Depression and Creative Intelligence

by

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Abstract

The present study explores the relationship between depression and creative intelligence in a sample of undergraduates. 118 participants were recruited from the University of Michigan introductory psychology subject pool. Participants were assessed for depression using the Center for Epidemiologic Studies Depression Scale (CES-D) and for creative intelligence using the creativity subtest of the Sternberg Triarchic Abilities Test Level H (STAT-H). Demographic information such as age, gender, and race, was also ascertained, along with ACT and SAT scores. Results showed that there was no overall significant association between depression and creative intelligence. However, there was significant evidence suggesting that higher depression scores may be associated with lower mathematical creative intelligence. Possible explanations for these findings are discussed along with their implications for future research.

Depression and Creative Intelligence

Mental illness and creativity are commonly associated with one another. There are countless examples of painters, writers, and musicians who have suffered from various forms of psychopathology. Sylvia Plath, Edgar Allan Poe, and Emily Dickenson are just several examples of writers whose creativity was associated with major depressive disorder (Thomas & Duke, 2007). The evidence for a link between depression and creativity is more than anecdotal. There have been several studies which have pointed to a higher prevalence of mental illness, including depression, among artists. A small number of studies have also suggested possible mechanisms by which depression influences the creative production of artists. Further research has suggested that symptoms associated with depression, such as feelings of social rejection and self-reflective rumination, are associated with increased creativity even in the general population. At the same time several studies have failed to find any relationship between unipolar depression and increased creativity. Previous research paints an unclear picture of the association between depression and creativity. The main goal of the present study, therefore, was to clarify a possible relationship between unipolar depression and creative intelligence (the distinction between creative intelligence and creativity will be discussed below). However, before describing the current study, the existing research on depression and creativity will be discussed.

Much of the current research on mental illness and creativity has focused on artists, creative writers, and poets, as this population provides the most immediately apparent evidence for a link between depression and creativity. Several studies have explored the role of depression in fostering creativity in this population. Many of these studies have highlighted the increased prevalence of depression in artists compared to the prevalence in the general population. In one of the most comprehensive explorations of the relationship between mental

illness and creativity, Jamison (1993) concluded that the prevalence rate of major depressive

disorder in artists was eight to ten times higher than the rate in the general population.

Furthermore, artists were ten times more likely to commit suicide than their general population

counterparts. Other, more recent studies have mirrored these findings. A study of a sample of

female writers in particular found the rate of depression to be close to seven times higher than

that in a control group (Ludwig, 1994). A survey of 1,004 significant 20th century figures found

that the prevalence of depression in people working in the creative arts was nearly 50 percent, as

compared with 24 percent for scientists (Ludwig, 1995).

Additional research has suggested possible ways in which depression influences creative

production. A study of depressed and non-depressed fiction writers and poets found that

depressed authors tend to employ more cognitive distortions in their work (Thomas & Duke,

2007). The authors of this study looked at the prevalence of seven common cognitive distortions

associated with depression (e.g., dichotomous thinking and selective abstraction) in the works of

famous depressed authors and non-depressed controls matched for variables such as time period

and region. Depressed authors used close to two more cognitive distortions per page than non-

depressed authors (Thomas & Duke, 2007). While the use of cognitive distortions is not directly

linked to increased creativity, this study suggests one possible mechanism through which

depression may produce a novel approach to writing. One significant limitation of this study was

that it failed to distinguish between unipolar depression and bipolar disorder, referring to both as

depression. Jamison (1993) found that the prevalence of bipolar disorder was anywhere from 10

to 40 times higher among artists than among the general population (compared with eight to 10

times higher for unipolar depression), thus it is probable that many of these authors suffered from

bipolar disorder rather than unipolar depression.

A study by Wu, Chang, and Chen (2009) explored another possible means by which depression may lead to a more creative (or at least novel) approach to a mosaic design task. 120 freshman design students were administered the CES-D and then asked to create a tile mosaic given the theme "different selves." Depressed participants (those with a score of 29 or greater on the CES-D) tended to use darker colors than non-depressed participants. Again, while the use of darker colors is not necessarily an indicator of increased creativity, it suggests a way in which depressed artists may approach a task differently than their non-depressed peers. This study is particularly pertinent to the present study in that it explored the effect of participants' depressive symptomatology (as measured by the CES-D) at the time they were asked to engage in a creative task. Many studies of depression in artists ignore whether or not depressive symptomatology was concurrent with artistic production. In fact, the composer Robert Schuman and the artist Vincent Van Gogh exhibited highly seasonal patterns of production, generally working outside their severe depressive episodes (Jamison, 1993).

