JOURNAL OF Creative Behavior
Publication of the Creative Education Foundation

VLADA REPEYKOVA
TEEMU TOIVAINEN
MAXIM LIKHANOV
KIM VAN BROEKHOVEN
YULIA KOVAS

Nothing But Stereotypes? Negligible Sex Differences Across Creativity Measures in Science, Arts, and Sports Adolescent High Achievers

ABSTRACT

Previous research has focused on understanding when, why, and how sex differences in creativity occur, as results vary across samples, measures, and methodologies. In the current study we investigated sex differences in creativity among 984 high achieving adolescents in three expertise areas: Sciences, Arts, and Sports. Eight creativity indicators were analyzed: Alternative uses task (AUT) fluency; creative self-efficacy (CSE); intraindividual strengths (difference between CSE and AUT Fluency); five self-reported creativity scales: Self/everyday, scholarly, performance, mechanical/scientific, artistic. The results showed negligible sex differences ($n_p^2 = .01$), with females performing better in AUT Fluency and males self-rating their CSE higher. No sex differences were found in self/everyday, scholarly and performance creativity. Males self-rated their mechanical/scientific creativity ($n_p^2 = .06$) higher than females; while females self-rated their artistic creativity ($n_p^2 = .02$) higher in comparison to males. Our results extend the existing literature by finding negligible sex differences in adolescent expert groups. However, some stereotypical differences emerged, for example, females with Sciences expertise rated their mechanical/scientific creativity lower than males with and even without Sciences expertise. Results call for further investigation into the links between sex differences, expertise, and specific creativity domains.

Keywords: sex differences, high-achieving adolescents, divergent thinking, Creative Self-Efficacy, Kaufman's Domains of Creativity Scale, intraindividual strengths, expertise groups.

INTRODUCTION

Creativity is often operationalized as the interaction among aptitude, process, and environment by which a person or a group of individuals produces a product which is both novel and useful in a given context (Barron & Harrington, 1981; Boden, 2007; Plucker, Beghetto, & Dow, 2004; Runco & Jaeger, 2012). Creativity is viewed as increasingly important in everyday life, playing a role in salient life outcomes, such as academic and professional achievement (Nami, Marsooli, & Ashouri, 2014).

Creativity can be measured with tests, self-reports, achievement records, etc. (Abra & Valentine-French, 1991; Kaufman, Plucker, & Baer, 2008; Woodman & Schoenfeldt, 1989). Research suggested many different facets of creativity, which only partially overlap, including domain-general versus specific; and divergent versus convergent thinking (Ishiguro, 2022). Wide individual differences are observed in all creativity facets, attributed to both biological and social factors (e.g., Abraham, Thybusch, Pieritz, & Hermann, 2014). For example, recent findings suggested that around 40%–60% of variance in different creativity facets was explained by genetic factors, with the remaining variance explained by non-shared and, to lesser extent, shared environmental factors (Piffer & Hur, 2014; Toivainen et al., 2021). At the behavioral level individual differences in creativity facets have been linked to differences in intelligence and personality (Batey & Hughes, 2017; Deary, 2001; Furnham, 2016; Furnham & Bachtiar, 2008; Xurui et al., 2018). Studies also found differences in creativity related to expertise in different domains. For example, one study found that musicians generated a greater number of "uses" for real objects in a divergent thinking task than non-musicians (Gibson, Folley, & Park, 2009).

The Journal of Creative Behavior, Vol. 0, Iss. 0, pp. 1–19 © 2023 The Authors. *The Journal of Creative Behavior* published by Wiley Periodicals LLC on behalf of Creative Education Foundation (CEF). DOI: 10.1002/jocb.623

Some studies have also suggested sex differences in creativity, although findings are inconsistent (Baer & Kaufman, 2008; Karwowski, 2011; Runco, Cramond, & Pagnani, 2010), likely reflecting different processes involved in sex differences for different facets of creativity. In a meta-analysis of 271 studies ($N = 137{,}247$; Thompson, 2016), the effect size of sex differences in creativity, measured by cognitive tests, evaluation of creative products, self- and other-report inventories was almost negligible ($g = .06$, with slight female advantage). A more recent meta-analysis from 251 studies ($N = 79{,}915$; Hora, Badura, Lemoine, & Grijalva, 2022) found a male advantage in creative performance (convergent thinking tasks were excluded) with the effect size of $\delta = .13$. This effect was shown to be moderated by contextual factors. For example, the effect size was smaller in communal versus agentic cultural contexts. Several studies also showed that stereotypes might affect gender differences in creativity, as it is often linked with qualities like agency, independence, and self-direction that are stereotypically associated with masculinity (Proudfoot, Kay, & Koval, 2015). For example, one study found that even when both genders produce identical outputs, males are often credited with more creativity (Proudfoot et al., 2015). Another study found that the announcement of evaluation of a creative task lowered girls' creative production significantly, while having little impact on boys (Baer, 1997). This result may reflect gender differences in opportunities, resources, and expectations that might interfere with the ability to translate creative potential into actual creative achievements (Runco, Millar, Acar, & Cramond, 2010).

Existing research also suggests that males and females differ on average in their meta-cognitive evaluations of creativity, that is, demonstrate different patterns of over- and underestimation of one's creative ability in different domains (Beghetto, 2006). Sex effects may also interact with ability or expertise (Baer & Kaufman, 2008); reflect differences in representation of males and females in arts and science domains; as well as social stereotypes of associating men with sciences and women—with arts (Richards, 2007). For example, sex differences in general self-reported creativity may at least partly reflect the documented male higher self-rated ability (Beghetto, 2006; Bender, Nibbelink, Towner-Thyrum, & Vredenburg, 2013; Karwowski, 2011). Therefore, we could expect greater sex differences in self-rated general creativity compared to measured creativity (i.e., measured in test). For creativity measures in specific domains this trend may be overridden by gender roles, stereotypes, and other social factors, contributing to different patterns of sex differences emerging for different domains (verbal vs. Science domains).

To provide further insights into such interactions, this study investigates sex differences in different aspects of creativity (cognitive tests, domain-general, and domain-specific self-reports) within a large sample of adolescents selected for high achievement in Sciences, Arts, or Sports. This focus allows us to assess whether sex differences in creativity exist at high levels of achievement in Science, Arts, and Sports, which have been linked with higher creativity (Hristovski, Davids, Passos, & Araujo, 2012; Jauk, Benedek, Dunst, & Neubauer, 2013). It is possible that sex differences that were previously found in some creativity measures are no longer present at higher levels of creativity. However, there might be some sex differences even at these levels of creativity in both mean creativity scores and variance. For example, males with expertise in Arts may score higher in mechanical/scientific creativity than females with expertise in Science. Such differences would suggest that social factors, such as expectations and stereotypes, affect measured and self-reported estimates of creativity even in high achievers. The following three sections review available literature on sex differences in creativity, separately for cognitive tests; domain-general self-reports; and domain-specific self-reports.

SEX DIFFERENCES IN COGNITIVE TESTS

Several cognitive measures of creativity have been proposed including convergent thinking (CT) and divergent thinking tasks (DT; Lubart, 2016). DT tasks require production of many responses to a given problem (Lubart, 2016), with different tests suggested in the literature (Runco, 2014; Runco, Abdulla, Paek, Al-Jasim, & Alsuwaidi, 2016; Torrance, 1966, 1974). A commonly used measure of DT is Alternative Uses Task (AUT; Guilford, 1968). AUT requires participants to come up with alternative uses for ordinary objects, such as "brick" or "paperclip." Researchers use several criteria to access different aspects of DT, such as fluency (number of ideas) and originality (appropriate novelty/infrequency of an idea to overall pool of ideas). In contrast, CT tasks require finding a single "correct" solution to a verbal or visual problem (Cropley, 2006; Mednick, 1968; Toivainen, Olteteanu, Repeykova, Likhanov, & Kovas, 2019).

The findings regarding sex differences in cognitive measures of creativity are inconsistent. Some studies showed no sex differences (Baer & Kaufman, 2008; Kogan, 1974; Runco et al., 2010); some studies reported females' advantage (Kim & Michael, 1995; Rejskind, Rapagna, & Gold, 1992); and some studies reported males' advantage (Cox, 2003; Zheng & Xiao, 1983). Potential explanations for inconsistent findings include differences in samples and measures (Baer & Baer, 2006; Boccia, Piccardi, Palermo, Nori, & Palmiero, 2015; Runco & Okuda, 1988; Xurui et al., 2018).

For example, modality of the task (verbal vs. figural) was shown to be an important moderator of sex differences in creativity. Previous research suggests that females perform better in tasks that require expressing one's ideas verbally (Torrance & Aliotti, 1969; Maccoby & Jacklin, 1974, as cited in Plomin & Foch, 1980; Hyde & Linn, 1988; Shimonaka & Nakazato, 2007). For example, females had a significant advantage over males in the verbal component of the Torrance Test of Creative Thinking (DeMoss, Milich, & DeMers, 1993, as cited in Bart, Hokanson, Sahin, & Abdelsamea, 2015). In another study, female primary school students scored higher than male students in the DT tasks focusing on linguistic expression in the subtests of fluency and flexibility, composite DT creativity, but not originality (Kousoulas & Mega, 2009, as cited in Bart et al., 2015). These effects may reflect overall female advantage in verbal tasks, such as phonological coding and object naming tasks (Camarata & Woodcock, 2006; Majeres, 1983, 1999, 2007; Roivainen, 2011). In contrast, males were shown to score higher than females in figural DT tasks, possibly due to average males' advantage in spatial ability (Lauer, Yhang, & Lourenco, 2019; Toivainen, Papageorgiou, Tosto, & Kovas, 2017; Voyer, Voyer, & Bryden, 1995). Task modality was also shown as a significant moderator in a recent meta-analysis (Abdulla Alabbasi, Thompson, Runco, Alansari, & Ayoub, 2022; N of studies = 187; N = 101, 328), extending findings from the meta-analysis by Thompson (2016). The meta-analysis suggested that sex differences in DT performance was moderated by year of publication, culture, age, DT subscale, type of task, and ability. For example, mean gender differences was significant for verbal but not for figural DT task. Females outperformed males in unselected sample and with larger effect—in gifted samples. More research is needed in order to explain why the effects differed as a function of ability level, including establishing whether this effect is true for all DT tasks and for which giftedness domains, as previous research has not been consistent (Runco & Albert, 1986 or Runco & Bahleda, 1986). For example, one study found no sex differences in three verbal DT tasks (The Instances, Uses, Similarities) among scientifically and mathematically gifted students (Runco & Okuda, 1988). Another study also found no differences in verbal AUT fluency and originality between female and male musicians (Diaz Abrahan, Sarli, Shifres, & Justel, 2021).

