**Relationship between creativity and depression: the role of reappraisal and rumination**

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# Abstract

Previous research has found mixed evidence about whether increased creativity is associated with higher depression. We investigated the relationship between creativity and depression, and the role of two emotion regulation strategies: reappraisal and rumination. Previous studies have found that creativity is associated with higher reappraisal ability, which would predict less depression. However, this appears to conflict with some findings that creative people have higher rates of depression. We hypothesized that creative people might have lower frequency of reappraisal, which could account for an overall positive association. To test this hypothesis, we measured creativity, self-reported reappraisal frequency, and trait depression in an online survey of N=200 participants. We also measured self-reported rumination tendency to attempt to replicate previous findings suggesting that rumination could underlie the relationship between creativity and depression. We found that [update based on results]. The results from this study provide evidence that emotional regulation strategies contribute to the relationship between creativity and depression.

*Keywords*: creativity, depression, reappraisal, rumination

# Introduction

There has been a long-standing belief that creativity and depression are related. This belief may have been inspired by the historical examples of great minds who suffered from depression, such as painter Edvard Munch, author Ernest Hemingway, poet Silvia Plath, and musical composer Tchaikovsky (Jamison, 1993, as cited in Greenwood, 2020). This was also perpetuated by movie tropes or stereotypes of “tortured artists”, which has convinced us that extraordinary gifts come at a cost. Is the association between creativity and depression just a myth, or is it supported by scientific evidence?

Upon examining the current literature about creativity and depression, we found several research gaps yet to be addressed. The present literature shows inconsistent findings, in which some studies found evidence that higher creativity is related to higher depression (e.g. Ludwig, 1992; MacCabe et al., 2018; Papworth et al., 2008; Taylor, 2017), while other studies failed to replicate similar results (e.g. Chermahini & Hommel, 2012; da Costa et al., 2015; Kyaga et al., 2013; Silvia & Kimbrel, 2010). There are also theoretical reasons that creativity and depression are unlikely to be directly related, as discussed later. Hence, this study investigates the possible linkage between creativity and depression and explores possible emotion regulation strategies that interact with creativity and depression.

## Creativity

Creativity is defined as the tendency to generate novel ideas or possibilities that have originality and functionality, and are useful in problem-solving, communications, and entertainment (Franken, 1994). Creativity is a multidisciplinary concept and researchers have approached it in different ways. For instance, Kaufman and Beghetto (2009) have proposed the Four C model (mini-c, little-c, Pro-c, Big-C), which divides creativity into four developmental levels of gradual expertise. Others have categorized creativity into domains (e.g. everyday, visual, verbal, performance, scientific etc.) (e.g. Taylor, 2017; Villanova & Cunha, 2020), achievements (e.g. 2005), professions (e.g. Ludwig, 1992) or activities (e.g. painting, writing, musical composition etc.) (e.g. Hocevar, 1980; Verhaeghen et al., 2005). It is also regarded as a relatively permanent and consistent dispositional trait that is linked to other stable attributes such as personality or intelligence (e.g. Feist, 1998; Puryear et al., 2017; Zhang et al., 2020).

One testable and reliable feature of creativity is divergent thinking. Divergent thinking is the thought process used to generate diverse and numerous ideas in a free-flowing manner (Razumnikova, 2012), in contrast to convergent thinking, which is to arrive at one single answer. Divergent thinking leads to originality (Runco & Acar, 2012; Kim, 2017), which is a central feature of creativity. Hence, divergent thinking abilities are indicative of creative thinking and creative potential (Cramond, 2020; Kim, 2017).

Creativity is usually regarded as a strength and an advantageous trait, but there may also be drawbacks to being creative. One potential drawback is that creativity may be associated with emotional instability and mental disorders.

## Creativity and Depression – Empirical evidence

Studies of the relationship between creativity and depression have reported mixed findings. Ludwig (1992) was the first to report evidence of a relationship between creativity and depression: 41.2% of 1005 eminent creative artists had depression, which is 2-3 times higher than people with other occupations. Similarly, a meta-analysis by Taylor et al. (2017) found evidence that creative individuals exhibited more instances of mood disorders, including unipolar depression. However, Taylor et al. (2017) did not observe higher creativity within the depressed sample. Holm-Hadulla et al. (2021) also found support for a positive association between creativity and depression, but only for mild-to-moderate levels of disorders. Holm-Hadulla et al. (2021) suggest that moderate disorders can motivate creative work to overcome emotional crises, while more severe illnesses will only inhibit creativity.