A study conducted by Akinola and Mendes (2008) looked at the role of perceived social rejection (a potential symptom of depression) in fostering creativity on a collage-making task. Participants were given either positive feedback, negative feedback, or no feedback on a speaking task and were then asked to produce a collage. Collages were assessed for creativity by a panel of artists (both professional and graduate students). Participants exposed to negative feedback (i.e. social rejection) produced more creative collages than participants in the control group and the positive feedback group. This association was moderated by biological vulnerability to depression, as measured by dehydroepiandrosterone-sulfate (DHEAS). There was a significant condition $\times$ DHEAS-level interaction on creativity such that participants in the social rejection condition with lower levels of DHEAS produced the most creative collages

(Akinola & Mendes, 2008). This study suggests a particular symptom of depression (feelings of social rejection) which may be responsible for increased creativity.

Another potential indicator of depression, a self-reflective ruminative tendency, may also be linked to creativity. Verhaeghen, Khan, and Joorman (2005) looked at the impact of past and present depressive symptomatology on reflection and rumination and at the effect of reflection and rumination on creativity. The authors found that increased rumination was correlated with both past and present depressive symptomatology and with increased activity in creative pursuits. The authors conclude that the relationship between depression and creativity is mediated entirely by ruminative tendencies and that depression on its own does not predict increased creativity.

In spite of the research which suggests that certain symptoms associated with depression may be linked to increased creativity, a recent study failed to find any overarching relationship between depression and creativity in a sample drawn from the general population. Silvia and Kimbrel (2010) assessed 189 university undergraduates for symptoms of depression, anxiety, and social anxiety. Using the Depression Anxiety Stress Scale (DASS), the authors were able to assess current and recent symptoms of depression and anxiety. Creativity was assessed across several domains including divergent thinking, creative self-concept, everyday creativity, and creative achievement. It is important to note that with the exception of divergent thinking, all of the domains of creativity were assessed by participant self-report. In other words, participants were asked to report on their past creative activities, but were not asked to engage in any creative task. Only the divergent thinking task required participants to engage in an ostensibly creative activity. Overall the authors found no effect of depression on any of the domains of creativity. In some cases variance in creativity could be explained in small part by symptoms of negative

affect, but these effects were typically small and inconsistent in direction (Silvia & Kimbrel, 2010).

Shapiro and Weisberg (1999) conducted a similar study of the relationship between various affective disorders and creativity in an undergraduate sample. Like the Silvia and Kimbrel (2010) study, this study employed a self-report assessment of creative behavior; participants did not engage in any creative activity. The authors found no evidence that predominantly depressive symptomatology was related to increased creativity. The only group of participants who displayed above-average creativity consisted of those participants who reported frequent symptoms of hypomania without accompanying symptoms of depression (Shapiro & Weisberg, 1999). This is not entirely surprising in light of past research which suggests that *positive* affect may be tied to increased creativity (Isen, 1987).

Clearly there is conflicting evidence regarding the relationship between depression and creativity. It seems clear that the lifetime prevalence of depression is higher among people engaged in creative pursuits, particularly for well-known figures. Additional evidence suggests that specific symptoms of depression (i.e. feelings of social rejection and self-reflective rumination) may be tied to increased creativity. At the same time, there have been studies which have failed to uncover any link between depression and creativity in the general population. One possible explanation for this stems from the methods used to assess creativity in the Silvia and Kimbrel (2010) study and the Shapiro and Weisberg (1999) study. These studies relied heavily on self-reports of creativity rather than direct measures of creativity. The aim of the present study was to elucidate the relationship between depression and creative intelligence using a direct measure, the creative intelligence subtest of the Sternberg Triarchic Abilities Test Level H

(STAT-H). Furthermore, the STAT-H allows for the assessment of three sub-domains of creative intelligence: verbal, mathematical, and figural creative intelligence.

Before continuing it is necessary to briefly discuss the distinction between creative intelligence and creativity. Sternberg (2006) defines creativity in terms of investment theory. He notes that the creative individual is one who pursues novel, initially unpopular ideas and is able to eventually produce something of value. Creative intelligence, again according to Sternberg (2003), refers to the ability to apply mental processes to relatively novel tasks and situations. These definitions appear to have substantial overlap and do not draw a clear distinction between creativity and creative intelligence. Kaufman, Cole, and Baer (2009) help to clarify this distinction by proposing a hierarchical model of creativity in which creative intelligence can be seen as a component of overall creativity. Creative intelligence, as measured by the STAT-H, corresponds closely to Kaufman et al.'s *problem-solving* aspect of creativity. Thus, the present study can be seen as measuring one element of overall creativity, just as previous studies have focused solely on artistic or verbal creativity (which are also included in Kaufman et al.'s model).

The present study was designed to test two main hypotheses related to the link between depression and creative intelligence. Based on the findings of Silvia and Kimbrel (2010) and Shapiro and Weisberg (1999), it might be expected that there would be no overall correlation between depression and creative intelligence. However, given the methodological weaknesses of both studies in assessing creativity, this topic warranted further exploration. This hypothesis was tested using both a Pearson's product moment correlation and an independent samples t-test comparing participants with higher levels of symptomatology to their less depressed

counterparts. The relationship between depression and the verbal, mathematical, and figural sub-domains of creative intelligence was also assessed.

