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Synesthetes are More Involved in Art — Evidence From the Artistic Creativity Domains Compendium (ACDC)

ABSTRACT

Creativity is a multidimensional, multistage, and time-dependent process, which can be expressed in various artistic domains and sub-domains (e.g., visual arts, literature, music, and performing arts). The present study investigated the involvement of synesthetes in art, and whether the type of synesthesia determines the preferred artistic domain. We tested 709 participants with either grapheme-color, sound-color, or sequence-space synesthesia (monotypical synesthesia) or a combination thereof (multiple synesthesia) and non-synesthete controls with the Artistic Creativity Domains Compendium (ACDC). The ACDC measures the involvement in art on the three levels "interest," "ability," and "performance" for the four domains "visual arts," "literature," "music," and "performing arts." Overall, the results showed that synesthetes have an affinity for all four artistic domains compared with non-synesthete controls. Moreover, the presence of multiple types of synesthesia affected the specific preference. Besides, compared with monotypical synesthetes, the group of grapheme-color-sound-color-and-sequence-space synesthetes showed higher involvement in all artistic domains, most pronounced in visual arts. Overall, the study demonstrates that synesthesia is associated with higher interest, ability, and performance in art.

Keywords: synesthesia, art, grapheme-color, sound-color, sequence-space.

INTRODUCTION

In synesthesia, ordinary stimuli trigger extraordinary experiences (e.g., sounds trigger color experiences). Being able to see sounds does automatically extend the activation of the semantic network while enjoying, for instance, music (cf. Chiou & Rich, 2014; Meier, 2013; Ramachandran & Hubbard, 2001). A broader semantic network with unusual connections is generally associated with creativity (Kenett, Anaki & Faust, 2014; Kozhevnikov, Kozhevnikov, Yu, & Blazhenkova, 2013; Paivio, 1970; Shindell, 1983). Recent studies state the importance of the semantic network structure and memory organization in the creative process (Beaty et al., 2014; Beaty et al., 2020; Gray et al., 2019; Kenett, 2019; Kenett et al., 2018). It is thus likely that synesthesia leads to enhanced creative output and, in fact, many artists such as Paul Klee or Lady Gaga are synesthetes (Mulvenna, 2013). Previous research has provided evidence for higher creative output in participants with several types of synesthesia (Chun & Hupé, 2016; Lunke & Meier, 2019; Ward, Thompson-Lake, Ely, & Kaminski, 2008). Synesthetes have also been shown to be more prone to study art, to pursue an artistic profession, or to be more involved in artistic leisure activities such as crafting (Rich, Bradshaw, & Mattingley, 2005; Rothen & Meier, 2010; Ward et al., 2008). The present study aimed to investigate whether synesthetes are not only more involved in art, but also higher performing, and whether the type of synesthesia determines the artistic domain.

Creativity is traditionally divided into divergent and convergent creative output. Divergent creative output is defined as the ability to present a high number of new and appropriate ideas, solutions, or products. Convergent creative output is defined as the ability to present the one and only adequate solution or response for a given problem (Goff & Torrance, 2002; Mednick & Mednick, 1967; Sternberg & Lubart, 1999; Takeuchi et al., 2011). These two types of creativity are tested in psychometric tasks to measure creativity. However, they are only seen as the basis for a vast number of multimodal forms and domains of creative output which are also driven by expertise and socio-cultural dynamics (Carson, Peterson, & Higgins, 2005; Glaveanu et al., 2020; Runco & Beghetto, 2019). For artistic creativity, it is particularly important to take into account not only the level of creation but also the level of presenting the output. (Carson et al., 2005; Glaveanu et al., 2020; Kaufman & Baer 2005; Lunke & Meier, 2016; Runco & Beghetto, 2019).

Creativity is associated with a broad semantic network with flexible associations, more distant connections, and better semantic processing (Beaty et al., 2014; Beaty et al., 2020; Gray et al., 2019; Kenett, 2019; Kenett et al., 2018). Moreover, mental imagery and visual–spatial abilities have been shown to be supportive (Kenett et al., 2014; Kozhevnikov et al., 2013; Paivio, 1970; Shindell, 1983). These qualities, that is, a broader semantic network, a more associative world of experiences, better memory performance, and a higher degree of visual–spatial abilities, are also characteristics found in synesthetes (Kozhevnikov et al., 2013; Lunke & Meier, 2018; Lunke & Meier, 2020; Meier, 2013; Ramachandran & Hubbard, 2001; Simner, Mayo, & Spiller, 2009). This has evoked interest into the question whether synesthetes may show a higher degree of creativity (Chun & Hupé, 2016; Lunke & Meier, 2019; Mulvenna, 2013; Rich et al., 2005; Rothen & Meier, 2010; Ward et al., 2008).