However, other studies have not observed a relationship between creativity and depression (e.g. Kyaga et al., 2011; 2013; Silvia & Kimbrel, 2010). Silvia & Kimbrel (2010) found that depression explained small amounts of variance in creativity while measuring divergent thinking, creative self-concepts, everyday creative behaviors, or public creative achievements. Kyaga et al., (2011; 2013) investigated the association between creative occupations and mental disorders among psychiatric patients and their relatives, and found no consistent pattern of association with depression. Thus, there remains uncertainty about the overall relationship between creativity and depression.

There is also evidence suggesting that the linkage between creativity and depression could vary across creative domains. Papworth et al. (2008) found that art students, compared to science students, displayed higher divergent thinking abilities - an indicator of higher creative potential - but also exhibited more depressive symptoms and lower moods. In line with this, MacCabe et al. (2018) also found that individuals who had an artistic education, such as visual arts, music, dance, theatre and drama, film, radio and TV production, and fashion design in high schools or universities have increased risks for depression.

## Creativity and depression – Theoretical relationship

Although some empirical evidence suggests a link between creativity and depression, there are some theoretical reasons to expect the opposite relationship.

Depression would generally be expected to inhibit creativity. Depressed individuals often experience anhedonia, a loss of interest and decreased energy, which inhibits creativity (Shapiro & Weisberg, 1999; as cited in Verhaeghen et al., 2005). Studies have shown that creativity is enhanced by positive affect and approach motivation, while sadness and depressed moods are deactivating moods and are not associated with creativity (Baas et al., 2008). Research also indicated that the divergent thinking elements within a creative thinking task can induce systematic mood swings, leading to a more positive mood, as opposed to depressed emotions (Chermahini & Hommel, 2012).

Another reason to expect less depression in creative individuals is that they tend to have higher emotional intelligence, as indicated by low alexithymia and high empathy (da Costa et al., 2015; Xu et al., 2019). Emotional intelligence entails the ability to perceive, express, regulate and reason with emotions (Mayer & Salovey, 1997). Studies show that emotional intelligence is negatively associated with depression and positively to a better overall mental wellness (Kousha et al., 2018). This suggests that creative people, who tend to have higher emotional intelligence, can better understand and manage negative emotions, leading to a more positive emotional outcome.

In addition, creative activities have been shown to have therapeutic effects (Leckey, 2010). These activities include painting, handicrafts making, journal writing, playing a musical instrument, drama performance and so on. Studies showed that taking part in creative activities as a leisure or a hobby acts as a buffer against depression (Israel et al., 2020), and suggests that creative activities unlock access to the flow experience, which is linked to an improved mental well-being (Chilton, 2013). Such findings have also established implications for art therapy interventions and theories.

The lack of a clear theoretical reason why creativity would be associated with higher depression suggests a need for further empirical study. Therefore, we tested whether creativity is positively related to depression, if at all.

It is also plausible that the association between creativity and depression is affected by an unknown third variable, such as through a confounding factor or a mediator. These factors could contribute to some shared features between creativity and depression or influence the interaction between them.

## Emotion regulation strategy: Rumination

Self-reflective rumination has been found to be a common trait for creative people and people suffering depression (Verhaeghen et al., 2005). Rumination usually involves repetitive thoughts about the past and present, causes and consequences, which results in and maintains negative moods (Sansone & Sansone, 2012; Smith & Alloy, 2010). Rumination is a hallmark symptom of depression (Alderman et al., 2015) and generally considered as a maladaptive emotion regulation strategy (ERS; Aldao et al., 2010). However, rumination could also be recognized as a style of thought that is repetitive and perseverative, detached from its negative contents and affect (Nolen-Hoeksema et al., 1993). Nolen-Hoeksema et al. (2008) proposed that this underlying style of thinking, with features of introspection, pondering, and an analytical assessment of problems, has commonalities with the adaptive strategy of self-reflection - the genuine curiosity about the self (Verhaeghen et al., 2005). Therefore, self-reflection can be considered as an adaptive type of rumination, which is defined as the recurrent thoughts that focus on the self, inner memories, and feelings (Verhaeghen et al., 2014).

