qquad (2)$$

[24]Due to the fact, that the list of adjectives was present for all participants, we can only identify adjectives not written on the list as self-generated. We are aware of the fact that it might have happened that a participant self-generated also adjectives that are written on the list, but without using the list. However, as we are not able to differentiate between these scenarios, we decided to use solely those adjectives, that can be unambiguously classified as self-generated.

Figure 22

Example of [A] Adolescents' Self-Complexity Task and [B] Filled-in Social Role of an Adolescent



Note. In [B] the adolescent sees her- or himself as a soccer player and labels her- or himself with the characteristics (loud, excitable, aggressive, fast, and fearless).
Kastner, L., Umbach, N., Jusyte, A., Cervera-Torres, S., Ruiz-Fernández, S., Nommensen, S., & Gerjets, P. (2021). Designing visual arts education programs for transfer effects: Development and experimental evaluation of (digital) drawing courses in the art museum designed to promote adolescents' socio-emotional skills. *Frontiers in Psychology*, *11*(603984), 1–22. doi: `https://doi.org/10.3389/fpsyg.2020.603984` © Frontiers.

Empathy

As outlined in the literature review, there seems to be a strong relationship between empathy, self-complexity, agreeableness, and parental support (Van Heel et al., 2020). In line with that, we identified in Kastner et al. (2021) a interaction between empathy and self-complexity. More concretely, the effect on self-complexity was moderated by the degree of empathy (high vs. low, cf. Kastner et al., 2021) which describes the ability to empathize (*"think into"* or *"feel into"*) with another person on a cognitive or affective level. Therefore, we included empathy in the present analyses. We used the *Toronto*

Empathy Questionnaire (TEQ, Spreng et al., 2009) consisting of 16 items. Participants had to answer on a 5-point Likert scale from [1] *never* to [5] *always* (example item: "*I can tell when others are sad even when they do not say anything*"). A high sum score describes a strongly developed ability empathic skills. The TEQ is a compound measure of emotional and cognitive (i. e., perspective taking) empathy.

Agreeableness

Since strong relations between empathy and agreeableness (but not other personality traits from the big five) were found in the literature (e. g., Graziano et al., 2007; Mooradian et al., 2011; Song & Shi, 2017; Van Heel et al., 2020), we used the HEXACO PI-R to assess participants' personality (Lee & Ashton, 2004; Moshagen et al., 2014). The HEXACO PI-R describes the personality of a person on six dimensions in total (*honesty-humility*, *emotionality*, *extraversion*, *agreeableness*, *conscientiousness*, and *openness to experience*). In accordance to Graziano et al. (2007), the relation between empathy and agreeableness even exist when we control for gender, social desirability and the other personality traits. Participants were asked how much they agreed or disagreed with each item on a 5-point Likert scale from [1] *strongly disagree* to [5] *strongly agree* (example item for agreeableness: "*If I want something from a person I dislike, I will act very nicely toward that person in order to get it*").

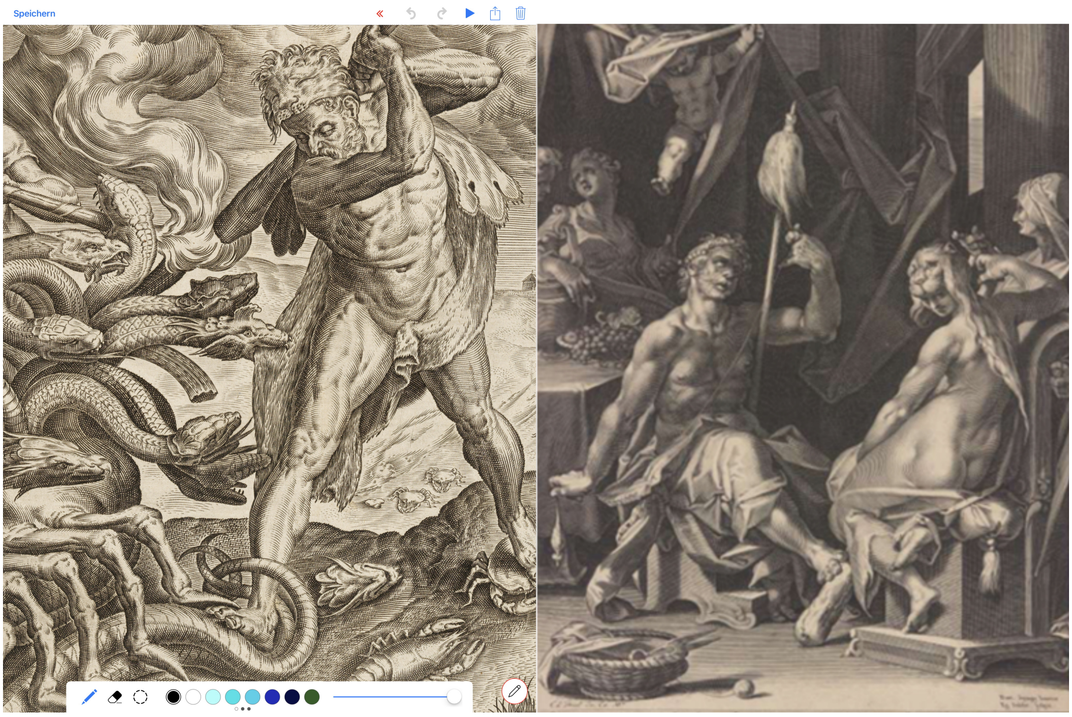
6.2.3 Digital Drawing on Tablets

Measuring Drawing Features

Central elements of the visual arts engagement in this study were empathy-based drawing tasks that involve participants in either elaborating on the complexity of the self-concept of a person depicted in an artwork or on elaborating on the visual details of portraits from different historical periods. All drawing tasks were performed on tablets (12.9" Apple iPad Pro) with a digital drawing pencil (Apple Pencil) using a specific iOS drawing application, which was developed and implemented for the present study (*Strokey*, Jaszkowic, 2018, see Figure 23 for a screenshot of the application). With this digital drawing approach, we were on the one hand able to benefit from motivational aspects of digital media (e. g., their potential for facilitating drawing processes or for using selfies as a basis for portrait drawing, which might support putting oneself in other roles (Kucirkova, 2021; Milivojević, 2014)). On the other hand, it also allows to record detailed features of the drawing processes, potentially enabling novel insights into underlying cognitive, motivational, and personality-related mechanisms of engaging in the creation of artistic drawings. According to our Engagement Hypothesis, we expect that participants who deeply engage with the empathy-based drawing tasks in the self-concept course (which might be detectable from analyzing the drawing data)

Figure 23

Example of the Drawing Material[a,b] in the Self-Concept Course in the Drawing App 'Strokey'



Note. At the bottom of the page several drawing functions were available from left to right (pencil, eraser, cut-and-paste, colors, fade-interactions) and at the top of the page from left to right (undo, save, play the video sequence showing the drawing process, share your drawing, or delete).

[a]Cornelis Cort: *Heracles defeats the Hydra of Lerna.* Copperplate Engraving, 1563, Braunschweig, Herzog Anton Ulrich-Museum.

[b]Egidius Sadeler: *Hercules spins at the Omphale.* Copperplate Engraving, 1590–1629, Braunschweig, Herzog Anton Ulrich-Museum.

will experience stronger SET effects on self-complexity that those who do not engage substantially. Since it is not known from prior research how a deep engagement in a drawing task might be reflected in specific features of the drawing process, we exploratively analyzed the drawing features we obtained from the *Strokey* app. For instance, participants use of several functions for elaboration and editing was logged (see interaction elements at the bottom of Figure 23 pencils, colors, an eraser, zooms, fades, and a cut-and-paste-function; interaction elements at the top of Figure 23 undo, save or delete). With the *Strokey* app, we could also record and replay the whole the drawing process as a video sequence comprising the drawing and editing activities. Moreover, severally measures were recorded that describe how the digital pen was used exactly at each point in time. In total, 17 drawing features were used for analyses: time pencil on tablet (*M*, *SD*, Min, Max), number of strokes (SUM), number of erased strokes (SUM), number of used tools such as eraser, cut-out, zoom, or fade interactions (SUM), number

Figure 24

Adolescents in the Self-Concept Course in the First Course Session Introducing the Topic "Self-concept" in Front of the "Family Picture"[a] of Cornelis de Vos (1618–1619)

[a]Cornelis de Vos: *Family picture.* Oil Painting, 1618. Braunschweig, Herzog Anton Ulrich-Museum, Germany.

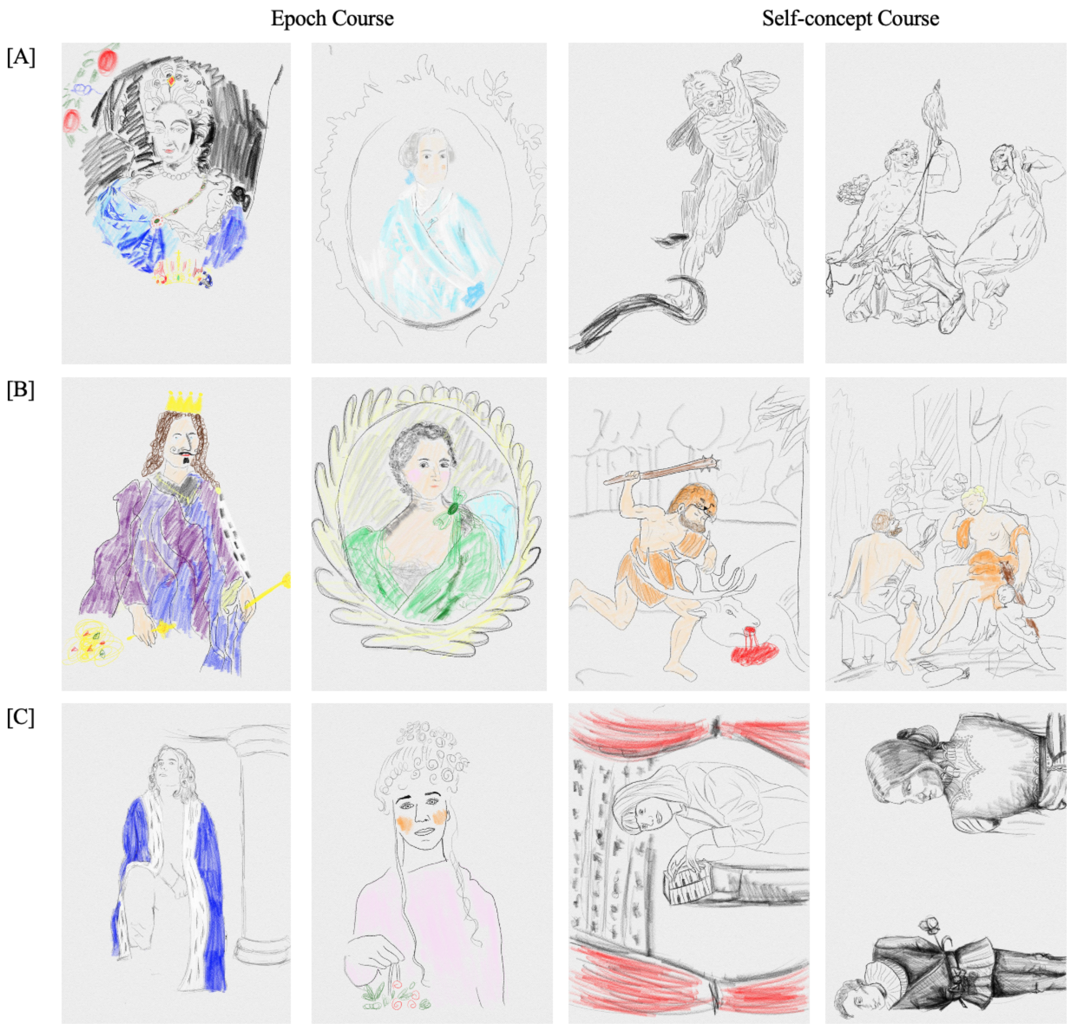
of used colors (SUM), number of zoom interactions (SUM), number of fade interactions (SUM), pressure exerted on the digital pen during drawing (*M*, *SD*, Max), and tilt of the pen due to the pen hold (*M*, *SD*, Min, Max), Potentially, all of these features could be plausible indicators of elaborated drawing processes. For instance, a participant drawing for a substantial amount of time, using many strokes and tools for the drawing, and displaying a high variability in pen pressure and tilt can be assumed to be more engaged than a participant with lower values on these variables. For a detailed description of all 17 drawing features see Kastner et al. (2022, Submitted for Publication).

Empathy-Based Tasks Related to Self-Concept and Historical Periods

We used three empathy-based drawing tasks to investigate whether drawing a specific topic, for instance, on socio-emotional skills yields specific learning outcomes in terms of more self-complexity. In Session 1, the courses were introduced in terms of their specific course topic on self-complexity or historical periods. While the self-concept course focused on the *Family Picture* of Cornelis de Vos (1618–1619), especially the girl

Figure 25

Examples of Participants' Drawings in the Three Different Drawing Tasks: [A] Tracing Drawing Task, [B] Intensifying Drawing Task, and [C] Selfie Drawing Task for the two Visual Arts Courses



Note. Epoch course with Baroque period (leftmost)/Rococo period (second from left); self-concept course with competence-oriented roles (second from right)/relationship-oriented roles (rightmost).

sitting in front of the piano and her social roles (*pianist*, *daughter*, *sister*, *fiancée*, Figure 24), the epoch course introduced the two historical periods of *Baroque* and *Rococo*. A detailed overview of the visual arts courses can be found in Kastner et al. (2021). In Session 2 and 3 of the courses, empathy-based drawing tasks had to be accomplished by the participants. These drawing tasks systematically increased in their difficulty. After a short familiarization phase with the tablet, participants started with the easiest drawing task, a *tracing* drawing task. In the self-concept course, participants had to draw *Hercules*, a hero from ancient mythology in different social roles or with different self-aspects. Participants should *trace* characteristic features of *competence* such as muscles or posture (i. e., Hercules as strong hero slaying the hydra, Figure 23) or *relationship* (i. e., Hercules as a vulnerable lover of Omphale, Figure 23). We used Hercules for drawing in the self-concept course because this example impressively shows adolescents that one's personality might differ depending on the situation, and that even a strong hero can be sometimes weak or vulnerable. In the epoch course, participants should *trace* characteristic features of the Baroque and the Rococo period (for more information, Kastner et al., 2021). Figure 25[A] shows examples of participants' drawings in the tracing drawing task for the two courses.

In the (moderately difficult) *intensifying* drawing task, participants received ambiguous portraits for drawing. Concretely, in the self-concept course a neutral representation of Hercules was used for drawing. Participants should change this representation in terms of characteristic features of either competence or relationship. In the epoch course, participants' task was to change the representation of a scholar into a Baroque prince (i. e., through a wig, cap, curtains, ermine fur) or a young girl into a classical representation of a lady of the Rococo period (i. e., by using pastel colors and characteristic symbols, such as flowers, books, or nature). Figure 25[B] shows examples of participants' drawings in the intensifying drawing task for the two courses.

In the (most difficult) *selfie* drawing task, participants should take selfies as basis for their drawings. In the self-concept course, we used de Vos' family picture as basis for generating competence- and relationship-oriented selfies and respective drawings (Figure 24). The participants should imagine themselves being a pianist, either practicing alone or with a teacher, or in a concert hall (competence-oriented) or imagine themselves being married to someone they do not love and how they would feel or act in this situation (relationship-oriented). In the epoch course, participants could use wigs and other requisites (e. g., a basket of flowers) to pose as a *Baroque prince/princess* or as a *Rococo gentleman/lady* for their selfie. Subsequently, they should draw a complete Baroque or Rococo scene using characteristic symbols and colors of the historical period. Figure 25[C] shows examples of participants' drawings in the selfie drawing task for the two courses.

6.3 Results

Data analyses were conducted with the free software R (R-Core-Team, 2020) and Matlab (Version 7.11.2; Thompson & Shure, 1995).

6.3.1 Demographic Data

We tested whether the courses differed regarding sociodemographic data (age, sex, personality [HEXACO PI-R], and empathy [TEQ]) and their pretest scores for $\mathrm{APR}_{\mathrm{self}_{(\mathrm{pre})}}$ and $\mathrm{duplicates}_{(\mathrm{pre})}$ in the self-complexity task before participating in one of the two courses. To do so, we conducted several *t*-tests for independent samples, which are presented in Table 14 together with the means and standard deviations for all variables tested. We found no differences between the two courses regarding age, sex (self-concept course: 30 female, 20 male; epoch course: 44 female, 39 male; $\chi^2(1) = 0.37$, $p = .545$), HEXACO PI-R (*honesty-humility*, *emotionality*, *extraversion*, *agreeableness*, *conscientiousness*, and *openness to experience*), TEQ, $\text{APR}_{\text{self}_{(\text{pre})}}$, and $\text{duplicates}_{(\text{pre})}$ (see Table 14 for results of the respective analysis of variances (ANOVAs)). This indicates that the two courses were comparable with respect to these variables before the intervention took place.

6.3.2 Specific Course Effects on Self-Complexity (*Specificity Hypothesis*)

To investigate whether the specific effect of the self-concept course on developing self-complexity (Kastner et al., 2021) could also be found when we compare only the self-concept course with the epoch course (cf. *Specificity Hypothesis*). Therefore, we calculated change scores of the number of self-generated adjectives per role ($\text{APR}_{\text{self}_{(\text{post})}} - \text{APR}_{\text{self}_{(\text{pre})}}$) the number of duplicates ($\text{duplicates}_{(\text{post})} - \text{duplicates}_{(\text{pre})}$). Because APR_{self} score is related to number of filled-in roles, we decided to do a linear transformation and multiplicate APR_{self} with factor 5. In the following, we report the linear transformed values for APR_{self}. Referring to the previous analyses (Kastner et al., 2021), we conducted as baseline models two analysis of covariances (ANCOVAs) with course (self-complexity vs. epoch) and TEQ (low vs. high) as predictors, age, and pretest as covariates, and APR_{self} and number of duplicates as dependent variables respectively. We used age and pretest as covariates because in the literature a strong relation between self-complexity and age was reported (Marsh & Ayotte, 2003). In general, descriptive deteriorations can be found in both dependent variables, in terms of a decrease in APR_{self} and a corresponding increase in duplicates (see Figure 26 and Figure 27). Surprisingly, this decrease could not be demonstrated for the self-concept course (target group). For the APR_{self} we found a significant Course × TEQ interaction, $F(1,107) = 4.16$, $p = .044$. This replicated our previous findings (reported in Kastner et al., 2021; see Table 2). Participants with low TEQ scores benefited from the visual arts engagement in the self-concept course ($M_{\text{self}} = 1.51$, $SD_{\text{self}} = 2.83$) in terms of generating more adjectives per role by themselves compared to participants in the epoch course ($M_{\text{epo}} = -0.31$, $SD_{\text{epo}} = 3.32$), $t(34.51) = -2.13$, $p = .020$. For participants with high TEQ scores, no difference between the courses were found (probably due to ceiling effects, APA, 2022). Figure 26 shows the change scores for APR_{self}.