The second hypothesis tested was whether specific symptoms of depression are more likely to impact creativity. Based on previous research suggesting that rumination and social rejection are associated with increased creativity, it was predicted that CES-D items which reflected these aspects of depression (e.g., *I felt people didn't like me* or *I thought my life had been a failure*), would show a positive correlation with creative intelligence scores. Although it was expected that these items in particular would have the greatest impact on creative intelligence, correlations between all CES-D items and STAT-H scores (and subscores) were obtained to determine whether any other depressive symptoms were significantly related to creative intelligence.

Method

Participants

The total sample for this study consisted of 118 University of Michigan undergraduate students. Participants were drawn from the university's introductory psychology subject pool. They were given 30 minutes of credit towards a five hour research participation requirement for taking part in this study.

Participants ranged in age from 18 to 35. However, the mean age was 18.35, reflecting the expected age breakdown of students in an introductory psychology class. There were 38 males (32.2%) and 78 females (66.1%) in the sample. Two participants did not indicate a gender (1.7%). Racially, the sample was 10.2 percent Black (12 students), 14.4 percent Asian (17 students), and 69.5 percent White (82 students). Three students indicated other as their race (2.5%) and four indicated more than one race (3.4%). Nine participants indicated that they spoke

a language other than English in the home (7.6%) and twelve indicated that they spoke more than one language fluently (10.2%). The remaining 97 participants (82.2%) listed English as their primary language.

While the demographic data provided above encompasses the entire sample, several participants were excluded from the primary analyses (those presented in the results section) for failing to complete the CES-D. While earlier studies have included incomplete assessments in their data analysis (Radloff, 1977), this study excluded any participants who omitted questions on the CES-D. The CES-D was administered as a paper and pencil test and as such it was difficult to interpret omitted answers – an answer may have been omitted by mistake, which could invalidate participants' future responses (i.e., a line error). This did not have any significant effect on sample size, as only two participants omitted questions, resulting in a final sample of 116. The average score on the CES-D was 12.15 and the average score on the STAT-H was 7.19.

Measures

Demographic information was gathered using a survey designed specifically for this study. In addition to the variables reported above, information on religious affiliation and prior academic achievement (as measured by SAT or ACT scores) was obtained. With the exception of the two participants who excluded their gender, all participants completed every part of this survey.

Depression was assessed using the Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977). The CES-D consists of twenty items corresponding to various symptoms of depression (i.e. "I felt sad"). Participants were asked to describe the frequency with which they experienced each of the 20 symptoms over the past week. The options were:

rarely or none of the time (less than 1 day), *some or a little of the time (1-2 days)*, *occasionally*

or a moderate amount of time (3-4 days), and *most or all of the time (5-7 days)*. Four of the 20

items reflected positive experiences (i.e. I felt I was just as good as other people). For these

items the low-frequency responses indicated higher depressive symptomatology. The full list of

CES-D items is presented in the appendix.

The CES-D was chosen because it was designed specifically to measure depressive

symptomatology in the general population (Radloff, 1977). Furthermore, the CES-D requires no

special training to administer, is easy and straightforward for respondents, and is generally not

affected by the assessment environment (Radloff, 1977). While not a diagnostic tool (in that

there is no cut-off score for clinical depression), the CES-D has been shown to have high

criterion-related and construct validity with respect to depression. The CES-D has been effective

in discriminating between psychiatric inpatient samples and samples drawn from the general

population. Furthermore, the CES-D correlated reasonably well with nurse ratings of patient

severity in an inpatient setting (Craig & Van Natta, 1976, as cited in Radloff, 1977) and with

other self-report scales of depression. The CES-D is inversely correlated with scales of positive

affect, suggesting appropriate discriminant validity (Radloff, 1977). Internal reliability for the

CES-D was also high, with a coefficient alpha of .85 (Radloff, 1977). For the sample used in

this study, Cronbach's Alpha was .88, suggesting comparable internal validity to that obtained

from larger samples.

Creative intelligence was assessed using an abbreviated version of the creative

intelligence subtest of the Sternberg Triarchic Abilities Test Level H (Sternberg, 1993). The

STAT-H was chosen for its objective scoring system when compared to other measures of

creativity (i.e., Akinola & Mendes, 2008). While the STAT-H typically consists of both an essay

section and a multiple choice section, for this study only the multiple choice section was used.

The creative intelligence subtest of the STAT-H is broken into three subsections reflecting verbal creativity, mathematical creativity, and figural creativity. Each section has four multiple choice questions with a single correct answer. The verbal subsection is comprised of novel analogies and the mathematical subsection is comprised of novel numerical operations. The figural subsection requires participants to complete a series of figures with the correct option.