Verhaeghen et al. (2005) found that self-reflective rumination is a confounding factor that explains the link between creativity and depression. They found no direct relations between creativity and depression, instead reporting that self-reflection independently increases the risk for depression and boosts creative interests and abilities simultaneously. The relation between self-reflective rumination and depression is due to the self-directed attention or self-focus, which was found to induce negative moods (Mor & Winquist, 2002, as cited in Verhaeghen et al., 2005). Self-reflective rumination is also associated with creativity as people who reflect upon their lives more are more motivated to seek creative outlets to share their emotions and use their negative moods as information to inspire new ideas (Watkins & Mason, 2002, as cited in Verhaeghen et al., 2005).

## Emotion regulation strategy: Reappraisal

Reappraisal is another emotion regulation strategy found to be associated with creativity (e.g. Fancourt et al., 2019; Orkibi et al., 2021; Perchtold-Stefan et al., 2021; Wu et al., 2017). Reappraisal (or cognitive reappraisal) is the cognitive change that involves changing our perceptions and reinterpreting a situation to reduce the negative impacts (Gross, 2002). For example, if you received a bad grade on a course, the immediate reaction is to fixate on the failure and feel frustrated. But, with reappraisal, one may look on the bright side, such as thinking that at least you did not fail, or find a silver lining, such as how this experience gave you a deeper understanding of your strengths and weaknesses. Reappraisal is regarded as an adaptive ERS. It is found that people who use reappraisals more often tend to have more positive emotions and an overall improvement in psychological health (Megías-Robles et al., 2019).

Researchers have distinguished the two facets of reappraisal: ability and frequency (Southward et al., 2021, Troy et al., 2010). Reappraisal ability is the ability to generate reinterpretations that are effective in changing mood. For example, in response to the negative thought of "I'm worthless", a low-quality reappraisal would be "I'm not worthless". By contrast, a more effective reappraisal would be more elaborated and contextualized, such as "Every person, including me, is inherently worthwhile. I'm also a committed partner who works hard at my job and cares for people in my community" (Southward et al., 2021). Whereas reappraisal frequency represents the habitual use of reappraisal in daily life (Liu & Thompson, 2017; Weber et al., 2014). The ability and frequency of reappraisal are found to be independent and unrelated to each other (Weber et al., 2014). Hence, the two factors may affect depression differently.

## Reappraisal and Depression

Reappraisal ability has been found to be negatively associated with depression. People with higher reappraisal ability exhibit fewer depressive symptoms (Troy et al., 2010). Southward et al. (2021) found that among people with low levels of depression, reappraisal ability can cause significant affective change, while reappraisal frequency has little effect. They found that participants who had lower depressive symptoms reported that they experienced a greater decrease in negative affect due to the quality of the reappraisals, regardless of how frequently they tended to use reappraisal in their lives.

There is also evidence of a negative association between reappraisal frequency and depression. Many studies have demonstrated a strong relation with depression (e.g. According to Southward et al. (2021), although reappraisal ability can cause significant mood change in people at low levels of depression, reappraisal frequency is more important than reappraisal ability for inducing mood change for people with high levels of depression. Studies showed that depressed people have significantly lower reappraisal frequency than people at lower levels or without depression (Aldao et al., 2010; Southward et al., 2021). Although depressed people may use reappraisal less frequently, they may not lack reappraisal ability. Liu and Thompson (2017) found that when instructed to implement cognitive reappraisals to regulate happy and sad emotions, their reappraisals are as effective as non-depressed controls (Liu & Thompson, 2017). The underutilization of reappraisals could be due to low self-efficacy beliefs and the self-perception of low reappraisal ability, which is not representative of their actual ability (Dryman & Heimberg, 2018; Liu & Thompson, 2017).