Beyond average sex differences, there may be sex differences in variability at least in some aspects of creativity. Some previous research have shown higher variability for males in cognitive abilities (e.g., intelligence; Simonton, 1994; Johnson, Carothers, & Deary, 2008; Gray et al., 2019; OECD, 2019) and in science interest and achievement (Jia, Zhang, & Li, 2020). This phenomenon has been referred to as Greater Male Variability Hypothesis (GMVH; Shields, 1982). Only a handful of studies investigated this hypothesis with creativity tasks (He & Wong, 2011; He, Wong, Li, & Xu, 2013; Karwowski et al., 2016, 2016). Some studies found support for Greater Male Variability Hypothesis (He et al., 2013; He & Wong, 2021; He, Wong, & Hui, 2015; Ju, Duan, & You, 2015; Karwowski, Jankowska, Gajda, et al., 2016; Karwowski, Jankowska, Gralewski, et al., 2016). However, at least in one recent study no sex differences in variability were found in creative writing and drawing, as well as in figural and verbal DT tasks (Taylor & Barbot, 2021). Moreover, greater male variability might occur regardless of small/large sex differences in mean scores (He & Wong, 2021). The meta-analysis by Abdulla Alabbasi et al. (2022) found that variability was generally greater in males than in females in verbal tasks and in the elaboration subscale, but this effect was affected by multiple moderators.

SEX DIFFERENCES IN CREATIVE SELF-EFFICACY

Various self-report questionnaires are used to measure self-perceptions of one's creativity (Karwowski, Lebuda, Wisniewska, & Gralewski, 2013), including domain-general (e.g., self-belief to efficiently generate a large amount of ideas) and domain-specific (e.g., self-belief to be creative in literature; Baer & Kaufman, 2008; Karwowski & Kaufman, 2017).

One commonly used measure of domain-general creativity is the creative self-efficacy questionnaire (CSE; Karwowski, 2011), which assesses one's confidence in ability to creatively solve a particular problem. Some studies report that males' self-ratings of CSE tend to be higher than females' (e.g., Beghetto, 2006; Bender et al., 2013; Karwowski, 2011). For example, in one study males evaluated their creative self-efficacy higher than females (r = .27), despite not performing better than female in a DT task (Brockhus, Van der Kolk, Koeman, & Badke-Schaub, 2014). However, some studies reported higher CSE for females. For example, one study found higher self-reported scores for females in the ideas generation subscale (d = .24; Hill, Tan, & Kikuchi, 2008). Zero differences between females and males in CSE were also reported (Al-Alusi, 2001; Aldhamit, Albdour, & Alshraideh, 2020; Turki & Al-Qaisi, 2012).

Yet another study, using data from intellectually gifted students, reported no sex differences in CSE (Aldhamit et al., 2020). Very little is known about any potential sex differences in CSE for experts from different domains, given average differences in CSE between people with expertise in different areas, such as Arts and STEM (Science, Technology, Engineering, Mathematics; Feist, 1998; Furnham, Batey, Booth, Patel, & Lozinskaya, 2011; Van Broekhoven, Cropley, & Seegers, 2020).

Sex differences in CSE may reflect true sex differences in general creativity or may emerge due to different patterns of under- and overestimation of abilities by males and females. This can be investigated by estimating intraindividual strengths scores by subtracting the creativity performance scores (e.g., cognitive measures) from the self-assessed creativity scores (e.g., CSE). For example, one study, used this approach in a sample of middle and high school students and reported that males over-estimated and females under-estimated their creative ability measured by test for creative thinking—drawing production (Karwowski, 2011).

SEX DIFFERENCES IN DOMAIN-SPECIFIC SELF-RATED CREATIVITY

A number of studies have investigated creativity in specific domains (Carson, Peterson, & Higgins, 2005; Dollinger, 2006; Furnham & Bachtiar, 2008; Hughes, Furnham, & Batey, 2013; Jaussi, Randel, & Dionne, 2007; Kaufman, 2012; Runco, Plucker, & Lim, 2001). For example, the short self-rating of creativity (SSRC) measures creativity in five broad domains: scientific, social, visual artistic, verbal artistic & sports (Hughes et al., 2013). Another instrument is The Kaufman's domains of creativity scale (K-DOCS), which measures creative self-beliefs in five broad domains: self/everyday, scholarly, performance, mechanical/scientific & artistic (Kaufman & Baer, 2005; Tan & Qu, 2012).

Previous research suggested different patterns of sex differences depending on domain, in which creativity is rated (Kaufman, 2006). For example, in a sample of high school and college students, males self-rated higher than females in 28 out of 56 creativity domains and females self-rated higher than males in 15 out of 56 domains (Baer & Kaufman, 2008; Kaufman, 2006). Researchers found that females self-rated higher in comparison to males in the visual artistic and social-communication creativity domains, with weak effect sizes. In contrast, males self-rated higher in comparison to females in science-analytic and sport creativity domains with weak-to-moderate effect sizes. No sex differences emerged in verbal-artistic domain (Baer & Kaufman, 2008, Kaufman, 2006). Research is needed to assess whether the same patterns can be found in expert samples. For example, there may be no sex differences in Scientific creativity in people with high achievement in Science. As sex differences in creativity are already weak in samples with full range of ability (e.g., a male advantage in creative performance of $\delta = .13$; Hora et al., 2022), their magnitude may be further reduced in high-ability samples, who are likely to also have higher creativity. On the other hand, sex differences may persist even in these groups, because self-perceived ability is influenced not only by actual ability and performance but also by such phenomena as gender roles and social stereotypes.

THE PRESENT STUDY

The current study aims to address inconsistencies found in previous research into sex differences in creativity. The literature reviewed here suggests that direction and magnitude of sex differences varies as a function of: specific creativity facets and measures used to tap into these facets; biological and social factors affecting different creativity facets; and demographics, including age and expertise. This study investigates average and variance sex differences in 3 facets of creativity: (a) performance-based creativity (AUT Fluency); (b) self-reported domain-general creativity (creative self-efficacy; CSE); and (c) self-reported domain-specific creativity (The Kaufman's domains of creativity scale); as well as in a pattern of over/underestimation in self-rated ability to generate ideas (CSE minus AUT Fluency; e.g., Karwowski, 2011). A large sample of adolescents selected for high achievement in Sciences, Arts, or Sports, recruited for this study, allowed to investigate whether sex differences exist in these facets of creativity among experts. Establishing patterns of sex differences in these groups, will provide new insights into etiology of individual differences in creativity.

The following three sets of hypotheses were formulated:

1. Performance-based creativity assessed by alternative uses task (AUT):

Hypothesis 1A: (H1A): Females will outperform males in creative ability, measured by verbal AUT Fluency.

Hypothesis 1B: (H1B): Males will have higher variability than females in creative ability, measured by verbal AUT Fluency.

Hypothesis 1C: (H1C): Effects 1A and 1B will be moderated by expertise area.

2 Self-reported domain-general creativity, assessed by creativity self-efficacy (CSE) questionnaire:

Hypothesis 2A: (H2A): There will be no sex differences in CSE.

Hypothesis 2B: (H2B): Females will under-estimate, and males will over-estimate their creative ability (as measured by differences in scores between subjective measure of CSE and objective measure of AUT Fluency).

Hypothesis 2C: (H2C): Effects 2A and 2B will be moderated by expertise area.

3 Self-reported domain-specific creativity, assessed by Kaufman domains of creativity scale (K-DOCS):

Hypothesis 3A: (H3A): There will be no sex differences in the Self/Everyday, Scholarly and Performance domains of creativity.

Hypothesis 3B: (H3B): Males will self-rate higher than females in Mechanical/Scientific domain.

Hypothesis 3C: (H3C): Females will self-rate higher than males in Artistic domain.

Hypothesis 3D: (H3D): Effects 3A, 3B and 3C will be moderated by expertise area.

METHODS

SAMPLE

The sample consisted of 984 schoolchildren ($n_{\text{female}} = 535$, $\text{Mage}_{\text{female}} = 15.37$; $n_{\text{male}} = 449$, $\text{Mage}_{\text{male}} = 14.81$) from different regions of Russia—high achievers in the areas of Sciences (mathematics, biology, chemistry, informatics, and physics), Arts (literature, ballet, academic painting, and music), or Sports (hockey, figure skating, and chess). Participants engaged in intensive extracurricular activities in their fields and demonstrated high achievement, such as winning in subject contests, Olympiads, and sport competitions. Data were collected in person at educational center, which provides intensive extracurricular program for high achievers in their respective domains (see Budakova et al., 2021; Papageorgiou et al., 2020 for more details). Students were nominated for these program by themselves, their parents, their teachers or regional authorities; and were selected based on their recorded achievement by expert panels. Students from these centers were recruited in this study over several months and included all students who agreed to participate and for whom parental consent was available. Frequencies by age, sex, and expertise areas are presented in Table 1. As can be seen from Table 1, gender composition of each group was uneven and may reflect existing societal trends in engagement, attitudes, and selection regarding specific domains. In addition, during the data collection, the Sports domain was mostly represented by all-male hockey teams. Here we refer to all participants as experts in respective domains.

Participants completed all tests on individual laptops in groups of up to 25 people. The testing session lasted maximum 90 min. Parents or legal guardians provided their informed consent and participants provided an assent on the day of testing.

MEASURES

Research measures included: (a) alternative uses task; (b) creative self-efficacy; and (c) Kaufman's domains of creativity scale. All measures were adapted to Russian by using the translation/back-translation procedure, following the ITC guidelines for test translations (International Test Commission, 2017). The Russian adaption and validation of K-DOCS is described elsewhere (Miroshnik, Shcherbakova, & Kaufman, 2022; Repeykova et al., in preparation). After removal of outliers (both univariate & multivariate) and missing data handling, the N for each measure was: AUT Fluency—855; creative self-efficacy—984; The Kaufman's domains of creativity scale—675. The smaller sample size for K-DOCS is linked to its last

TABLE 1. Sample Sizes Across Sexes and Expertise Areas

Age	Sciences		Arts		Sports		Total sample
	Female	Male	Female	Male	Female	Male	
13	14	27	9	3	1	4	58
14	40	89	59	23	11	71	293
15	63	69	78	8	8	31	257
16	55	67	90	13	4	1	230
17	34	33	67	9	2	1	146
Total	206	285	303	56	26	108	984
	491		359		134		

position in the battery—not all participants completed this test. Participants also provided demographic information: sex, age, and expertise area.