Table 14

Means (M) and Standard Deviations (SD) and the Results for the ANOVAs for Age, HEXACO, TEQ, $APR_{self(pre)}$ and Duplicates(pre) for the two Courses

	Course				ANOVA					
	Epoch		Self							
	M	*SD*	*M*	*SD*	*MSE*	*F*	*df1*	*df2*	*p*	η^2
Age	15.93	1.21	15.74	1.37	1.10	0.68	1	131	0.410	0.01
Honesty-Humility	3.22	0.67	3.30	0.65	0.16	0.37	1	106	0.552	< 0.01
Emotionality	3.04	0.59	3.18	0.64	0.53	1.44	1	106	0.234	0.01
Extraversion	3.33	0.66	3.42	0.63	0.23	0.55	1	106	0.458	0.01
Agreeableness	3.05	0.58	3.19	0.47	0.52	1.78	1	106	0.185	0.01
Conscientiousness	3.37	0.53	3.49	0.48	0.40	1.51	1	106	0.222	0.01
Openness to Experience	2.95	0.06	2.90	0.62	0.05	0.14	1	106	0.714	< 0.01
TEQ	50.41	6.34	51.55	6.73	35.14	0.84	1	116	0.362	0.01
$APR_{self_{(pre)}}$	0.82	0.68	0.74	0.63	0.16	0.36	1	120	0.550	< 0.01
$Duplicates_{(pre)}$	5.30	4.08	5.13	3.71	0.78	0.05	1	120	0.824	< 0.01

Notes. APR_{self} = self-generated adjectives per role. Epoch = epoch course, self = self-concept course. TEQ = Toronto Empathy Questionnaire, HEXACO = Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, Openness for Experience.

Table 15
ANCOVA for the Change Over Time for APR_{self}

	SS	*F*	*p*-value
Intercept	7.70	$F(1{,}107) = 1.08$	0.302
Course	2.03	$F(1{,}107) = 0.28$	0.596
TEQ	6.17	$F(1{,}107) = 0.86$	0.355
Age	1.79	$F(1{,}107) = 0.25$	0.618
$\mathbf{APR_{self(pre)}}$	**204.99**	**$F(1{,}107) = 28.65$**	**$< 0.001^{***}$**
TEQ (high) × Course (self)	**29.73**	**$F(1{,}107) = 4.16$**	**0.044^{*}**
Residuals	765.47		

Note. $N = 134$ adolescents. Self = self-concept course, epo = epoch course.
$^{*}p < .05$, $^{***}p < .001$.

Besides the replication of our findings on APR_{self}, we were interested additionally in the number of duplicates. Results show again a Course × TEQ interaction. Participants with low TEQ scores used less duplicates in the self-concept course ($M_{self} = 0.00$, $SD_{self} = 3.18$) than in the epoch course ($M_{epo} = 1.76$, $SD_{epo} = 3.76$), $t(34.85) = 1.82$, $p = .038$. Surprisingly, participants with high TEQ scores in the self-concept course ($M_{self} = 1.91$, $SD_{self} = 3.48$) used more duplicates than participants in the epoch course ($M_{epo} = 0.09$, $SD_{epo} = 2.63$), $t(39.15) = \text{-}2.11$, $p = .021$. As already mentioned, a decrease in the number of self-generated adjectives might have occurred for the participants with high TEQ scores for motivational reasons, such as the task was too easy or too boring. Figure 27 shows the change scores for duplicates.

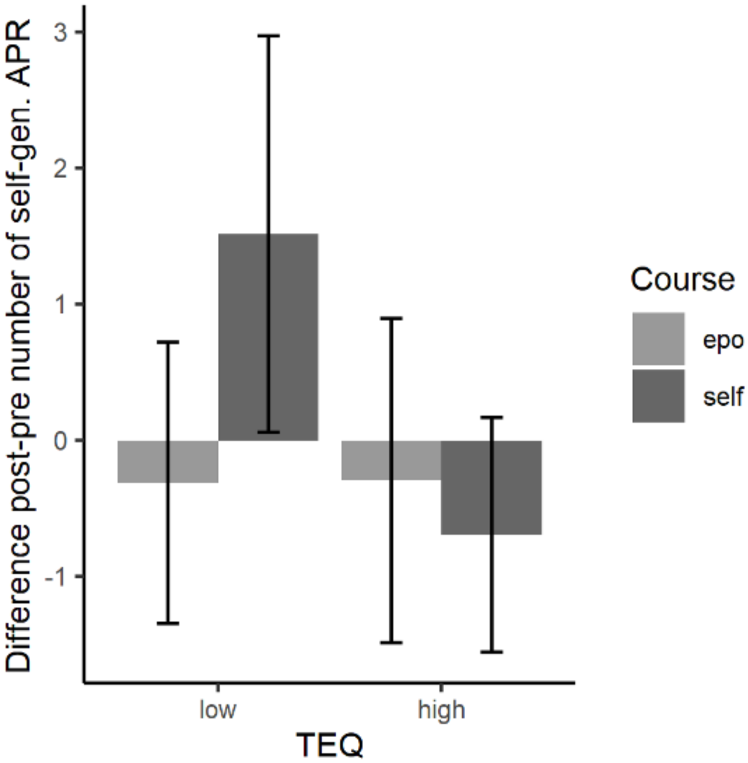
Additionally, we were interested in possible other moderators besides the TEQ, because the multiple R^2 only explained for APR_{self}, $R^2 = 25.41\,\%$ (adjusted $R^2 = 21.93\,\%$), and for duplicates, $R^2 = 15.31\,\%$ (adjusted $R^2 = 11.35\,\%$), of the variance in the data. We expected that personality traits (particularly agreeableness) and process features of the drawing activation might have a crucial influence. However, because the number of possible variations (the HEXACO PI-R comprises besides agreeableness five additional personality traits, the differentiation of high vs. low empathy [TEQ], and we determined 17 different drawing features) were too large to exploratively test everything (over 200 possible combinations) and such a multiple testing would also lead to a cumulation of alpha error (Ryffel, 2017), we decided to use a machine learning approach to identify most important moderators.

6.3.3 Exploratory Analysis: A Machine Learning Approach to Predict Gains in Self Complexity from Personality, Empathy, and Drawing Data

We chose a machine learning based approach to identify the most relevant features with regard to participants personality traits, their empathy level, as well as their draw-

Figure 26

Mean Change Scores for APR_{self}



Note. Epo = epoch course, self = self-concept course. TEQ = Toronto Empathy Questionnaire. The error bars represent the standard error of the mean.

Table 16

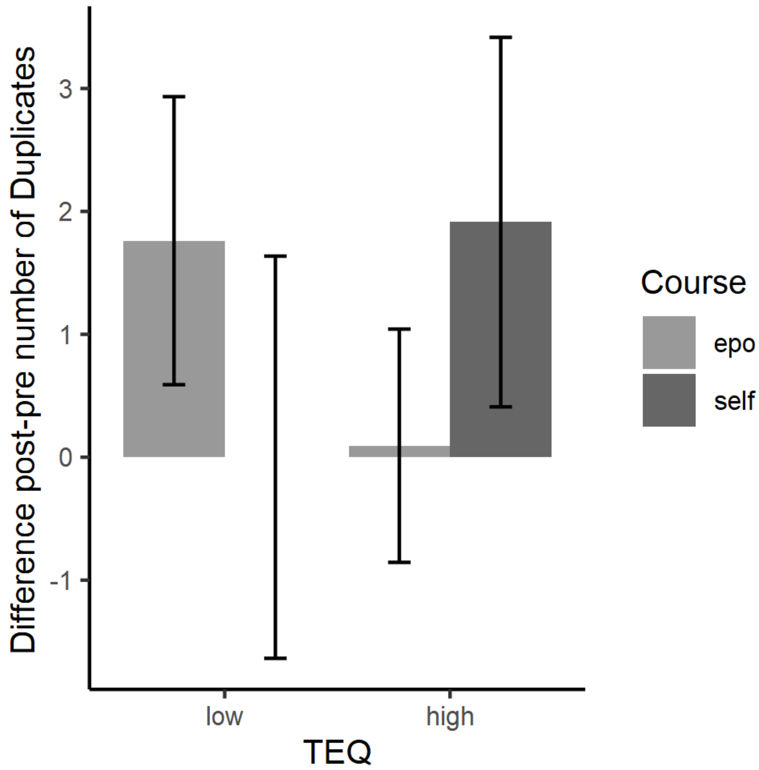
ANCOVA for the Change Over Time for Duplicates

	SS	*F*	*p*-value
Intercept	38.56	$F(1{,}107) = 3.73$	$0.056^{\dagger}$
Course	0.01	$F(1{,}107) < 0.01$	0.978
TEQ	0.06	$F(1{,}107) = 0.01$	0.939
Age	19.57	$F(1{,}107) = 1.89$	0.172
Duplicates$_{\mathbf{(pre)}}$	**92.52**	$\boldsymbol{F(1{,}107) = 8.94}$	$\mathbf{0.003^{**}}$
TEQ (high) × Course (self)	**76.06**	$\boldsymbol{F(1{,}107) = 7.35}$	$\mathbf{0.008^{**}}$
Residuals	1107.25		

Note. $N = 134$ adolescents. Self = self-concept course, epo = epoch course.
$^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$, $^{\dagger}p < 0.1$.

Figure 27

Mean Change Scores for Duplicates



Note. Epo = epoch course, self = self-concept course. TEQ = Toronto Empathy Questionnaire. The error bars represent the standard error of the mean.

ing behavior to predict gains in self-complexity. Supervised machine learning algorithms can handle large numbers of input features and are especially robust to the inclusion of irrelevant features. Regarding the 17 drawing features, we decided to not permute individual features but group them into a total of six feature groups (presented in Table 17) and to permute each whole group, because certain features (e. g., *M*, *SD*, Min, and Max of the same type) are highly correlated. The groups were: *Timing* (total time of pencil on screen, *M*, *SD*, Min, and Max of active time per stroke), *Number of Strokes* (number of strokes, number of eraser strokes), *Pressure* (*M*, *SD*, and Max), *Tilt* (*M*, *SD*, Min, and Max), *Used Tools* (number of used colors and additional tools), and *Zooms & Fades* (number of zoom and fade interactions) for the drawing features. The remaining features (i. e., the participants' characteristics) were permuted separately. Therefore — as a first step in our exploratory analysis — we trained models that apply all available data (six dimensions of personality traits, two levels of empathy, as well as the 17 different drawing features, that we grouped into the six categories: *Timing*, *Number of Strokes*, *Pressure*, *Tilt*, *Used Tools*, *Zooms & Fades*) at once to classify high from low levels of APR_{self} and duplicates. Based on these comprehensive models, we applied feature ranking techniques to identify the features that contribute most to the overall model performance. In a subsequent second step, we further analyzed the variables identified by this approach with ANCOVAs.

In the first step, we accordingly trained separate classification models for the self-concept and the epoch course using a total set of 28 single features each (17 feature groups: age, sex, TEQ, 6 HEXACO PI-R, 6 drawing feature categories/17 single drawing features, as well as either $APR_{self_{(pre)}}$ or $duplicates_{(pre)}$ depending on whether the classification models concerned APR_{self} or duplicates respectively; see Table 17 for the self-concept course data). We used a top vs. bottom 40 % data split in two separate models of either APR_{self} or duplicates to create a binary classification problem with some margin between the two classes. All classification models were created using random forests classifiers (Breiman, 2001; Ho, 1995). Random forests are ensemble learners which use a large number of weak learners to create a combined predictor. We found such models particularly suited for our application since random forests typically create very interpretable models and are robust to irrelevant features. All models were evaluated with repeated 10-fold cross validation using a 80/10/10 split for training, validation and test data. Models trained with data from the self-concept course achieved an average classification accuracy of 94.20 % on unseen data of APR_{self} and of 87.40 % for unseen data of duplicates (using 58 of 71 available data points), while models trained with data from the epoch course achieved an average accuracy of 80.22 % for APR_{self} and 79.11 % for duplicates (using 90 of 111 available data points).

The impact of single features was evaluated using permuted feature importance values. For this, we trained models with random permutations of certain features, effectively substituting the included information content with random noise. The degradation of classification accuracy corresponds to the importance of the respective feature within the final ensemble learner. The reported importance ratings were calculated by subtracting the results of the randomly permutated model with the unaltered version and thus a higher value means the feature is more important (with the maximum being the accuracy of the original models; $FI^j = e^{perm} - e^{orig}$). In Table 17 the classification models and identified feature importance values are presented for all used features.

6.3.4 Using Feature Importance to Prove Potential Moderation Effects (*Personality- & Engagement Hypotheses*)

Adopting this machine learning approach allowed us to identify feature importance values, that we use in the second step to investigate possible moderation effects for the features with the best classifications and to investigate our Personal *Prerequisites Hypothesis* and *Engagement Hypothesis*. As expected, and in line with our previous results, the TEQ showed the best classifications for APR_{self} and high classifications for duplicates. Regarding the new, additionally investigated features on *personal prerequisites* and *engagement* (indicated by the drawing process) in the present paper, we

Table 17

Self-Concept Course Data Were Used to Train Different Classification Models and Identify Feature Importance Values (for HEXACO-PI R, TEQ, Sociodemographics, and Drawing Features)

	APR_{self}	Duplicates
HEXACO-PI R		
Honesty-Humility	0.068	0.015
Emotionality	0.007	0.007
Extraversion	0.008	0.033
Agreeableness	0.052	0.031
Conscientiousness	0.010	–0.003
Openness to Experience	0.027	0.003
TEQ	0.089	0.024
Sociodemographics		
Age	0.003	0.017
Sex	0.014	0.002
Respective pre-value: $APR_{self_{(pre)}}$/Duplicates$_{(pre)}$*	0.028	0.009

	APR_{self}	Duplicates
Drawing Features		
Timing	0.013	0.002
Number of Strokes	0.008	–0.003
Pressure	0.008	–0.002
Tilt	0.045	0.065
Used Tools	0.002	0.017
Zooms & Fades	–0.004	0.025

*In the classification models concerning APR_{self} the $APR_{self_{(pre)}}$ was included, whereas in the classification models concerning duplicates the duplicates$_{(pre)}$ was included.

found as expected high classifications for the HEXACO PI-R scales of *agreeableness* (cf. Table 17). For the drawing feature categories, we found the strongest feature importance for *Tilt* (*M*, *SD*, Min, and Max). We analyzed the mean tilt ($tilt_M$) exemplarily for the whole feature group in the two following moderation analyses, since in the classical inferential statistics we could not integrate drawing feature categories. We tested these identified moderators (i. e., $tilt_M$ and agreeableness) in two separate ANCOVAs (APR_{self}, duplicates) by adding them into the respective baseline models ($DV \sim Course \times TEQ + Age + Pretest_{DV}$). Thus, we used in two respective analyses the predictors course, TEQ, agreeableness, and $tilt_M$ and included all main effects and possible interactions (also the four-way interaction: Course × TEQ × Agreeableness × $Tilt_M$) on the two dependent variables APR_{self} and duplicates. Results of the two ANCOVAs are presented in Table 18 for APR_{self} and in Table 20 for duplicates.

Influence on APR_{self}. We found a significant four-way interaction between Course × TEQ × Agreeableness × $Tilt_M$ on APR_{self} (as well as a tendency for a three-way-interaction between Course × TEQ × $Tilt_M$, and a significant two-way-interaction between Agreeableness × $Tilt_M$, that both have to be interpreted in the light of the significant four-way-interaction; see Table 18 for statistical values, Table 19 and Figure 28). As expected, only participants with low agreeableness and low empathy, who hold the

Table 18
ANCOVA for APR_{self} Dependent from Course, TEQ, Age, Pretest, $Tilt_M$, and Agreeableness

	SS	*F*	*p*-value
Intercept	10.21	$F(1{,}77) = 1.51$	0.222
Course (self vs. epo)	0.43	$F(1{,}77) = 0.06$	0.801
TEQ	3.35	$F(1{,}77) = 0.50$	0.483
Agreeableness	3.21	$F(1{,}77) = 0.48$	0.493
Tilt_M	3.02	$F(1{,}77) = 0.45$	0.506
Age	3.50	$F(1, 77) = 0.52$	0.473
$\mathbf{APR_{self_{(pre)}}}$	**173.53**	**$F(1{,}77) = 25.73$**	**$< 0.001^{***}$**
Course (self) × TEQ (high)	16.19	$F(1{,}77) = 2.40$	0.125
Course (self) × Tilt_M	9.42	$F(1{,}77) = 1.40$	0.241
TEQ (high) × Tilt_M	1.13	$F(1{,}77) = 0.17$	0.683
Course (self) × Agreeableness	5.02	$F(1{,}77) = 0.74$	0.391
TEQ (high) × Agreeableness	0.63	$F(1{,}77) = 0.09$	0.761
Agreeableness × Tilt_M	**31.45**	**$F(1{,}77) = 4.66$**	**0.034^{*}**
Course (self) × TEQ (high) × Tilt_M	0.11	$F(1{,}77) = 0.02$	0.897
Course × TEQ (high) × Agreeableness	**25.38**	**$F(1, 77) = 3.76$**	**$0.056^{\dagger}$**
Course (self) × Agreeableness × Tilt_M	2.87	$F(1{,}77) = 0.43$	0.516
TEQ (high) × Agreeableness × Tilt_M	0.01	$F(1{,}77) < 0.01$	0.967
Course (self) × TEQ (high) × Agreeableness × Tilt_M	**27.63**	**$F(1{,}77) = 4.10$**	**0.046^{*}**
Residuals	519.24		

Note. Self = self-concept course, epo = epoch course.
$^{\dagger}p < 0.1$, $^{*}p < .05$, $^{***}p < .001$.

pencil relatively flat above the tablet benefit from the self-concept course in terms of more self-generated adjectives, $F(1, 77) = 9.53$, $p = .003$.

