

## The creative self: Do people distinguish creative self-perceptions, efficacy, and personal identity?

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### **Abstract**

There is a growing use of self-report measures of creativity with university students (Snyder, Hammond, Grohman, & Katz-Buonincontro, 2019). Creative self-perceptions, creative self-efficacy, and creative personal identity are common self-report constructs (Karwowski & Kaufman, 2017). The present study sought to determine whether participants differentiate between these constructs in their survey responses and whether there are groups of participants with different patterns of responses. Participants were 826 university students recruited from two campuses: one in the US and one in the UK. Hierarchical cluster analyses were used to determine the patterns of responses to items, and latent class analyses were used to determine whether there are different groups of participants. Results suggest that participants do not differentiate their responses by type of measure, but rather by domain. Results also suggest different groups of participants, with some groups rating themselves similarly across domains, and other groups differentiating by domain.

Keywords: creativity, self-assessment, self-efficacy, identity, creative achievement

### The creative self:

Do people distinguish creative self-perceptions, efficacy, and personal identity?

The field of creativity is experiencing a renaissance of research and theory about the creative self. The World Economic Forum 2018 Future of Jobs Report indicates increasing demand for creativity in the workplace by 2022 (ranked third, pg. 12). When creativity is included in the hiring process and measured in the applicant, it is common to use self-report or personality-style tests (Moy & Lam, 2004). Recent evidence suggests an increasing use of self-report measures of creativity in university students (Snyder, Hammond, Grohman, & Katz-Buonincontro, 2019). Creative self-assessments can have people reporting creative accomplishments, evaluating their creativity, answering questions about their creative process, or sharing their beliefs about creativity (Kaufman, 2019). This last category, creative-self beliefs (CSBs), can encompass a wide range of constructs (Karwowski & Kaufman, 2017; Karwowski & Lebuda, 2016). These can range from people's self-estimates of their creativity in general to a person's creative identity or mindset to a person's ability to accurately estimate their creativity (Karwowski, 2014; Kaufman & Beghetto, 2013b).

Three of the most-studied CSBs are creative self efficacy, creative personal identity, and creative self-perceptions. Tierney and Farmer (2002) proposed the idea of creative self-efficacy (CSE) as being how creative a person believes that she or he can be at a particular task. Based on the broader construct of self efficacy (Bandura, 1997), CSE is situation-specific (Jaussi, Randel, & Dionne, 2007). For example, student CSE (as measured both domain-generally and domain-specifically) has been moderately tied to teacher assessments of students' creativity (Beghetto, 2006; Beghetto, Baxter, & Kaufman, 2011). However, when teachers rated student creativity, they were unable to distinguish scientific and

mathematical creativity. In contrast, students were able to distinguish their own creative self-efficacy in these two domains (Beghetto et al, 2011).

Creative personal identity (CPI) is how much a person values creativity (Randel & Jaussi, 2003). This construct is often measured by seeing how much people include creativity as being a strong component of how they see themselves (Karwowski, Lebuda, & Wisniewska, 2018). Evidence suggests that CPI makes a unique contribution to creative performance, beyond CSE (e.g., Jaussi et al., 2007). Although CSE and CPI are distinct constructs as theoretically conceived, empirical studies have shown high correlations (Karwowski et al., 2018).

Creative self-perception (CSP) is how a person would rate her or his ability at a creative activity in a non-specific sense. In other words, someone might have very high CPI and value creativity. Someone may have high CSE and estimate higher levels of performance on a specific task (such as writing a haiku) before doing so. CSP is more of a general overview of one's ability: it can be about one's overall creativity, or it may differ by domain. Someone may have high CSP for creative writing, for example, but a low CSP for entrepreneurship. One domain-specific measure of CSP is the Kaufman Domains of Creativity Scale (K-DOCS; Kaufman, 2012), which assesses CSP in five domains: Everyday, Scholarly, Performance (including music, acting, and creative writing), Scientific (also including mathematics and mechanical creativity), and Artistic. The K-DOCS has shown both convergent and discriminant validity (Kandemir & Kaufman, in press; McKay, Karwowski, & Kaufman, 2017).

As indicated above, previous research shows that creative self-perceptions are correlated with each other (e.g., Karwowski et al., 2018). The relationships of creative self-assessments and self-beliefs to actual creative performance are inconsistent. Several studies find relationships between such creative self measures and more objective tests, particularly

divergent thinking (e.g., Batey, Furnham, & Safiullina, 2010; Furnham, Batey, Anand, & Manfield, 2008). In contrast, other studies find no such relationship, particularly with rated creativity (Kaufman, Evans, & Baer, 2010; Priest, 2006). One common trend is that creativity self-assessments that are more domain-specific are more accurate (i.e., correlated to rated creativity) than those that are more general (Beghetto, et al, 2011; Kaufman, Beghetto, & Watson, 2016; Pretz & McCollum, 2014). A recent meta-analysis (Haase, Hoff, Hanel, & Innes-Ker, 2018) suggests that CSE is most correlated with other self-report measures of creativity (e.g., creative achievement) and least correlated with measures of divergent thinking. This may reflect the domain and situation general nature of divergent thinking tasks. Research also suggests that different CSBs contribute differently to creative performance. For example, Karwowski and Lebuda (2017) found that CSE, CPI, and K-DOCS all made significant contributions to creative achievement and activities, beyond the contribution of personality variables. They also found domain differences in the amount each scale contributed to achievement.