1. Alternative uses task (AUT; Guilford, 1968).

Verbal divergent thinking (Fluency) was assessed with the AUT. Five verbal stimuli (brick, paperclip, glass bottle, newspaper, and straw) were presented to participants one at a time. The task was to come up with as many alternative uses as possible to each stimulus in 3 min (15 min in total). This task allows to derive four measures of DT: Fluency, originality, flexibility, and elaboration. In this study we opted for the fluency score as the most readily quantifiable measure that does not involve scorers' (participants' or researchers') subjective judgments. Moreover, studies showed very high correlations (.75–.89) between fluency and other three measures (Ishiguro et al., 2022). Overall, we received approximately 25,000 responses from all participants. Each participant's responses across the five stimuli were summed up into a fluency score.

2 Creative Self-Efficacy (CSE; Beghetto, 2006).

Creative Self-Efficacy is a domain-general self-report questionnaire measuring one's beliefs to be good at generating ideas. The CSE consists of three items: "I am good at coming up with new ideas," "I have a lot of good ideas," and "I have a good imagination."

Participants rated their agreement with the three statements on a scale from one (completely disagree) to five (completely agree). To calculate the final score, we summed up the scores across the items (range: 3–15).

In addition, in order to explore whether females and males over- or under-estimate their creative potential, we calculated the difference score, subtracting the standardized objective measure (AUT Fluency) from standardized subjective measure (CSE)—following the procedure described in the studies by Karwowski (2011) and Stoet and Geary (2018). As the two measures were on different scales, we calculated z-scores for both measures for the three areas of expertise separately, as well as for the full sample. Positive values indicate overestimation of one's creative abilities, negative values indicate underestimation, and scores near zero suggest accurate estimation.

3 Kaufman's domains of creativity scale (K-DOCS; Kaufman, 2012).

Kaufman's domains of creativity scale is a 50-item domain-specific self-report questionnaire, measuring one's perceptions of their creativity in five domains (McKay, Karwowski, & Kaufman, 2017). Participants rated themselves in comparison to others (e.g., peers) on a 5-point Likert Scale from one (much less creative) to five (much more Creative). The five domains were:

a. Self/Everyday domain (11 items) measures intra- and interpersonal creative behaviors, similar to extraversion and agreeableness personality traits. Example: "Being able to work through my personal problems in a healthy way."
b. The Scholarly domain (11 items) measures the engaging in deep analysis and pursuits that involve gaining knowledge. Example: "Researching a topic using many different types of sources that may not be readily apparent."

c. The Performance domain (10 items) measures participants' beliefs about their creativity in such activities as music, writing, and acting. Example: "Learning how to play a musical instrument."
d. The Mechanical/Scientific domain (nine items) measures participants' beliefs about their creativity in science, engineering, and mathematics related activities. Example: "Constructing something out of metal, stone, or similar material."
e. The Artistic domain (nine items) measures participants' beliefs about their creativity in art related activities. Example: "Taking a well-composed photograph using an interesting angle or approach."

Items were presented in a randomized order so that items from the same domain were not clustered together. To calculate the final score for each domain, respective items were summed up (Self/Everyday range: 11–55; Scholarly range: 11–55; Performance range: 10–50; Mechanical/Scientific: 9–45; Artistic range: 9–45).

STATISTICAL ANALYSES

All analyses were conducted in IBM SPSS Statistics 26, JASP version 0.13.1.0 and RStudio. For group analysis we performed ANOVAs and MANOVAs. Normality assumption was assessed through Shapiro–Wilk's test and homogeneity of variances—through Levene's test. Where the parametric assumptions were violated, we used robust methods and nonparametric tests (Field & Wilcox, 2017). Further details are available in the following sections and in Table S1 in SOM.

RELIABILITY ANALYSIS

Internal consistency (Cronbach's α; average inter-item correlations) across measures can be found in Table 2. All measures showed high reliability as per used metrics.

RESULTS

DESCRIPTIVE STATISTICS

Means, standard deviations, and sample sizes for all measures (AUT, CSE, K-DOCS) across sex (female, male) & three expertise areas (Sciences, Arts, Sports) are presented in Table 3.

CORRELATION ANALYSIS

Figure 1 presents results for the correlation analysis across all measures for females and males separately. Results for the correlation analysis for full sample, and expertise areas separately are available in SOM (Tables S2 and S3–S15).

TABLE 2. Cronbach's α and AIIC for the AUT, CSE, K-DOCS

Name of the measure	Dimension/Scale/Domain (n of items)	Cronbach's α [upper and lower bound of 95% CI]	Average inter-item correlation [upper and lower bound of 95% CI]	Sample size (listwise deletion across items)
AUT	AUT Fluency (5 items)	.94 [.94, .95]	.77 [.74, .80]	855
CSE	CSE (3 items)	.83 [.81, .85]	.62 [.59, .66]	984
K-DOCS	K-DOCS Self/Everyday (11 items)	.86 [.85, .88]	.37 [.33, .41]	675
	K-DOCS Scholarly (11 items)	.88 [.86, .89]	.39 [.35, .43]	675
	K-DOCS Performance (10 items)	.88 [.87, .89]	.43 [.40, .47]	675
	K-DOCS Mechanical/ Scientific (9 items)	.87 [.86, .88]	.43 [.39, .46]	675
	K-DOCS Artistic (9 items)	.86 [.84, .87]	.40 [.36, .44]	675

Note. AUT = alternative uses task; CSE = creative self-efficacy; K-DOCS = Kaufman''s domains of creativity scale. AIIC = average inter-item correlation: the average r between .20 and .40 is considered as an optimal level of item specificity (Piedmont, 2014). Values of .7 and higher as acceptable for Cronbach's α (Kline, 1999).

TABLE 3. Means, Standard Deviations, Sample Sizes Across AUT, CSE, K-DOCS by Sex and Expertise Area

Measure (range)	**Sciences**		**Arts**		**Sports**	
	Mean (SD)		**Mean (SD)**		**Mean (SD)**	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
AUT Fluency (0 – no upper limit)	28.30 (14.63)	22.82 (13.86)	24.24 (14.69)	18.06 (11.82)	14.88 (8.80)	12.79 (8.84)
N	189	256	245	47	25	93
CSE (3–15)	10.90 (2.73)	11.00 (2.48)	11.73 (2.47)	11.48 (2.41)	10.31 (2.72)	12.07 (2.15)
N	206	285	303	56	26	108
K-DOCS: Self/Everyday (5–55)	40.07 (6.31)	39.12 (7.77)	41.18 (6.23)	40.98 (7.58)	39.22 (4.11)	38.23 (8.98)
K-DOCS: Scholarly (5–55)	37.70 (6.43)	40.98 (7.58)	39.85 (7.17)	37.76 (8.20)	32.65 (5.31)	35.32 (9.31)
K-DOCS: Performance (5–50)	29.43 (8.36)	27.64 (8.94)	33.25 (7.77)	34.02 (7.71)	26.78 (6.49)	31.46 (9.52)
K-DOCS: Mechanical/Scientific (5–45)	26.40 (6.00)	30.40 (6.57)	22.34 (7.63)	25.62 (8.07)	24.24 (5.06)	29.82 (7.94)
K-DOCS: Artistic (5–45)	30.61 (6.28)	26.13 (7.70)	33.07 (5.98)	29.64 (7.08)	27.48 (5.46)	28.36 (7.93)
N	156	154	244	42	23	56

Note. AUT = alternative uses task; CSE = creative self-efficacy; K-DOCS = Kaufman''s domains of creativity scale; SD = standard deviation.

As can be seen from Figure 1, males and females demonstrated similar patterns of correlations. All K-DOCS subscales at least modestly correlated with each other. AUT Fluency showed non-significant or weak correlations with other measures, with the exception of a moderate correlation with K-DOCS Scholarly. CSE showed moderate to strong correlations with K-DOCS domains but did not correlate with AUT Fluency.

GROUP DIFFERENCES

The results of group comparisons are presented in Table 4, including sex & expertise area main effects and sex by expertise area interaction effects across study measures. PostHoc tests comparing expertise areas (adjusted and not adjusted for sex) are presented in Tables S16–S29 in SOM. Pairwise deletion was used for the calculations.

Sex differences in cognitive measure of creativity

Hypothesis 1A: In line with our expectations, females outperformed males in creative ability, measured by verbal AUT Fluency with small effect size. As we detected violations of parametric assumptions in AUT fluency, we used robust methods (R package WRS2; Field & Wilcox, 2017). The results from the robust ANOVA analysis and parametric ANOVA did not differ, and are available from the authors on request.

Hypothesis 1B: Contrary to our expectations, females had higher variability in AUT Fluency than males. As can be seen from the Figure 2—male and female distributions overlap greatly, but females had slightly higher max scores, median, mean, and SD values in comparison to males.