Studies comparing synesthetes in psychometric creativity tasks indicate that different types of synesthesia differ in their creative abilities. Ward et al. (2008) found that the presence of multiple types of synesthesia correlated with higher verbal convergent creativity, but synesthetes did not show any advantage in verbal divergent creativity. Chun and Hupé (2016) found that a mixed group of various types of synesthesia scored higher in figural convergent and divergent verbal tasks but not in figural divergent or verbal convergent tasks. In contrast, Lunke and Meier (2019) showed that the multiple type of grapheme-color-and-sound-color synesthesia had higher scores in a verbal and a figural divergent task. Thus, different types of synesthesia, in particular multiple and monotypical types, differ in their involvement in art and their creative abilities.

Several studies have also shown a higher involvement in art for synesthetes. Rothen and Meier (2010) found higher prevalence of grapheme-color synesthetes in art students. Rich et al. (2005) found more artistic professionals in a mainly grapheme-color synesthetic sample. Ward et al. (2008) found that among various types of synesthesia, significantly more pursued a creative profession and/or actively produced art. Niccolai, Jennes, Stoerig, and Van Leeuwen (2012) also found a higher degree of artistic professionals in a sample of various synesthetic types. Lunke and Meier (2019) found that various types of synesthetes, especially sound-color synesthetes, were more likely to be involved in a creative profession. Sound-color synesthetes played and consumed music more frequently and consumed more visual art. Sequence-space synesthetes consumed more visual art. Thus, the type of synesthesia seems to affect which artistic hobby or profession a synesthete choses (cf. Rich et al., 2005; Ward et al., 2008).

So far, no study has investigated whether across a range of different types of synesthesia synesthetes are merely more interested and active in art or also higher performing. We used the Artistic Creativity Domain Compendium (ACDC), a self-report questionnaire, which includes four artistic domains *visual arts* (VA), *literature* (Lit), *music*, and *performing arts* (PA), and three levels of involvement *interest, ability*, and *performance* to assess involvement in creativity (Lunke & Meier, 2016). We tested a large sample of synesthetes: grapheme-color (GC), sequence-space (SS) and as multiple types of grapheme-color-and-sound-color (GC-SC), grapheme-color-and-sequence-space (GC-SS), and grapheme-color-sound-color-sequence-space (GC-SC-SS). We compared these groups with a non-synesthetic control group and the original ACDC validation sample (Lunke & Meier, 2016). Specifically, we hypothesized that synesthetes are more involved in art. Moreover, we assessed whether the type of synesthesia (inducer and concurrent, monotypical or multiple types) determines the artistic domain of involvement. Specifically, we tested whether different types of synesthesia have different preferences for different domains (VA, Lit, Music, and PA), and whether synesthetes are more likely to reach a higher level of involvement in their artistic domain. These questions are addressed in the present study.

METHOD

PARTICIPANTS

Seven hundred nine participants (610 female and 99 male) who had filled out the synesthesia-check, an online survey at the synesthesia-page of the University of Bern between August 2015 and June 2020, were included in the study. They were asked whether they experienced grapheme-color synesthesia, sound-color synesthesia, and sequence-space synesthesia. Overall, 638 of the participants reported to experience any type of synesthesia and 71 did not. The latter are used as non-synesthetic controls (59 female and 12 male; M_{age} = 34.04, SD = 14.33). Seventy-three participants reported to experience only grapheme-color synesthesia (64 female and 9 male; M_{age} = 35.32, SD = 14.81), 13 only sound-color synesthesia (10 female and 3 male; M_{age} = 34.54, SD = 8.98), and 25 participants reported to experience only sequence-space synesthesia (17 female and 8 male; M_{age} = 33.80, SD = 11.72). Moreover, 154 reported to experience

grapheme-color-and-sound-color synesthesia (131 female and 23 male; M_{age} = 32.69, SD = 13.05), 112 to experience grapheme-color-and-sequence-space synesthesia (97 female and 15 male; M_{age} = 34.71, SD = 12.14), and 246 to experience grapheme-color, sound-color, and sequence-space synesthesia. (221 female and 25 male; M_{age} = 30.85, SD = 11.48). Fifteen participants experienced sound-color-sequence-space synesthesia (11 female and 4 male; M_{age} = 42.00, SD = 12.16). For 96 of the participants who experienced grapheme-color synesthesia, consistency for numbers and letters was confirmed with a consistency test (cf. Eagleman et al., 2007).