Despite the mixed pattern of evidence regarding the use of CSB assessments as a proxy measure of actual creativity, it is important to note that there are other reasons to measure CSB's. Individuals scoring high on CSB's are more likely to engage in creative activities (e.g. Beghetto, 2006). This engagement brings a range of potential benefits for the individual including increased creative performance as a result of practice (cf. Kaufman & Beghetto, 2009), personal growth (Forgeard & Elstein, 2014), and an increase in wellbeing (Conner, DeYoung & Silvia, 2018;). Further, CSB assessments, when used in conjunction with performance-based measures, can offer insights into creative metacognition and how interests and values align with ability (e.g., Kaufman, 2019).

Personality has long been associated with creative self-perceptions (e.g., Karwowski & Labuda, 2016). A recent meta-analysis (Karwowski & Labuda, 2016) showed significant

correlations between creative self perceptions and all five of the Big 5 personality factors (openness, extraversion, conscientiousness, neuroticism, and agreeableness), although the strength of the correlations differed, with openness and extraversion showing the strongest correlations with the creative self-perception variables. They also found that the strength of the correlation varied by type of creative self-perception measure. For example, the strongest correlations were between openness and general creative self efficacy and creative personal identity, with weaker correlations between domain specific creative self-perceptions as measured by the K-DOCS.

It is unclear whether these self-assessment of creativity measures (CSE, CPI, K-DOCS) are indeed measuring different constructs (e.g., Kaufman, Plucker, & Baer, 2008). The purpose of the present study was to (1) use cluster analyses to determine if measures of self-perceptions of creativity, creative self-efficacy, and creative personal identity are assessing nearly identical or merely related constructs; and (2) use latent class analyses to determine if there are groups of participants that differ in their self-ratings. The present study also examined differences in personality and creative achievement in the identified groups.

Cluster analysis and latent class analysis offer complementary views of how these many facets of creative self-perception relate to each other, and both methods go beyond traditional factor analytic models. Cluster analysis can illuminate complex, hierarchical structures in the data, thus revealing groupings of items at different levels of generality. Latent class analysis views the problem from the other direction by looking for groupings of participants rather than items. By identifying clusters of people with similar profiles of scores, it can reveal distinct kinds of profiles that are obscured when the sample is treated as a homogeneous whole (Silvia, Kaufman, & Pretz, 2009).

## Method

### Participants

Participants were university students enrolled in a psychology course at public university in the US ( $n = 605$ ) or a university in the UK ( $n = 221$ ). Participants from the US university were largely female (424; 70.1%), with 127 males (21%), 6 (1%) who preferred not to say, and 48 (7.9%) who did not answer this question. The ages ranged from 18 years to 54 years, with an average of 20.48 ( $SD = 4.75$ ); this was missing for 47 (7.8%) of participants. Almost half of the participants were first year students (279; 46.1%), whereas 108 (17.9%) were second year, 81 (13.4%) third year, 75 (12.4%) fourth year and 13 (2.1%) other or Master's; this information was missing for 49 (8.1%) participants. As for ethnicity, 479 (79.2%) identified as White or Caucasian, 51 (8.4%) as Black or African American, 12 (2%) as Hispanic or Latino, 6 (1.0%) as Asian or Pacific Islander, 3 (.5%) as American Indian or Alaska Native, 17 (2.8%) multiple ethnicities, and 9 (1.5%) preferred not to say. The most frequent majors reported were: 123 (20.3%) psychology (of these seven reported having a second major in a different discipline: biology, sociology, social work, English literature, computer science), 97 (16%) education (includes preschool/early, elementary, secondary, art, health, music, and special education), 55 (9.1%) nursing, 46 (7.6%) undeclared/undecided, and 38 (6.3%) Criminal Justice. This information was missing for 59 (9.8%) participants.

Participants from the UK university were also largely female (182, 82.4%), with 28 (12.7%) male and two (.9%) who preferred not to say; this information was missing for nine (4.1%) participants. The ages ranged from 18 years to 45 years, with an average of 19.75 ( $SD = 3.60$ ); this was missing for 10 (4.5%) of participants. Over half of the participants were first year students (148, 67%), whereas 58 (26.2%) were second year, two (.9%) were third year, one (.5%) was fourth year, three (1.4%) were other or master's and this information was

missing for nine (4.1%) of the participants. As for ethnicity, 160 (72.4%) identified as White, 27 (12.2%) as Asian/Asian British, 12 (5.4%) as Black/African/Caribbean/Black British, 8 (3.6%) as mixed/multiple, 5 (2.3%) as other, and this information was missing for 9 (4.1%) of the participants. Almost all of the participants were psychology majors (210, 95%), whereas two (.9%) were other (engineering and marketing); this information was missing for nine (4.1%) of the participants. This difference in percentage of psychology majors between the campuses is due to cultural and program differences. Undergraduate programs in the UK usually focus on one major discipline, with no minor. Conversely, students in US undergraduate programs take non-major courses to complete general education requirements for their degrees. In addition, several non-Psychology major programs do require students to take Psychology for their degrees, including Nursing, Education, Speech and Hearing Science, and Social Work.