In addition, we computed males to females variance ratios (VR_{mf}) for the total sample by dividing variance of males by variance of females in AUT Fluency. Females had higher variability than males (VR_{mf} = 177/218 = .81). We also created "ability groups," comparing variance ratios across upper and lower ends of the distribution. The results showed that variance was: higher for females in the lower end of

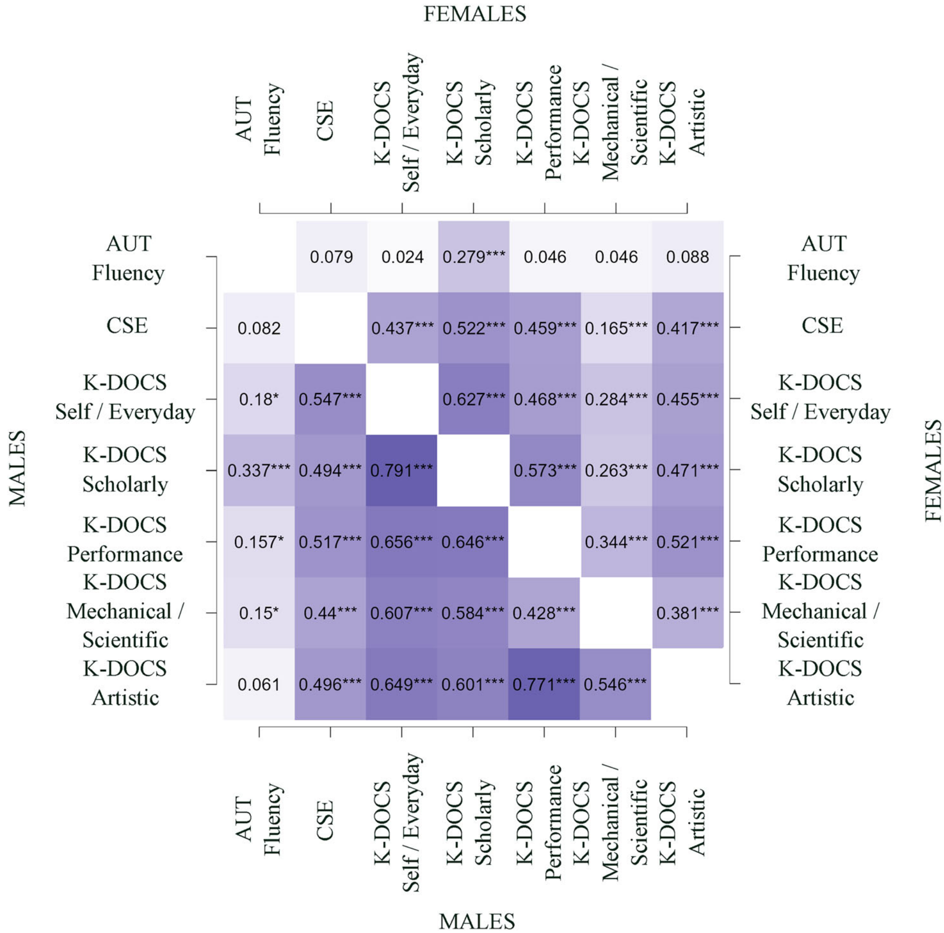

FIGURE 1. Heatmap of Pearson's Product moment correlations between alternative uses test fluency, creative self-efficacy, Kaufman's domains creativity scale for females (above the diagonal) and for males (below the diagonal). *$p < .05$, **$p < .01$, ***$p < .001$. N varied from 353 to 459 for females, and from 202 to 396 for males.

the distribution; approximately equal near the center; and higher for males closer to the upper end. Results are available in Table S30 in SOM.

Hypothesis 1C: In respect to moderating effect of expertise area on the links between sex and AUT Fluency, our data showed that females in Sciences and Arts areas outperformed males with very small effects (both p's $< .001$) and had slightly higher variability. No average or variance sex differences were found in Sports experts. Results are in Table S30 in SOM.

Sex differences in creative self-efficacy

Hypothesis 2A: As expected, sex differences in CSE were negligible ($\eta^2_p = .005$). We ran an additional analysis (Mann–Whitney U test & uni-factorial ANOVA). This analysis showed no sex differences in CSE (more in Table S1 in SOM).

TABLE 4. ANOVA Results of Sex & Expertise Area Comparisons, and Interactions of Sex*Expertise Area for AUT Fluency, CSE, and 5K-DOCS Domains.

Scale	Interaction (sex*area) Effect		Main effect of sex		Main effect of expertise area (sciences, arts, sports)	
	F	n_p^2	F	n_p^2	F	n_p^2
AUT Fluency	.63	<.001	11.94***	.014	26.98***	.060
CSE	4.92**	.010	5.35*	.005	4.66*	.009
K-DOCS: Self/Everyday	0.15	<.001	0.94	.001	3.32*	.010
K-DOCS: Scholarly	2.31	.007	0.03	.000	9.36***	.030
K-DOCS: Performance	4.49*	.013	1.91	.003	18.97***	.050
K-DOCS: Mechanical/Scientific	2.40	.007	44.71***	.060	20.01***	.060
K-DOCS: Artistic	4.63*	.013	10.85***	.020	10.87***	.010

Note. AUT, alternative uses test, CSE, creative self-efficacy; K-DOCS, Kaufman's domains of creativity scale, *, significance at $p < .05$; **, significance at $p < .01$; ***, significance at $p < .001$. For n_p^2 we used the following thresholds for the interpretation: 0.01 as small; 0.09 as medium; 0.25 as large (Cohen, 1966). Ns for the analysis are in Table 3.

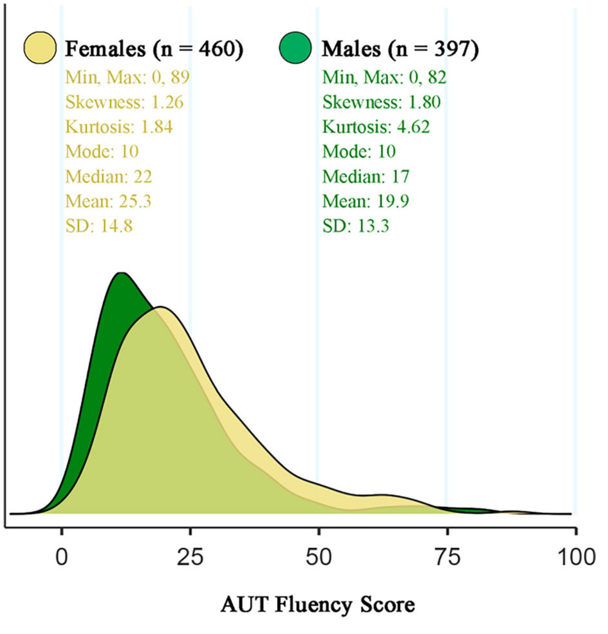

FIGURE 2. Densities for AUT Fluency across sex.

Hypothesis 2B: In line with our hypothesis, females under-estimated, and males over-estimated their creative ability, as measured by subtracting objective (AUT) from subjective (CSE) measures of creativity. See results in Figure 3.

Hypothesis 2C: No moderating effects of expertise area were found for CSE and over/underestimation of creative ability, as sex differences were similarly negligible across the areas (n_p^2 was equal to .010 and .009, respectively).

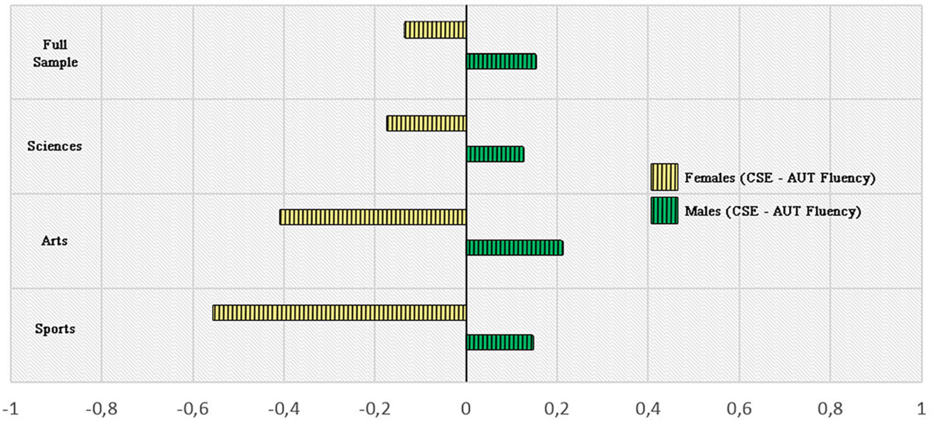

FIGURE 3. Under- and Overestimation of creative ability across sex. Positive values indicate the overestimation. Negative values indicate underestimation. AUT, alternative uses test. CSE, creative self-efficacy. *Note*. Sample sizes were as follows: Full sample—459 females, 396 males; Science—189 females, 256 males; Arts—245 females, 41 males; Sports—25 females, 93 males.

Sex differences in domain-specific self-rated creativity

We performed 2 (sex) by 3 (expertise area) MANOVAs to investigate main effects and interaction effects in five 5 K-DOCS domains. The interaction effect of sex and area was significant ($\text{Trace}_{\text{Pillai}} = .05$, App. F (2, 669) = 3.81, $p < .001$); the main effect of sex was significant ($\text{Trace}_{\text{Pillai}} = .36$, App. F (1, 669) = 74.01, $p < .001$); and the main effect of expertise area was significant ($\text{Trace}_{\text{Pillai}} = .26$, App. F (2, 669) = 19.53, $p < .001$). We conducted several two (sex) by three (expertise area) ANOVAs to test our hypotheses on separate K-DOCS domains.

Hypothesis 3A: In line with our hypothesis, there were no sex differences in the Self/Everyday, Scholarly and Performance domains of creativity.

Hypothesis 3B: As predicted, males self-rated higher than females in Mechanical/Scientific domain with weak effect size ($n_p^2 = .063$).

Hypothesis 3C: As predicted, females self-rated higher than males in Artistic domain, although the effect size was weak ($n_p^2 = .016$).

Hypothesis 3D: In regards to moderation effect of expertise area, our data showed no significant interaction for Self/Everyday, Scholarly, and Mechanical/Scientific domains. Significant interactions were found for Performance and Artistic domain (n_p^2 was equal to .013 in both cases). Additional analysis for Mechanical/Scientific domain is in Table S31 in SOM.

In Performance domain males had higher scores than females only in the Sports group ($n_p^2 = .057$). In Artistic domain females in Sciences and Arts groups self-rated higher than males (n_p^2 ranging from .038 to .094).

Differences in creativity scores across three expertise areas

Further analyses were run to examine the main effects of expertise area. ANOVA results are presented in Table 4, showing significant difference across all creativity measures, with small effects (n_p^2 ranged from .01 to .06) involved in the current study. Mean values, standard deviation and sample sizes per each scale (AUT Fluency, CSE, 5 K-DOCS domains) across three expertise areas (Sciences, Arts, Sports) are presented in Table 5.