The STAT-H is based on Sternberg's Triarchic Theory of Intelligence which posits that intelligence is constituted by three separate domains: practical intelligence, analytical intelligence, and creative intelligence (Sternberg, 1985). A large scale study conducted across three countries provided more detail on the psychometric properties of the STAT-H. The coefficient alpha of the creativity subtest was .57. Within the verbal, math, and figural subsections of the creativity subtest, inter-item correlation was lower, which is not surprising given the small number of items in each subsection (Sternberg, Castejon, Prieto, Hautamaki, & Grigorenko, 2003). A confirmatory factor analysis of the STAT-H found support for the three domains of intelligence proposed by Sternberg (Sternberg et al., 2003). Nonetheless, Sternberg et al. (2003) note the need to improve the internal consistency of the STAT-H subtests.

Some researchers have criticized the STAT-H and the underlying theory of triarchic intelligence. Brody (2003) and Koke and Vernon (2003) both claim that all three subtests of the STAT-H are highly correlated with general intelligence and with one another, suggesting that creative intelligence does not warrant consideration as a distinct category of intelligence.

With the data collected from the current sample it was possible to address one of these issues: the discriminant validity of the STAT-H creativity subtest with respect to general intelligence. STAT-H creativity scores were compared to ACT and SAT scores, which are

highly correlated with other measures of general intelligence (Koenig, Frey, & Detterman, 2008; Frey & Detterman, 2004). There was a moderate correlation between ACT scores and creative intelligence scores on the STAT ($r = .42$, $p < .01$). Verbal and mathematical creativity scores were both significantly correlated with overall ACT scores (verbal $r = .38$, $p < .01$; mathematical $r = .29$, $p < .01$), while figural scores were not ($r = .17$, n.s.). There was no significant correlation between SAT scores and either overall STAT-H creativity scores or any of the subsections, though this may be due to the relatively few SAT scores reported relative to the ACT (only 20 participants reported scores on the SAT). These results suggest that the STAT-H is only moderately correlated with general intelligence, if at all. There were no significant correlations between the verbal, mathematical, and figural subsections of STAT-H suggesting that the three subsections measure relatively distinct constructs.

Procedures

Participants signed up for the study using an online system. While participants were aware of the time required to complete the study, they were given no additional information on the study prior to signing up. This prevented any sort of recruitment bias. Assessments were administered to participants in one-to-one half-hour sessions with the experimenter in a standard office. The experimenter remained in the room as participants completed the assessments to answer any questions but did not actively watch participants as they worked. Participants were first shown a consent form and asked to indicate whether or not they were willing to take part in the study. Participation in this study was completely anonymous; responses could not be connected back to individual participants.

An element of deception was employed to prevent acquiescence bias in participants' responses. Participants were told they were taking part in a study of the effect of environment on

different types of psychological assessments. While it is not clear whether knowing the aims of

the study would have biased participants, this manipulation ensured that it would not.

After agreeing to take part in the study, participants were given the demographic survey.

Next, participants were given either the CES-D or the STAT-H. The order of these two

assessments was randomized to prevent any consistent effect of taking one assessment on

performance on the other. Verhaeghen, Joorman, and Khan (2005) noted that CES-D and other

assessments which address symptoms of dysphoria may influence participants' mood, and as a

corollary, their performance on other tasks. In this study there actually was a significant effect of

assessment order, although not in the direction predicted by Verhaeghen et al. (2005).

Participants who took the CES-D first scored an average of .83 points higher on the STAT-H

than did those who took the STAT-H first (CES-D first=7.55, STAT-H first=6.72; $t(114)=2.34$,

$p=.02$). Participants were only given the next assessment after they had completed the one

before it. All assessments were paper and pencil based. After completing all three assessments,

participants were debriefed on the actual goals of the study and thanked for their time.

Results

The first hypothesis tested was whether there was any overarching relationship between

depression and creative intelligence. Given the methodological flaws of past research on this

topic, further exploration of this relationship was warranted. The association between depression

and creative intelligence was assessed two ways: treating depression as a continuous variable

(using a Pearson's product moment correlation) and as a categorical variable (using an

independent samples t-test and a chi-square analysis).

As was predicted, there was no significant correlation between CES-D scores and STAT-H scores (r=-.03, n.s.). Correlations between CES-D scores and verbal and figural subsection scores were also not significant (verbal r=-.02, n.s.; figural r=.11, n.s.).

The relationship between depression and the mathematical subsection approached significance (r=-.16, p=.097). Higher depression scores weakly predicted lower mathematical creative intelligence (see Figure 1). However, this finding was not significant at traditionally accepted levels. It is important to note, however, that scores on the math subsection were not normally distributed. There was a strong ceiling effect with 53.4 percent of participants achieving a perfect score (see Figure 2). As a result, a second correlational analysis was conducted, this time with math scores as a dichotomous variable. Scores were categorized as either perfect (a score of 4) or low (anything below 4). Using this method, there was a significant, inverse correlation between depression scores and performance on the math subsection (r=-.22, p=.02), as shown in Figure 3.