## Measures

**Kaufman Domains of Creativity Scale.** Self-perceptions of creativity were measured using the Kaufman Domains of Creativity Scale (K-DOCS; Kaufman, 2012). This instrument measures self-perceptions in five domains: Everyday (e.g., “finding something fun to do when I have no money”), Scholarly (e.g., “Writing a nonfiction article for a newspaper, newsletter, or magazine”), Performance (e.g., “Writing a poem”), Scientific (e.g., “Carving something out of wood or similar material”), and Artistic (e.g., “Drawing a picture of something I’ve never actually seen (like an alien)”). The Everyday scale was used as a domain general scale for the purpose of this study. The measure asks participants to rate themselves as compared with same aged peers with similar levels of experience in creativity for the task on a five-point scale ranging from *much less creative* to *much more creative*. Cronbach alphas for the domain specific scales ranged from .846 to .890.

**Creative Self-efficacy.** Creative Self-efficacy (CSE) was measured using six items from Beghetto (2006, 2009). This scale was originally developed to be domain general (“I am good at coming up with new ideas”). Participants rated the statements on a five-point scale ranging from *not true* to *very true*. The average rating was computed for the scale score. Domain specific scales appropriate for university students were developed for this study based on the domains included in the K-DOCS, e.g., “In regards to your creativity in school (such as debating multiple points of view, or writing a nonfiction paper)...”. Cronbach alphas ranged from .898 to .957.

**Creative Personal Identity.** Creative Personal Identity (CPI) was measured using four items from Jaussi et al. (2007). This scale was originally developed as domain general (“my creativity is an important part of who I am”). Participants rated their agreement with each statement on a five-point scale ranging from *strongly disagree* to *strongly agree*. One item was reverse coded (“Overall, my creativity has little to do with how I feel about myself”) and the average rating was used for the scale scores. Domain specific scales appropriate for university students were developed for this study based on the domains included in the K-DOCS in the same way as was done for the CSE. Cronbach alphas ranged from .750 to .805.

**HEXACO-PI-R.** Personality was measured using the 60 item HEXACO-PI-R (Ashton & Lee, 2009). Participants rated each statement on a five-point scale ranging from *strongly disagree* to *strongly agree*. The average scores for the statements in the six scales were used: Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, and Openness to Experience. Cronbach alphas ranged from .701 to .801.

**Creative Achievement Questionnaire.** Creative achievement was measured using the Creative Achievement Questionnaire (CAQ; Carson, Peterson, & Higgins, 2005). Participants were asked to check all levels of achievement reached in each of ten domains:

visual arts, music, dance, architectural design, creative writing, humor, inventions, scientific discovery, theatre and film, and culinary arts. Each domain has items that escalate in levels of achievement, ranging from none (“I do not have recognized talent in this area”) to high levels, such as “my work has been reviewed in national publications” for the domain of creative writing. The scoring for this measure is unusual in that each response is weighted so that higher-level achievement is given more weight than lower-level achievements. If people endorsed the first item—having no accomplishments in an area—they received a zero for that domain. The remaining items are weighted, in most cases, by the item’s number; some items are multiplied by the number of times an achievement occurred. Due to the nature of this measure, computation of Cronbach alpha for reliability is not appropriate (Silvia, Wigert, Reiter-Palmon, & Kaufman, 2012).

### **Procedures**

Students were recruited via an email invitation (US) or via an online system used for research projects (UK). Participants completed the survey online via LimeSurvey. After clicking consent, students began the survey. All measures except for the demographics were presented in random order. The demographics page was always presented last. The scales (e.g., artistic, scientific, etc.) within the measures were randomized (except for the CAQ), and items were randomized within scales (except for the CAQ and demographics). US students received extra credit for participation. UK students received lab tokens that they could use for their own future research projects. The study received ethics committee approval from both universities.

## **Results**

### **Descriptive Statistics**

See Table 1 for descriptive information for all self-perception of creativity and personality variables. See Table 2 for descriptive information for all Creative Achievement Questionnaire (CAQ) variables.

Table 1

Descriptive statistics for all creative self-perception and personality variables

Variable	<i>n</i>	Mean	CI Mean Lower/Upper	<i>SD</i>	Skew/Kurtosis
CSE General	780	3.68	3.63/3.73	0.70	-.506/1.058
CSE Everyday	785	3.86	3.81/3.91	0.71	-.428/.562
CSE School	779	3.49	3.44/3.55	0.78	-.462/.590
CSE Performance	778	3.17	3.10/3.24	1.01	-.286/-.429
CSE Math/Science	777	3.00	2.93/3.07	1.00	-.079/-.500
CSE Art	774	3.22	3.15/3.30	1.03	-.361/-.451
KDOCS Everyday	754	3.72	3.67/3.76	0.60	-.755/1.825
KDOCS School	760	3.16	3.11/3.21	0.70	-.376/.659
KDOCS Performance	757	2.83	2.77/2.90	0.91	.050/-.685
KDOCS Math/Science	751	2.43	2.37/2.49	0.84	.389/-.317
KDOCS Art	760	3.08	3.02/3.14	0.87	-.114/-.446
CPI General	773	3.46	3.40/3.52	0.82	-.390/.092
CPI Everyday	777	3.58	3.52/3.63	0.75	-.420/.322
CPI School	780	3.31	3.25/3.36	0.77	-.312/.288
CPI Performance	781	3.20	3.14/3.26	0.87	-.206/-.155
CPI Math/Science	780	2.77	2.71/2.83	0.82	.079/-.086
CPI Art	783	3.18	3.11/3.24	0.90	-.093/-.372
Hexaco Honesty-Humility	757	3.33	3.29/3.37	0.59	-.109/-.112
Hexaco Emotionality	755	3.46	3.41/3.50	0.64	-.350/-.149
Hexaco Extraversion	758	3.25	3.21/3.30	0.65	-.157/.024
Hexaco Agreeableness	753	3.13	3.09/3.17	0.59	-.237/.138
Hexaco Conscientiousness	756	3.48	3.44/3.53	0.61	-.018/-.295
Hexaco Openness	759	3.21	3.17/3.26	0.63	.046/-.214