DISCUSSION

In the current study, we investigated sex differences in different aspects of creativity among Russian adolescents with expertise in Sciences, Arts, or Sports. Our study showed negligible to weak sex differences for

TABLE 5. Mean Values, Standard Deviation and Sample Sizes Per Each Scale Across Expertise Areas

Scale/Expertise area	Sciences Mean (SD), *N*	Arts Mean (SD), *N*	Sports Mean (SD), *N*
AUT Fluency	25.15 (14.43), 445	23.24 (14.43), 292	13.23 (8.84), 118
CSE	10.96 (2.58), 491	11.69 (2.46), 359	11.72 (2.37), 134
K-DOCS: Self/Everyday	39.60 (7.08), 310	41.15 (6.43), 286	38.52 (7.86), 79
K-DOCS: Scholarly	37.63 (7.42), 310	39.54 (7.35), 286	34.54 (8.40), 79
K-DOCS: Performance	28.54 (8.69), 310	33.36 (7.75), 286	30.10 (8.96), 79
K-DOCS: Mechanical/Scientific	28.39 (6.59), 310	22.83 (7.77), 286	27.57 (8.01), 79
K-DOCS: Artistic	28.40 (7.37), 310	32.56 (6.26), 286	28.10 (7.27), 79

AUT = alternative uses test; CSE = creative self-efficacy; K-DOCS = Kaufman's domains of creativity scale.

all measures of creativity for all three expert groups, and weak sex by expertise interactions for some measures. We also found weak associations among different aspects of creativity, and among objective and subjective measures of creativity.

SEX DIFFERENCES IN PERFORMANCE-BASED CREATIVITY

In line with previous research (e.g., females advantage was found in 84% of the studies reviewed by Baer & Kaufman (2008, as cited in He & Wong, 2021), females slightly outperformed males in idea generation as measured with AUT Fluency task. This small advantage is likely due to the well-established female advantage in verbal tasks (Buitink, 2017; Hyde & Linn, 1988; Kousoulas & Mega, 2009).

Our results also partly supported The Greater Male Variability Hypothesis (He et al., 2013, 2015; He & Wong, 2011). There were more than twice as many males as females in the lowest 10% score percentile of AUT Fluency. However, contrary to some previous findings (He et al., 2015), we did not find an over-representation of males in the 0%–25% upper regions of the distribution. Moreover, the overall variability on this task was slightly higher for females.

SEX DIFFERENCES IN SELF-REPORTED DOMAIN-GENERAL CREATIVITY

There were no meaningful sex differences in CSE for Sciences and Arts groups (but males in Sports groups reported slightly higher CSE compared to females in this group). These results are in line with a study in intellectually gifted adolescents that also found no sex differences in CSE (Aldhamit et al., 2020) and a meta-analysis that showed weak sex differences in creativity in samples with full range of ability (e.g., a male advantage in creative performance of $\delta = .13$; Hora et al., 2022). Positive self-evaluation and external feedback that gifted schoolchildren receive on their performance, may help to override existing gender stereotypes in creativity.

We also aimed to evaluate a pattern of over-/underestimation of creative ability. However, the correlation between AUT Fluency and CSE in our sample was non-significant ($r = .08$), suggesting that adolescents with expertise in Sciences, Arts, and Sports, are not very accurate at evaluating their idea generation ability. This is in line with a study that showed teachers' accuracy of students' creativity is also generally low (Gralewski & Karwowski, 2013). This pattern of association is also consistent with findings of only weak correlations between some self-reported measures of creativity and creative performance (Kaufman et al., 2008). The absence of correlation supports conceptualizing different facets of creativity, as reflecting mostly unrelated traits. Specifically, the ability to quickly come up with many potential uses to common objects (AUT Fluency) may rely on different psychological processes compared with general imagination and ideas generation (CSE; Toivainen, 2021; Kaufman et al., 2008). Indeed, some previous research reported stronger correlations between CSE and other measures of creative performance (e.g., $r = .39$; measured by the following task: "List problems which might occur at work—your place of employment"; Mathisen & Bronnick, 2009). Moreover, previous research in a sample of middle and high school students with another measure (Test of Creative Thinking-Drawing Production) found that males over-estimated and females under-estimated their creative ability (Karwowski, 2011)—a pattern also suggested by our results. This overestimation may be explained by several factors, including gender stereotypes, self-comparisons with peers, and feedback from others (Kim & Kwon, 2016). For example, previous studies showed that teachers rate females' creativity lower than males' (Beghetto, Kaufman, & Baxter, 2011; Pfeiffer & Jarosewich, 2007), which likely to be a bias.

SEX DIFFERENCES IN DOMAIN-SPECIFIC SELF-RATED CREATIVITY

The only notable sex difference was identified in the mechanical/scientific and artistic domains of K-DOCS instrument, consistent with the original research by Kaufman (Kaufman, 2006). In mechanical/scientific domain males self-rated higher than did females with medium effect in all groups. This may reflect true differences in some STEM-related characteristics. For example, a recent study found that even females with expertise in STEM had lower spatial ability (specifically mechanical reasoning) than both STEM expert and STEM non-expert male groups (Budakova et al., 2021; Tsigeman et al., 2023).

In the current study males also self-rated higher than did females in mechanical/scientific domain creativity not only in Arts and Sports group, but also in Sciences expert group. These results are consistent with a wealth of studies that showed higher self-evaluation in males compared to females for skills that are related to STEM; Bleeker & Jacobs, 2004; Preckel, Goetz, Pekrun, & Kleine, 2008). Even more strikingly, in our study males from other expert groups rated their Mechanical/Scientific creativity the same (Arts) or higher (Sports) than females in the Sciences expert group. This result is consistent with several studies, showing lower self-concept and self-rated abilities in females.

For example, one study found that females' academic self-concept of mathematics was lower than boys' in the 6th grade for both gifted and non-gifted groups (Preckel et al., 2008). Another study found that female high school students felt less confident about their abilities in physics (Bleeker & Jacobs, 2004). Also, research found that males rated their mathematical and spatial intelligence facets higher than females (Rammstedt & Rammsayer, 2002). Research suggests that cultural beliefs and sex stereotypes, including widely spread stereotype about males' superiority in intelligence, might have an impact on self-assessments (Fallan & Opstad, 2016; Niederle & Vesterlund, 2010); especially if people believe that cognitive abilities are not malleable (Wood & Bandura, 1989).

Further research is needed to disentangle gender-role stereotypes, such as male advantage in STEM (Niederle & Vesterlund, 2010) from potential true average differences in interests and performance; and their links to creativity—explaining why females selected for highest achievement in Sciences among their school peers still report lower self-evaluation of creativity in this domain.

In artistic creativity, males rated lower than females, not only in the Art experts group, but also than females in STEM group. Previous research showed similar results (Hass, 2015) and suggested some reasons for these differences. For example, female adolescents on average are more engaged in the arts and cultural activities, than male adolescents both inside and outside of school (Dumais, 2002; Mak & Fancourt, 2021), such as attending art museums or dance performances (Katz-Gerro & Meier Jæger, 2015). Higher self-reported artistic creativity in females might also reflect sex differences in openness—that correlates with artistic creativity (.50; Repeykova, 2019) and musical sophistication (Ruth, Tsigeman, Likhanov, Kovas, & Müllensiefen, 2023). For example, slightly higher openness in females was found in several large-scale cross-cultural studies, including in gifted samples (Likhanov et al., 2021; Mac Giolla & Kajonius, 2019).

The relatively low self-reported estimates of scientific creativity in females selected for Sciences achievement and Artistic creativity in males selected for Arts achievement, suggest that their achievement has only weak connection to their self-concept. This is consistent with a study that showed only a weak correlation between science self-efficacy and Science performance across 67 participating nations in PISA 2015 ($r = .17$, 95% CI = [0.16, 0.18], $n = 472\ 242$, $p < .001$; Stoet & Geary, 2018). The results are again consistent with gender-role stereotypes.

The overall pattern of results is consistent with viewing sex differences in creativity as at least partially societally "created." The fact that even experts in a particular domain rate their creativity lower if this domain has a strong stereotypical association with another gender role, may be a product of sex stereotypes. However, the current state of knowledge on the topic of sex differences in creativity has limited insights on how societal expectations and stereotypes might affect sex differences in different aspects of creativity, including DT tasks and self-evaluations. Proudfoot et al. (2015) posited that creativity is often linked with qualities like independence and self-direction, typically associated with masculinity, leading to biases in how creativity is perceived across genders. They found that even when both genders produce identical outputs, males are often credited with more creativity. The study concluded that common perceptions of men being more creative that women may stem from a biased view of men possessing greater agency and agency being associated with creativity. The observed sex differences may also reflect differences in opportunities, resources, and expectations—a context for translation of creative potential into actual creative achievements (Runco et al., 2010).

For example, higher scores in males compared to females in our study may reflect features of the school curriculum in Russia. Traditionally, male schoolchildren perform some of activities that are relevant to such items from K-DOCS mechanical/scientific creativity scale as "Carving something out of wood or similar material" or "Constructing something out of metal, stone, or similar material." In contrast, females are usually do not engage in such activities, but instead have cooking and sewing classes. The importance of cultural context was also highlighted in a study with Chinese schoolchildren where girls traditionally are expected to be polite and restrained (Cheung & Lau, 2013).

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The current study has a number of limitations. First, there were differences in sample sizes of sex by expertise groups, with some groups too small to conduct meaningful analysis of sex by expertise effects. Second, there might be some differences in motivation to participate in the study across the expertise groups. Specifically, students with expertise in Sports (who were mostly male hockey players) showed overall less interest in completing the tests and could have produced more random responses. Although we have controlled for "clickers" as part of outliers removal, potential lower motivation in this group may have influenced the results. Third, groups were heterogeneous in their expertise, for example, Arts group was comprised of academic drawing, musicians and literature sub-groups. This heterogeneity within expertise groups might obscure the differences between domains of expertise. The small sample size in sub-groups precluded a more fine-grained analysis.

CONCLUSIONS

Overall, our data showed negligible mean and variance sex differences in several aspects of measured and self-reported creativity in Science, Arts, and Sports adolescent expert groups. Our results are consistent with previous research that has supported the gender similarities hypothesis for creativity (Hyde, 2005; Gralewski & Karwowski, 2013; He & Wong, 2011; Taylor & Barbot, 2021). However, when compared males and females from different expert groups in their self-ratings on specific domains, some stereotypical differences of larger magnitude emerged. In addition, the negligible correlation found between creativity measured by AUT Fluency and by general self-reported creativity, highlights that creativity is not a unitary construct (Toivainen, 2021). More research is needed to gain further insights into complex interactions between sex, expertise and different aspects of creativity.