MATERIAL

The synesthesia-check is a brief synesthesia screening (Meier, Rothen, & Walter, 2014). To assess the presence of grapheme-color synesthesia, participants were asked whether words, letters, digits, weekdays, and/or months elicit color experiences. To assess the presence of sound-color synesthesia, they were asked whether music, sounds, tones, and/or specific instruments elicit color experiences. To assess the presence of sequence-space synesthesia, they were asked whether numbers, weekdays, months, and/or years elicit a visual–spatial arrangement, and if so, to describe this arrangement.

The ACDC is a standardized questionnaire about interest, ability, and performance in four artistic domains (visual arts, literature, music, and performing arts) and 18 corresponding sub-domains (painting, sculpting, photography, graphic design, fictional- writing, poetry, play-writing, journalism, classical music, jazz music, rock music, folk music, movie-acting, theater-acting, dancing, ballet-dancing, and musical performance). The full questionnaire and scale construction are presented in Lunke and Meier (2016). It is available in German and in English; the present study was conducted with the German version.

PROCEDURE

When starting the synesthesia-check, participants are first asked about their synesthetic experiences, and then demographic information such as date of birth, handedness, native language, and gender is assessed. At the end of the synesthesia-check, participants can leave their Email address when they are interested in being contacted for further research. Moreover, they were asked whether they wanted to take part in a study on artistic creativity. If they agreed, the ACDC was conducted. Participants who had indicated grapheme-color synesthesia and who had left their email address were later contacted for the consistency test.

STATISTICAL ANALYSIS

For analysis, we computed mean scores of the ACDC scales across domains (visual arts, literature, music, and performing arts), across levels of involvement (interest, ability, and performance), and across both domains and levels of involvement (interest in visual arts, ability in visual arts, and performance in visual arts; interest in literature, ability in literature, and performance in literature; interest in music, ability in music, and performance in music; and interest in performing arts, ability in performing arts, and performance in performing arts). First, to test whether synesthetes and non-synesthetes differ per se in their artistic creativity, a 2 × 3 × 4 ANOVA with the between-subject factor *synesthesia (yes/no)* and the within-subject factors' *involvement (interest/ability/performance)* and *domain (VA/Lit/Music/PA)* was conducted. Second, to test whether the type of synesthesia determines artistic domain and level of involvement, a 6 × 3 × 4 repeated measures ANOVA with the between-subject factor *group (Control, GC, SS, GC-SC, GC-SS, and GC-SC-SS)* and the within-subject factors' *involvement (interest/ability/performance)* and *domain (VA/Lit/Music/PA)* was run. The groups of sound-color synesthetes and of sound-color-sequence-space synesthetes were not included in the group analysis as their group sizes were too small. When homogeneity of variance was violated, Greenhouse–Geisser corrected values are reported. Alpha was set at .05 for all ANOVAs. For the posthoc t-tests, a Bonferroni correction was applied.

RESULTS

In Figures 1 and 2, descriptive statistics are presented for each level of involvement across each of the four domains. Higher scores indicate higher involvement (on a scale from 1 to 4). Confirmative statistics were run to test, first, whether the presence of any kind of synesthesia affects artistic creativity, and second, whether specific types of synesthesia have domain-specific effects. The mean values of the sample of non-synesthetes from the validation study of the ACDC (N = 270; Lunke & Meier, 2016) are included in the figures for illustration; however, these data are not included in the statistical analyses.