*Note.* CI = confidence interval; SD = standard deviation; CSE = Creative Self-Efficacy Scale; CPI = Creative Personal Identity Scale; KDOCS = Kaufman Domains of Creativity Scale.

Table 2

Descriptive statistics for all Creative Achievement Questionnaire (CAQ) variables

Variable	<i>M</i>	<i>Mdn</i>	<i>SD</i>	<i>Min/Max</i>	<i>Skewness</i>	<i>Kurtosis</i>
Art	.09	0	.92	0, 21	17.06	344.34
Music	.03	0	.51	0, 14	26.03	709.94
Dance	.03	0	.38	0, 5	12.57	158.66
Architecture	.01	0	.18	0, 4	19.87	408.11
Writing	.03	0	.31	0, 5	12.04	155.79
Humor	.02	0	.19	0, 3	11.43	155.61
Invention	.01	0	.10	0, 1	9.42	86.79
Science	.02	0	.13	0, 1	7.48	54.02
Theatre	.02	0	.53	0, 15	27.80	785.77
Culinary	.03	0	.19	0, 3	8.23	89.90
CAQ Total	.29	0	1.52	0, 22	10.33	128.38
CAQ Arts Subscale	.22	0	1.42	0, 21	10.94	139.65
CAQ Science Subscale	.03	0	.19	0, 2	7.35	59.20

*n* = 826. *Mdn* = median; *SD* = standard deviation

### Cluster Analyses

Cluster analysis is a technique that seeks to group together data objects into clusters, such that members within a cluster are similar to each other and members of different clusters are dissimilar from each other. In the present case the data objects were scores on the various measures' subscales. We ran hierarchical cluster analyses to explore participants' patterns of

responding on the six subscales of the CSE questionnaire (General [the original scale], Everyday, School, Performance, Math/Mechanical/Science, and Art), the six subscales of the CPI questionnaire (General [the original scale], Everyday, School, Performance, Math/Mechanical/Science, and Art) and the five subscales of the K-DOCS (Self/Everyday, School, Performance, Mechanical/Science, and Art). As all the variables were measured on a five-point scale there was no need to standardize the variables before clustering. The hierarchical cluster analysis does not make specific distributional assumptions, other than that the data structure contains clusters (cf. Everitt, Landau, Leese & Stahl, 2011). However, as the order of variable entry can influence results we ran the cluster analyses with different variable orders to check generalizability. Since the findings were consistent across the orders, the results from the first order used are reported.

We ran the hierarchical cluster analysis (Figure 1) using the method of complete linkage. This starts by clustering together the two most similar subscales and then, at each stage, joins the next most similar subscales or clusters of subscales until all the subscales are joined in a complete classification tree (Figure 1). The complete linkage method serves to maximize homogeneity within a cluster.

Two, three, four and five cluster solutions were suggested. At the two cluster level an initial split was visible between math/mechanical/scientific creativity and the other domains of creativity (general, everyday, scholarly, artistic, and performance). Adding a third cluster split artistic and performance creativity off from the general domains of general, everyday, and school creativity. Adding a fourth cluster separated artistic and performance creativity. Finally, adding a fifth cluster split school from general and everyday creativity. The five cluster solution separated all but the general and everyday domains, and further clusters did not show any systematic separation of these domains. Overall the analysis suggests that the

subscales tended to cluster by domain rather than by the “parent” (CPI, CSE, K-DOCS) scale, suggesting that the domains are dissociable from each other.