AUTHOR CONTRIBUTIONS

VR, TT, ML, and YK designed the study. VR wrote the manuscript and performed all analyses. TT, ML, KvB, and YK provided editorial feedback. YK supervised all aspects of the study. The authors have no conflict of interests.

ETHICAL CONSIDERATIONS

The present study gained ethical approval from the Tomsk State University's ethical committee for interdisciplinary studies. The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

DATA AVAILABILITY STATEMENT

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

REFERENCES

Abdulla Alabbasi, A.M., Thompson, T.L., Runco, M.A., Alansari, L.A., & Ayoub, A.E.A. (2022). Gender differences in creative potential: A meta-analysis of mean differences and variability. *Psychology of Aesthetics, Creativity, and the Arts*, 1–14; doi: 10.1037/aca0000506.

Abra, J., & Valentine-French, S. (1991). Gender differences in creative achievement: a survey of explanations. *Genetic, Social, and General Psychology Monographs*, *117*(3), 233–284.

Abraham, A., Thybusch, K., Pieritz, K., & Hermann, C. (2014). Gender differences in creative thinking: Behavioral and fMRI findings. *Brain Imaging and Behavior*, *8*(1), 39–51; doi: 10.1007/s11682-013-9241-4.

Al-Alusi, A. (2001). *Self-efficacy and its relationship to self-esteem among university students*. Master thesis, University of Baghdad, Baghdad, Iraq.

Aldhamit, Y., Albdour, N.T., & Alshraideh, M.K. (2020). Creative self-efficacy and its' relationship to intellectual stress among gifted students at the jubilee school. *World Journal of Education*, *10*(3), 208; doi: 10.5430/wje.v10n3p208.

Baer, J. (1997). Gender differences in the effects of anticipated evaluation on creativity. *Creativity Research Journal*, *10*(1), 25–31; doi: 10.1207/s15326934crj1001_3.

Baer, J., & Baer, S.K. (2006). Gender differences in creativity. In J.A. Chambers (Ed.), *Selected papers from the 17th International Conference on College Teaching and Learning* (pp. 1–13). Florida Community College at Jacksonville.

Baer, J., & Kaufman, J.C. (2008). Gender differences in creativity. *The Journal of Creative Behavior*, *42*(2), 75–105; doi: 10.1002/j.2162-6057.2008.tb01289.x.

Barron, F., & Harrington, D.M. (1981). Creativity, intelligence, and personality. *Annual Review of Psychology*, *32*(1), 439–476; doi: 10.1146/annurev.ps.32.020181.

Bart, W.M., Hokanson, B., Sahin, I., & Abdelsamea, M.A. (2015). An investigation of the gender differences in creative thinking abilities among 8th and 11th grade students. *Thinking Skills and Creativity*, *17*, 17–24; doi: 10.1016/j.tsc.2015.03.003.

Batey, M., & Hughes, D.J. (2017). Individual difference correlates of self-perceptions of creativity. *The Creative Self*, 185–218; doi: 10.1016/b978-0-12-809790-8.00011.

Beghetto, R. (2006). Creative self-efficacy: Correlates in middle and secondary students. *Creativity Research Journal*, *18*(4), 447–457; doi: 10.1207/s15326934crj1804_4.

Beghetto, R.A., Kaufman, J.C., & Baxter, J. (2011). Answering the unexpected questions: Exploring the relationship between students' creative self-efficacy and teacher ratings of creativity. *Psychology of Aesthetics, Creativity, and the Arts*, *5*(4), 342–349; doi: 10.1037/a0022834.

Bender, S.W., Nibbelink, B., Towner-Thyrum, E., & Vredenburg, D. (2013). Defining characteristics of creative women. *Creativity Research Journal*, *25*(1), 38–47; doi: 10.1080/10400419.2013.752190.

Bleeker, M.M., & Jacobs, J.E. (2004). Achievement in Math and Science: Do mothers' beliefs matter 12 years later? *Journal of Educational Psychology*, *96*(1), 97–109; doi: 10.1037/0022-0663.96.1.97.

Boccia, M., Piccardi, L., Palermo, L., Nori, R., & Palmiero, M. (2015). Where do bright ideas occur in our brain? Meta-analytic evidence from neuroimaging studies of domain-specific creativity. *Frontiers in Psychology*, *6*, 1–12; doi: 10.3389/fpsyg.2015.01195.

Boden, M.A. (2007). Creativity in a nutshell. *Think*, *5*(15), 83–96; doi: 10.1017/s147717560000230x.

Brockhus, S., Van der Kolk, T.E.C., Koeman, B., & Badke-Schaub, P.G. (2014). The influence of creative self-efficacy on creative performance. In Proceedings of the DESIGN 2014 13th International Design Conference.

Budakova, A.V., Likhanov, M.V., Toivainen, T., Zhurbitskiy, A.V., Sitnikova, E.O., Bezrukova, E.M., & Kovas, Y. (2021). Measuring spatial ability for talent identification, educational assessment, and support: Evidence from adolescents with high achievement in science, arts, and sports. *Psychology in Russia: State of the Art*, *14*(2), 59–85; doi: 10.11621/pir.2021.0205.

Buitink, M. (2017). *A gender-comparison between verbal and figural divergent thinking in 4-year-old children, using the Torrance Test of Creative Thinking and the Alternative Uses Task*, Master thesis.

Camarata, S., & Woodcock, R. (2006). Sex differences in processing speed: Developmental effects in males and females. *Intelligence*, *34*, 231–252.

Carson, S.H., Peterson, J.B., & Higgins, D.M. (2005). Reliability, validity, and factor structure of the Creative Achievement Questionnaire. *Creativity Research Journal*, *17*(1), 37–50; doi: 10.1207/s15326934crj1701_4.

Cheung, P.C., & Lau, S. (2013). A tale of two generations: creativity growth and gender differences over a period of education and curriculum reforms. *Creativity Research Journal*, *25*(4), 463–471; doi: 10.1080/10400419.2013.843916.

Cox, B.F. (2003). *The relationship between creativity and self-directed learning among adult community college students*, Unpublished doctoral dissertation, University of Tennessee.

Cropley, A. (2006). In praise of convergent thinking. *Creativity Research Journal*, *18*(3), 391–404; doi: 10.1207/s15326934crj1803_13.

Deary, I.J. (2001). Individual differences in cognition. *British Journal of Psychology*, *92*, 217–237.

DeMoss, K., Milich, R., & DeMers, S. (1993). Gender, creativity, depression, and attributional style in adolescents with high academic ability. *Journal of Abnormal Child Psychology*, *21*(4), 455–467; doi: 10.1007/bf01261604.

Diaz Abrahan, V., Sarli, L., Shifres, F., & Justel, N. (2021). Music expertise and gender differences in verbal and visual divergent thinking. A behavioral study. *Creativity Research Journal*, *33*(3), 235–245; doi: 10.1080/10400419.2021.1938.

Dollinger, S.J. (2006). Autophotographic individuality predicts creativity: A seven-year follow-up. *The Journal of Creative Behavior*, *40*(2), 111–124; doi: 10.1002/j.2162-6057.2006.tb01268.x.

Dumais, S.A. (2002). Cultural capital, gender, and school success: The role of habitus. *Sociology of Education*, *75*(1), 44–68; doi: 10.2307/3090253.

Fallan, L., & Opstad, L. (2016). Student self-efficacy and gender-personality interactions. *International Journal of Higher Education*, *5*(3), 32–44.

Feist, G.J. (1998). A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review*, *2*(4), 290–309; doi: 10.1207/s15327957pspr0204_5.

Field, A.P., & Wilcox, R.R. (2017). Robust statistical methods: A primer for clinical psychology and experimental psychopathology researchers. *Behaviour Research and Therapy*, *98*, 19–38; doi: 10.1016/j.brat.2017.05.013.

Furnham, A. (2016). Individual differences in intelligence, personality, and creativity. *Creativity and Reason in Cognitive Development*, 327–353; doi: 10.1017/cbo9781139941969.017.

Furnham, A., & Bachtiar, V. (2008). Personality and intelligence as predictors of creativity. *Personality and Individual Differences*, *45* (7), 613–617; doi: 10.1016/j.paid.2008.06.023.

Furnham, A., Batey, M., Booth, T.W., Patel, V., & Lozinskaya, D. (2011). Individual difference predictors of creativity in Art and Science students. *Thinking Skills and Creativity*, *6*(2), 114–121; doi: 10.1016/j.tsc.2011.01.006.

Gibson, C., Folley, B.S., & Park, S. (2009). Enhanced divergent thinking and creativity in musicians: A behavioral and near-infrared spectroscopy study. *Brain and Cognition*, *69*(1), 162–169; doi: 10.1016/j.bandc.2008.07.009.

Gralewski, J., & Karwowski, M. (2013). Polite girls and creative boys? Students' gender moderates accuracy of teachers' ratings of creativity. *The Journal of Creative Behavior*, *47*(4), 290–304; doi: 10.1002/jocb.36.

Gray, H., Lyth, A., McKenna, C., Stothard, S., Tymms, P., & Copping, L. (2019). Sex differences in variability across nations in reading, mathematics and science: A meta-analytic extension of baye and monseur (2016). *Large-scale Assessments in Education, 7*(1), 1–29.

Guilford, J.P. (1968). *Creativity, intelligence, and their educational implications*. San Diego, CA: EDITS/Robert Knapp.

Hass, R.W. (2015). Domain-specific exemplars affect implicit theories of creativity. *Psychology of Aesthetics, Creativity, and the Arts*, *9*(1), 96–104.

He, M.W.-J., Wong, W.-C., & Hui, A.N.-N. (2015). Gender differences in means and variability on creative thinking: Patterns in childhood, adolescence, and emerging adulthood. *Creativity, Culture, and Development*, 85–98; doi: 10.1007/978-981-287-636-2_6.

He, W., & Wong, W. (2011). Gender differences in creative thinking revisited: Findings from analysis of variability. *Personality and Individual Differences*, *51*(7), 807–811; doi: 10.1016/j.paid.2011.06.027.

He, W., & Wong, W. (2021). Gender differences in the distribution of creativity scores: Domain-specific patterns in divergent thinking and creative problem solving. *Frontiers in Psychology*, *12*, 626911; doi: 10.3389/fpsyg.2021.626911.