The first hypothesis was also tested using an independent samples t-test to compare participants with higher depressive symptomatology to their non-depressed peers. Although the CES-D does not have an official cutoff for clinical depression, a score of 16 or higher has been cited in several studies as a marker of significant depressive symptomatology (Radloff, 1977; Gong et al., 2009). Based on this, participants who scored a 16 or higher on the CES-D were categorized as potentially depressed while those who scored below a 16 were categorized as non-depressed. Using this method, 83 participants were categorized as non-depressed and 33 as potentially depressed. The independent samples t-test yielded similar results to the correlational analysis. There was no significant difference between the potentially depressed and non-depressed groups on overall creative intelligence (non-depressed=7.25, potentially

depressed=7.03; $t(114)$=.56, n.s.). There was also no significant difference between potentially depressed and non-depressed participants on the verbal and figural subsections of the STAT-H (verbal: non-depressed=2.52, potentially depressed=2.48; $t(114)$=.17, n.s.; figural: non-depressed=1.37, potentially depressed=1.58; $t(114)$=-.96, n.s.).

Given that scores on the math subsection were not normally distributed it was not possible to do an independent samples t-test. To account for this, a chi-square analysis was employed instead of a t-test. Math scores were again divided into two groups: a perfect score group and a low math score group. Results showed that students in the non-depressed group were more likely to have achieved perfect scores on the math subsection than students in the potentially depressed group, χ^2 $(1, N = 116) = 9.93, p < .01$. While potentially depressed participants made up 28.4 percent of the total sample, they accounted for only 16.1 percent of the people who obtained perfect scores on the math subsection. Depressed participants were overrepresented among people who did not obtain perfect math scores, accounting for 42.59 percent of this group (see Figure 4).

The second hypothesis explored whether specific symptoms of depression were related to overall STAT-H scores and scores on the three subsections. It was hypothesized that CES-D items reflecting ruminative tendencies and perceived social rejection would be positively associated with creative intelligence scores. Based on the results obtained in testing hypothesis one it is not surprising that there were few significant correlations between STAT-H scores and scores on individual CES-D items. There were no significant correlations between any CES-D items and overall STAT-H scores, verbal subsection scores, or figural subsection scores. There were, however, significant associations between several CES-D items and mathematical creative intelligence (these results are presented in Table 1). The item *I had trouble keeping my mind on*

what I was doing (question 5) was inversely correlated with mathematical subsection scores ($r=-$.19, $p=.045$). The item *I was happy* (question 12) was actually positively correlated with mathematical subsection scores. However, because this item was reverse coded (a score of zero indicated more frequent feelings of happiness), the resultant correlation is presented as an inverse ($r=-.19$, $p=.042$). Finally, the item *People were unfriendly* (question 15) was inversely correlated with mathematical subsection scores ($r=-.24$, $p=.01$). Contrary to the original hypothesis, items which might appear related to ruminative tendencies and social rejection (*I had trouble keeping my mind on what I was doing* and *People were unfriendly* respectively) actually predicted lower scores on the mathematical creativity subsection of the STAT-H. A linear regression analysis of these three items' effect on depression showed that no one item made a significant unique contribution to lower math scores. This is not surprising given the high covariance between CES-D items (see Table 2).

Given the abnormal distribution of the math subsection, correlations were also conducted between all CES-D items and the dichotomized math score variable used in testing the first hypothesis. While the same three items retained significance, the strength of the inverse correlations was altered. The correlation between math scores and question five increased to -.24 ($p=.01$), the correlation between math scores and question 12 increased to -.20 ($p=.029$), and the correlation between math scores and question 15 decreased to -.19 ($p=.04$). One additional item, *I felt lonely* (question 14), became a significant predictor of lower math scores using this method ($r=-.205$, $p=.027$). A binary logistic regression of the effect of these four items found that no one item individually increased the likelihood of achieving a perfect math score (see Table 3).

Discussion

As would be expected based on the research of Silvia and Kimbrel (2010) and Shapiro and Weisberg (1999) there was no overall correlation between depression and creative intelligence found in testing the first hypothesis. Given that several items on the CES-D would seem intuitively to militate against creative performance (e.g., *I felt that everything I did was an effort*), this result is not entirely surprising. There was also no relationship between depression and both the verbal and figural subsections of the STAT-H. While an initial analysis of the correlation between depression and the math subsection did not yield a statistically significant result, this was heavily influenced by the skewed distribution of scores on the math section. Given that over 50 percent of participants attained a perfect score, it would be difficult to obtain a significant correlation treating math scores as a continuous variable. Recoding math scores dichotomously produced a significant correlation between the math subsection and CES-D scores.