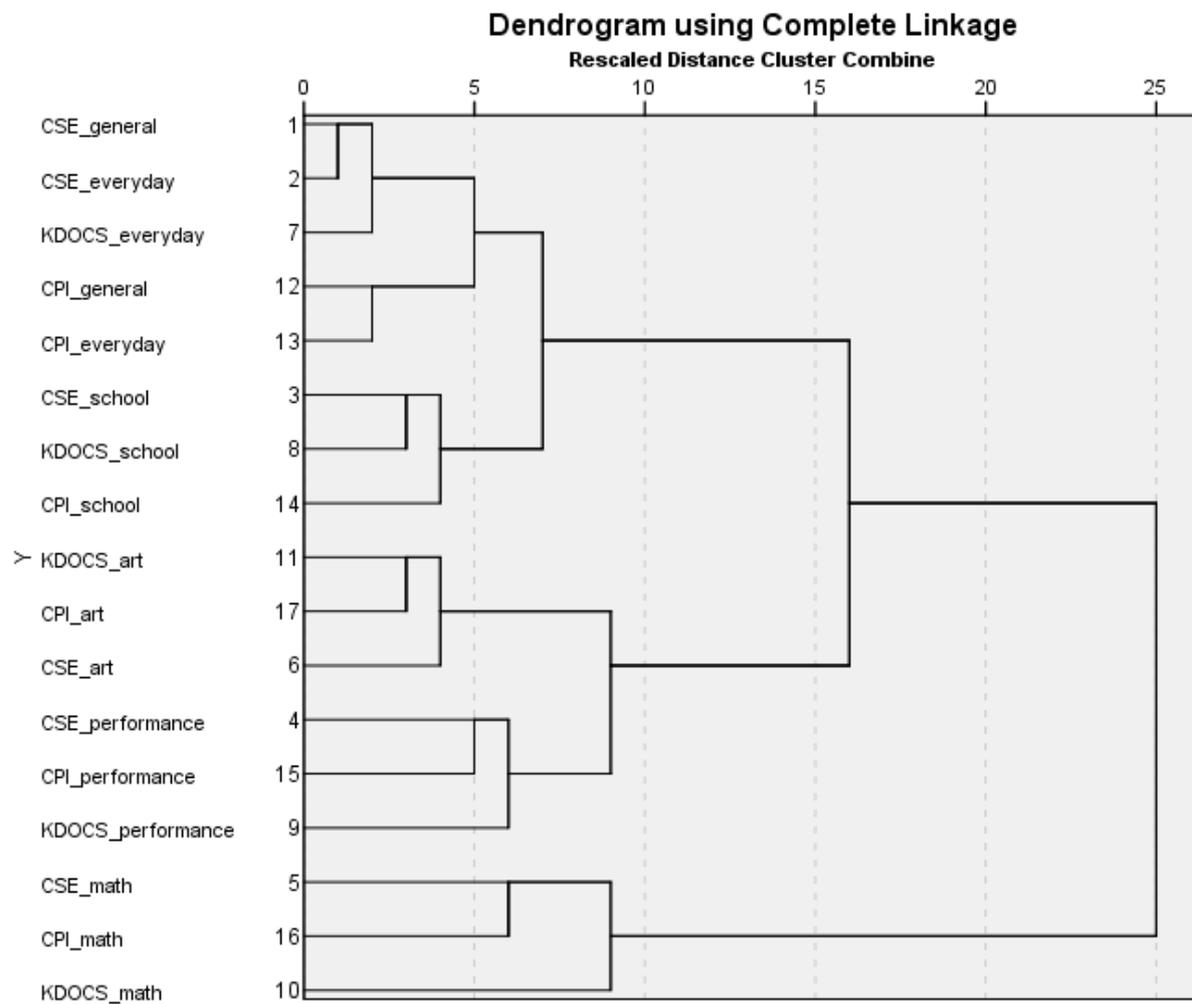


Figure 1. Dendrogram of Hierarchical Cluster Analyses. CSE = Creative Self-Efficacy Scale; CPI = Creative Personal Identity Scale; KDOCS = Kaufman Domains of Creativity Scale.

### Latent Class Analyses

Latent class analysis (LCA) offers another way of finding and representing types and clusters. Whereas cluster analysis groups *items* into nested hierarchies, LCA groups *participants* into categories. Scores on the dependent variables—the many creativity scales, in this case—are used to identify clusters of people that are relatively more similar to each other than to the people in another cluster. These clusters are nominal and unordered and can be viewed as “types” of creative self-perceptions. LCA is an exploratory method that suggests answers to a few questions. First, are there types in the data? Second, if types appear, how many are there, and how large are they?

The LCA was estimated in Mplus 8.1 using maximum likelihood estimation with robust standard errors. The indicators used for the classes were the subscales of the CSE, CPI, and K-DOCS. We evaluated models ranging from 2 to 8 classes. LCA uses random starting values to explore a larger range of the likelihood surface. For these models, we used 500 random starts, using a scaling factor of 30 and least 20 iterations. The 50 models with the best initial log-likelihood values were then iterated to final solutions. For the final model, we examined different randomizing seeds and scaling values to ensure that the solution was robust.

Choosing the best-fitting LCA model involves weighting different criteria that often disagree (Collins & Lanza, 2010; Jung & Wickrama, 2008). For the initial evaluation, we used entropy values (higher is better) and AIC and BIC values (lower is better). Adjacent models (e.g., 4 vs 5 class models) can then be compared using likelihood ratio tests, which compare a criterion model to an alternative model with one less class. We balanced these statistical against parsimony. A model with fewer classes is more likely to replicate (Collins & Lanza, 2010), and metrics for selecting classes perform better when the classes have large

sample sizes (Swanson, Lindenberg, Bauer, & Crosby, 2012). We thus sought models with fewer classes and with no tiny classes (e.g., fewer than 5% of the sample).

As sometimes happens, the quantitative metrics pointed in different directions. For this sample, the inconsistency was unusually large. AIC and BIC values declined from 2 to 8 classes, which implies models with many classes. Entropy wasn't great for any model (the maximum was .847 for 3 classes; the minimum was .819 for 2 classes). The likelihood ratio tests, however, implied models with fewer classes. These tests rejected alternate models until it reached 3. In short, some metrics suggested at least 5 classes, and others suggested only 3. Because LCA is an exploratory method and we have no strong *a priori* hypotheses, we settled on presenting two alternate, credible models: one with 3 and one with 5 classes.