Influence on Duplicates. We also found a significant four-way interaction for Course × TEQ × Agreeableness × Tilt_M on duplicates (as well as a significant three-way-interaction between Course × Agreeableness × Tilt_M, and a tendency for a three-way-interaction between TEQ × Agreeableness × Tilt_M, that again both have to be interpreted in the light of the significant four-way-interaction; see Table 20 for statistical values, Table 21 and Figure 29). Although, as expected, participants with low agreeableness and low empathy, who hold the pencil relatively flat, generate fewer duplicates, at least descriptively, when they participated in the self-concept course compared to the epoch course, this comparison (unlike the effect for self-generated adjectives noted above) was statistically not significant for duplicates, $F(1, 77) = 1.45$, $p = .232$. Unexpectedly, there were several significant effects for participants with high entry level skills regarding empathy. Firstly, participants with high empathy and high agreeableness, who hold the pencil relatively upright in the self-concept course generate more duplicates, $F(1,$

77) = 4.40, $p = .039$. Moreover, this analysis detected two statistically significant effects for participants with high empathy and low agreeableness: if these participants hold the pencil relatively flat, they generate more duplicates, $F(1, 77) = 5.36$, $p = .023$), whereas if they hold the pencil relatively upright, they generate less duplicates, $F(1, 77) = 5.18$, $p = .026$. It has to be noted, that this particular subgroup of participants — in line with the theoretical assumption that agreeableness plays a key role in the development of empathy (e. g., Lee & Park, 2020; Mooradian et al., 2011; Song & Shi, 2017) and thus participants with low agreeableness mostly also develop lower levels of empathy — consisted of only very few participants and thus cannot be meaningfully interpreted (see density plots; Figure 30). Figure 31 shows examples of participants with high and low tilt.

Figure 28

Change Over Time for APR_{self} Dependent from Course, TEQ, $Tilt_M$ and Agreeableness

Table 19

Means and Standard Errors (in Parentheses) of Self-Complexity (APR_{self}) as a Function of TEQ, $Tilt_M$, and Agreeableness

	TEQ											
	Low						High					
	$Tilt_M$ (M − 1 SD)			$Tilt_M$ (M + 1 SD)			$Tilt_M$ (M − 1 SD)			$Tilt_M$ (M + 1 SD)		
	Epo	Self	F	Epo	Self	F	Epo	Self	F	Epo	Self	F
Agreeableness (M − 1 SD)	−0.25 (0.17)	0.67 (0.25)	$F(1,77) = 9.53$, $p = .003$	0.09 (0.16)	−0.21 (0.23)	$F(1,77) = 1.12$, $p = .293$	0.53 (0.24)	−0.63 (0.46)	$F(1,77) = 1.29$, $p = .260$	−0.40 (0.32)	0.15 (0.39)	$F(1,77) = 1.15$, $p = .286$
Agreeableness (M + 1 SD)	−0.03 (0.19)	−0.40 (−0.57)	$F(1,77) = 0.86$, $p = .358$	0.11 (0.24)	0.46 (0.26)	$F(1,77) = 1.05$, $p = .309$	−0.86 (0.16)	−0.58 (0.33)	$F(1,77) = 1.78$, $p = .186$	0.27 (0.40)	−0.06 (0.26)	$F(1,77) = 0.47$, $p = .496$

Table 20
ANCOVA for Duplicates Dependent from Course, TEQ, Age, Pretest, Tilt$_M$, and Agreeableness

	SS	*F*	*p*-value
Intercept	19.42	$F(1,77) = 2.02$	0.16
Course (self vs. epo)	90.37	$F(1,77) = 0.04$	0.845
TEQ	1.68	$F(1,77) = 0.17$	0.677
Agreeableness	0.33	$F(1,77) = 0.03$	0.853
Tilt$_M$	0.11	$F(1,77) = 0.01$	0.915
Age	8.36	$F(1,77) = 0.87$	0.355
APR$_{self(pre)}$	**74.31**	$\boldsymbol{F(1,77) = 7.71}$	**.007****
Course (self) × TEQ (high)	18.74	$F(1,77) = 1.94$	0.167
Course (self) × Agreeableness	22.02	$F(1,77) = 2.28$	0.135
TEQ (high) × Agreeableness	0.09	$F(1,77) = 0.01$	0.923
Course (self) × Tilt$_M$	12.83	$F(1,77) = 1.33$	0.252
TEQ (high) × Tilt$_M$	3.76	$F(1,77) = 0.39$	0.534
Agreeableness × Tilt$_M$	4.27	$F(1,77) = 0.44$	0.507
Course (self) × TEQ (high) × Agreeableness	0.96	$F(1,77) = 0.10$	0.754
Course (self) × TEQ (high) × Tilt$_M$	13.39	$F(1,77) = 1.39$	0.242
Course (self) × Agreeableness × Tilt$_M$	**66.8**	$\boldsymbol{F(1,77) = 6.93}$	**.010***
TEQ (high) × Agreeableness × Tilt$_M$	**30.94**	$\boldsymbol{F(1,77) = 3.21}$	**.077**†
Course (self) × TEQ (high) × Agreeableness × Tilt$_M$	**53.59**	$\boldsymbol{F(1,77) = 5.56}$	**.021***
Residuals	742.19		

Note. Self = self-concept course, epo = epoch course.
$^{\dagger}p < 0.1$, $^{*}p < .05$, $^{**}p < .01$.

Figure 29

Change Over Time for Duplicates Dependent from Course, TEQ, Tilt$_M$, and Agreeableness

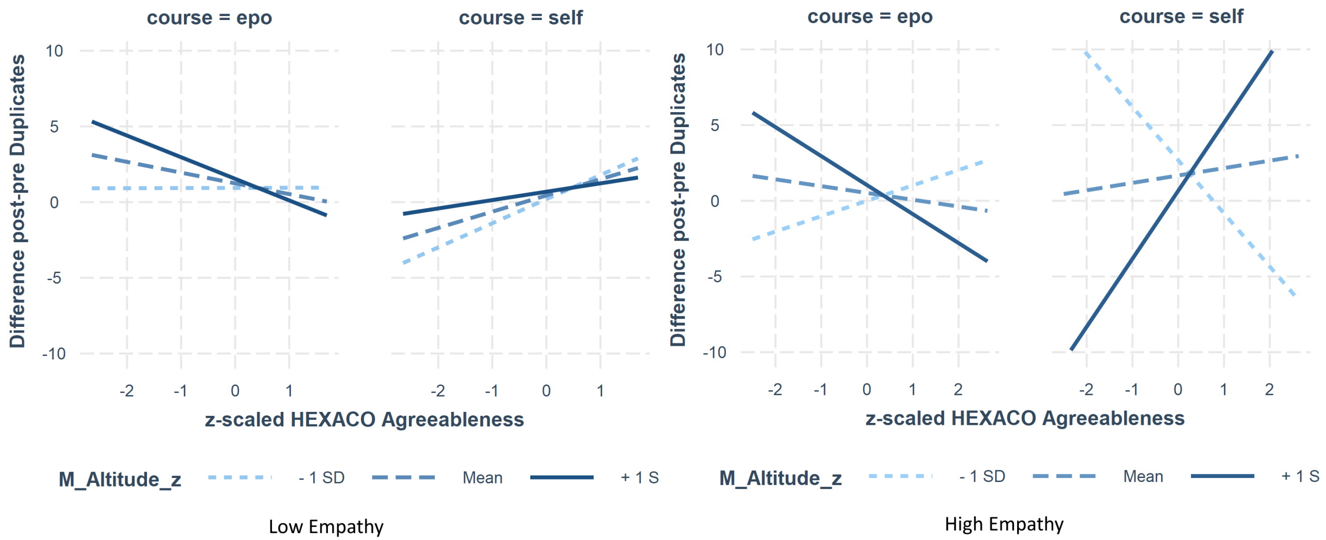


Table 21

Means and Standard Errors (in Parentheses) of Self-Complexity (APR$_{self}$) as a Function of TEQ, Tilt$_M$, and Agreeableness

	TEQ											
	Low						High					
	Tilt$_M$ (M – 1 SD)			Tilt$_M$ (M + 1 SD)			Tilt$_M$ (M – 1 SD)			Tilt$_M$ (M + 1 SD)		
	Epo	Self	F	Epo	Self	F	Epo	Self	F	Epo	Self	F
Agreeableness (M – 1 SD)	0.97 (1.01)	–1.18 (1.47)	$F(1, 77) = 1.45$, $p = .232$	2.90 (0.98)	0.05 (1.43)	$F(1, 77) = 2.68$, $p = .106$	–0.92 (1.46)	6.24 (2.73)	$F(1, 77) = 5.36$, $p = .023$	2.98 (1.93)	–4.02 (2.37)	$F(1, 77) = 5.18$, $p = .026$
Agreeableness (M + 1 SD)	1.17 (1.16)	1.56 (1.99)	$F(1, 77) = 0.27$, $p = .870$	–0.07 (1.45)	1.10 (1.56)	$F(1, 77) = 0.31$, $p = .577$	0.89 (0.96)	–0.74 (1.98)	$F(1, 77) = 0.54$, $p = .464$	–0.79 (2.40)	5.23 (1.55)	$F(1, 77) = 4.40$, $p = .039$

6.4 Discussion

The aim of the present study was (1) to investigate causal SET effects of specifically designed visual arts courses that deploy the studio habits of mind to engage participants with socio-emotional contents (cf. Hetland et al., 2013) and (2) to identify potential moderating factors of these SET effects in an art museum context. To do so, we compared two deliberately designed and standardized visual arts courses that differed only in their content (i. e., self-concept course vs. epoch course) regarding their specific effects on developing a more complex self-concept structure (i. e., self-complexity). To test this *Specificity Hypothesis*, we conducted a reanalysis of two out of three experimental groups reported in Kastner et al. (2021) with regard to an additional measure of self-complexity. Beyond this, we investigated two other hypotheses (*Personal Prerequisite Hypothesis*, *Engagement Hypothesis*) to disentangle the potential moderating role of the three factors *entry level skills regarding empathy*, *personality traits* (particularly in terms of agreeableness), and *engagement*. Innovatively, for investigating the latter factor we used a digital drawing procedure on tablets to relate potential gains in self-complexity to process measures obtained during digital drawing.

6.4.1 Summary of Results

In line with the prior overall analysis (published in Kastner et al., 2021), our extended reanalysis showed higher gains on self-complexity in the self-concept course compared to the epoch course, particularly for participants with lower empathy (see *Specificity Hypothesis*). Concretely, these adolescents (with lower empathy) in the self-concept course not only generated more adjectives by themselves to describe their roles in the posttest as compared to the pretest but also refrained from using more duplicates from pre- to posttest. In the other three conditions, on the contrary, less self-generated adjectives and more duplicates were used over time. However, since these basic analyses could only explain 25.41 % of the variance in the data for self-generated adjectives and 15.31 % for duplicates, we were interested in identifying additional influencing moderators (cf. *Personal Prerequisites Hypothesis*, *Engagement Hypothesis*). For instance, we expected that besides entry level empathy (that was already identified in the prior overall analysis by Kastner et al. (2021)) stable personality traits (particularly agreeableness) as well as process features of the drawing activity might be of crucial importance for course effects. Considering all possible interactions of personality traits (6 dimensions), empathy (high vs. low), and 17 drawing features would have led to over 200 possible combinations which were too much to test them all exploratively. For that reason and to keep the alpha error accumulation low, we used a machine learning approach in a first step to identify candidates for the strongest moderation effects in the data (Ryffel, 2017). The variables identified by this approach were tested in a second step by means of a traditional statistical moderation analysis. Our analyses yielded that not only entry level

Figure 30

Density Plot Regarding Agreeableness of Participants With Low vs. High Levels of Empathy

Low Empathy	High Empathy

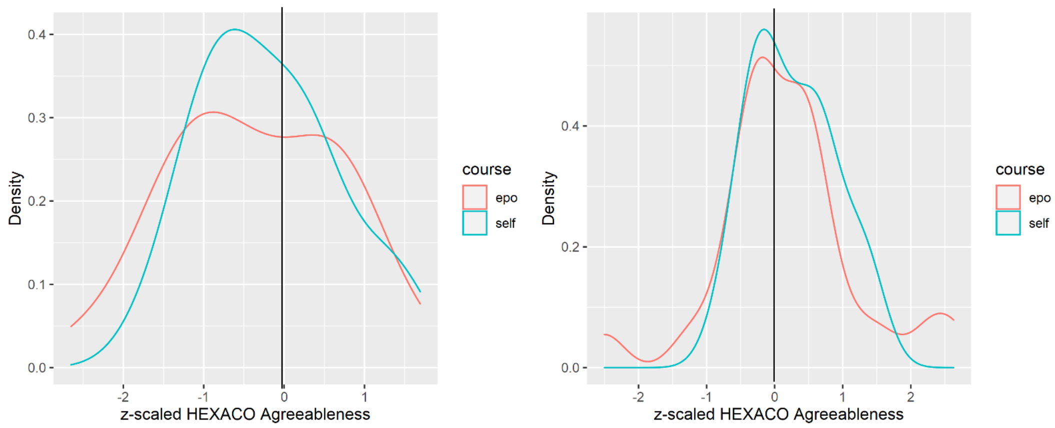
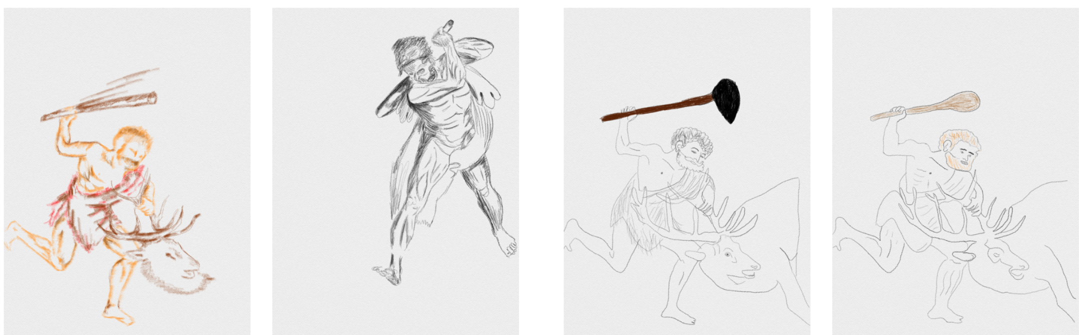


Figure 31

Examples of Participants' Drawings Differing in Their Tilt in the Tracing Drawing Task

Low Tilt	High Tilt



skills regarding empathy but also personality traits in terms of agreeableness as well as drawing features in particular with regard to the tilt of the pen influenced course effects on self-complexity gains, which was the specific SET effect that was in the instructional focus of the experimental visual arts course addressing the self-concept (i. e., the self-concept course that engaged participants in stepping into the shoes of others and in imagining their diverse and potentially conflicting social roles). By adding agreeableness and pent tilt as factors to the basic analyses we were able to explain 43.75 % (+ 18.43 %) of the variance in the data for self-generated adjectives and 26.70 % (+ 11.39) of the variance for duplicates.

6.4.2 How Are Personal Prerequisites Related to SET Effects in Terms of Increased Self-Complexity?

Personal prerequisites comprised in our study particularly entry level skills regarding empathy (lower vs. higher according to a median split) and the personality trait agreeableness (lower vs. higher as defined by +/- 1 *SD* when using agreeableness as continuous variable in the analyses), thereby resulting in four hypothetical subgroups of participants that might however differ in size due to the strong relation between empathy and agreeableness (lower empathy-lower agreeableness; higher empathy-lower agreeableness, lower empathy-higher agreeableness, higher empathy-higher agreeableness). With regard to these personal prerequisites, we found that particularly adolescents with lower entry skills in empathy as well as lower agreeableness (i. e., the subgroup low empathy-lower agreeableness) benefitted from the engagement with visual arts, depending on their engagement in the drawing assignments (cf. next section). A potential explanation for these findings might be that adolescents with lower personal prerequisites (i. e., entry level skills and personality traits) per se might have "more room for improvement". Moreover, and in accordance with Van Heel et al. (2020), adolescents with lower personal prerequisites regarding the personality trait agreeableness might have experienced less parental support and this in turn might have led to fewer opportunities to observe and train socio-emotional skills such as empathy in their past. In general, parental support seems to be associated with such training opportunities because children can easily observe, experience, and imitate the empathic responses by their parents. In addition, Van Heel et al. (2020) argued that adolescents with lower levels of agreeableness — even when they had opportunities to practice empathy (e. g., in terms of observing empathic responses by their parents) — might be less motivated to engage themselves in practicing their empathic skills. The results of the present study indicate that well-designed visual arts engagement might provide meaningful experiences regarding in terms of training opportunities for adolescents with lower entry levels of personal prerequisites, such as lower entry levels of empathy or lower agreeableness.

In line with this reasoning and as already briefly mentioned in the results section, in our sample we only could identify very few participants with lower levels of agreeableness that have developed higher levels of empathic skills regarding empathy (i. e., the subgroup higher empathy-lower agreeableness). This finding is theoretically not surprising as agreeableness plays a key role in the development of empathic skills during childhood (e. g., Lee & Park, 2020; Mooradian et al., 2011; Song & Shi, 2017). Accordingly, we formulated no hypotheses for this very small subgroup of participants with regard to potential course effects (cf. next section for a discussion of the unexpected results in the four-way-interaction on duplicates).

In contrast, adolescents who are highly agreeable, but have low empathy (i. e., the subgroup lower empathy-higher agreeableness) are assumed not to benefit from another round of opportunities of visual arts engagement because these adolescents may have had many opportunities to engage in empathy in the past through parental support, which, however, did not result in higher levels of empathic skills. In line with this assumption, we did not find any positive effects of the self-concept course on self-complexity gains for these participants.

Similarly, adolescents with high entry levels of empathy and higher agreeableness (i. e., the subgroup higher empathy-higher agreeableness) should also not benefit from the socio-emotional course program. There is no reason to assume that highly agreeable adolescents who presumably had ample opportunities for practicing empathy in childhood and who had indeed developed higher levels of empathic skills should additionally benefit from our short-term targeted empathy intervention in the context of a visual arts engagement. And indeed, descriptively this group benefited least from the self-concept course in terms of self-complexity gains. This might go also back to the possibility that ceiling effects regarding the self-complexity task have occurred for this group. For instance, adolescents with higher personal prerequisites might have felt limited by the number of just five social roles/self-aspects with just five respective adjectives to capture their self-representation. Accordingly, they might have demonstrated a high level of self-complexity in the pretest already before course participation, so that they had no more room for improvement when filling in the posttest.

Actually, we even found that when adolescents with high personal prerequisites filled in the posttest to describe themselves, they numerically had the biggest decline in using self-generated adjectives and the biggest increase in using duplicates (as compared to the pre-test) from all four groups. However, as all groups (except for our target group wither lower empathy -lower agreeableness) displayed this pattern numerically (decline in using self-generated adjectives and increase in using duplicates as compared to the pre-test) this might be traced back to a lack of motivation when filling in the post-test, which took place after the third course session (each lasting about three hours). Adolescents might not have worked on the task as carefully and conscientiously as at the beginning because they might have been tired and wanted to finish quickly to go home as soon as possible. This might have resulted in the most pronounced declines for those participants that had demonstrated particular high levels of self-complexity in the pretest, i. e., potentially for those participants with the best personal prerequisites.