He, W., Wong, W., Li, Y., & Xu, H. (2013). A study of the greater male variability hypothesis in creative thinking in Mainland China: Male superiority exists. *Personality and Individual Differences*, *55*(8), 882–886; doi: 10.1016/j.paid.2013.07.017.

Hill, A., Tan, A.-G., & Kikuchi, A. (2008). International high school students' perceived creativity self-efficacy. *Korean Journal of Thinking & Problem Solving*, *18*(1), 105–115.

Hora, S., Badura, K.L., Lemoine, G.J., & Grijalva, E. (2022). A meta-analytic examination of the gender difference in creative performance. *Journal of Applied Psychology*, *107*(11), 1926–1950; doi: 10.1037/apl0000999.

Hristovski, R., Davids, K., Passos, P., & Araujo, D. (2012). Sport performance as a domain of creative problem solving for self-organizing performer-environment systems. *The Open Sports Science Journal*, *5*(1), 26–35.

Hughes, D.J., Furnham, A., & Batey, M. (2013). The structure and personality predictors of self-rated creativity. *Thinking Skills and Creativity*, *9*, 76–84; doi: 10.1016/j.tsc.2012.10.001.

Hyde, J.S., & Linn, M.C. (1988). Gender differences in verbal ability: A meta-analysis. *Psychological Bulletin*, *104*(1), 53–69; doi: 10.1037/0033-2909.104.1.53.

International Test Commission. (2017). *The ITC guidelines for translating and adapting tests* (2nd edn). www.InTestCom.org

Ishiguro, C., Sato, Y., Takahashi, A., Abe, Y., Kato, E., & Takagishi, H. (2022). Relationships among creativity indices: Creative potential, production, achievement, and beliefs about own creative personality. *PLoS One*, *17*(9), e0273303; doi: 10.1371/journal.pone.0273303.

Jauk, E., Benedek, M., Dunst, B., & Neubauer, A.C. (2013). The relationship between intelligence and creativity: New support for the threshold hypothesis by means of empirical breakpoint detection. *Intelligence*, *41*(4), 212–221; doi: 10.1016/j.intell.2013.03.003.

Jaussi, K.S., Randel, A.E., & Dionne, S.D. (2007). I am, I think I can, and I do: The role of personal identity, self-efficacy and cross-application of experiences in creativity at work. *Creativity Research Journal*, *19*(2–3), 247–258; doi: 10.1080/10400410701397339.

Jia, M., Zhang, N., & Li, L. (2020). The power of teacher supportive communication: effects on students' positive emotions and engagement in learning. *The Northwest Journal of Communication*, *48*, 9–36.

Johnson, W., Carothers, A., & Deary, I.J. (2008). Sex differences in variability in general intelligence: A new look at the old question. *Perspectives on Psychological Science*, *3*(6), 518–531; doi: 10.1111/j.1745-6924.2008.00096.x.

Ju, C., Duan, Y., & You, X. (2015). Retesting the greater male variability hypothesis in mainland China: A cross-regional study. *Personality and Individual Differences*, *72*, 85–89; doi: 10.1016/j.paid.2014.07.021.

Karwowski, M. (2011). It doesn't hurt to ask…But sometimes it hurts to believe: Polish students' creative self-efficacy and its predictors. *Psychology of Aesthetics, Creativity, and the Arts*, *5*(2), 154–164; doi: 10.1037/a0021427.

Karwowski, M., Jankowska, D.M., Gajda, A., Marczak, M., Groyecka, A., & Sorokowski, P. (2016). Greater male variability in creativity outside the WEIRD world. *Creativity Research Journal*, *28*(4), 467–470; doi: 10.1080/10400419.2016.1229978.

Karwowski, M., Jankowska, D.M., Gralewski, J., Gajda, A., Wiśniewska, E., & Lebuda, I. (2016). Greater male variability in creativity: A latent variables approach. *Thinking Skills and Creativity*, *22*, 159–166; doi: 10.1016/j.tsc.2016.10.005.

Karwowski, M., & Kaufman, J.C. (Eds.). (2017). *The creative self: Effect of beliefs, self-efficacy, mindset, and identity*. Amsterdam, The Netherlands: Elsevier Academic Press.

Karwowski, M., Lebuda, I., Wisniewska, E., & Gralewski, J. (2013). Big five personality traits as the predictors of creative self-efficacy and creative personal identity: Does gender matter? *The Journal of Creative Behavior*, *47*(3), 215–232; doi: 10.1002/jocb.32.

Katz-Gerro, T., & Meier Jæger, M. (2015). Does women's preference for highbrow leisure begin in the family? Comparing leisure participation among brothers and sisters. *Leisure Sciences*, *37*(5), 415–430; doi: 10.1080/01490400.2014.995326.

Kaufman, J.C. (2006). Self-reported differences in creativity by gender and ethnicity. *Journal of Applied Cognitive Psychology*, *20*, 1065–1082.

Kaufman, J.C. (2012). Counting the muses: Development of the Kaufman Domains of Creativity Scale (K-DOCS). *Psychology of Aesthetics, Creativity, and the Arts*, *6*(4), 298–308; doi: 10.1037/a0029751.

Kaufman, J.C., & Baer, J. (2005). The amusement park theory of creativity. In J.C. Kaufman & J. Baer (Eds.), *Creativity across domains: Faces of the muse* (pp. 321–328). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Kaufman, J.C., Plucker, J.A., & Baer, J. (2008). Essentials of psychological assessment series. In *Essentials of creativity assessment*. Hoboken, NJ: John Wiley & Sons.

Kim, J., & Michael, W.B. (1995). The relationship of creativity measures to school achievement and to preferred learning and thinking style in a sample of Korean high school students. *Educational and Psychological Measurement*, *55*, 60–74.

Kim, Y.H., & Kwon, H. (2016). Why do people overestimate or underestimate their abilities? A cross-culturally valid model of cognitive and motivational processes in self-assessment biases. *Journal of Cross-Cultural Psychology*, *47*(9), 1201–1216; doi: 10.1177/0022022116661243.

Kline, P. (1999). *The handbook of psychological testing* (2nd edn). London: Routledge.

Kogan, N. (1974). Creativity and sex differences. *The Journal of Creative Behavior*, *8*(1), 1–14; doi: 10.1002/j.2162-6057.1974.tb01103.x.

Kousoulas, F., & Mega, G. (2009). Students' divergent thinking and teachers' ratings of creativity: Does gender play a role? *The Journal of Creative Behavior*, *43*(3), 209–222; doi: 10.1002/j.2162-6057.2009.tb01315.x.

Lauer, J.E., Yhang, E., & Lourenco, S.F. (2019). The development of gender differences in spatial reasoning: A meta-analytic review. *Psychological Bulletin*, *145*(6), 537–565; doi: 10.1037/bul0000191.

Likhanov, M.V., Tsigeman, E.S., Papageorgiou, K.A., Akmalov, A.F., Sabitov, I.A., & Kovas, Y.V. (2021). Ordinary extraordinary: Elusive group differences in personality and psychological difficulties between STEM-gifted adolescents and their peers. *British Journal of Educational Psychology*, *91*(1), 78–100; doi: 10.1111/bjep.12349.

Lubart, T. (2016). Creativity and convergent thinking: reflections, connections and practical considerations. *RUDN Journal of Psychology and Pedagogics*, *4*, 7–15.

Mac Giolla, E., & Kajonius, P. J. (2019). Sex differences in personality are larger in gender equal countries: Replicating and extending a surprising finding. *International Journal of Psychology*, *54*(6), 705–711.

Maccoby, E.E., & Jacklin, C.N. (1974). *The psychology of sex differences*. Redwood City, CA: Stanford University Press.

Majeres, R.L. (1983). Sex differences in symbol-digit substitution and speeded matching. *Intelligence*, *7*, 313–327.

Majeres, R.L. (1999). Sex differences in phonological processes: Speeded matching and word reading. *Memory & Cognition*, *27*, 246–253.

Majeres, R.L. (2007). Sex differences in phonological coding: Alphabet transformation speed. *Intelligence*, *35*, 335–346.

Mak, H.W., & Fancourt, D. (2021). Do socio-demographic factors predict children's engagement in arts and culture? Comparisons of in-school and out-of-school participation in the Taking Part Survey. *PLoS One*, *16*(2), e0246936; doi: 10.1371/journal.pone.0246936.

Mathisen, G.E., & Bronnick, K.S. (2009). Creative self-efficacy: An intervention study. *International Journal of Educational Research*, *48*, 21–29.

McKay, A.S., Karwowski, M., & Kaufman, J.C. (2017). Measuring the muses: Validating the Kaufman Domains of Creativity Scale (K-DOCS). *Psychology of Aesthetics, Creativity, and the Arts*, *11*(2), 216–230; doi: 10.1037/aca0000074.

Mednick, S.A. (1968). The remote associates test. *The Journal of Creative Behavior*, *2*(3), 213–214; doi: 10.1002/j.2162-6057.1968.tb00104.x.

Miroshnik, K.G., Shcherbakova, O.V., & Kaufman, J.C. (2022). Kaufman Domains of Creativity Scale: Relationship to occupation and measurement invariance across gender. *Creativity Research Journal*, *34*(2), 159–177; doi: 10.1080/10400419.2021.1953823.

Nami, Y., Marsooli, H., & Ashouri, M. (2014). The relationship between creativity and academic achievement. *Procedia - Social and Behavioral Sciences*, *114*, 36–39; doi: 10.1016/j.sbspro.2013.12.652.

Niederle, M., & Vesterlund, L. (2010). Explaining the gender gap in math test scores: The role of competition. *Journal of Economic Perspectives*, *24*(2), 129–144; doi: 10.1257/jep.24.2.129.

OECD. (2019). *PISA 2018 results (volume II): Where all students can succeed*. Paris: PISA, OECD Publishing; doi: 10.1787/b5fd1b8f-en.

Papageorgiou, K.A., Likhanov, M., Costantini, G., Tsigeman, E., Zaleshin, M., Budakova, A., & Kovas, Y. (2020). Personality, behavioral strengths and difficulties and performance of adolescents with high achievements in science, literature, art and sports. *Personality and Individual Differences*, *160*, 109917; doi: 10.1016/j.paid.2020.109917.

Pfeiffer, S.I., & Jarosewich, T. (2007). The gifted rating scales-school form. *Gifted Child Quarterly*, *51*(1), 39–50; doi: 10.1177/0016986206296658.