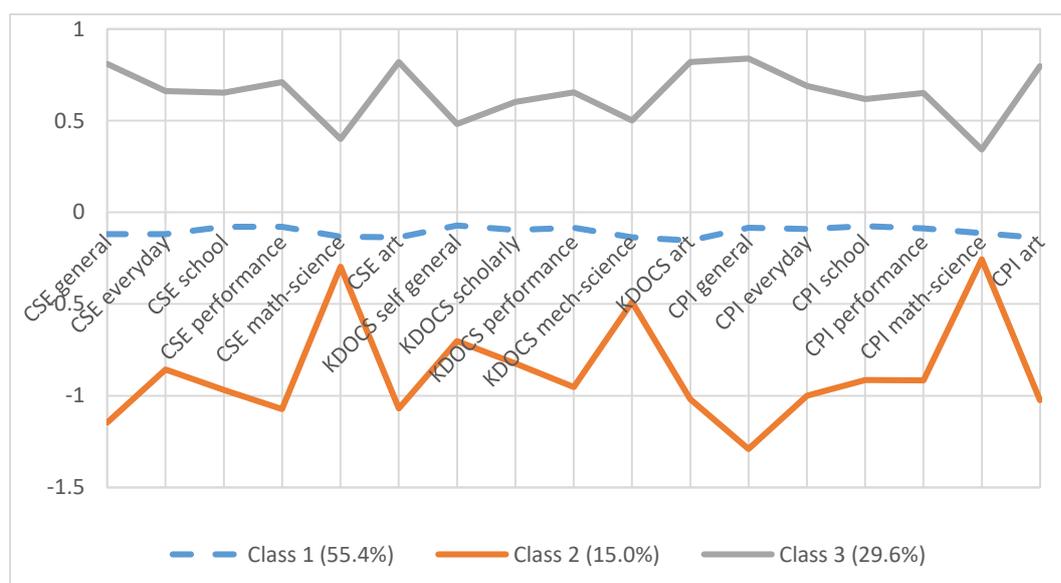


Figure 2. Latent Class Analysis, 3 Class Model. CSE = Creative Self-Efficacy Scale; CPI = Creative Personal Identity Scale; KDOCS = Kaufman Domains of Creativity Scale.

The 3-class model is shown in Figure 2. In this model, there's a smaller group of people (15%) that view themselves as relatively uncreative except in math, science, and technical domains. This group has low scores on all the subscales but has its highest scores

for the CSE math-science, K-DOCS mechanical-science, and CPI math-science subscales.

The largest group (55.4%) rated themselves as essentially average in all the subscales. No one subscale stuck out, and all the values are around the sample mean of zero. And a third group (29.6%) rated themselves as basically above average in all the domains, but the lowest values tended to be in the math-mechanical-science subscales.

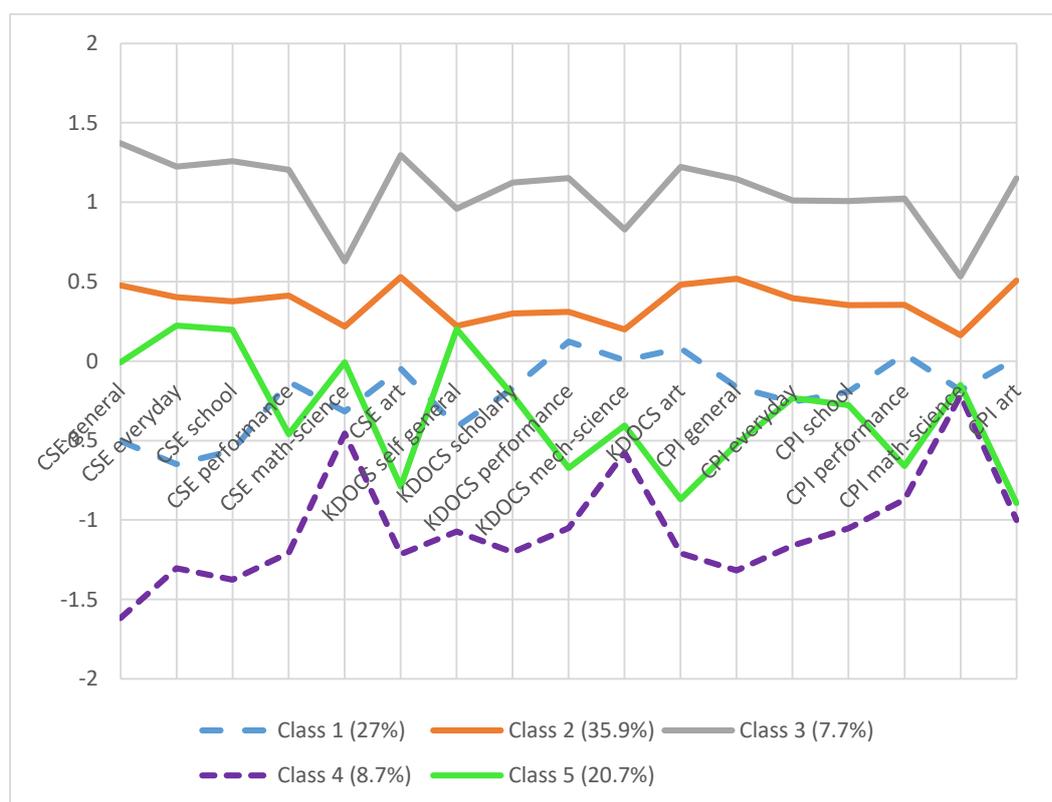


Figure 3. Latent Class Analysis, 5 Class Model. CSE = Creative Self-Efficacy Scale; CPI = Creative Personal Identity Scale; KDOCS = Kaufman Domains of Creativity Scale.