Given this general motivational decline, however, it is particularly noteworthy that participants with lower entry levels of empathy and lower agreeableness (i. e., the subgroup low empathy-lower agreeableness) where the only one who improved in the level of self-complexity demonstrated in the post-test task when they participated in the self-concept course (and were sufficiently engaged in the drawing assignments, cf. next section). So, they either did not experience a general decline in motivation as all other subgroups or they were able to improve so much in self-complexity by taking part in the self-concept course that this gain could even counteract the negative effects of lower motivation in the posttest.

In sum, our main finding that participants with low personal prerequisites gained most from targeted opportunities of engagement in a specific visual arts program (if they were sufficiently engaged, cf. next section) is also in line with previous studies showing positive effects of art interventions (e. g., music or theater interventions) on self-concept development only for children with unfavorable personal prerequisites (e. g., DeBettignies & Goldstein, 2020; Emler, 2001; Kennedy, 1998; Wright, 2006). Some experimental studies, as the one by DeBettignies and Goldstein (2020), already demonstrated beneficial SET effects of improvisational theater classes on the self-concept development of elementary school students. Similar to our study, mostly students with a lower level of self-concept benefited from this theater engagement. However, the present study provides some added value to this research area by demonstrating for the first time experimentally that there can be measurable positive effects of specific visual arts engagements on participants' self-complexity.

6.4.3 How is Engagement Related to SET Effects in Terms of Increased Self-Complexity?

In contrast to previous studies on visual arts engagements, we designed specific drawing activities and drawing tasks into our visual arts courses that would stimulate empathic and imaginative elements in terms of role-playing and "putting oneself into the shoes of others" (comparable to theater interventions, e. g., DeBettignies & Goldstein, 2020; Goldstein & Winner, 2012). We fostered participants with specific drawing assignments to perceive, imagine, and take over the perspective of other persons (in the sense of mental role-playing). Accordingly, the drawing tasks during the visual arts engagement focused on elaborating conflicting social roles and we intensified this elaboration by relying on the studio habits of mind (Winner, Goldstein, et al., 2013). Prior research (e. g., Goldstein and Winner (2012) explained the missing effects of visual arts engagement (and also music interventions — in comparison to theater interventions) by the fact that specific effects only would be found when adolescents were pushed to "explore and invent the world" in a special way (cf. Winner, Goldstein et al., 2013; p. 196). Since in prior visual arts (and music) interventions adolescents mainly learned basic drawing or music skills without being embedded in a "social" focus, it is not surprising that no improvements regarding socio-emotional skills could be found. On the contrary improvisational theater interventions (that often per se incorporate elements with such a "social" instructional focus) showed positive effects of on developing socio-emotional skills (DeBettignies and Goldstein (2020). DeBettignies and Goldstein (2020) postulated various potential mechanisms that might have played a role for the development of a better self-concept in the theater intervention, such as the imagination, active listening, spontaneity, close observation, or emotional presence required in. The present study is a first promising step on the avenue of enhancing also visual arts engagements by including exactly these identified elements and mechanisms postulated for theater interventions — namely: perceiving, imagining, and taking the perspective of other persons — thereby sharpening the socio-emotional instructional focus of the drawing assignments involved. Our results demonstrate, accordingly, that it is possible by means of this approach to convey socio-emotional skills such as empathy or self-complexity also in a *visual* arts context. Particularly, in the present study adolescents (with low entry level skills regarding empathy and lower agreeableness) could achieve SET effects in terms of self-complexity gains when they were involved with drawing assignments focusing on stepping into the shoes of other persons thereby exploring the different roles and the self-concept structures of these persons in great detail. Performing the drawing assignments on tablets allowed us to assess many characteristics of the drawing activities in details by obtaining diverse process measures. Therefore, besides the personal prerequisites empathy and agreeableness we could also analyze process features of the drawing activities as possible moderators for course effects as these features can be interpreted as plausible indicators for participants' level of engagement in the empathy-based drawing assignments. Using a machine-learning approach in a first step we identified particularly one process feature group (i. e., features such as that describe the *M*, *SD*, Min, or Max of the tilt of the pen) as an important third predictor for SET effects of the self-concept course. As reported above, low empathic and low agreeable participants benefited from the visual arts engagement in the self-concept course in terms of self-complexity gains, but this was mainly the case when they often hold the pencil with a low tilt, i. e., in a flat angle to the tablet. Therefore, in a second step we investigated the four-way interaction between course $\times$ empathy $\times$ agreeableness $\times$ tilt_M for both dependent self-complexity variables (self-generated adjectives and duplicates). As expected, particularly low empathic adolescents with lower agreeableness benefit from the self-concept course in terms of an increasing number of self-generated adjectives, but mainly if they use a low mean tilt — or in other words if they mostly hold the pencil relatively flat above the tablet. In these moderation analyses, we focused on the mean tilt feature because all four variables of the Tilt feature group were highly correlated, and the mean tilt variable seemed to be easiest to interpret. Moreover, mean tilt was related to pressure during drawing. A flat angle of the pencil to tablet ($< 45°$) was associated with less pressure during drawing, while a high angle of holding the pencil upright to tablet ($\sim 90°$) was associated with greater pressure and more aggressive drawing. Figure 31 shows examples of adolescents' drawings with extreme low (versus extreme high) tilt in their drawings. These examples might be illustrative for the claim that holding a pencil flat and relaxed with a small angle of pencil to tablet can be seen as an indicator of highly elaborated and engaged drawing processes because it allows best to work with precision and expression, to adjust the amount of pressure, and to inspect the drawing during its creation without the pen preventing the view (Mißfeldt, 2020; Nguyen, 2016). Additionally, drawing with this pen position might improve the ease of drawing and the creativity of the participants (Stanyer, 2020). The examples in Figure 31 show that participants strongly differing in the tilt might also strongly differ in their elaboration and engagement.

Besides effects on self-generated adjectives, we also found a significant four-way-interaction for duplicates. However, a particular positive effect (for low empathic adolescents with lower agreeableness drawing with flat angles of the pencil was not significant for duplicates, even though the numerical values pointed in the expected direction. Unexpectedly, the moderation analysis on duplicates yielded significant effects for high empathic adolescents with lower agreeableness, which we however consider not to be interpretable due to the low number of participants in this subgroup (due to the strong negative relation between lower agreeableness and empathy development only a handful of participants in our sample displayed the combination of high empathy and low agreeableness; (e. g., Lee & Park, 2020; Mooradian et al., 2011; Song & Shi, 2017).

In sum, not only personal prerequisites but also process features of the drawing activities implemented in the visual arts intervention play an important moderating role for the effectiveness of such programs. Our analyses reveal exactly for what combination of factors the visual arts program yielded the most beneficial effects.

6.4.4 Strengths and Limitations of the Present Study

Several strengths of the present study can be pointed out. First, the study offers a novel visual arts course program that proactively expands the visual arts experience of the students into the field of socio-emotional skills by designing theory-driven visual arts assignment with an instructional focus. Second, the designed visual arts program is not just based on a specific theoretical background but is also implemented within an experimental and digital approach that allows to test for causal course effects as well as to identify important moderating variables such as drawing features. This combination, to the best of our knowledge, is both powerful and unique. Third, this study provided the first experimental evidence for a causal relationship between a specific visual arts engagement and improved socio-emotional skills when specific constraints regarding prerequisites and engagement were met.

Besides the uniqueness, there might be also some limitations: For instance, we measured self-concept using a paper-pencil based self-complexity task. Participants were asked to fill in five social roles or self-aspects, while two of these social roles or self-aspects were already given. The highly empathic participants already completed all social roles or self-aspects and adjectives in the pretest, so that there was "no room for improvement" for these participants. As a result of this task limitation, some participants dropped in their performance from pretest to posttest probably due to motivational losses. However, this paper-pencil based self-complexity task provided enough "room for improvement" for the low empathic and low agreeable participants so that they could even overcome these negative motivational effects. It might be the case, that this task was not specific enough to measure small changes from pre- to posttest. Furthermore, another limiting factor is that measuring a complex self-concept with such a verbal test is dependent from the verbal intelligence or vocabulary that a person brings with them (Lauermann et al., 2020; McArthur et al., 2016). For some adolescents, it might be the case that they possess a complex self-concept, but they have not the necessary vocabulary to describe themselves as complex. Particularly, for non-native German speakers this might lead to an insufficiently represented self-concept. Thus, it might be the case that the task only measures vocabulary, but not the complexity of the adolescents' self-concept — at least for some of the participants. Thus, future studies should rather investigate self-complexity with tasks and questionnaires comprising also graphical items and allowing for improvements of participants with a highly complex self-concept (e. g., by offering the possibility to fill in as many roles as they want).

A further limitation of the present study is the duration of the visual arts engagement. The whole course program only lasted nine hours over three weeks which resulted in a rather short intervention regarding SET effects compared to course programs lasting half a school year or even a whole school year (e. g., DeBettignies & Goldstein, 2020; Goldstein, 2015; Goldstein et al., 2012; Goldstein & Winner, 2012). The course program was conducted during the school lessons. For that reason, the students and arts educators were under pressure to finish all tasks within the limited amount of time.

Finally, with the design of the present study we cannot draw certain conclusions as to which course elements (knowledge acquisition/different portraits in art museum exhibition, drawing of portraits or selfies) had the central influence on the specific effect found on self-complexity. Therefore, further studies are needed to disentangle the effects of the different course elements in a controlled manner.

6.4.5 Conclusion

In sum, specific effects of a visual arts program on the formation of a complex self-concept could be found. Engagement with different social roles or self-aspects (self-concept course) lead to improved self-complexity in terms of creating more self-generated adjectives when students scored low in pretests on empathy and agreeableness compared to students engaging with art historical periods (epoch course) or high pretest values. The combined instructional and digital drawing approach of this study enabled the use of machine learning algorithms to identify specific drawing features that foster positive learning outcomes for socio-emotional skills, thereby paving the way for the next generation of visual arts course designs.

CHAPTER 7

GENERAL DISCUSSION

Visual arts engagement is claimed to have potential benefits "beyond arts' sake" to not only the individual in terms of socio-emotional skill acquisition or personality development but also for society (Emert, 2009; Liebau, 2018; Winner, Goldstein, et al., 2013). While just a few years ago only 16 % of studies on arts education addressed transfer effects (Liebau et al., 2013, pp. 6-30) the growing interest and financial support from non-empirical institutions, such as the Federal Ministry of Education, towards visual arts engagement lead to a drastic increase in empirical evidence in the field. As a result of these initiatives, many researchers began to study *what*, *when*, *how*, *where*, and *under which circumstances* transfer effects of visual arts engagement occur (Hetland & Winner, 2001; Winner, Goldstein, et al., 2013; Winner & Hetland, 2000).

Despite all efforts, no clear evidence could be provided regarding cause-and-effect relations. The studies conducted in the meta-analysis of Winner, Goldstein, et al. (2013), for instance, were heterogenous in terms of their unique context, characteristics and quality making the comparability of the studies and programs difficult (Ewing, 2010; Schneider & Rohmann, 2021). Most studies examine existing course programs using correlative analyses (Kosica, 2017), while randomized (field) experiments or longitudinal control-group designs remain rather missing. To address the challenges of current socio-emotional transfer effects, the present dissertation analyzes existing theories and frameworks that might be suitable to explain the benefits of visual arts engagement (studio habits of mind, Hetland et al., 2013; GAEM, Konrath & Kisida, 2021; human flourishing, Tay et al., 2018). Although, these frameworks do not explicitly focus on training of socio-emotional skills and therefore might be not specific enough to explain the differential transfer effects on socio-emotional skills sufficiently (see »Chapter 1.2«). The frameworks mutually explain the benefits of the (visual) arts engagement by focusing on underlying activities and mechanisms, as well as personal and situational variables. In line with this, Holochwost et al. (2021) argued that it is important to define studies explicitly regarding the arts genre, context/setting and the experience of the learners and the domain of socio-emotional development. For this reason, a central component of this dissertation is the development of a conceptual framework and evaluation of a visual arts education program addressing socio-emotional learning in an art museum context that is based on instructional design principles (instructional approach) and cognitive and motivational characteristics of engagement in visual arts classrooms (artistic approach).

Our visual arts education program consisted of three separate courses that were identical in their structure differing only in their content. While two of the three courses specifically addressed socio-emotional contents (i. e., emotion course, self-concept course) the third course was designed as a traditional visual arts course focusing on historical periods as control condition (i. e., epoch course). In accordance with Winner, Goldstein, et al. (2013, p. 196), the visual arts program was designed in a way to "push" participants actively to "explore and invent" socio-emotional skills. Therefore, the visual arts education program was evaluated and provided new insights into the specificity of transfer effects on socio-emotional skills by using a randomized controlled field trial. Results showed specific transfer effects for the two "psychologically" instructed visual arts courses but not for the traditional one. In detail, the emotion course led to a better emotion recognition ability, while the self-concept course led to a more complex self-concept. No effects were found for the epoch course focusing on art historical periods. Furthermore, the specificity of the transfer effects (found in Study 1) was investigated in detail by analyzing the underlying mechanisms of drawing tasks, activities, and drawing quality (Study 2) as well as the influencing factors of personality (Study 3).

In the following, the findings of the three empirical studies are discussed in four parts reflecting on the central research questions: First, »Chapter 7.1« summarizes and discusses which new insights might be gained from the three empirical studies (cf. »Chapter 7.1.1«), whether specifically designed transfer effects are really transfer effects (»Chapter 7.1.2«), and how drawing tasks and drawing activities should be designed to achieve transfer effects on socio-emotional skills (»Chapter 7.1.3«). Second, »Chapter 7.2« provides a discussion of the strengths (»Chapter 7.2.1«) and limitations (»Chapter 7.2.2«) of the studies as well as further research (»Chapter 7.2.3«). Third, »Chapter 7.3« presents the theoretical (»Chapter 7.3.1«) and practical implications, e. g., for Museums and the Arts or Health and Clinical Psychology (»Chapter 7.3.2«). Finally, the key results of this dissertation are presented in a conclusion (»Chapter 7.4«).

7.1 Summary and Discussion of the Empirical Studies

The empirical studies of this dissertation were built on the theoretical conceptualization of a visual arts course program. As already mentioned, this course program consisted of three visual arts courses that either instructionally focused on a *psychological* topic (emotion course, self-concept course) or *not* (epoch course). To answer the first research question (RQ1, outlined in »Chapter 3«) of whether visual arts engagement led to socio-emotional transfer effects, we compared all three visual arts course with regard to their effectiveness in promoting socio-emotional skills (Study 1, see »Chapter 4«). The second research question (RQ2, outlined in »Chapter 3«) focused on the underlying mechanisms and circumstances, assuming that the differential transfer effects exist. Therefore, this dissertation focused on (a) drawing tasks and drawing activities, and (b) personal prerequisites, such as personality traits (e. g., agreeableness), baseline socio-emotional skills (before course participation), and prior knowledge. These underlying mechanisms were addressed in two in-depth studies (reported in »Chapter 5/6«).

Study 1 addressed the comparison of all three visual arts courses to examine the specificity of transfer effects with an experimental study design. The data were collected in two data collection phases in which independent cohorts of students were studied. To enable randomization at student-level, two of the three courses were offered simultaneously for each participating school class. The results showed transfer effects on socio-emotional skills for specifically designed and instructed visual arts courses but not for the control condition. Especially, for the first addressed socio-emotional target construct (*empathy*) and related subcomponent (*emotion recognition*), specific effects of the emotion course could be found (measured with an animated morph task, see Jusyte et al., 2017; Schönenberg et al., 2014; Schönenberg et al., 2013; Schönenberg et al., 2016). In this task, emotional facial expressions were presented slowly developing from (0 %) to full (100 %) emotional expression. The students should recognize the emotional facial expressions as fast and accurately as possible. After course participation, students in all three visual arts courses were more sensitive in their emotion recognition (answered "quicker") but only the students in the emotion course were also more accurate (answered "correct"). For the second socio-emotional target construct *self-concept* and related subcomponent *self-complexity*, also specific transfer effects were demonstrated in the self-concept course. In the self-complexity task (according to Linville, 1985, 1987), students should describe themselves with adjectives in different social roles. It could be shown that students in the self-concept course reported a more differentiated self-concept by measuring the number of self-generated adjectives. In general, a highly complex self-concept (i. e., self-complexity) was characterized by using a high number of self-generated adjectives. However, the effect on self-complexity was moderated by empathy. While students with low levels of (self-reported) empathy benefited more from the visual arts engagement, students with high levels did not benefit from participation in the self-concept course, which might also be due to a ceiling effect (for more about the limitations of the used measurements, see »Chapter 7.2«). Compared to the self-concept course, students in the emotion and epoch courses did not benefit in terms of their self-complexity development. For the third course focusing on historical periods, no specific socio-emotional transfer effects could be found, neither for emotion recognition nor for self-complexity.

Since we found specific course effects on socio-emotional skills, Study 2 and Study 3 were conducted as in-depth (exploratory) analyses to explore which variables might modulate the specific transfer effects of visual arts engagement (reported in Study 1) at an individual and drawing-feature level. The aim of these two studies was therefore to better understand the socio-emotional learning processes taking place during the visual arts education program (Study 2 focused on the transfer effects on emotion recognition/empathy; Study 3 focused on transfer effects on self-complexity/self-concept).

In Study 2, variables from the "classical" learning-by-drawing literature that are known as effective parameters for learning, such as drawing quality or prior knowledge were analyzed (e. g., Ainsworth et al., 2011; Ainsworth & Scheiter, 2021; Cook, 2006; Cromley et al., 2020). In detail, the impact of (1) prior knowledge and drawing quality, (2) the role of appropriate drawing tasks regarding their generation versus elaboration depth in drawing, and (3) the role of self-reference versus distraction in portrait drawing on emotion recognition abilities were analyzed. First, it was assumed that declarative prior knowledge might have an impact on drawing quality and this, in turn, might be predictive of an individual's emotion recognition abilities. The mediation analysis indicated that a high declarative prior knowledge about emotions influenced drawing quality but this in turn had no influence on the emotion recognition abilities. Since drawing quality and prior knowledge could not explain the specific findings on emotion recognition abilities, a special interest in this dissertation was in analyzing drawing tasks and drawing features. However, it must be noted that the outcomes for the drawing tasks and drawing features (reported in »Chapter 5«) were only correlative in nature and do not necessarily indicate causality. Nevertheless, the correlations can be seen as theoretical explanations. Regarding drawing tasks and drawing features, the number of correlations with the emotion recognition abilities were analyzed to identify important underlying mechanisms and components of the emotion course and its outcomes. If the drawing features and drawing tasks are not crucial for the outcomes, then variations in how drawing tasks are accomplished should not matter much. To test this hypothesis, several drawing tasks differing in their elaboration depth (i. e., *tracing*, *intensifying*, *transfer*, *selfie* drawing task) were compared by analyzing the number of substantial correlations (see »Chapter 5« for description of the *Generation* vs. *Elaboration Depth Hypothesis*; *Self-reference* vs. *Distraction Hypothesis*). The number of correlations indicated that drawing tasks with a high elaboration depth (i. e., *intensifying*, *transfer*, *selfie* drawing tasks), provided by envisioning and reflecting elements, might support transfer effects more than drawing tasks with less engagement (i. e., *tracing* drawing task). Additionally, the selfie drawing task stimulated a deeper processing of facial expressions of emotions in terms of the personalization principle (i. e., Mayer, 2014; Mayer & Fiorella, 2014) and did not lead to distraction. Additionally, not only the drawing tasks were analyzed but also the drawing features. Therefore, an exploratory analysis based on a machine learning approach was conducted to address the overall interaction patterns that might be associated with improvements in the emotion course. The results showed that drawing features such as time pencil on tablet or pencil/brush pressure might be involved to predict course effectiveness on the acquisition of emotion recognition abilities.