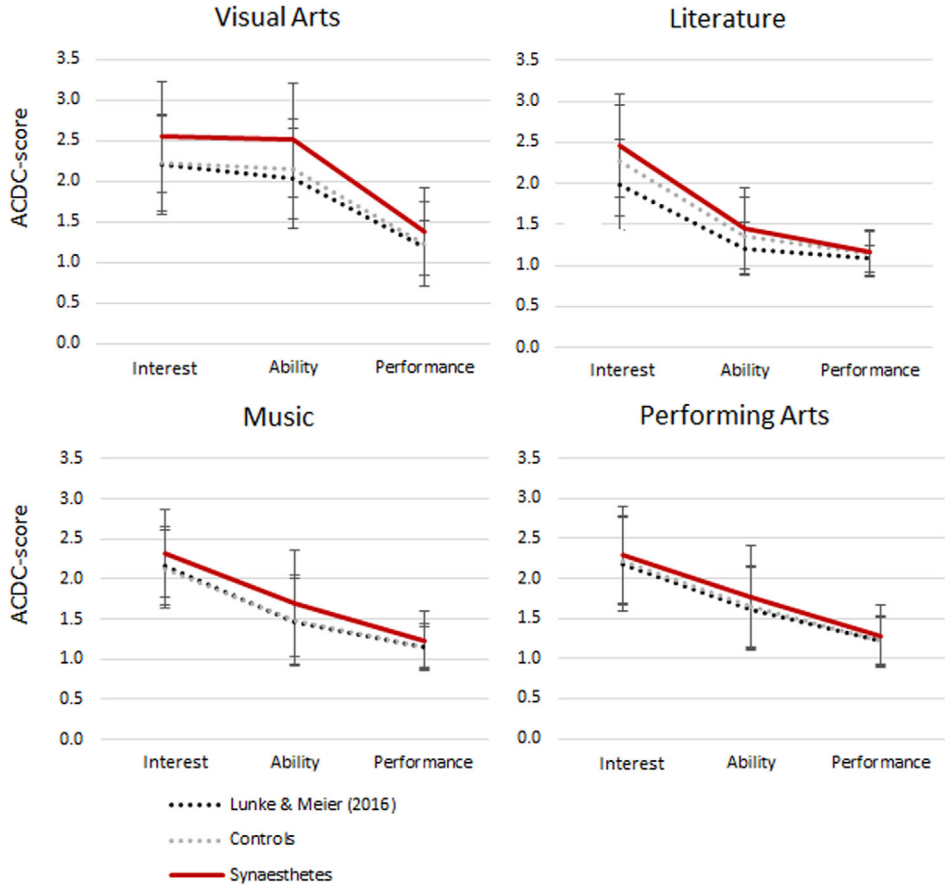

FIGURE 1. Mean level of involvement (interest, ability, and performance) for the four domains (VA, Lit, Music, and PA), for synesthetes and non-synesthetic controls. The sample of non-synesthetes from the validation study of the Artistic Creativity Domains Compendium (ACDC) (Lunke & Meier, 2016) is included for illustration. Error bars represent standard deviations.

Presence of synesthesia. For the 2 × 3 × 4 ANOVA with the between-subject factor *synesthesia (yes/no)* and the within-subject factors' *involvement (interest/ability/performance)* and *domain (VA/Lit/Music/PA)*, we found a two-way interaction between *synesthesia (yes/no)* and *involvement (interest/ability/performance)*, $F(1.78, 1262.80) = 4.75$, $p = .011$, $\eta_p^2 = 0.01$ and a two-way interaction between *synesthesia (yes/no)*, and *domain (VA/Lit/Music/PA)*, $F(2.77, 1959.76) = 3.07$, $p = .030$, $\eta_p^2 = 0.004$, as well as a main effect of *synesthesia (yes/no)*, $F(1, 707) = 15.23$, $p < .001$, $\eta_p^2 = 0.02$. To resolve these interactions, we conducted three separate repeated measures ANOVAs for each level of *involvement (interest/ability/performance)* with the between-subject factor *synesthesia (yes/no)* and the within-subject factor *domain (VA/Lit/Music/PA)*. For each level of *involvement (interest/ability/performance)*, there resulted a main effect of *synesthesia (yes/no)*, all $p \leq .006$, $\eta_p^2 \geq 0.01$. There resulted two two-way interactions between *synesthesia (yes/no)* and *domain (VA/Lit/Music/PA)* on the levels *interest,* $F(2.90, 2052.22) = 2.65$, $p = .049$, $\eta_p^2 = 0.04$ and *ability*, $F(2.82, 1996.15) = 3.17$, $p = .026$, $\eta_p^2 = 0.004$. Bonferroni-corrected follow-up *t*-tests for the interaction between *synesthesia (yes/no)* and the within-subject factor *domain (VA/Lit/Music/PA)* on the levels *interest* and *ability* showed significantly higher *interest* and *ability* in VA and *interest* and *ability* in Music (all $p < .005$, all $d > 0.31$; all other $p > .010$).