The 5 class model is shown in Figure 3. As before, a small group of people (8.7%) viewed themselves as low in creativity in all domains except the math-science domains, and another small group (7.7%) viewed themselves as high in all the domains except the math-science ones. The rest of the sample was divided into three groups. Classes 1 and 2 represented groups that tended to rate themselves fairly consistently across all the subscales.

They had similar profiles but different mean levels (sometimes called “intensity classes”). Class 5 (20.7%) was highest in intellectual and scholarly areas, such as school, scholarly areas, and math-science, but low in general and artistic areas of creativity, broadly speaking.

Viewed broadly, the LCA models show that there were clusters that represented undifferentiated self-ratings (some people rated themselves similarly across all domains) as well as clusters with differentiated ratings (some distinguished between domains). When people rated themselves differently across domains, the biggest hinge was the math-science-technical domains. One group viewed themselves as poor overall but relatively creative in those areas. Conversely, another group viewed themselves as creative overall but relatively poor in those areas.

To enrich our understanding of these classes, we evaluated how the classes differed on other variables—the HEXACO personality traits and CAQ scores—using the BCH function for estimating means across latent classes (Bakk & Vermunt, 2016). For simplicity, we focus on the 3-class solution and on Extraversion and Openness to Experience, the two personality traits that have received the most attention in creativity research. (The effects for all traits for all models are available in the online supplemental material.)

For personality, all 3 classes differed significantly from the others in both extraversion and openness. As Table 3 shows, the class that was highest in self-rated creativity (Class 3) was highest in both extraversion and openness, the class that was lowest in creativity (Class 2) was lowest in both extraversion and openness, and the middle creativity class was in the middle in both traits. Self-rated creativity thus corresponded to the levels of these personality traits.

For creative achievement, we evaluated total CAQ scores (summed across all 10 domains). Although Class 3, the class with the highest self-rated creativity, had the highest CAQ scores (see Table 3), none of the classes differed significantly from another in CAQ

scores. We then divided the CAQ domains into subscales using Kaufman et al.'s (2016) scoring for *arts* (sum of visual arts, music, dance, creative writing, humor, and theatre) and *sciences* (sum of inventions and scientific discovery) subscale scores. As Table 3 shows, the three classes did not differ significantly in their CAQ subscale scores.<sup>1</sup>

Table 3

Estimated means for extraversion, openness to experience, and creative achievement

	Latent Class		
	Class 1 (55.4%)	Class 2 (15%)	Class 3 (29.6%)
Extraversion	3.25 <sub>a</sub> (.03)	2.96 <sub>b</sub> (.06)	3.43 <sub>c</sub> (.05)
Openness to Experience	3.15 <sub>a</sub> (.03)	2.70 <sub>b</sub> (.05)	3.61 <sub>c</sub> (.04)
CAQ Total Score	.21 <sub>a</sub> (.06)	.25 <sub>a</sub> (.11)	.46 <sub>a</sub> (.15)
CAQ Arts	.15 <sub>a</sub> (.06)	.17 <sub>a</sub> (.09)	.40 <sub>a</sub> (.14)
CAQ Sciences	.02 <sub>a</sub> (.01)	.07 <sub>a</sub> (.03)	.03 <sub>a</sub> (.01)

*Note.* The values are estimated means and standard errors. Cells in the same row with differing subscripts are significantly different at  $p < .01$ . CAQ = Creative Achievement Questionnaire.

## Discussion

The findings suggest that participants do not respond differently by type of measure, but rather by domain, especially in the math/science subscales, as compared with everyday creativity. This is consistent with previous research suggesting that participants differentiate

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<sup>1</sup> CAQ scores are usually highly skewed with a preponderance of zeros. This was certainly true in our sample, which saw near-zero medians and means (indicating no accomplishments) and a wide range of variability in the 10 CAQ domains (see Table 2). The CAQ skew is less troublesome for the LCA models than for other kinds of analyses. The BCH method makes assumptions about the within-class distribution of means, but simulation studies show that it is much more robust to violations of normality than other methods (Bakk & Vermunt, 2016). Because our project is exploratory, we are inclined to take the lack of between-class CAQ differences at face value instead of assuming that the skewed distributions are obscuring otherwise significant effects.

by domain, even across measures. For example, Ivcevic and Meyer (2009) found distinctions in responses between artistic, everyday, and intellectual creativity using act frequency and life space scales. Kaufman and Baer (2004) found that CSP in mathematics was generally unrelated to CSP in other domains. The present research findings suggest that using different CSB measures in studies of university students' CSBs, whether CSE, CPI, or CSP, will not result in different findings. It is more important to measure domain-specific constructs to capture university students' self-perceptions of their creativity than to measure each of the CSB constructs separately. Researchers therefore can focus limited participant time and attention on domain specific measures rather than different CSB measures.