Study 3 was similarly designed as Study 2 but had a special focus on the formation of a differentiated (or complex) self-concept under consideration of the personal prerequisites such as personality traits. It was expected that besides the analyzed drawing features in Study 2 (see »Chapter 5«), also personality traits might influence the transfer effects in socio-emotional learning processes (see »Chapter 6«). In Study 1, a specific effect of the self-concept course in the self-complexity task could be demonstrated which was moderated by empathy. Since this basic model was only able to explain $R^2 = 25.41\,\%$ (adjusted $R^2 = 21.93\,\%$) variation in the data for the adjectives per role, it was expected that other factors might be important. An explanatory machine learning approach was again used to identify the most relevant influencing factors from personality (as well as drawing data) to predict course outcomes on self-complexity. The results of the Machine Learning (ML) approach showed strongest feature importance values for the personality traits of agreeableness and the drawing feature altitude. In turn, we analyzed the interaction between course, empathy, agreeableness, and altitude and found a significant four-way interaction which could $R^2 = 43.75\,\%$ (adjusted $R^2 = 31.33$) of variance in the data. Thereby, students with low levels of empathy and agreeableness benefited most in terms of building a complex self-concept from visual arts engagement not only when they draw in a certain way, while students with high levels of empathy and agreeableness could not benefit which might be due to ceiling effects.

In sum, this dissertation provides answers to both research questions mentioned in »Chapter 3«. This dissertation shows that transfer effects on socio-emotional skills can be achieved through properly designed visual arts engagement, but not visual arts engagement per se (RQ1). Additionally, the circumstances and underlying mechanisms that might influence socio-emotional learning through visual arts engagement could be identified (RQ2). Concretely, for the drawing quality no significant impact on emotion recognition abilities could be found. For the drawing tasks and drawing features, it was found that the elaboration depth of the tasks had a decisive impact on the learning outcome. Additionally, also personality traits determined the learning outcomes. Students with low abilities in the areas of empathy and agreeableness seem to benefit especially from specifically designed visual arts engagement and elaboration. In the following section, the new insights about learning in the visual arts and artistic drawing for the acquisition of socio-emotional skills are demonstrated.

7.1.1 New Insights About Learning in the Visual Arts and Artistic Drawing for Socio-Emotional Transfer Effects

This dissertation provides unique insights into learning with and in the visual arts, especially in the context of socio-emotional learning. Furthermore, it gives answers to the question of how visual arts education programs should be designed to achieve positive transfer effects on socio-emotional skills. Central aspects in the design of the course program were, following Holochwost et al. (2021), clear *definitions* of the arts field (i. e., visual arts), the *context* (i. e., art museum), and the *target* of the addressed socio-emotional skills (i. e., empathy, self-concept) in the context of an experimentally controlled field-trial. Thus, the results of this dissertation go far beyond general claims about the impact of visual arts and simultaneously provide empirical evidence for the existence of socio-emotional transfer effects. Previous studies have already proposed various frameworks to explain the modes of action of the (visual) arts (Hetland et al., 2013; Konrath & Kisida, 2021; Tay et al., 2018), which were not specific enough to explain effects on socio-emotional skills. For this reason, we first clearly defined the target construct of socio-emotional skills (empathy, self-concept) and selected appropriate instruments to measure changes in these constructs. In a further step, existing models were drawn upon and integrated into a conceptual framework, with a specific focus on the underlying activities and mechanisms and how these must be designed to achieve specific transfer effects (in accordance with an arts-integrated education approach, Casciano et al., 2019; The Kennedy Center, 2021). To achieve this, aspects of the normative and value-based qualitative research tradition of art for art's sake (also referred to as artistic approach, Hetland et al., 2013) were linked to the quantitative instructional research tradition of learning-by-drawing (referred to as the instructional approach, Ainsworth & Scheiter, 2021; Van Meter & Firetto, 2013; Van Meter & Garner, 2005). It should be noted that even these two selected approaches were not *per se* designed to achieve transfer effects in socio-emotional learning. Rather, they describe general features of engagement with visual arts or central mechanisms of action that occur in learning with images and text. To establish the connection to socio-emotional skills, a visual arts course program was developed in the present dissertation, which specifically aimed to promote socio-emotional skills. It has been impressively demonstrated that socio-emotional skills can be achieved in the context of visual arts engagement, but only if individuals are explicitly "pushed" to engage with the subject and specific tasks are employed (Winner, Goldstein, et al., 2013, p. 196). For example, some studies have demonstrated positive transfer effects on empathy when engaging with theater, but not when engaging with visual arts (Goldstein et al., 2012; Goldstein & Winner, 2012). One possible explanation for this result is that visual arts, when targeting only drawing techniques and not pursuing a broader goal in terms of arts-integrated education, cannot achieve broader effects on, for example, empathy or self-concept. This means that transfer effects of visual arts on socio-emotional skills can only be expected if these skills are also explicitly addressed in the context of the engagement. In the following section, I will first take a critical look at the question whether the observed effects are really "transfer" effects if they are specifically designed into the engagement with visual arts. Afterwards I will give advice on how to design visual arts engagement to address transfer effects on socio-emotional skills.

7.1.2 Are the Observed Effects Really "Transfer" Effects?

In the present dissertation, specific "transfer" effects of visual arts engagement on socio-emotional skills could be demonstrated when they were specifically instructed. As already mentioned before, transfer effects on emotion recognition and empathy were found exclusively in the emotion course, whereas positive effects on the formation of a complex self-concept were found only in the self-concept course. These findings are in line with Winner's (2013) assumption that transfer effects on socio-emotional skills only occur when students intensively engage with a specific topic. Nevertheless, the question arises whether one can speak of "transfer" effects if these effects can only be demonstrated with explicit training. Would it not make more sense to refer to them as specifically instructed primary effects?

In a narrower sense, specific transfer effects could also be seen as "primary effects of specifically trained content", as the constructs are also addressed within the visual arts engagement. Contrary, in a broader sense, visual arts engagement is seen under the creative, aesthetic, and artistic aspects in which socio-emotional skills are normally not addressed. Depending on whether the narrow or broad definition of transfer effects is chosen, there will be profound consequences for research on visual arts engagement. If the narrow definition is chosen, it must be stated that the high expectations of advocacies and society for the existence of positive transfer effects can only be fulfilled to a limited extent. The consequences of this interpretation for research and practice are particularly unclear. However, it must be noted that the absence of measurable transfer effects does not necessarily mean that there are no transfer effects at all (Altman & Bland, 1995). Rather, it is conceivable that the sample size used in our study was not large enough to find the searched effect. In a broader sense, the specific course effects are still understood as transfer effects, from which instructions can be derived as to how visual arts programs should be designed. To clarify whether the effects are rather transfer or primary effects, the definition of *transfer* was analyzed. *Transfer* effects (German: Übertragung, Latin: *trans*, over/über; *ferre*, carry/ tragen) describe processes in learning, thinking and problem solving that are acquired in one task and transferred to another (Bredenkamp et al., 2019). The performance of the second task can be influenced positively or negatively by the first one. If the two tasks are similar, one speaks of *close* transfer effects (e. g., learning Latin vocabulary has a positive effect on the understanding of a doctor's letter), if they are very different, one speaks of *far* transfer effects (e. g., learning Latin grammar favors learning in other languages). Based on Bredenkamp et al.'s (2019) definition of transfer effects, I and my colleagues assume that dealing with emotions or social roles of Hercules in the context of visual arts leads to close transfer effects regarding a positive effect on dealing with emotions in everyday life or one's own self-concept. Therefore, a concrete design advice on how visual arts courses should be designed to achieve transfer effects on socio-emotional skills is given in the following section.

7.1.3 How Should Drawing Tasks be Designed to Achieve Transfer Effects on Socio-Emotional Skills?

Based on the results in this dissertation and the discussion on transfer effects, it seems obvious to ask in a second step how drawing tasks and drawing activities should be designed to achieve transfer effects. To find an answer to this question, the focus was first on general learning principles, which are known from the learning-by-drawing literature, e. g., that drawing leads to a reduction of information and a deeper processing (e. g., Ainsworth et al., 2011; Ainsworth & Scheiter, 2021). However, learning-by-drawing refers to learning with images and texts, and not to learning contents acquired in the classroom context (compare declarative knowledge phase, »Chapter 2«). In contrast to classical studies, students were supposed to perform drawing tasks that differed not only in their instruction but also in their elaboration depth (i. e., tracing, intensifying, transfer, selfie drawing task, cf. instructional approach). Besides the instructional approach, the active learning and the exchange between students, teachers and museum educators in visual arts classroom were considered regarding critical reflection and feedback (compare critique phase, Hetland et al., 2013, p. 20). More concretely, based on the findings of this dissertation, the following conclusions can be drawn regarding the design of drawing tasks (in terms of a criteria list) that will be explain in detail below:

- Drawing tasks should be designed specifically.
- Empathy-related drawing tasks allow adolescents to “step into the shoes of other’s”.
- Drawing tasks with deep elaboration foster learning outcomes.
- Drawing tasks with self-reference foster learning outcomes.
- Drawing quality influences declarative knowledge but has no effect on procedural knowledge.
- Adolescents with low prerequisites benefit most from visual arts engagement but only when they engage in a certain way.
- Drawing features differ depending on the drawing tasks and might predict learning outcomes.

Specific Drawing Tasks. The drawing tasks should be specifically addressing the desired learning outcome, such as empathy or self-concept. This means that the contents and concepts must be explicitly instructed. Based on our findings, it cannot be expected that cross-over effects might exist, for example, that a visual arts engagement focusing on empathy also leads to the formation of a more complex self-concept, or conversely, a more complex self-concept leads to more empathy. Additionally, this dissertation shows that the expectations that are often placed on the engagement with and in the visual arts are clearly exaggerated. An engagement in a traditional visual arts course *per se* does not lead to an improvement in socio-emotional skills.

Empathy-Related Drawing Tasks. A particular characteristic of the drawing tasks used in this dissertation to promote socio-emotional skills was the reliance on empathy-based drawing tasks (cf. theater classes, Goldstein et al., 2012; Goldstein & Winner, 2012). Students should empathize with either an emotion, a social role, or a historical period. This phenomenon, described by Winner (2019) as "putting oneself in the shoes of another person" seems to be a necessary prerequisite for the acquisition of socio-emotional skills (DeBettignies & Goldstein, 2020; Goldstein et al., 2012; Goldstein & Winner, 2012).

Elaboration Depth of Drawing Tasks. Drawing tasks that require more elaboration depth increase learning success (Bonwell & Eison, 1991; Freeman et al., 2014; Markant et al., 2016). However, this observation must be interpreted with extreme caution, as the reported results were exclusively correlations. To vary the elaboration depth in drawing, different drawing tasks were used that were successively increased in difficulty. For example, in the tracing drawing task, students were only asked to trace the respective content (e. g., emotional facial expression, body position, or features of historical periods), whereas in the intensifying and transfer drawing tasks, ambiguous paintings/graphics were presented as drawing templates, which were then to be changed into unambiguous paintings/graphics. Furthermore, in the selfie drawing task, students were asked to take selfies or photos of themselves before drawing and use them as drawing templates. Specifically, in the emotion course, students had to draw emotions, while in the self-concept course, students had to draw the mythological person Hercules. In the epoch course, the drawing focus was on the characteristic features of historical epochs (more on the respective drawing tasks can be found in »Chapter 2«). The drawing tasks started with the simplest drawing tasks and increased in their difficulty to prevent learners from being overwhelmed with the drawings and, consequently, leaving the learning situation.

Drawing Tasks with Self-Reference. Drawing tasks with self-reference led to a deeper elaboration of learning content (in the sense of the personalization principle proposed by Mayer, 2005). Thus, information linked to the self is not only better encoded (Gutchess et al., 2007), but also better retrieved due to stronger memory representations (Symons & Johnson, 1997). Depending on the course content, students were asked to draw themselves in various self-portraits, such as a Rococo princess or with an emotional facial expression or in the social role of another person. From literature, it is known that when students engage with learning materials related to themselves, processing occurs through personal involvement (Klein, 2012; Symons & Johnson, 1997). However, it should be noted that the self-reference effect or personalization principle has classically been studied only with verbal information (e. g., "my emotion" rather than "an emotion"), and not with pictures (Moreno & Mayer, 2000). Nevertheless, it seems plausible to investigate this self-reference effect/personalization principle also in the context of drawing selfies.

Surprisingly, the selfies did not lead to distraction in terms that adolescents focused on characteristics of the face that are irrelevant for the emotional expression, such as on pimples or other features of the face. The statements about the self-reference effect/ personalization principle are also based on correlative findings and do not allow causal conclusions.

Drawing Quality. Drawing quality might not have a significant impact on procedural knowledge such as the emotion recognition abilities (measured with the animated morph task), but on declarative knowledge. This finding demonstrates that different kinds of knowledge exist. While declarative knowledge describes factual knowledge that can be verbalized, procedural knowledge includes knowledge about processes that are difficult to verbalize (like *riding a bike* or, in this dissertation, *emotion recognition*). It was expected that creating a high-quality drawing requires declarative prior knowledge before the drawing can be put to paper (Quillin & Thomas, 2015). Surprisingly, declarative prior knowledge about emotions and drawing quality was not beneficial in improving emotion recognition abilities (procedural knowledge). Although, drawing quality was not investigated as in classical learning-by-drawing studies (in terms of drawing versus not drawing, or in the context of text and pictures), it can still be concluded that drawing influences the results in declarative knowledge.

Influence of Personal Characteristics. Drawing tasks appear to vary in their effectiveness depending on the personal characteristics of the learner. For example, the results of this dissertation show that students with low prerequisites (i. e., low empathy, low agreeableness) benefit most from visual arts engagement. This may be because these children and adolescents have more “room for improvement” in general, or that the children and adolescents with high prerequisites could not benefit further from this course program because they already have so many opportunities to improve socio-emotional skills in the private context (i. e., ceiling effect).

Drawing Features. Drawing features such as time pencil on tablet or pencil/brush pressure seem to have different effects in relation to the tasks to be drawn. Even if the previous analyses do not yet allow causal conclusions, some effective drawing parameters and tasks can already be identified from them, as well as considerations for the instructional design of visual arts in the context of the acquisition of socio-emotional skills. Besides the drawing features, using an explorative machine learning approach, allowed to identify personality traits as predictive for the course outcomes.

7.2 Strengths, Limitations, and Future Directions

The present dissertation, to the best of my knowledge, combined and integrated the qualitative and quantitative research traditions of visual arts engagement into a common conceptual framework to measure transfer effects by using objective instruments and retaining the individual value of the visual arts to get a deeper insight in the underlying activities and mechanisms. In the following sections strength, limitations and future directions of this approach will be discussed.

7.2.1 Strengths in Measuring Transfer Effects on Socio-Emotional Skills

One central strength of this dissertation is the experimental study design. The standardized visual arts courses as well as the randomized assignment of participants to the visual arts courses in the two data collection phases (data collection phase 1: emotion vs. epoch course, data collection phase 2: self-concept course vs. epoch course) allowed avoiding self-selection effects. Since self-selection effects have been identified as a key weakness in previous studies, they do not allow for causal inferences. In addition, the present dissertation is particularly innovative because it not only has an instructional focus, but also provides empirical evidence for the existence of specific transfer effects based on objective measurements (emotion recognition/self-complexity task). As outlined at the beginning, clear definitions of the target constructs are obligatory, as well as precise operationalization of the target constructs from a psychological background. Specific transfer effects can be found only if these requirements of explicit training are met. For example, in Study 1, positive transfer effects could only be found for the emotion and self-concept courses, but not for the epoch course. The combination of the two drawing approaches represents a distinct added value, since not only the content is considered (instructional approach), but at the same time also processes and interactions in the visual arts classroom (artistic approach).

Another strength of this dissertation can be seen in the digital drawing. This is because digital drawing not only allows the result, the drawing, to be viewed, but also provides insights into cognitive processing and underlying mental elaboration processes (Study 2 and 3). However, since personality also plays a particularly important role in drawing, Study 3 also examined the influence of personality traits. It could be shown that especially adolescents with poor prerequisites can benefit from engaging with visual arts if they draw appropriately, e. g., with a flat pen posture (low altitude). A particularly innovative approach in this dissertation was the use of machine learning algorithms to predict learning success (Study 2) and to identify potential moderators (Study 3). The machine learning approach helped to reduce the number of possible combination of features that could potentially be tested. This approach also proved to be particularly successful in this dissertation, as significant interactions could actually be demonstrated for the potential moderations. This suggests a successful interplay of the different approaches and might be a first step towards the possibility of using machine learning to improve visual arts training or drawing apps.

7.2.2 Problems in Measuring Transfer Effects on Socio-Emotional Skills

Besides the strengths, there are also some limitations in this dissertation that should be mentioned in detail. One of the main problems in this dissertation lies in the instruments used to measure the transfer effects. Admittedly, the instruments allow to measure socio-emotional skills precisely by dividing the target constructs of interest (empathy, self-concept) into smaller measurable units (emotion recognition, self-complexity). However, it remains unclear to what extent the findings found in this dissertation can be generalized. For the emotion recognition task, several limitations can be found: First, this task is a purely cognitive measure ("thinking what another person is thinking") which does not allow for inferences about a person's affective or emotional experience ("feeling what another person is feeling", cf. Reniers et al., 2011). Second, the focus of this dissertation was exclusively on basic emotions, which represent only a fraction of emotional experience, in contrast to mixed or complex emotions. Third, the same stimuli were used in the pre- and posttest, so adolescents may have recognized emotions more quickly in the posttest due to familiarity (Dubois et al., 1999; Vokey & Read, 1992). Alternatively, however, it is conceivable that adolescents were anticipating the end of the course in the posttest and therefore were faster in their responses. Both explanations postulated here are potentially suitable to explain the results on sensitivity found in Study 1. However, it cannot explain why adolescents were also more correct in their responses in the emotion course.