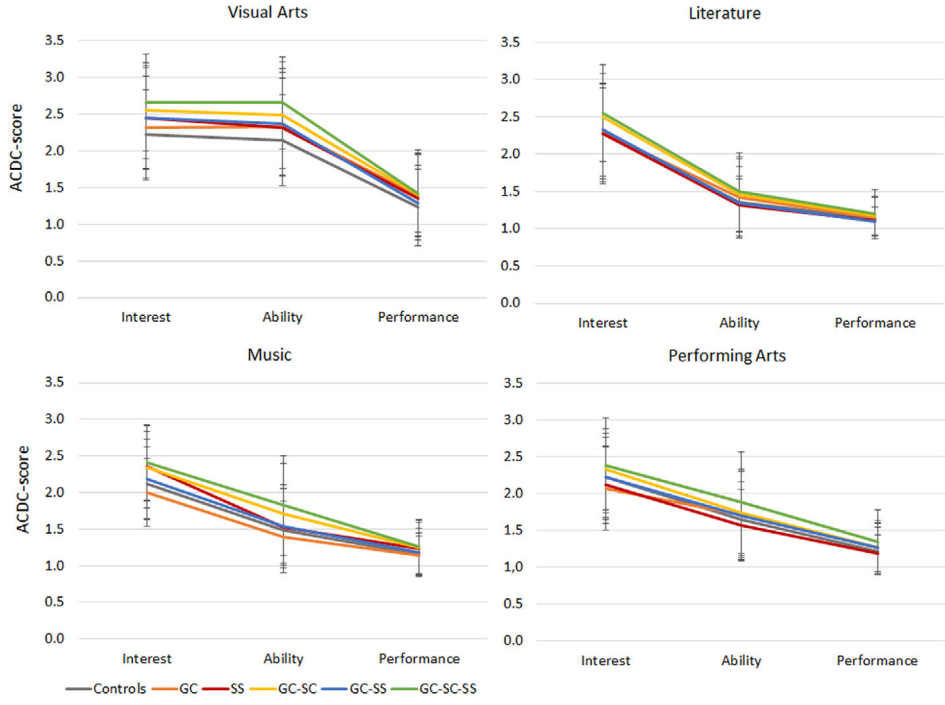

FIGURE 2. Mean level of involvement (interest, ability, and performance) for the four domains (VA, Lit, Music, and PA), separately for the five groups of synesthesia (GC, SS, GC-SC, GC-SS, and GC-SC-SS) and non-synesthetic controls. Error bars represent standard deviations.*Note*. GC = grapheme-color; SS = sequence-space; SC = sound-color.

Group effect. For the 6 × 3 × 4 ANOVA with the between-subject factor *group (Control, GC, SS, GC-SC, GC-SS, and GC-SC-SS)* and the within-subject factors, *involvement (interest/ability/performance)* and *domain (VA/Lit/Music/PA)* resulted a marginal three-way interaction between *group* and the within-subject factors' *involvement (interest/ability/performance)* and *domain (VA/Lit/Music/PA)*, $F(27.53, 3716.99) = 1.47$, $p = .054$, $\eta_p^2 = 0.01$, a two-way interaction between *group* and the within-subject factors' *involvement (interest/ability/performance)*, $F(8.83, 1191.68) = 5.88$, $p < .001$, $\eta_p^2 = 0.04$ and a main effect of *group*, $F(5, 675) = 11.75$, $p < .001$, $\eta_p^2 = 0.08$.

To resolve these interactions, we conducted three separate repeated measures ANOVAs for each level of *involvement (interest/ability/performance)* with the between-subject factor *group* and the within-subject factor *domain (VA/Lit/Music/PA)*. For each level of *involvement (interest/ability/performance)*, there resulted a main effect of *group*, all $p \leq .001$, $\eta_p^2 \geq 0.03$. On the level *ability*, there resulted a two-way interaction between *group* and *domain (VA/Lit/Music/PA)*, $F(14.01, 1890.81) = 1.96$, $p = .018$, $\eta_p^2 = 0.01$.