## Creativity and reappraisal

Reappraisal ability is found to be strongly linked to creativity through divergent thinking. People who are highly creative are found to have higher divergent thinking abilities (Runco & Acar, 2012), which allows them to come up with novel reappraisals that effectively reassess a bad situation from multiple perspectives. This is because the process of generating novel reappraisals is similar to that of generating ideas during creative thinking. The measures for reappraisal ability (e.g. Reappraisal Generation tasks, Reappraisal Inventiveness Test, or the Script-based Reappraisal Test) were also developed based on divergent thinking theories and activities, and it was found that the scores of a creative test can predict reappraisal ability (Wu et al., 2017). Neuroscientific studies have also found supporting evidence: when observed under an EEG or an fMRI, reappraisals involve the same cognitive processes and activates the same brain region as generating verbal creative ideas (Fink et al., 2017; Perchtold et al., 2018), which are the same verbal tasks used in the current study.These findings suggest a strong association between creativity and reappraisal ability.

There is evidence that creative people tend to have higher reappraisal ability, and that higher reappraisal ability is associated with less depression. Based on these findings, higher creativity should be associated with lower depression (a negative association). However, this inference contradicts some findings that creativity is linked to with greater depression (a positive association). No studies have reported lower depression among creative people compared to non-creative individuals, as might be expected based on their reported better reappraisal ability.

One possible explanation is that some confounding factor counteract the potentially beneficial effect of higher reappraisal ability among creative individuals - namely, the effect of reappraisal frequency. Reappraisal frequency is believed to be independent of reappraisal ability (Weber et al., 2014), so it may be associated with creativity in a different way. No studies have investigated the relationship between creativity and reappraisal frequency. Based on this missing link, as well as the mixed evidence regarding the association between creativity and depression, we hypothesize that reappraisal frequency may have a suppressing effect on these variables, which changes the relationship between creativity and depression. It is possible that even though creative people are skilled in reappraisals, they might not access this ability habitually, which increases depressive tendencies. In this case, when we control for reappraisal frequency, a negative relation between creativity and depression could emerge. Alternatively, it is also possible that there is no systematic relationship between creativity and reappraisal frequency - perhaps creative people do not differ in the use of reappraisal frequency compared to non-creative people. In this case, the relationship between creativity and depression remains unchanged when reappraisal frequency is introduced.

## The present study

The current study investigates how ERSs could explain the connection between creativity and depression. Specifically, we examined how creativity is associated with the normal variations of depression in the general population through the use of reappraisal and rumination. Table 1 summarizes the questions, hypotheses, and research plan.

First, our study addressed the basic question of (1) whether there is an overall positive association between creativity and depression.

Second, we added self-reflective rumination to our present model of creativity and depression. Based on the findings by Verhaeghen et al. (2005), they showed that self-reflective rumination is a confounding variable while there no direct relation is detected between creativity and depression. Therefore, we hypothesized that (2) when self-reflective rumination is controlled, the positive association between creativity and depression will be reduced.

Finally, we hypothesized that reappraisal frequency could influence the relation between creativity and depression. We added reappraisal frequency to our model as a suppressor for the relationship of creativity and depression. We predicted that (3) when reappraisal frequency is controlled, the positive association between creativity and depression will be reduced further or even become negative.

# Methods

## Preregistration

The research plan was preregistered on OSF prior to data collection: https://osf.io/vp2zq.

The only deviation from the preregistered plan was the change in depression measures from the 20-item Centre for Epidemiological Studies Depression Scale (CES-D) to the 18-item Maryland Trait and State Depression – Trait Scale (MTSD-T). This was due to the ethical concern that we are unable to offer professional knowledge or advice to participants who appear to have depression based on the CES-D survey. In addition, the MTSD-T could be more stable as it captures large variations in depression experienced throughout one’s adult life, rather than smaller fluctuations within a short period of time (2 weeks), which allows us to measure normal variations of depression in the general population. [Note: the preregistration will be modified prior to data collection based on reviewer feedback, and this section will be modified accordingly.]

## Participants

A total of ?? participants were recruited through Amazon’s Mechanical Turk (MTurk) service. [Describe basic demographic information after data has been collected.] As this is an epidemiological study that evaluates normal variations of depression in the general population rather than a diagnostic one, we included subjects varying from no experiences with depression to those with severe depressive symptoms. We excluded people who have experiences with Torrance Tests of Creative Thinking or any other creativity thinking tests, because experience with these tasks could affect the measurements in this study. Subjects with mental illness diagnoses of bipolar disorders and schizophrenia were also excluded, because these diagnoses are associated with the component of mania or positive symptoms, which are found to be associated with enhanced creativity (e.g. MacCabe, 2018; Power et al., 2015; Silvia & Kimbrel, 2010) and also higher depressive symptoms (Bosanac & Castle, 2013; McCormick et al., 2015; Stamouli, 2010; Upthegrove et al., 2017).