Also, for the second instrument for measuring transfer effects, several limitations can be found: For the measurement of the self-concept, a new instrument was developed in the dissertation, which allows both the number of self-generated adjectives (per role) and the number of duplications to be recorded. Two roles were given to all adolescents (student, child) in a standardized format, while three roles could be completed in an open response format. The task of the adolescents was to fill in up to five roles with up to five adjectives per role. The disadvantage of this procedure was that adolescents who already had a complex self-concept before participating in the course could possibly achieve little growth, in the sense that no "room for improvement" was possible (cf. ceiling effect). This could be the reason why the self-complexity of some adolescents might have decreased from the pre- to the posttest. Another limitation is that non-native speakers may have performed worse in this task, not because they do not have a differentiated self-concept, but because they generated fewer adjectives due to the language barrier, leading to a bias in the results.

In conclusion, the results found in this dissertation represent small effects, which can also be attributed to the intervention's brevity, the relatively low sample size (despite the desired large sample size), and the instruments used. These instruments allow first indications of cause-effect relationships, which is an enormous progress in the research on the transfer effects of (visual) arts engagement. However, it cannot be clearly attributed to which elements of the course program (e. g., declarative knowledge acquisition, drawing, or the museum itself) particularly contributed to the positive transfer effects. Nevertheless, it can be stated that the visual arts course program was effective and led to specific improvements in socio-emotional skills. To obtain insights into the effects of the individual course elements, single studies are needed to analyze these elements in greater detail. In addition, longitudinal studies would be desirable, as these have been extremely rare in transfer effect studies so far. This is particularly unfortunate, as these studies are especially appropriate for capturing the long-term effects of visual arts engagement in an ecologically valid setting. One of the reasons why longitudinal studies have been rare so far may be due to the funding landscape itself, in which research projects are usually only funded for a short period of time (2-3 years).

The results of this dissertation seem rather weak about the recorded drawing tasks and drawing features as well as personality traits regarding the number of tested participants. With regard to drawing tasks and drawing features, the results refer exclusively to correlative relationships that do not allow for causal conclusions. In line with previous studies of the learning-by-drawing literature (e. g., Ainsworth et al., 2011; Ainsworth & Scheiter, 2021; Cook, 2006; Cromley et al., 2020), an influence of prior knowledge and drawing quality was demonstrated only for the declarative learning content (knowledge about emotions) but not for the procedural learning content (emotion recognition task). For the drawing tasks, also in line with the assumptions from the learning-by-drawing literature, the tasks with more elaboration depth (intensifying, transfer, selfie) were shown to correlate more frequently with the learning outcome in the emotion recognition task. We interpreted these correlations in the single tasks as evidence for stronger engagement. However, since these are exclusively correlative relationships, we should be cautious about interpretation. With respect to our machine learning analyses, it could be shown that the emotion recognition abilities can be predicted based on drawing features; the better if emotions are differentiated (approximately 70 % correct classification). In addition, machine learning was used to identify important moderators of personality development (specifically: self-concept). In particular, the results of this dissertation suggest that adolescents with poor prerequisites could benefit especially from specifically designed visual arts course programs. To be able to make even more precise statements about transfer effects, studies with even larger sample sizes or more drawing data would be useful, especially as the effects of visual arts engagement are particularly small. However, it must be noted that the sample size was rather large in relation to other studies in the field of visual arts engagement, concretely when considering that it was a randomized controlled sample. In sum, some methodological problems have been stated, for which in the following section some possible solutions are proposed. However, the uniqueness of this study must be emphasized regarding the design and the results found. This leads to the question: what could be done better or differently in future studies?

7.2.3 Future Studies and Future Research

Future studies in the context of the (visual) arts should equally integrate qualitative and quantitative research traditions, instead of considering them as competing approaches. Especially, the combination of these two research traditions offers an enormous added value, since not only the norm- and value-based research tradition (artistic approach) is covered, but also the psychological theories and models (instructional approach) are taken into account. For the present dissertation, this required not only a clear definition of target constructs, the measurements, and experimental research design, but it also left room for motivational aspects, such as interest, classroom event (i. e., studio habits of mind), and prior knowledge. Furthermore, future studies should take over the clear operationalization and definition of the target constructs, which allow for a better comparability of studies (cf. Holochwost et al., 2021). However, this raises the question of the generalizability of the results found in this dissertation: Can the same results be found if the course is conducted in another museum or with other school classes? Or might these effects be specific to the Herzog Anton Ulrich-Museum in Braunschweig? Would the results be the same if other graphics/paintings were used for drawing? And additionally, would the results change if adolescents in the drawing tasks were given the same drawing templates in all three courses, to eliminate the possibility that the transfer effects found in this dissertation are due to different templates?

Future studies should also investigate the age span of adolescents in greater detail. Here, adolescents aged 12-18 were studied and corrected for age, gender, and educational level, but it is probable that age-related differences can be found upon closer examination (cf. Holochwost et al., 2021). Not only should age be investigated further, but also the drawing data are promising in that they might be able to predict learning success in unknown samples. Since the analyses so far are based on relatively small data sets, a replication or follow-up study would be useful to check the robustness of the data (found in the machine learning analyses). It seems that personality traits could also be predicted from drawing behavior. If drawing proves to be an implicit method for predicting learning success, this offers a variety of possible applications such as diagnostics or process measurement and consequently an individualized therapy program (for more on possible implications see »Chapter 7.3«). In general, however, studies such as these are not only relevant to clinical practice, but also to the educational mission of justifying why students should engage in subjects such as visual arts. For this reason, it is conceivable that in the future, comparisons of curative educational programs (e. g., with other educational programs in sports or science, technology, engineering, and mathematics (STEM)) will be conducted, for example, to evaluate the effects of visual arts versus STEM subjects. However, no consistent indicator could be identified so far. This suggests that other influencing factors might play an important role in the engagement with visual arts that have not been yet extensively. For this reason, this section will focus more on other influencing parameters such as gestures and aha-experiences.

Personality Traits and Personal Prerequisites of a Learner. The personal entry-level of a person determines the level of improvement from the beginning of the engagement with the visual arts. It seems obvious that people with little prior knowledge have "more room for improvement" than people who already have a higher level of functioning at the beginning of their artistic engagement. A possible explanation for the different level of functioning is the parental home, which interacts as a role model especially in the acquisition of empathy, theory of mind and prosocial behavior (Holochwost et al., 2021; Konrath & Kisida, 2021; Van Heel et al., 2020). Children and adolescents from high-functioning families seem to have more opportunities per se to address these issues. The frequent engagement with these issues also means that we cannot rule out the possibility that adolescents do not differ in other aspects as well. This finding is consistent with previous studies that have also found specific effects of engagement with visual arts among disadvantaged children and adolescents (Erickson et al., 2020; Greene et al., 2014). One possible explanation for this specific finding in disadvantaged adolescents could be that gestures have not been included as additional modality.

Gestures as an Additional Modality for Socio-Emotional Skills. It is known from studies on the near-hand effect that cognitive processing can be improved by hand proximity through increased attention in this area (Brucker et al., 2021; Reed et al., 2006). Thus, Brucker et al. (2021) were able to show that not only the proximity of the hand is important for processing, but furthermore also the length of the touch. The authors suggest that the processing of visual learning material may be influenced by these two factors. This effect might also have had a crucial influence in the studies of the present dissertation, because they focused on visual learning material (emotions and their features, persons in social roles with a focus on the different presentation in the roles or staging as a Baroque prince through visual features) and also because in Brucker et al. (2021) the same museum materials are used as in the present dissertation. Future studies should pay more attention to the near-hand effect and investigate the question of whether drawing leads to similar effects as touching without a pen and what role the pen plays in this, or in what way near-hand or embodied cognition should be taken into account. The present work could not provide answers to these questions.

Aha-Experiences. Another topic that, like the near-hand effect (Brucker et al., 2021; Reed et al., 2006), has received little attention yet are the so-called *"aha-experiences"* that occur when engaging with visual arts (Rittelmeyer, 2012a, 2012b). Rittelmeyer (2012a, 2012b) describes these experiences as central prerequisites for an independent interest in artistic activities: an interest in discovery, a sense of solidarity, the awakening of a critical consciousness, and analytical processing. According to Rittelmeyer (2012a, 2012b), it is not surprising that visual arts course programs do not achieve transfer effects if the visual arts — whether in museums or art classes — fail to arouse the interest of the recipient or student. It can be concluded that emotions and motivation are of enormous importance when engaging with visual arts and therefore also need to be considered (Falk, 2008, 2009; Gerjets & Schwan, 2020). Especially, the processes of *attention catch* and *attention hold* (Serrell, 1997; Serrell, 1998) have shown the great importance of motivational and affective processes when engaging with the arts. Even though museum programs, unlike the course programs considered here, are "free choice learning situations" it can be assumed that these processes are equally effective.

7.3 General Implications of This Dissertation

This dissertation provides implications for the design of theory and practice. First, implications for theory that arise from this dissertation are given. Second, some implications can be derived for art museums and arts education as well as health and clinical psychology.

7.3.1 Theoretical Implications

What can Psychology Teach Arts Education and Vice Versa?

The present dissertation provides first empirical evidence that instructional principles of psychology are particularly useful to promote transfer effects by combining them with an artistic motivational approach. Winner, Goldstein, et al. (2013) noted that transfer effects could be expected only when children were instructed to explore the world; likewise, the results of this dissertation also suggest that effects on another domain can be expected only when they are specifically instructed. From the perspective of instructional psychology, it cannot be assumed that a short intervention of 9 hours leads to profound changes in personality traits (i. e., Grosz et al., 2020). However, this does not mean that small effects cannot be detected (Altman & Bland, 1995). One limitation in this regard lies in the operationalization of constructs (as mentioned in »Chapter 7.2.2«). To obtain clear results by means of objective measurements, complex constructs such as personality or acquisition of competencies must be broken down into small units, which thereby become measurable in a psychological manner. As a result of this, only a small subcomponent of the much more complex overall construct can be obtained. The results of this dissertation, however, should not be seen as unalterable "gold standard" for how future research in the field of (visual) arts education must be designed (i. e., that only quantitative research should be done), but rather that there is an equal need for qualitative methods such as qualitative content analysis or the study of "*aha-experiences*" that some people make, and some do not when engaging with visual arts or listening to music (Rittelmeyer, 2012b, 2013, 2018).

One implication of this dissertation is that arts education can learn from psychology that precise instruction is needed if one wants to achieve specific transfer effects. And vice versa, psychology can learn from arts education to become more "cultural", finding an approach to study arts education that considers both qualitative and quantitative aspects. Bringing the two different approaches together represents a first promising step in combining quantitative and qualitative analyses together and recognizing them as equally valid and enriching, especially in a field like the arts that has a long tradition in the humanities.

7.3.2 Practical Implications

Museums & Arts Education

In general, museums and visual arts education have a high value for society (Institut-für-Museumsforschung, 2017; Noschka-Ross & Kampschulte, 2020) and perform an important task in the training of culturally educated citizens (Kultusministerkonferenz, 2007/2013). However, Kröner et al. (2021) referred in their article to the grievances of the state of research, especially that museums often lag in their development or are rather conservative in their attitude (see also Gerjets & Schwan, 2020). Meanwhile, many museum researchers see in the Covid-19 pandemic the potential to make the decisive and long-awaited progress regarding digital media modernization (Noschka-Ross & Kampschulte, 2020). But for good empirical education research to stop being tomorrow's goal, several conditions must be met:

- Stronger interweaving of practice and basic research
- Expanding the repertoire of methods

Stronger Interweaving of Practice and Basic Research: To establish museums as places for the promotion of socio-emotional skills in the long term, both knowledge of the recipients and knowledge of psychological structures and mechanisms concerning socio-emotional skills are necessary. Up to now, with few exceptions, there have been no systematic empirical analyses or theoretically based findings in the museum pedagogical field on the effective factors of visual arts engagement in art museums in general and for socio-emotional skills in particular. Therefore, this dissertation shows that it is possible to train socio-emotional skills by engaging with visual arts, but only when these skills are explicitly addressed within an instructional design. In addition, digital media enable new application formats, such as the digital drawing tool in this dissertation, and afford the creation of selfies or the collection of drawing features during the drawing process (Kröner et al., 2021; Schmidt, 2020). For this, however, a mutual close cooperation between research and practice is necessary. In this process, practice provides research with necessary data for statistical analyses and findings, and conversely, educational programs can be directly adjusted and improved through these findings.

Expanding the Repertoire of Methods: So far, little attention has been paid to digital media in the context of visual arts engagement, although it can not only lead to a facilitation of familiar forms of visual arts work, but also offer completely new forms of engagement and design (Peez, 2018; Schmidt, 2020). Schmidt (2020) distinguishes between digital media as a *medium* (*motivating*, *functional*, and *participatory*) and as a *tool* (*researching & analyzing*, *experimenting & intensifying*, and *documenting & presenting*). Interestingly, this division was utilized in the present dissertation by using tablets to motivate adolescents and to take away their fear of drawing. In addition, drawing data were collected and exploratively analyzed with machine learning. The drawing data could predict not only the learning success of the adolescents but also their personality traits. Thus, this dissertation provides evidence that drawing could be a useful tool for visual arts training or drawing apps, which could make drawing more objectively detectable and be used to identify drawing features that are particularly predictive of learning success. Conversely, if one knows which drawing features are promising, one could train exactly these patterns to increase learning success. This should be the subject of future research and has implications for health and clinical psychology, as discussed in the next section.

Health & Clinical Psychology

The results of this dissertation offer first insights as well as specific conclusions and possible applications for health and clinical psychology. In accordance with previous studies, the healing role on health and wellbeing of the arts could also be demonstrated (Fancourt & Finn, 2019; Karkou et al., 2022). For instance, the World Health Organization (WHO) has raised awareness to the arts and health and launched a specific program (Fancourt & Finn, 2019), which was also addressed in a Frontier Research Topic and focused on psychological and physiological benefits (Karkou et al., 2022).

Specific Support of Disadvantaged Adolescents Through Visual Arts Engagement: In the empirical studies of this dissertation, it was found that adolescents with low skills, prerequisites, and knowledge in the socio-emotional domain benefit more from the visual arts engagement in that they develop a more differentiated self-concept or show more gains in their emotion recognition abilities. However, it must be noted that this was not a clinically emergent sample. Nevertheless, adolescents with low self-rated empathy scores in particular seem to benefit in terms of building a more differentiated self-concept. Thus, findings of this dissertation are consistent with previous studies (DeBettignies & Goldstein, 2020; Greene et al., 2014; Koch & Thompson, 2017; Robinson, 2013). Greene et al. (2014) similarly demonstrated that disadvantaged students from high-poverty schools or rural areas and minority students showed stronger gains after a museum field trip for the domains of critical thinking, historical empathy, tolerance, and arts interest than the overall sample. For the non-disadvantaged adolescents, null effects tended to emerge. Greene et al. (2014) concluded that disadvantaged adolescents must rely on enriching museum field trips to compensate for the fact that their parents do not take them to museums. DeBettignies and Goldstein (2020), in contrast to Greene et al. (2014) examined long-term effects of arts engagement in an after-school program on self-concept formation in children and adolescents ages 8 to 11, finding specific outcomes in children with low self-concept. Similar results to the two exemplary studies mentioned above were provided by a review that specifically addressed the question of whether disadvantaged students particularly benefit from engagement with visual arts, and demonstrated positive effects on self-efficacy, self-regulation, and the use of learning strategies (Robinson, 2013). In addition, these adolescents have also been shown to feel more valued and noticed by their peers (Koch & Thompson, 2017; Robinson, 2013).

Further research questions arise from these findings, such as whether the same could be found in adolescents with ADHD, autism, or callous unemotional traits (which some studies in the review suggest; cf. Robinson, 2013). Clinical disorders are generally associated with problems in emotion recognition abilities (e. g., Derntl et al., 2009; Domes et al., 2009; Surcinelli et al., 2006) and are accompanied by a low differentiated self-concept (Hanks et al., 2016; Houck et al., 2011). An interesting resulting research question might be whether adolescents with clinical abnormality might benefit in the same way as adolescents without clinically relevant disorders.

Visual Arts and Digital Drawing as an Assessment Tool: The analysis of the drawing data by using a machine learning approach showed that drawing can be relevant as clinical assessment tool in the context of diagnostics to predict learning outcomes, such as emotion recognition abilities or self-complexity. A specific research question would be whether clinical abnormalities can be predicted from drawing. It is conceivable that various clinical abnormalities are associated with specific drawing behaviors. For example, it would be conceivable that an impulsive child with ADHD or callous unemotional traits would generally draw with more pencil/brush pressure, whereas a child with autism might be more likely to draw with very many strokes and little pencil/brush pressure to the paper. In addition, it is possible to define areas of interest (AOI) in drawing tasks and analyze whether students engage in relevant areas (e. g., of emotion recognition), which could be an indicator for shifted attention. If it were possible to use drawing data for implicit diagnostics, drawing would be a highly desirable objective diagnostic tool in addition to the other assessment tools used. Another clinical application would be to use drawing data not only as an objective diagnostic tool, but also as an assessment tool to examine the course of symptoms based on objective drawing behavior parallel to the course of therapy, linked with the question of whether the drawing behavior changes in the same way as the symptoms. A comparable tool for early diagnosis of dementia and Alzheimer's disease is the digital clock test (for more information, see Polgar et al., 2018). Like how drawing is used for early detection of Alzheimer's and dementia, one could consider whether drawing could be suitable for prevention of clinical abnormalities: Having shown that even clinically non-dysfunctional adolescents can benefit from engagement with visual arts in terms of their socio-emotional skills, it is possible to hypothesize that such programs could be used to prevent clinical disorders. For example, it is known that clinical disorders are associated with problems in emotion recognition skills (e. g., Derntl et al., 2009; Domes et al., 2009; Surcinelli et al., 2006) or are also associated with a rigid minimally differentiated self-concept (Hanks et al., 2016; Houck et al., 2011). This could be countered by explicit training in the context of such programs as the one presented here to build and maintain competence. Furthermore, the results of this dissertation provide a justification for the use of (visual) arts therapy, as positive effects on empathy and self-concept were proven experimentally within.