Bonferroni-corrected follow-up *t*-tests were conducted between all *groups* on all levels of *involvement (interest/ability/performance)* for all *domains (VA/Lit/Music/PA)*.

Comparisons between Controls and Synesthete groups. The control group indicated significantly lower scores compared with *GC-SC* in *interest*, $t(223) = 3.50$, $p < .001$, $d = 0.49$ and *ability*, $t(223) = 3.43$, $p < .001$, $d = 0.49$ of *VA*, *interest*, $t(223) = 2.54$, $p = .003$, $d = 0.41$ and *ability*, $t(160.08) = 2.71$, $p = .004$, $d = 0.36$ in *Music* and compared with GC-SC-SS in *interest*, $t(315) = 4.97$, $p < .001$, $d = 0.67$, *ability*, $t(315) = 6.03$, $p < .001$, $d = 0.81$ and *performance*, $t(113.43) = 2.70$, $p = .004$, $d = 0.37$ of *VA*, *interest* in *Lit*, $t(315) = 3.18$, $p = .001$, $d = 0.43$, *interest*, $t(315) = 4.19$, $p < .001$, $d = 0.56$ and *ability*, $t(132.74) = 4.28$, $p < .001$, $d = 0.52$ in *Music* and *ability*, $t(150.12) = 3.15$, $p = .001$, $d = 0.37$ in *PA*.

Comparisons between the different Synesthete groups. *SS*-synesthetes compared with *GC*-synesthetes showed a significantly greater *interest* in *Music*, $t(40.52) = 3.31$, $p = .001$, $d = 0.78$. For *GC-SC*-synesthetes

compared with *GC*-synesthetes resulted a significantly higher *interest,* $t(225) = 4.61$, $p \leq .001$, $d = 0.65$ and *ability,* $t(225) = 3.62$, $p \leq .001$, $d = 0.51$ in *Music* and *interest,* $t(225) = 3.20$, $p = .001$, $d = 0.43$ in *PA*. The group of *GC-SC-SS*-synesthetes compared with *GC*-synesthetes showed significantly higher means in *interest,* $t(317) = 3.91$, $p < .001$, $d = 0.52$ and *ability,* $t(317) = 3.70$, $p < .001$, $d = 0.48$ in *VA*, in *interest* in *Lit,* $t(317) = 3.07$, $p = .001$, $d = 0.43$, in *interest,* $t(317) = 6.19$, $p < .001$, $d = 0.83$, *ability,* $t(317) = 5.03$, $p < .001$, $d = 0.67$ and *performance,* $t(317) = 2.75$, $p = .003$, $d = 0.37$ in *Music* and in *interest* in *PA,* $t(317) = 3.67$, $p < .001$, $d = 0.47$. Compared with *GC-SS*-synesthetes, for *GC-SC-SS*-synesthetes resulted significantly higher *interest,* $t(356) = 2.80$, $p = .003$, $d = 0.31$ and *ability,* $t(356) = 3.86$, $p < .001$, $d = 0.43$ in *VA, interest,* $t(356) = 3.14$, $p < .001$, $d = 0.36$, *ability,* $t(293.98) = 3.22$, $p < .001$, $d = 0.31$ and *performance,* $t(338.11) = 3.42$, $p < .001$, $d = 0.34$ in *Lit, interest,* $t(356) = 3.83$, $p < .001$, $d = 0.44$ and *ability,* $t(254.27) = 4.20$, $p < .001$, $d = 0.45$ in *Music*. There resulted no significant differences between *GC-SC*- and *GC-SS*-synesthetes or between *GC-SC*- and *GC-SC-SS*-synesthetes, all $p > .09$, all $d < 0.28$.