This hypothesis was also assessed with depression transformed into a dichotomous variable. Instead of looking at the continuum of depression scores and their effect on creative intelligence, participants were classified as either non-depressed or depressed based on a cutoff score of 16. As was expected based on the correlational analysis, non-depressed and depressed participants performed equally well on the STAT-H overall and on the verbal and figural subsections. However, there was a significant effect of depressed status on the math subsection. Participants who were classified as non-depressed were significantly more likely to have achieved a perfect score on the math section than those who were labeled as potentially depressed. Based on their representation in the overall sample, one would expect that depressed participants would constitute approximately 17 of the 62 participants who achieved a perfect

math score. In actuality, only 10 participants (58% of the expected total) in the potentially

depressed category achieved a perfect score. This discrepancy was significant at an extremely

high level ($p<.01$). Analysis of this first hypothesis yielded strong evidence that depression is

associated with decreased mathematical creative intelligence.

The second hypothesis concerned the relationship between individual items on the CES-

D (i.e., various symptoms associated with depression) and creative intelligence. Although CES-

D scores were not related to scores for overall creative intelligence or the verbal and figural

subsections, correlations between all CES-D items and these scores were obtained in case any

individual items strongly predicted overall, verbal, or figural creative intelligence. This analysis

yielded no significant correlations, which was expected based on the results obtained in testing

the first hypothesis.

It seemed more plausible that mathematical creative intelligence would be correlated with

individual CES-D items given that depression predicted lower math subsection scores in part

one. This was assessed with math scores treated both continuously and dichotomously. Using

the continuous method, three CES-D items emerged as significant predictors of mathematical

creativity. The items *I had trouble keeping my mind on what I was doing*, *I was happy*, and

people were unfriendly were all correlated with mathematical intelligence, with more frequent

depressive symptoms predicting lower creative math performance. Given the high covariance

between CES-D items, none of these items individually made a significant, unique, contribution

to math subsection scores.

Treating math scores as a dichotomous variable made one additional CES-D item (*I felt

lonely*) significant in predicting a lower math score. All three other items that were significant in

the prior test retained significance using this method, although the correlation coefficients shifted

in magnitude somewhat. Again, it was impossible to separate the unique contribution of each

item due to the high covariance between items.

This study adds substantially to the body of research surrounding the relationship

between unipolar depression and creative intelligence. The present study was designed to assess

the impact of *current* depressive symptomatology on creative intelligence using a direct

assessment of creative intelligence (as opposed to a self-report measure). Unlike many studies

which have suggested an either positive or non-existent relationship between depression and

creativity, the present research points to a clear negative association between depression and

creative intelligence, specifically in the mathematical domain. Interestingly, several of the

symptoms that were linked to increased creativity by previous research were among the

symptoms that were linked with reduced mathematical creative intelligence in the present study.

Items reflecting social isolation (i.e., *I felt lonely* and *I felt people didn't like me*) were both

negatively related to performance on the math subsection. While none of the CES-D items speak

directly to self-reflective rumination, the item *I had a hard time keeping my mind on what I was

doing* (which was negatively correlated with mathematical performance), could be indicative of

ruminative tendencies which interfere with concentration.

One particularly noteworthy aspect of the present study is its focus on creativity and

depression in the general population. Much research has explored the increased prevalence of

mental illness among artists and writers, with only more recent research exploring the association

between depression and creativity in broader samples. This is an important step in understanding

how depression and creativity are linked. Verhaeghen, Joorman, and Khan (2005), note that

psychopathologic behavior may be normalized to some extent in artistic circles. In other words,

artists may show higher degrees of psychopathology simply because it is not seen as an

impediment to their profession (in light of the stereotype of the mad-artist, it may even be seen as a boon to their credibility). As a result, it is important to explore whether higher rates of depressive illness prevail among creative people in the general population. The present research found no such results. While overall creative intelligence was equivalent between depressed and non-depressed participants, participants who demonstrated high mathematical creative intelligence were less likely to be depressed than those with lower mathematical creative intelligence. It is possible therefore, that positive associations between depression and creativity may be more pronounced in artistic circles and less pronounced, or even inverted, among the population at large.

Silvia and Kimbrel (2010) noted that the effects in their study were small and inconsistent in direction. By contrast, the present study found consistent (albeit in the weak to moderate range) correlations between depression and mathematical creative intelligence. This raises the question as to why only math scores were impacted by higher levels of depression. One of the individual CES-D items that was correlated with mathematical intelligence was *I had a hard time keeping my mind on what I was doing*. It is easy to imagine why participants who endorsed this item would perform lower on the mathematical subsection. Scores on the math subsection in particular are susceptible to careless errors in calculation and the application of different operations. Participants who had trouble focusing on the task at hand would no doubt be at a disadvantage in trying to complete this section. This explanation is particularly parsimonious in that it also explains why items such as *people were unfriendly* would be inversely correlated with mathematical creative intelligence. Participants who felt this way might be more inclined to ruminate on their interactions with others, decreasing their ability to focus. Feelings of sadness and loneliness could also contribute to increased rumination and distractibility.