7.4 Conclusions

To the best of my knowledge, this dissertation is one of the first empirical studies to systematically link the research fields of arts education and psychology in an interdisciplinary way by developing, scientifically monitoring, and evaluating a visual arts course program, considering psychological standards such as randomized group assignment and the use of process measures. The study focused on the question of whether psychological theories, models, and instruments can be used to measure transfer effects on socio-emotional skills. For this purpose, a conceptual framework in terms of arts-integrated education (Casciano et al., 2019) was proposed that takes into account both the individual value of arts in terms of “arts for the arts’ sake” (Hetland et al., 2013), as well as the instructional goal of promoting socio-emotional skills by considering generic drawing tasks in terms of the learning-by-drawing approach (Ainsworth et al., 2011; Van Meter & Firetto, 2013). The empirical research showed that specific transfer effects using psychological theories and methods on socio-emotional skills can be demonstrated when courses are properly designed to train these skills. Personal prerequisites influence the learning success in the sense that persons with especially low skills seem to benefit most. But also, that drawing quality and the drawing tasks themselves influence learning outcomes. However, regarding the drawing features, no clear influencing parameters could be found.

This dissertation provides empirical evidence that is of interest to researchers, as well as policy makers and society. First, based on an experimental study design, the present dissertation provides empirical evidence that engagement with the visual arts can indeed contribute to socio-emotional skill acquisition. Second, the study shows that socio-emotional skills can be trained if the course program and the drawing tasks are specifically designed to train these skills and foster deep elaboration through mechanisms known from learning-by-drawing. Third, the use of digital media is recommended for children and adolescents not only because drawing on tablets is more fun for them, but also because they are more creative with digital tools than adults (Heydon, 2012; Schmidt, 2020). Additionally, drawing on tablets also allows to collect drawing features and to draw conclusions about the underlying processes and mechanisms. For instance, de Witte et al. (2021), identified three important mechanisms (“embodiment”, “concretization", "symbolism and metaphors") in creative arts therapies that are completely in line with the learning-by-drawing approach used in this dissertation. This finding shows that interdisciplinary collaborations are needed to find common definitions and objects to advance the research field in the long term. My hope (and of my colleagues) is to make a first promising step in analyzing drawing features in the context of socio-emotional learning, to offer opportunities for future growth in research and practice, and to prevent the "silence that descends without art and culture". Even if further investigations are necessary to validate these conclusions.

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ABBREVIATIONS

ADHD	Attention Deficit Hyperactivity Disorder
AI	arts integration
ANCOVA	analysis of covariance
ANOVA	analysis of variance
AOI	areas of interest
APR	adjectives per role
$\mathrm{APR}_{\mathrm{self}}$	self-generated adjectives per role
AQ	Autism Questionnaire
BMBF	Bundes Ministerium für Bildung und Forschung (engl.: Federal Ministry of Education and Research)
CLT	Cognitive Load Theory
DCT	Dual-Coding Theory
DMN	Default Mode Network
DV	dependent variable
Emo	Emotion Course
Epo	Epoch Course
FWEA	Fragebogen zur Wahrnehmung der Emotionen anderer/ Questionnaire on Perception of Others
GAEM	General Arts Engagement Model
GLM	General Learning Model
GLT	Generative Learning Theory
HAUM	Herzog Anton Ulrich-Museum

HEXACO PI-R	Personality Traits
ICU	Inventory of Callous Unemotional Traits
M	Mean
MET	Multifaceted Empathy Test
ML	Machine Learning
RQ	Research Question
SAT	standardized achievement test
SCD	self-concept differentiation index
SD	Standard Deviation
SE	Standard Error
SEE training	sensitivity to emotional expressions training
Self	Self-Concept Course
SES	socio-emotional skills
SET	socio-emotional transfer
STEM	science, technology, engineering, and mathematics
TAS	Toronto Alexithymia Questionnaire
TEQ	Toronto Empathy Questionnaire
ToM	theory of mind
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organization
WST	Wortschatz Test [engl. verbal intelligence test]

TABLES

FIGURES

PUBLICATIONS

ARTICLE IN PEER-REVIEWED JOURNALS

Dankowski, T., Kastner, L., Suenkel, U., von Thaler, A.-K., Mychajliw, C., Krawczak, M., Maetzler, W., Berg, D., Brockmann, K., Thiel, A., Eschweiler, G. W., Heinzel, S. (Prepared for Submission, 2022). Longitudinal dynamics of depression in subgroups of older individuals during the COVID-19 pandemic. *Frontiers in Epidemiology.*

Kastner, L., Brucker, B., Mock, P., Jusyte, J., Ruiz Fernández, S., Nommensen, S., Thiel, A., & Gerjets P. (Under Review). How and under which circumstances might visual arts engagement support adolescents' self-concept development? Psychological boundary conditions for socio-emotional transfer effects of visual arts programs. *PLOS ONE.*

Kastner, L., Brucker, B., Mock, P., Jusyte, J., Ruiz Fernández, S., Nommensen, S., Thiel, A., & Gerjets P. (Under Review). Focusing on emotions in digital drawing courses fosters emotion recognition: The influence of drawing tasks and drawing activities. *Computers in Human Behavior Reports.*

Greule, C., Sudeck, G., Thiel, A., Kastner, L., Janßen, P., Nieß, A., & Krauß, I. (Under Review). Correlates of sport enjoyment in children and adolescents for a new perspective on movement-related treatment prevention of overweight – A systematic literature review. *Obesity Reviews.*

Ziser, K., Junne, F., Herrschbach, A., Martus, P., Jacoby, J., Stuber, F., Rahmani Azad, Z., Mack, I., Weiland, A., Krauß, I., Greule, C., Sudeck, G., Kastner, L., Zurstiege, G., Hoell, A., Bethge, W., Sammet, T., Schliesing, O., Zipfel, S., Ehehalt, S., & Giel, K. (2022). Supporting families to achieve a healthy weight development for their child with overweight/obesity using the STARKIDS intervention: Study protocol for a cluster-randomized controlled trial. *TRIALS BMC, 23*(590), 1–18. doi: https://doi.org/10.1186/s13063-022-06525-0

Kastner, L., Umbach, N., Jusyte, J., Cervera-Torres, S., Ruiz Fernández, S., Nommensen, S., & Gerjets P. (2021). Evaluation of (digital) drawing courses in the art museum designed to promote adolescents' socio emotional skills. *Frontiers in Psychology, 11*, 4031. doi: https://doi.org/10.3389/fpsyg.2020.603984

Ruiz Fernández, S., Kastner, L., Cervera-Torres, S., Müller, J., & Gerjets, P. (2019). Moved by emotions: Affective concepts representing personal life events induce freely performed steps in line with combined sagittal and lateral space-valence associations. *Frontiers in Psychology, 10,* 2787. doi: https://doi.org/1010.3389/fpsyg.2019.02787

Article in Conference Proceedings

Kastner, L., Umbach, N., Jusyte, A., Ruiz Fernández, S., Nommensen, S., & Gerjets, P. (2020). Kulturelle Bildung im Kunstmuseum evidenzbasiert gestalten: Entwicklung und Evaluation (digitaler) Kunstkurse zur Förderung sozial-emotionaler Fähigkeiten von Jugendlichen. In S. Timm, J. Costa, C. Kühn, & A. Scheunpflug (Eds.), *Kulturelle Bildung. Theoretische Perspektiven, methodologische Herausforderungen und empirische Befunde* (pp. 231-246). Münster: Waxmann.

Conference Papers

Kastner, L., Umbach, N., Jusyte, A., Ruiz Fernández, S., Nommensen, S., & Gerjets, P. (2021, June). Can portrait-drawing foster socio-emotional skills? Life Improvement Science Conference, Tübingen, Germany. [Talk]

Kastner, L., Umbach, N., Jusyte, A., Ruiz-Fernández, S., Nommensen, S., & Gerjets, P. (2019, November). Körper, Digitalisierung, Kulturelle Bildung. Was wir von kultureller Bildung lernen können, um Bildung zu fördern. Eingeladener Vortrag auf der Netzwerktagung „Wieviel Körper braucht die Kulturelle Bildung?“. Merseburg, Deutschland. [Talk]

Kastner, L., Umbach, N., Jusyte, A., Ruiz Fernández, S., Nommensen, S., & Gerjets, P. (2019, August). Digital drawing in the Art Museum: Can digital portrait drawing help to enhance socio-emotional skills of adolescents? 18th Biennial Conference of the European Association for Research on Learning and Instruction (EARLI). Aachen, Germany. [Talk]

Kastner, L., Umbach, N., Nommensen, S., Jusyte, A., Ruiz Fernández, S., & Gerjets, P. (2019, Oktober). Projekt DigiSelbst – Zeichnen digitaler Porträts im Kunstmuseum: Transfereffekte kultureller Bildung auf sozial-emotionale Fähigkeiten. Bundesministerium für Bildung und Forschung „Förderung von Forschungsvorhaben zur Kulturellen Bildung". Berlin, Deutschland. [Talk]

Kastner, L., Umbach, N., Nommensen, S., Jusyte, A., Ruiz Fernández, S., & Gerjets, P. (2019, Oktober). Kulturelle Bildung im Museum gestalten: Kursprogramm zu Förderung sozial-emotionaler Fähigkeiten bei Jugendlichen. Bundesministerium für Bildung und Forschung „Förderung von Forschungsvorhaben zur Kulturellen Bildung". Berlin, Deutschland. [Poster]

Kastner, L., Jusyte, A., Ruiz Fernández, S., & Gerjets, P. (2018, März). DigiSelbst - Zeichnen digitaler Porträts im Kunstmuseum: Transfereffekte kultureller Bildung auf soziale Fertigkeiten. 2. BMBF Vernetzungstreffen „Förderung von Forschungsvorhaben zur Kulturellen Bildung". Köln. [Talk]

Kastner, L., Jusyte, A., Ruiz Fernández, S., & Gerjets, P. (2018, September). The effects of digital drawing on socio-emotional skills: A pilot study. 7th International Conference on Spatial Cognition (ICSC). Rome, Italy. [Poster]

Kastner, L., Jusyte, A., Ruiz Fernández, S., & Gerjets, P. (2018, März). Digitalisierung und Kulturelle Bildung. Nutzung digitaler Medien für kulturelle Bildungsangebote: Fluch oder Segen? 2. BMBF Vernetzungstreffen „Förderung von Forschungsvorhaben zur Kulturellen Bildung". Köln. [Talk]

Kastner, L., Jusyte, A., Ruiz Fernández, S., Nommensen, S., & Gerjets, P. (2018, April). Drawing Portraits in the Art Museum: Effects of Digital Drawing on Social-Emotional Skills. LEAD Retreat. Blaubeuren. [Poster]

Kastner, L., Jusyte, A., Ruiz Fernández, S., Nommensen, S., & Gerjets, P. (2018, März). Effekte des Digitalen Zeichnens auf sozial-emotionale Fähigkeiten. 2. BMBF Vernetzungstreffen „Förderung von Forschungsvorhaben zur Kulturellen Bildung". Köln. [Talk]

Kastner, L., Jusyte, A., Ruiz Fernández, S., Nommensen, S., & Gerjets, P. (2018, März). DigiSelbst - Effekte des Digitalen Zeichnens auf sozial-emotionale Fähigkeiten. 2. BMBF Vernetzungstreffen „Förderung von Forschungsvorhaben zur Kulturellen Bildung". Köln. [Talk]

Kastner, L., Müller, J., Rahona López, J. J., Gerjets, P., & Ruiz Fernández, S. (2018, June). Moved by Emotions: How Emotional Life Events Influence Where We Move. 9th European Conference on Positive Psychology (ECPP). Budapest, Hungary. [Poster]

Kastner, L., Müller, J., Rahona López, J. J., Gerjets, P., & Ruiz Fernández, S. (2018, March). Personal time-related events influence the direction of whole-body movements. 60. Tagung experimentell arbeitender Psychologen (TeaP). Marburg. [Poster]

Mueller, J., Kastner, L., Rahona, J. J., Gerjets, P., & Ruiz Fernández, S. (2017, March). Positive life events induce forward bodily movements. 59. Tagung experimentell arbeitender Psychologen (TeaP). Dresden. [Poster]

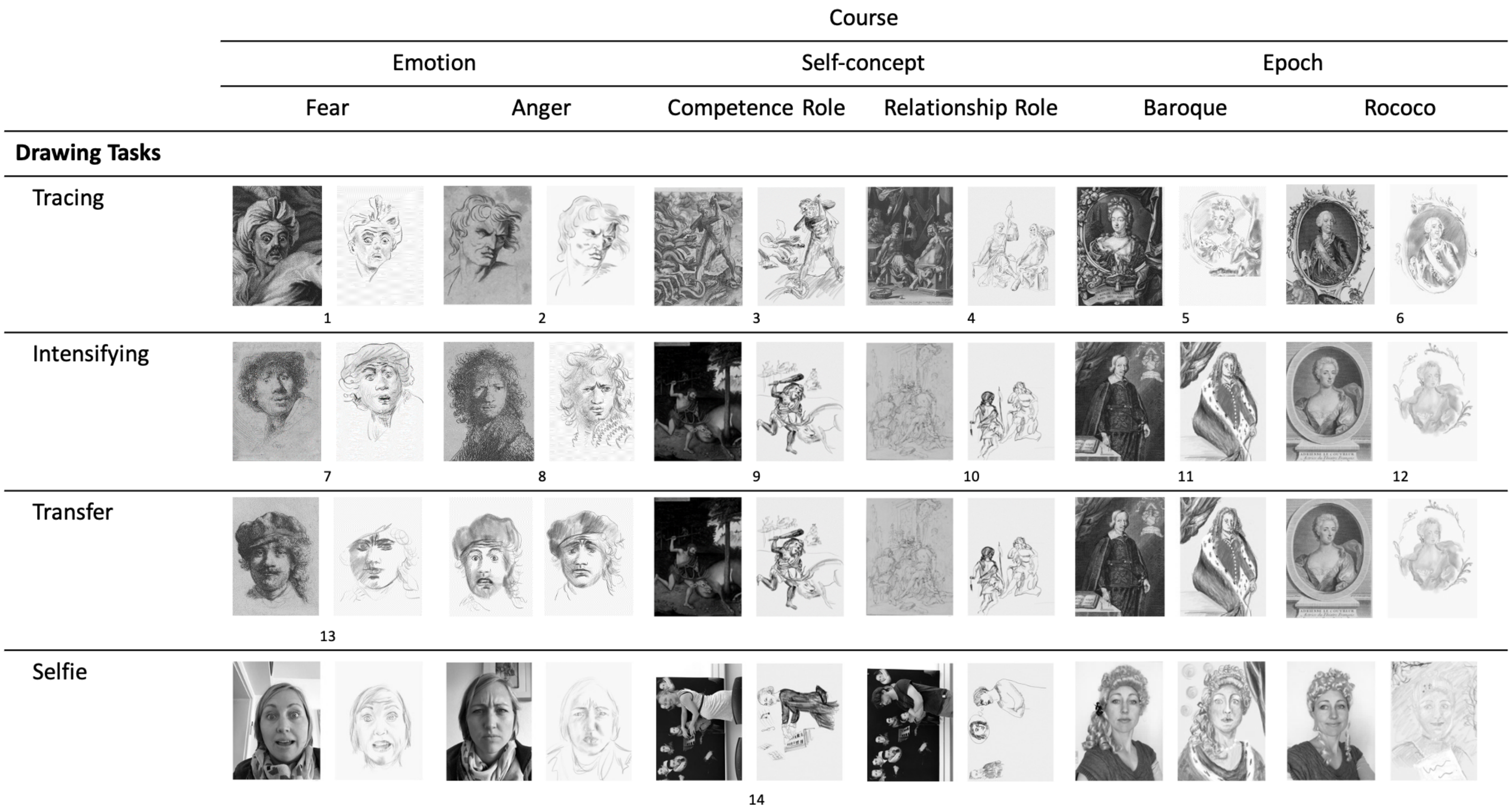
APPENDIX A

The attached CD contains a digital version of the course manual "*Emotions, Self-Concept & Epochs – Exploring Portraits with the Digital Drawing Pencil*" and this dissertation.

APPENDIX B

Figure B1

Overview Over the Picture Used in the Visual Arts Education Programs for Drawing



[1]Johann Elias Ridinger: Asia. Mezzotint, Braunschweig, Herzog Anton Ulrich-Museum.
[2]G. Stein: Representation of different emotional states. Copperplate Engraving, Wolfenbüttel, Herzog August Bibliothek.

[3]Rembrandt: Self-portrait with cap, big eyes and open mouth. Etching and drypoint, 1630, Braunschweig, Herzog Anton Ulrich-Museum
[4]Rembrandt: Self-portrait with wrinkled forehead. Etching, 1630, Braunschweig, Herzog Anton Ulrich-Museum.

[5]Rembrandt: Self-portrait with beret. Etching and hand coloring, 1630, Braunschweig, Herzog Anton Ulrich-Museum.

[6]Cornelis Cort: Heracles defeats the Hydra of Lerna. Copperplate Engraving, 1563, Braunschweig, Herzog Anton Ulrich-Museum.
[7]Egidius Sadeler: Hercules spins at the Omphale. Copperplate Engraving, 1590–1629, Braunschweig, Herzog Anton Ulrich-Museum.
[8]Lucas Cranach d. Ältere: Hercules and Diana's hind. Oil Painting, 1537, Braunschweig, Herzog Anton Ulrich-Museum.
[9]Lorenzo Pasinelli: Hercules and Omphale. Oil on canvas, 1649–1700. Braunschweig, Herzog Anton Ulrich-Museum, Gallery of Prints.
[10]Cornelis de Vos: Family picture. Oil Painting, 1618. Braunschweig, Herzog Anton Ulrich-Museum.

[11]Elias Christoph Heiss: Wilhelmine Amalia, Duchess of Braunscheig-Lüneburg. Mezzotint, 1674–1725. Braunschweig, Herzog Anton Ulrich-Museum.
[12]Johannes Esaias Nilson: Leopold Graf von Daun. Etching, 1741–1788. Braunschweig, Herzog Anton Ulrich-Museum, Gallery of Prints.
[13]Melchior Küsel: Joseph Furttenbach. Copperplate Engraving, 1651. Braunschweig, HAUM, Gallery of Prints.
[14]Georg Friedrich Schmidt: Adrienne Lecouvreur. Copperplate Engraving, 1737–1755. Braunschweig, Herzog Anton Ulrich-Museum, Gallery of Prints.

APPENDIX C

(1) Explicit Knowledge about Emotions

In the following, you will be asked some more questions about emotions and their characteristics and functions in everyday life.
There are 4 alternative answers to each question, one of which is always correct. Always choose the correct answer.
If you do not know an answer, it does not matter. Just try to guess. For each question you should also indicate how sure you are about your answer.
You can only continue with the next question if you have answered a question and indicated its answer certainty.