DISCUSSION

The present study aimed to investigate whether synesthetes are not only more involved in art but also higher performing (Kozhevnikov et al., 2013; Lunke & Meier, 2019; Meier, 2013; Ramachandran & Hubbard, 2001; Rich et al., 2005; Rothen & Meier, 2010; Simner, Mayo, & Spiller, 2009; Ward et al., 2008). Moreover, it was analyzed whether the type of synesthesia determines the artistic domain. Controls, grapheme-color synesthetes, sound-color synesthetes, sequence-space synesthetes, and multiple synesthetes indicated their involvement on three levels (interest, ability, and performance) in four domains of art (VA, Lit., Music, and PA) on the Artistic Creativity Domains Compendium (ACDC; Lunke & Meier, 2016). Overall, the results indicated a higher involvement in art for synesthetes. They were more interested, more active, and higher performing. Thus, in general, synesthetes have a more pronounced affinity for art. This result is consistent with previous studies that found higher prevalence of creative professionals in synesthetes and higher prevalence of synesthetes among artists (Lunke & Meier, 2019; Niccolai et al., 2012; Rich et al., 2005; Rothen & Meier, 2010; Ward et al., 2008).

The results also show that differences between the three levels of involvement are profound even in a special, generally more creative population such as synesthetes. This confirms the importance of differentiating between levels of involvement in the assessment of artistic creativity (Carson, Peterson, & Higgins, 2005; Kaufman & Baer 2005; Lunke & Meier, 2016). It supports the theory of a multistage creative process in which the interaction with the audience is integrated (Glaveanu et al., 2020, Runco & Beghetto, 2019).

Moreover, a novel result of the present study is that there were differences between different types of synesthesia across artistic domains and the levels of involvement. The more types of synesthesia involved the higher was the involvement over all domains. This result extends findings from a previous study in which only the multiple type of grapheme-color-sound-color synesthetes showed a higher divergent creativity (Lunke & Meier, 2019). The present study indicates that it is important to assess whether different modalities are involved in each type of synesthesia. Multiple types show larger differences in creativity across levels of interest compared with non-synesthetes.

Moreover, the results demonstrate that the number of types of synesthesia and the number of different modalities involved also affect the preference for a particular artistic domain. The latter result compliments findings from Lunke and Meier (2019), Meier and Rothen (2013) and Ward et al. (2008) who found that different types of synesthesia, especially multiple types did differ in their cognitive style, and creative abilities and preferences. They indicate that monotypical and multiple synesthetes do not only differ in their cognitive style and pattern of divergent and convergent output, but also in their self-reported artistic involvement. This suggests that synesthetes with multiple types show more pronounced differences in their cognitive profile and presumably also their cortical specifics (cf. Ward, 2019). Importantly, not only the number of types of synesthesia a person experiences, but also the number of modalities involved appears to have an impact on the specificity of interest, ability, and performance of creativity.

Notably, the strongest effect was apparent for the multiple GC-SC-SS-synesthetes who showed a large affinity for visual arts. Given that both grapheme-color and sound-color synesthesia involve color as the concurrent, it appears that beyond a general enhancement of creative interest and involvement, a domain-specific aspect may also be involved. There is evidence that for synesthesia involving color, enhanced encoding and retention of color stimuli and color associations occurs, suggesting enhanced color processing (cf. Bankieris & Aslin, 2016a, 2016b; Lunke & Meier, 2019; Rothen & Meier, 2010; Yaro & Ward, 2007). This

facilitation in processing and integrating colors and colored visual input into the semantic network might build the basis for the enhanced involvement in visual arts. Notably, in the present study, the monotypical synesthetes experiencing grapheme-color synesthesia did not show a higher involvement in visual arts. It is possible that an advantage in color processing is already evident in monotypical grapheme-color synesthetes, but to influence creativity multiple types of color synesthesia are necessary. Testing this hypothesis is an interesting avenue for future research.

Finally, the results of the presents study are in line with recent insights in creativity research which indicate that a broader semantic network with more distant associations, beneficial memory organization a more associative world of experiences and a higher degree of visual–spatial abilities benefit the creative process (e.g., Beaty et al., 2014; Beaty et al., 2020; Gray et al., 2019; Kenett, 2019; Kenett et al., 2018).

CONCLUSION

The present study demonstrates that synesthetes are more involved in creative activities and higher performing in art. It replicates and extends previous research by showing that different types of synesthetes are involved in art in different ways. It shows that the presence of multiple types of synesthesia enhances the affinity for art in general, and in particular for visual art. Moreover, as emphasized in topical theoretical accounts of creativity, the study confirms that a differentiation between levels of involvement and domains of expertise of artistic creativity is fruitful.

CONFLICTS OF INTEREST

We have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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