Piedmont, R. L. (2014). Inter-item correlations. *Encyclopedia of quality of life and well-being research*, 3303–3304. Berlin, Germany: Springer. doi:10.1007/978-94-007-0753-5_1493

Piffer, D., & Hur, Y.-M. (2014). Heritability of creative achievement. *Creativity Research Journal*, *26*(2), 151–157; doi: 10.1080/10400419.2014.901068.

Plomin, R., & Foch, T.T. (1980). A twin study of objectively assessed personality in childhood. *Journal of Personality and Social Psychology*, *39*(4), 680–688; doi: 10.1037/0022-3514.39.4.680.

Plucker, J.A., Beghetto, R.A., & Dow, G.T. (2004). Why isn't creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research. *Educational Psychologist*, *39*(2), 83–96; doi: 10.1207/s15326985ep3902_1.

Preckel, F., Goetz, T., Pekrun, R., & Kleine, M. (2008). Gender differences in gifted and average-ability students. *Gifted Child Quarterly*, *52*(2), 146–159; doi: 10.1177/0016986208315834.

Proudfoot, D., Kay, A.C., & Koval, C.Z. (2015). A gender bias in the attribution of creativity. *Psychological Science*, *26*(11), 1751–1761; doi: 10.1177/0956797615598739.

Rammstedt, B., & Rammsayer, T.H. (2002). Gender differences in self-estimated intelligence and their relation to gender-role orientation. *European Journal of Personality*, *16*(5), 369–382; doi: 10.1002/per.454.

Rejskind, F.G., Rapagna, S.O., & Gold, D. (1992). Gender differences in children's divergent thinking. *Creativity Research Journal*, *5* (2), 165–174; doi: 10.1080/10400419209534430.

Repeykova, V.A. (2019). *Examining linear and non-linear associations between personality and creativity in high achieving adolescence*, Master thesis, National Research Tomsk State University. doi: 10.13140/RG.2.2.34457.08807.

Repeykova, V.A., Likhanov, M.V., Toivainen, T., & Kovas, Y.V. (in preparation). Validation of the Kaufman's domains of creativity scale among russian high achieving adolescents in areas of sciences, arts and sports.

Roivainen, E. (2011). Gender differences in processing speed: A review of recent research. *Learning and Individual Differences*, *21* (2), 145–149; doi: 10.1016/j.lindif.2010.11.021.

Runco, M.A. (2014). *Creativity: Theories and themes: Research, development, and practice* (2nd ed.). Amsterdam, The Netherlands: Elsevier Academic Press.

Runco, M.A., Abdulla, A.M., Paek, S.H., Al-Jasim, F.A., & Alsuwaidi, H.N. (2016). Which test of divergent thinking is best? Creativity. *Theories – Research – Applications*, *3*(1), 4–18; doi: 10.1515/ctra-2016-0001.

Runco, M.A., & Albert, R.S. (1986). The threshold theory regarding creativity and intelligence: An empirical test with gifted and nongifted children. *Creative Child & Adult Quarterly*, *11*(4), 212–218.

Runco, M.A., & Bahleda, M.D. (1986). Implicit theories of artistic, scientific, and everyday creativity. *The Journal of Creative Behavior*, *20*(2), 93–98; doi: 10.1002/j.2162-6057.1986.tb00423.x.

Runco, M. A., Cramond, B., & Pagnani, A. R. (2010). Gender and creativity. *Handbook of gender research in psychology: Volume 1: Gender research in general and experimental psychology*, 343–357.

Runco, M.A., & Jaeger, G.J. (2012). The standard definition of creativity. *Creativity Research Journal*, *24*(1), 92–96; doi: 10.1080/10400419.2012.650092.

Runco, M.A., Millar, G., Acar, S., & Cramond, B. (2010). Torrance tests of creative thinking as predictors of personal and public achievement: A fifty-year follow-up. *Creativity Research Journal*, *22*(4), 361–368; doi: 10.1080/10400419.2010.523393.

Runco, M.A., & Okuda, S.M. (1988). Problem discovery, divergent thinking, and the creative process. *Journal of Youth and Adolescence*, *17*(3), 211–220; doi: 10.1007/BF01538162.

Runco, M.A., Plucker, J.A., & Lim, W. (2001). Development and psychometric integrity of a measure of ideational behavior. *Creativity Research Journal*, *13*(3–4), 393–400; doi: 10.1207/s15326934crj1334_16.

Ruth, N., Tsigeman, E., Likhanov, M., Kovas, Y., & Müllensiefen, D. (2023). Personality and engagement with music: Results from network modeling in three adolescent samples. *Psychology of Music*, *51*(4), 1223–1242; doi: 10.1177/03057356221135346.

Shields, S.A. (1982). The variability hypothesis: The history of a biological model of sex differences in intelligence. *Signs: Journal of Women in Culture and Society*, *7*(4), 769–797; doi: 10.1086/493921.

Shimonaka, Y., & Nakazato, K. (2007). Creativity and factors affecting creative ability in adulthood and old age. *Japanese Journal of Educational Psychology*, *55*(2), 231–243; doi: 10.5926/jjep1953.55.2_231.

Simonton, D.K. (1994). *Greatness: Who makes history and why*. New York, NY: Guilford Press.

Stoet, G., & Geary, D.C. (2018). The gender-equality paradox in science, technology, engineering, and mathematics education. *Psychological Science*, *29*(4), 581–593; doi: 10.1177/0956797617741719.

Tan, C.S., & Qu, L. (2012). Generality and specificity: Malaysian undergraduate students' selfreported creativity. *International Journal of Creativity and Problem Solving*, *22*(2), 19–30.

Taylor, C.L., & Barbot, B. (2021). Gender differences in creativity: Examining the greater male variability hypothesis in different domains and tasks. *Personality and Individual Differences*, *174*, 110661; doi: 10.1016/j.paid.2021.110661.

Thompson, T.L. (2016). *The mothers and fathers of invention: A meta-analysis of gender differences in creativity*.

Toivainen, T. (2021). *Individual differences in creativity: measurement, structure, aetiology and prediction*, Doctoral thesis, Goldsmiths, University of London.

Toivainen, T., Madrid-Valero, J.J., Chapman, R., McMillan, A., Oliver, B.R., & Kovas, Y. (2021). Creative expressiveness in childhood writing predicts educational achievement beyond motivation and intelligence: A longitudinal, genetically informed study. *British Journal of Educational Psychology*, *91*(4), 1395–1413; Portico; doi: 10.1111/bjep.12423.

Toivainen, T., Olteteanu, A. M., Repeykova, V., Likhanov, M., & Kovas, Y. (2019). Visual and linguistic stimuli in the remote associates test: a cross-cultural investigation. *Frontiers in Psychology*, *10*, 926, 1–4; doi: 10.3389/fpsyg.2019.00926.

Toivainen, T., Papageorgiou, K.A., Tosto, M.G., & Kovas, Y. (2017). Sex differences in non-verbal and verbal abilities in childhood and adolescence. *Intelligence*, *64*, 81–88; doi: 10.1016/j.intell.2017.07.0.

Torrance, E.P. (1966). *The Torrance Tests of Creative Thinking – Norms-technical manual research edition – Verbal tests, Forms A and B – Figural tests, Forms A and B*. Princeton, NJ: Personnel Press.

Torrance, E.P. (1974). *Norms technical manual: Torrance Tests of Creative Thinking*. Lexington, MA: Ginn and Co.

Torrance, E.P., & Aliotti, N.C. (1969). Sex differences in levels of performance and test-retest reliability on the Torrance Tests of Creative Thinking Ability. *The Journal of Creative Behavior*, *3*(1), 52–57; doi: 10.1002/j.2162-6057.1969.tb00044.x.

Turki, J., & Al-Qaisi, L. (2012). Adjustment problems and self-efficacy among gifted students in Salt Pioneer Center. *International Journal of Educational Sciences*, *4*(1), 1–6; doi: 10.1080/09751122.2012.11890.

van Broekhoven, K., Cropley, D., & Seegers, P. (2020). Differences in creativity across art and STEM students: We are more alike than unalike. *Thinking Skills and Creativity*, *38*, 100707. doi: 10.1016/j.tsc.2020.100707.

Voyer, D., Voyer, S., & Bryden, M.P. (1995). Magnitude of sex differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin*, *117*(2), 250–270; doi: 10.1037/0033-2909.117.2.250.

Wood, R., & Bandura, A. (1989). Social cognitive theory of organizational management. *The Academy of Management Review*, *14*(3), 361–384; doi: 10.2307/258173.

Woodman, R.W., & Schoenfeldt, L.F. (1989). Individual differences in creativity: An interactionist perspective. In J.A. Glover, R.R. Ronning, & C.R. Reynolds (Eds.), *Perspectives on individual differences. Handbook of creativity* (pp. 77–91). New York, NY: Plenum Press.

Xurui, T., Yaxu, Y., Qiangqiang, L., Yu, M., Bin, Z., & Xueming, B. (2018). Mechanisms of creativity differences between art and non-art majors: A voxel-based morphometry study. *Frontiers in Psychology*, *9*:2319, 1–8; doi: 10.3389/fpsyg.2018.02319

Zheng, R.C., & Xiao, B.L. (1983). A study of the creativity of high school students. *Acta Psychologica Sinica*, *15*, 445–452.

Vlada Repeykova, National Research Tomsk State University, National Research University Higher School of Economics

Teemu Toivainen, Goldsmiths, University of London

Maxim Likhanov, Beijing Normal University

Kim van Broekhoven, Erasmus University Rotterdam

Yulia Kovas, Goldsmiths, University of London

Correspondence concerning this article should be addressed to Yulia Kovas, Department of Psychology, Goldsmiths, University of London, SE14 6NW, London, UK.
E-mail: y.kovas@gold.ac.uk

ACKNOWLEDGMENTS

This study was supported by the Tomsk State University Development Programme («Priority-2030»).

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1 Data analyses protocol.
Table S2. Correlation analysis for research measures for the full sample.
Tables S3–S15. Correlation analysis for the research measures across areas of expertise.
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Table S30. Variance & Proportion Ratios for males and females in AUT Fluency.
Table S31. Bootstrapped PostHoc Comparisons (sex*area) for Mechanical/Scientific (K-DOCS) creativity.