The findings also suggest that there are different groups (classes) of people in that some people perceive themselves to be uncreative or similarly creative across domains and measures, whereas other people appear to differentiate between domains, especially math/science. This is consistent with some previous studies (e.g., Lemons, 2010) and inconsistent with others (e.g., Silvia et al, 2009). Lemons (2010) identified five groups of participants based on qualitative analysis of responses to questions about their creative abilities, and over half of these participants rated themselves as average in creative abilities, whereas others rated themselves as high, and others as low. In contrast, Silvia et al (2009) found distinct classes for creative achievement, but not for creative self-perceptions as measured by the Creativity Domain Questionnaire, on which the K-DOCS was based (e.g., Kaufman, 2006; Kaufman, Cole, & Baer, 2009). They found that there were no distinct classes for creative self-perceptions.

The findings suggest that the classes differ not just in their ratings of CSBs, but also on personality factors, including in openness and extraversion, with the class that rated themselves above average in CSBs also rating themselves higher on these factors as compared with those who rated themselves lower on CSBs. This is consistent with previous

research that demonstrates correlations between CSBs and personality (e.g., Karwowski & Lebuda, 2016). The classes did not differ in creative achievement, a finding that should be investigated further in future research. University students tend to score low on creative achievement because they have not yet started their careers or spent enough time in a domain to accumulate high-level accomplishments (Silvia et al., 2012). It may be that different CSB classes would demonstrate differences in creative behaviors or activities using other measures more appropriate for university students' likely level of creative activities.

Overall, these findings suggest that university students may think about their creativity differently. Some will consider their creativity across domains in similar ways, in that they can be creative or creativity is important to them, regardless of domain. Other students will differentiate among domains, especially in math and science. These students may perceive themselves as either more or less creative in math and science as compared with other domains. This has real implications for how we teach and nurture creativity in higher education, particularly in regards to STEM fields. Both the three-class and five-class solutions reveal that there are some people who see themselves as generally less creative except for STEM areas (where they are high). Conversely, there are also some people who see themselves as generally more creative except for STEM areas (where they are low).

This split is potentially concerning. If people who recognize their STEM creativity generally do not see themselves as creative, they may be less likely to pursue creative activities (perhaps even in STEM areas). Past studies have indicated that both math teachers (Patston, Crompton, Marrone, & Kaufman, 2018) and math and science students (Munakata, & Vaidya, 2012) may be more likely to endorse the arts bias. Students who do not identify as creative but nevertheless can see themselves as potentially creative in STEM areas may believe that non-artistic activities simply are not creative, and they may not necessarily be challenged by their teachers to be creative in STEM areas.

Given there is an extensive literature on creativity in mathematics (Sak, Ayvaz, Bal-Sezerel, & Özdemir, 2017), engineering (Cropley, 2015), and science (Feist, 2017), part of the solution may involve improving communication between researchers and teachers. Teachers may also benefit from learning how to promote creativity in their students, including and especially those teachers in STEM disciplines (e.g., Beghetto & Kaufman, 2010; Gregerson, Snyder, & Kaufman, 2013). In addition, university creativity courses may promote higher CSBs, especially for those who rate themselves low across domains, because they may address students' misconceptions about creativity, including the arts bias (Plucker & Dow, 2010).

There are several limitations of the present study. Participants completed all scales in one sitting, which may have led to fatigue. Furthermore, whereas the K-DOCS provides a standard of comparison for ratings, the CSE and CPI measures do not, so it is unclear what definition and standard participants are using for their ratings. Are they thinking about creativity similarly to how researchers approach the topic and therefore considering different levels of creativity (e.g., the 4 C model that differentiates levels of novelty that range from solely the individual only to the world; Kaufman & Beghetto, 2013a)? Or, conversely, are they considering Big C models or innovation in their definitions? Or does this differ across latent classes, such that those in the class rating themselves lower across domains compared themselves with Big C models or innovation, and those in the class that rated themselves higher across domains used a lower creativity standard for comparison or aspire to the innovation or Big C level? However, since the ratings differed in domains rather than by measure, and the K-DOCS used a lower standard, it is likely that they considered individual levels of creativity rather than Big C creativity.

Future research should directly address participants' conceptualizations of creative self-perceptions to determine whether they perceive CSE, CPI, and creative self-perceptions

as different constructs. There is evidence that undergraduate students may perceive creativity differently than researchers (e.g., Pachucki, Lena, & Tepper, 2010), so directly measuring their conceptualizations may capture subtle differences not evident in these current measures. Furthermore, future research should explore whether university students differentiate between academic self-efficacy, academic achievement, and CSBs in these domains, especially math and science. It may be that these responses reflect their academic performance rather than creative performance. Future research should also determine whether there are differences between latent classes in their academic majors and whether there are differences by country. Since this sample largely consisted of students with psychology majors, future research should explore whether the same latent class differences emerge in students with non-science majors, such as in the humanities and arts, business, and education.

This study focused on self-perceptions, so all measures were self-report. Given the inconsistent findings (e.g., Haase et al., 2018) regarding how well self-perceptions relate to actual creative thinking, behaviour, problem-solving, and products using other types of measures, future research is needed to explore whether these latent classes of university students differ in actual creative performance, beyond self-report. It would be interesting to examine whether there are class differences in the connection between CSBs and creative performance using non-self-report measures. It may be that students in the class with higher CSBs may be more discerning in their creative self-perceptions (e.g., Silvia, 2008), which could help explain the inconsistent results in the literature.

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