This theory contradicts Verhaeghen, Khan, and Joorman (2005) who found that rumination was the primary mediator of a positive association between depression and creativity. The discrepancy between these findings highlights a crucial limitation of this study. As mentioned in the introduction, creative intelligence is only one component of the broad construct of creativity. The present study made no attempt to look at other facets of creativity such as artistic creativity, divergent thinking, entrepreneurial creativity, and many others. As such, it is difficult to directly compare the results across studies. While this limitation is not unique to the current study, it presents a substantial obstacle to understanding the relationship between depression and creativity. While depression can be assessed using the same well-validated measures across studies (for example, the CES-D), there is little consensus on the best way to measure creativity. Nearly every study cited in this paper has used a different method for assessing creativity. Thus while I have been referring to studies of creativity in general, it would be appropriate to consider the specific domains of creativity assessed in each study. The effect of depression on creativity may differ dramatically across domains of creativity. Social rejection may aid artistic creativity and impede mathematical creativity. However, as research expands to cover more domains of creativity, it may be possible to paint a more complete picture of the relationship between these two facets.

One other concern with the current study is the extent to which mathematical creative intelligence is distinct from general mathematical ability. This paper has made a significant point of highlighting the inverse relationship between mathematical creative intelligence and depression. However, it is possible that mathematical creative intelligence does not differ substantially from general mathematical ability, which would adversely affect the validity of this finding. To assess this possibility, mathematical creative intelligence scores were compared to

scores on the ACT math section, a relatively straightforward assessment of mathematical ability. The correlation between STAT-H math scores and ACT math scores was .44 ($p<.01$). The correlation between the two tests is not surprising. One would not expect mathematical creative intelligence to be totally distinct from general mathematical ability. However, the fact that this correlation was relatively moderate in magnitude suggests reasonable discriminant validity of mathematical creative intelligence relative to general mathematical ability.

In spite of its limitations, this study makes an important contribution to the field of creativity research by suggesting one additional domain of creativity that appears to be negatively associated with depression, mathematical creative intelligence. Clearly the association between depression and creativity is inconsistent across domains of creativity, and further research needs to be done to produce a more nuanced understanding of this relationship.

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Author Note

Table 1

Correlations Between Individual CES-D Items and Overall and Subsection Scores on the

STAT-H (N=116)

CES-D Item #	Total STAT-H Score	Verbal Subsection Score	Math Subsection Score	Figural Subsection Score
1	.11	.09	.03	.11
2	.06	.05	.03	.04
3	.09	.12	-.06	.12
4	-.11	-.12	-.10	.00
5	-.06	.02	**-.19***	.05
6	.07	.09	-.09	.12
7	-.06	-.14	-.12	.12
8	-.04	-.07	-.12	.10
9	-.10	-.00	-.13	-.06
10	-.01	.02	-.10	.07
11	-.07	-.07	-.13	.04
12	-.13	-.07	**-.19***	.00
13	.02	.00	-.04	.07
14	-.02	-.01	-.08	.05
15	-.17	-.07	**-.24***	-.04
16	-.00	-.06	.00	.05
17	-.08	-.10	-.10	.04
18	.03	-.02	-.10	.18
19	.07	.07	-.04	.03
20	.08	.07	-.02	.10

*p<.05

Note. In this analysis math scores were treated as a continuous variable with possible values

ranging from zero to four. A full list of CES-D items is presented in the appendix.

Table 2

Linear Regression Analysis of CES-D Items Predicting Lower Mathematical Creative

Intelligence Scores on a Continuous Scale (N=116)

	Unstandardized Beta	S.E.	Standardized Beta	t	Sig.
Constant	3.587	.16		22.02	.000
Question 5	-.12	.11	-.10	-1.01	.313
Question 12	-.14	.12	-.11	-1.10	.273
Question 15	-.25	.14	-.17	-1.79	.077

Note. No individual CES-D items were significant ($p<.05$), unique predictors of lower

mathematical creative intelligence scores.

Table 3

Binary Logistic Regression Analysis of CES-D Items Predicting Lower Mathematical Creative

Intelligence Scores on a Dichotomous (Perfect vs. Non-Perfect) Scale (N=116)

	B	S.E.	Wald	Sig.
Constant	1.20	.40	8.87	.003
Question 5	-.44	.27	2.80	.094
Question 12	-.25	.30	.71	.400
Question 14	-.28	.26	1.19	.275
Question 15	-.26	.33	.63	.427