→ **Correct answers are marked bold.**

1. *How many basic emotions exist?*
   - ◻ 4
   - ◻ **6**
   - ◻ 8
   - ◻ 10

2. *What is the characteristic of basic emotions?*
   - ◻ Individual and culture-dependent activation pattern of facial muscles.
   - ◻ Universal and culture-dependent activation pattern of facial musculature.
   - ◻ **Universal and culture-independent facial musculature activation pattern.**
   - ◻ Individual and culture-independent facial musculature activation pattern.

3. *Which emotional facial expression is characterized by raised eyebrows?*
   - ◻ Anger
   - ◻ Disgust
   - ◻ **Fear**
   - ◻ Sadness

4. *Which emotional facial expression is characterized by eyebrows drawn down?*
   - ◻ **Anger**
   - ◻ Surprise
   - ◻ Disgust
   - ◻ Fear

5. *Which emotional facial expression results in horizontal wrinkles on the forehead?*
   - ◻ Anger
   - ◻ **Fear**
   - ◻ Sadness
   - ◻ Disgust

6. *Which emotional facial expression results in vertical wrinkles on the forehead?*
   - ◻ Sadness
   - ◻ **Anger**
   - ◻ Happiness
   - ◻ Surprise

7. *Which emotional facial expression is characterized by a "Small Triangle" below the eyebrow?*
   - ◻ Anger
   - ◻ Fear
   - ◻ Disgust
   - ◻ **Sadness**

8. *Which emotion is <u>NOT</u> a basic emotion?*
   - ◻ **Shame**
   - ◻ Anger
   - ◻ Sadness
   - ◻ Happiness

9. *What is the function of the emotion "fear"?*
   - ◻ Protection
   - ◻ Attack
   - ◻ Rejection
   - ◻ **Orientation**

10. *Which two emotional facial expressions are often confused with each other due to great similarity in presentation?*
    - ◻ **Anger-Disgust**
    - ◻ Anger-Fear
    - ◻ Sadness-Surprise
    - ◻ Anger-Surprise

11. *Which two emotional facial expressions are often confused with each other due to great similarity in presentation?*
    - ◻ Happiness-Surprise
    - ◻ **Fear-Surprise**
    - ◻ Fear-Sadness
    - ◻ Happiness-Sadness

12. *What is <u>NOT</u> one of the characteristics of a (basic) emotion?*
    - ◻ Short duration (from a few minutes to hours).
    - ◻ Are subjective and intense.
    - ◻ **Are accompanied by specific physiological responses that are different for each emotion.**
    - ◻ Are accompanied by specific facial expressions.

13. *Which emotional facial expression is easiest to recognize?*
    - ◻ **Happiness**
    - ◻ Surprise
    - ◻ Fear
    - ◻ Anger

14. *Which part of the face is most important for recognizing emotional expressions?*
    - ◻ Nose
    - ◻ Mouth
    - ◻ **Eyes**
    - ◻ Forehead

15. *Which is NOT a complex emotion?*
    - ◻ Pride
    - ◻ Relief
    - ◻ Hope
    - ◻ **Surprise**

16. *To identify a person's emotional state, we have several sources of information at our disposal. Check off which source of information does NOT provide clues to a person's emotional state.*
    - ◻ Voice Pitch
    - ◻ Posture
    - ◻ Facial Expression
    - ◻ **Face shape**

17. *At What Age Can Children Recognize and Distinguish Basic Emotions in Faces?*
    - ◻ 9 Months
    - ◻ 3 Months
    - ◻ **6 Months**
    - ◻ 12 Months

18. *For the emotion "sadness" which part of the face does not provide a specific indication of the emotion itself?*
    - ◻ **Nose**
    - ◻ Eyes
    - ◻ Mouth
    - ◻ Forehead

19. *Wrinkling the nose is a characteristic feature of the emotion ...*

- ◻ Fear
- ◻ Anger
- ◻ Sadness
- ◻ **Disgust**

20. *Which part of the face most often does NOT provide relevant information About a person's emotional state?*

- ◻ Eyebrows
- ◻ **Cheek**
- ◻ Eyes
- ◻ Mouth
- ◻

21. *Which emotion has the mouth open the widest?*

- ◻ Happiness
- ◻ Fear
- ◻ Sadness
- ◻ **Surprise**

22. *What is the function of the emotional facial expression "surprise"?*

- ◻ It serves to attack.
- ◻ It helps to connect.
- ◻ **It is used for orientation in situations.**
- ◻ It serves to build social relationships.

23. *In which emotional facial expression does the mouth form a u-shaped curve?*

- ◻ Anger
- ◻ Fear
- ◻ Sadness
- ◻ **Happiness**

24. *Which emotion can children name first?*

- ◻ **Happiness**
- ◻ Anger
- ◻ Surprise
- ◻ Disgust

25. *Recognizing emotions correctly is sometimes very difficult for us. In the following, you will be presented With Several Statements that explain why correct emotion recognition fails. Which statement is <u>NOT</u> true?*

- ◻ Emotions last only a short time.
- ◻ Emotional facial expressions can be incompatible with the spoken word.
- ◻ **Basic emotions are shown very differently depending on the culture and the person.**
- ◻ Sometimes people show more than one emotion.

26. *What do the emotional facial expressions disgust and happiness have in common?*

- ◻ The characteristic features of both emotions are located in the area of the nose.
- ◻ The characteristic features of both emotions are located in the area of the forehead.
- ◻ The characteristic features of both emotions are located in the area of the eyes.
- ◻ **The characteristic features of both emotions lie in the area of the mouth.**

27. *In addition to facial expressions, other characteristics play an important role in emotional expression. What does <u>NOT</u> apply?*

- ◻ Gestures
- ◻ Posture
- ◻ Spoken word
- ◻ **Eye shape**

28. *In which visual details do the emotional facial expressions of "anger" and "sadness" differ?*

- ◻ In anger, eyebrows tend to be drawn together inward and downward, whereas in sadness, eyebrows tend to be drawn together inward and upward.
- ◻ **In anger, eyebrows tend to be drawn together outward and downward, whereas in sadness, they tend to be drawn together outward and upward.**
- ◻ In anger, the eyebrows tend to be drawn together inward and upward, while in sadness they tend to be drawn together inward and downward.
- ◻ When angry, eyebrows tend to be drawn together outward and upward, but when sad, they tend to be drawn together outward and downward.

(2) Explicit Knowledge about self-concept

Below you will be asked a few more questions about your self-concept and the roles you can take on in everyday life.

For each question there are 4 alternative answers, one of which is always correct. Always choose the correct answer.

If you do not know an answer, it doesn't matter. Just try to guess. For each question you should also indicate how sure you are about your answer.

You can only continue with the next question if you have answered a question and indicated its answer certainty.

→ **Correct answers are marked bold.**

1. *What is understood by the self-concept?*
   - □ **All knowledge, ideas, and beliefs about one's own person.**
   - □ All feelings and sensations about one's own person.
   - □ Overall attitude toward oneself on an evaluation dimension negative to positive.
   - □ Overall evaluation of a person's physical appearance, abilities, and skills.

2. *Which statement describes best the self-reference effect?*
   - □ There are structures in the brain that help organize past experiences and process new self-relevant information.
   - □ Self-recognition is based on feedback from important caregivers.
   - □ **Information related to the self is processed more thoroughly and deeply and thus remembered better than other information.**
   - □ Events experienced together are processed in the same way by all participants.

3. *The self-reference effect can be tested with a list of traits. In this case, 20 trait words are read aloud, and these are then to be remembered. Which statement is true?*
   - □ Words with which we do not identify at all are remembered particularly well.
   - □ Words that rhyme with other words are remembered particularly well.
   - □ Words that are like other words in the list are remembered better.
   - □ **Words that we identify with are remembered especially well.**

4. *Imagine that you did poorly in a class assignment for which you had not prepared well. You justify the bad grade <u>BUT</u> with the fact that it was particularly loud during the class work. What information bias is this?*
   - □ **Self-esteem-serving attribution**
   - □ Actor-Observer-Divergence
   - □ Fundamental attribution error
   - □ Positivistic attribution

5. *What is the worst source I can use to get information about myself?*
   - □ **Comparison with others (social source)**
   - □ Looking inside myself (introspective source)
   - □ Google (web source)
   - □ Asking other people (communicative source)

6. *Which statement about observer-actor divergence is true?*
   - □ The actor infers the personality of the observer through observations.
   - □ **The observer infers the personality of the actor through observations.**
   - □ Actor and observer reach the same conclusions about the personality of the actor.
   - □ Actor and observer reach the same conclusions about the personality of the observer.

7. *To test whether children already had a self-concept, researchers painted red dots on their faces. According to the researchers' assumptions, what should happen if the children already possessed a self-concept?*
   - □ They should touch the red dot of their reflection.
   - □ **They should touch themselves at the location of the red dot on their face.**
   - □ They should start testing grimaces in the reflection.
   - □ They should look especially deeply into the eyes of their reflection.

8. *The self-concept becomes more complex throughout life. Which statement is <u>NOT</u> true?*
   - □ A simple self-concept develops in children around the age of two.
   - □ A complex self-concept is related to psychological well-being.
   - □ **Children have a complex self-concept from birth.**
   - □ After puberty, the self-concept is relatively stable.

9. *What distinction can be made regarding roles?*
   - □ **Competence- vs. relationship-oriented**
   - □ Individual- vs. group-oriented
   - □ Relationship- vs. group-oriented
   - □ Competence- vs. group-oriented

10. *What is a common idea about the self-concept?*
   - □ The self-concept is like a complex knot.
   - □ The self-concept is like a library of stories about the self.
   - □ **The self-concept is like a network with many nodes.**
   - □ The self-concept is like an encyclopedia of person characteristics.

11. *Which of these roles is NOT one of the relationship-oriented roles?*
   - □ Daughter
   - □ Sister
   - □ **Girlfriend**
   - □ Schoolgirl

12. *Which of these roles is NOT one of the competency-based roles?*
   - □ Student
   - □ **Friend**
   - □ Soccer Player
   - □ Triathlete

13. *What is the function of the self-concept?*
   - □ **It helps to structure the knowledge we have of ourselves.**
   - □ It helps to structure the knowledge that others have of us.
   - □ It helps structure sensations we have about ourselves.
   - □ It helps to structure sensations that others have for us.

14. *Which roles are likely to show the greatest overlap in self-concept, i.e., are most similar?*

- ◻ Girlfriend-Student
- ◻ **Girlfriend-Daughter**
- ◻ Daughter-Student
- ◻ Athlete-Daughter

15. *Which roles are likely to show the greatest overlap in self-concept, i.e., are most similar?*

- ◻ Son-Friend
- ◻ Son-Brother
- ◻ Athlete-Student
- ◻ **Student-Friend**

16. *What does social identity theory say?*

- ◻ **People identify more strongly with groups to which they belong than with other groups.**
- ◻ Other groups are included in the self-concept to distinguish them from the self-group.
- ◻ Other group and self-group do not differ in their role in a person's social identity.
- ◻ Intrinsic group is included in the self-concept without differentiation from the extrinsic group.

17. *Through what can one become least aware of aspects of one's own personality?*

- ◻ Through situational contexts.
- ◻ By rethinking one's own personality traits.
- ◻ By rethinking one's own roles.
- ◻ **By observing other people.**

18. *Why can it be positive to have a flexible self-concept?*

- ◻ **Negative feedback in one area does not affect other areas of the self-concept as much.**
- ◻ Positive feedback in one area does not impact other areas of self-concept as much.
- ◻ Positive feedback in one area more strongly impacts self-concept in that area.
- ◻ Negative feedback in one area does not impact self-concept in that area as much.

19. *Which formulation most closely captures the notion of self-concept?*

- ◻ Self as subject of cognition
- ◻ **Self as object of cognition**
- ◻ “I”-feeling
- ◻ Idea of how others perceive you

20. *In which situation can a brave hero be weak?*

- ◻ In a fight against a beast
- ◻ In a battle
- ◻ **In a love relationship**
- ◻ On the run

(3) Explicit Knowledge about historical periods

In the following, you will be asked some questions about art history topics (e.g., the structure, historical context, or content of artworks).
There are three types of questions in this section:

Multiple-choice

You always get four answer alternatives in text form or as pictures. One of these four answers is correct. Always choose the correct answer by touching the white border surrounding the answer. Additionally, you can enlarge images that are possible answers to a question by touching the image. You cannot enlarge images that are embedded in the question text.

Classification in categories

You get pictures and three answer categories. Your task is to drag and drop the four pictures into the corresponding categories. All pictures must be assigned, and each category must contain at least one picture. Images in this task type can also be enlarged (see above).

Marking image features

You are given an image that you cannot enlarge. In this type of task, you have to mark places in the artwork by clicking on them that correspond to the criteria of the task (e.g., places that show the use of an artistic technique). You have to mark as many different places as described in the task.

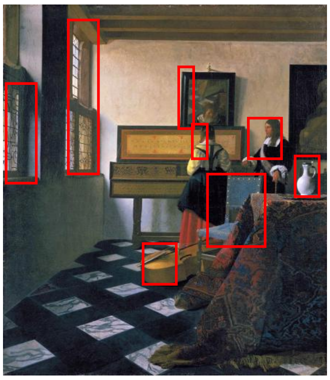
If you do not know an answer, it doesn't matter. In this case try to guess. Also, for each question you should indicate how sure you are about your answer. You can only continue with the next question if you have answered a question and indicated your answer certainty.

→ Correct answers are marked bold.

1. *In which work is the strongest effect of deep space created?*




2. *Mark 4 locations with light reflections.*



3. *The art of which of the following eras is considered playful and ornate?*

□ Classicism

□ Renaissance

□ Middle Ages

□ **Rococo**

4. *Which of the following is NOT a characteristic of Renaissance painting?*

□ **Symmetry**

□ Harmony

□ Excessiveness

□ Fidelity to Nature

5. *To which era does this sculpture belong?*

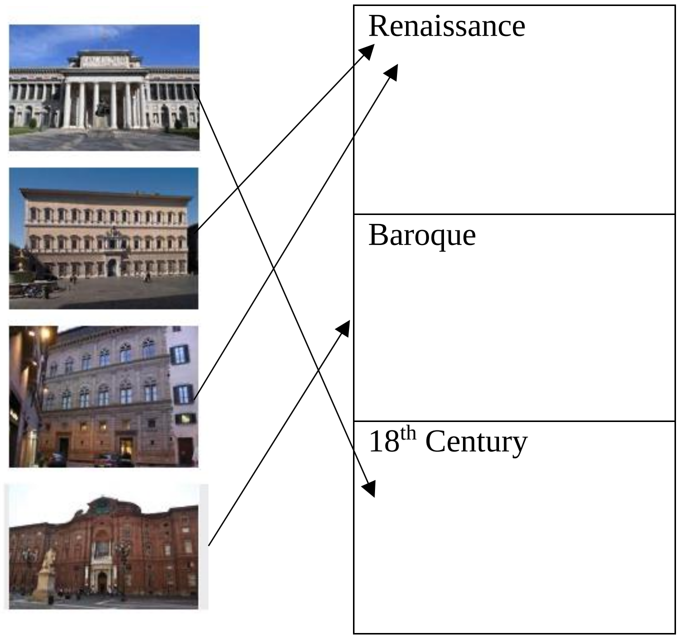
□ **Baroque**

□ Classicism

□ Middle Ages

□ Renaissance

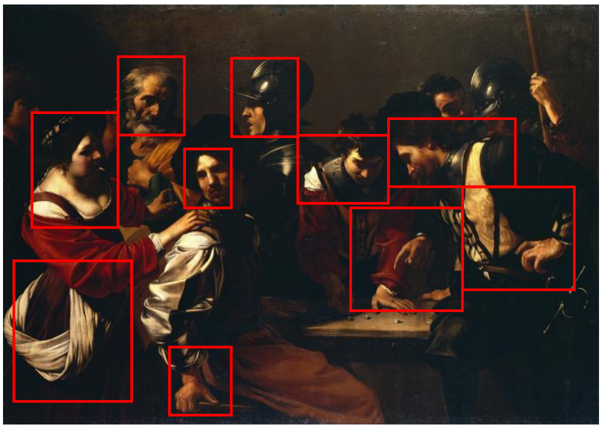
6. *Similar to painting and other art forms, the formal language in architecture behaved similarly. Assign the following elements of buildings to the corresponding epochs.*



7. *Which of the following portraits does NOT represent a ruler?*

8. *Which of the works below does NOT address transience?*

9. *Mark 4 places with strong light and shadow contrasts.*



10. *From which direction does the light fall on the depicted persons.*

- ☐ **Top Left**
- ☐ Bottom Left
- ☐ Right Above
- ☐ Right Below

11. *Which of the following eras follows the ideal of calm and balance?*

- ☐ Baroque
- ☐ Renaissance
- ☐ Romanticism
- ☐ **Rococo**

12. *Which of the following is NOT a characteristic of Baroque painting?*

- ◻ Movement
- ◻ Drama
- ◻ Contrasts
- ◻ **Symmetry**

13. *Which era does this shape give its name to?*

- ◻ **Rococo**
- ◻ Classicism
- ◻ Renaissance
- ◻ Impressionism

14. *The style of which epochs is considered a countermovement to Baroque?*

- ◻ Classicism
- ◻ **Rococo**
- ◻ Renaissance
- ◻ Romanticism

15. *Which of the following is a Baroque artist?*

- ◻ Dürer
- ◻ Giorgione
- ◻ Chodowiecki
- ◻ **Permoser**

16. *Which of the following paintings belongs to the same style as this work?*

17. *In which of the following epochs is special emphasis placed on the correct rendering of the human body?*

- □ Middle Ages
- □ **Renaissance**
- □ Baroque
- □ Rococo

18. *Strong contrasts of light and shadow are a characteristic of which of the following eras?*

- □ Renaissance
- □ **Baroque**
- □ Rococo
- □ Classicism

19. *In which work is the effect of depth space less strong?*

20. *Which of the following elements occurs rather rarely in an image with dynamic composition?*

- □ Crossings
- □ Diagonals
- □ **Horizontals**
- □ Circles

21. *Which of these subjects did Rembrandt either not depict at all or only rarely?*

- □ Portraits
- □ landscapes
- □ **still life**
- □ history paintings

22. *Which of the following landscapes appears to be painted from nature?*

23. *Which of the following attributes does <u>NOT</u> belong to the so-called attributes of rulership?*

- □ Scepter
- □ Crown
- □ **Command Staff**
- □ Horse

24. Mark the spot with light reflex.

25. What kind of atmosphere do strong light-shadow contrasts create?

- □ depressing
- □ **dramatic**
- □ peaceful
- □ harmonious

26. *In which work can you <u>NOT</u> see a strong contrast of light and shadow?*

27. *Which of the following works is painted with pastels?*

28. *In which work can you <u>NOT</u> see a drop shadow?*