Note. No CES-D items significantly ($p<.05$) increased the likelihood of participants achieving a
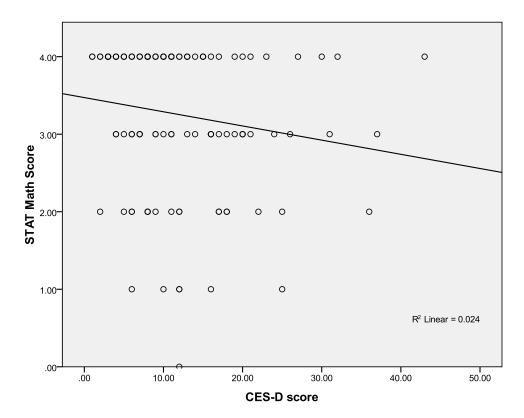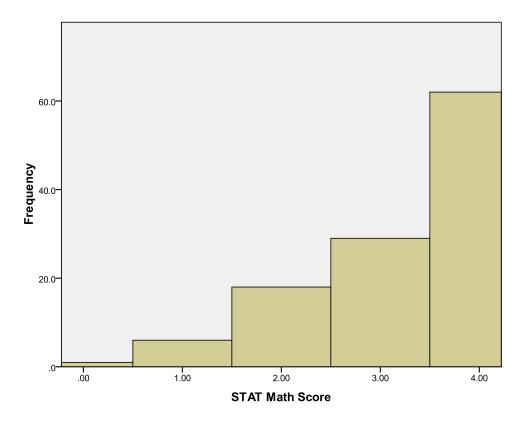
non-perfect math score.

Figure 1. The correlation between STAT-H mathematical creative intelligence scores and overall CES-D scores. Although not significant at traditionally accepted levels (*p*=.097), there is a trend suggesting an inverse relationship between depression scores and scores on the math subsection of the STAT-H.

Figure 2. Distribution of mathematical creative intelligence scores on the STAT-H. Over 50

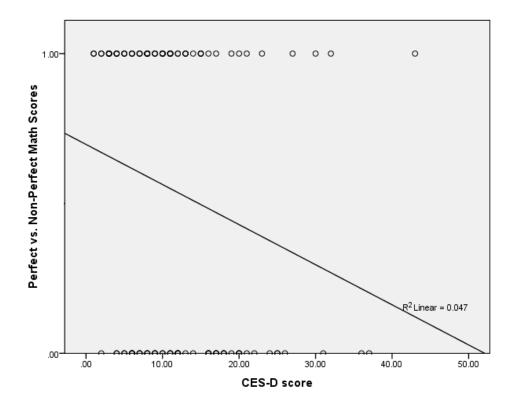percent of participants attained a perfect score (4 out of 4).

Figure 3. The correlation between overall CES-D scores and perfect vs. non-perfect math

scores. Perfect scores are represented by a value of one and non-perfect scores are represented

by a value of zero. Lower CES-D scores predicted a higher probability of attaining a perfect

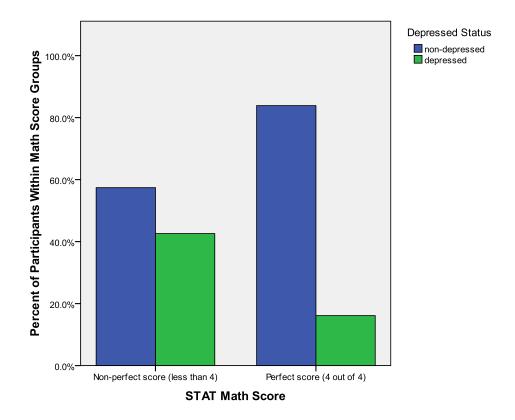math score. This result was significant (*p*=.02).

Figure 4. Percentage of depressed vs. non-depressed participants within the perfect and non-perfect math score groups. Depressed participants made up 28.4 percent of the total sample. However, they are significantly overrepresented (43%) within the non-perfect math score group and significantly underrepresented (16%) within the perfect math score group.

Appendix

CES-D Questionnaire (Radloff, 1977)

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

	During the Past Week			
	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
1. I was bothered by things that usually don't bother me.	☐	☐	☐	☐
2. I did not feel like eating; my appetite was poor.	☐	☐	☐	☐
3. I felt that I could not shake off the blues even with help from my family or friends.	☐	☐	☐	☐
4. I felt I was just as good as other people.	☐	☐	☐	☐
5. I had trouble keeping my mind on what I was doing.	☐	☐	☐	☐
6. I felt depressed.	☐	☐	☐	☐
7. I felt that everything I did was an effort.	☐	☐	☐	☐
8. I felt hopeful about the future.	☐	☐	☐	☐
9. I thought my life had been a failure.	☐	☐	☐	☐
10. I felt fearful.	☐	☐	☐	☐
11. My sleep was restless.	☐	☐	☐	☐
12. I was happy.	☐	☐	☐	☐
13. I talked less than usual.	☐	☐	☐	☐
14. I felt lonely.	☐	☐	☐	☐
15. People were unfriendly.	☐	☐	☐	☐
16. I enjoyed life.	☐	☐	☐	☐
17. I had crying spells.	☐	☐	☐	☐
18. I felt sad.	☐	☐	☐	☐
19. I felt that people dislike me.	☐	☐	☐	☐
20. I could not get "going."	☐	☐	☐	☐