The target sample size was N = 200. This was the largest sample size that was feasible given funding and time constraints and would be enough to detect small-to-medium correlations. The sample size could have 80% power to detect small effects of r>.19 or 95% power to detect medium effects of r>.25, and could show trends that could be used as the basis for further study. The width of the 95% confidence intervals for correlation estimates would be range from .28 for small correlations (r<.2) to .21 for a medium correlation (r=.5). This would provide some information even if effects are too small to detect.

No previous studies have directly investigated the relationship between creativity and reappraisal frequency, but there have been studies of the relationship between reappraisal frequency and depression. A meta-analysis by Aldao et al. (2010) found evidence for a small-to-moderate correlation between reappraisal frequency and depression. The correlations observed in individual studies ranged from *r* = -.14 to -.29 and the overall correlation estimated across studies was *r* = -.17. Another study by Verhaeghen et al. (2005) measured the relationships between creativity, rumination, and depression. Verhaeghen et al. (2005) reported a correlation of *r* = .24 between self-reflective rumination and depression, and a correlation of r = .09-.35 between rumination and creativity measures (including fluency, originality, elaboration) in a large path model. The pairwise correlation between creativity and rumination would likely be larger than *r* = .09 if the multiple measures had been collapsed into a single measure of creativity.

We excluded the data from ?? participants because they did not follow instructions or complete the task. Specific reasons for exclusion were: blank responses in the creativity task (?? participants), failure to complete all sections (?? participants), failure to follow instruction on attention check items (?? participants) and [other reasons]. [If excluding for reasons that were not in the preregistration, note that here.] The data from the remaining ?? participants were used for analysis.

## Materials

The task and measures used in this study are described below. The full questions and scales are available at https://osf.io/fczpd/.

### Creativity

To measure creativity, we used a subset of four tasks selected from the verbal subscale of the Torrance Tests of Creative Thinking (TTCT; Torrance, 1966). TTCT measures creativity by using a set of open-ended idea-generation tasks, which engages divergent thinking abilities. TTCT is the most widely used creative test and has been regarded as the gold standard of creativity measure (Cramond, 2020). There are two modalities, TTCT-figural that requires mostly drawing responses and TTCT-verbal that elicits written or oral responses. Although studies have found that TTCT-figural to be a more comprehensive, reliable and valid measure of creativity than TTCT-verbal (Kim, 2017), no online platforms offer a reliable solution to collect drawing responses, hence only questions that warrant text responses were chosen.

For each question, participants were asked to generate as many ideas as possible in under 2 minutes. An example of a task is “try to think of many different possible uses for a brick.” Participants could not proceed to the next question until the 2 minutes had elapsed. The standard TTCT uses a 3 min response period per trial. We used a shorter duration because we were collecting data through an online platform, and we were concerned that a longer duration would deter people from participating.

The responses were manually screened to make sure that participants were performing the task as instructed. If responses were irrelevant to the question on any trials, the data from that subject was excluded.

Responses were rated on fluency (the number of ideas), flexibility (the number of categories), and originality (the number of novel ideas). Fluency is scored by counting the number of answers. Flexibility is scored by counting the number of categories. Originality is scored by counting how many times an answer is duplicated among other participants, which suggests that the answer is not original. To obtain the originality raw score, this number is inverted using 1/n. The sum of the three sub scores forms the creativity total score. Hence, there is little subjectivity in scoring and TTCT is largely reliable (Runco & Acar, 2012).

One rater scored the TTCT according to the guidelines on the TTCT interpretive manual (Torrance, 2018). Interrater reliability was assessed by having a second rater independently scored a subset of 30 responses. The intraclass correlation coefficient (ICC) across the items was ??.

 To prepare the TTCT data for analysis, the ratings on fluency, flexibility, and originality were added up to form a total creativity score, which was converted to a standard score with a mean of 100 and standard deviation of 20. According to the Interpretive Manual (Torrance, 2018), the frequency distribution usually captures a range of total scores from <50 to 150+. The total scores were used in the main analyses for our hypotheses, while the sub-scores of fluency, flexibility, and originality were used in the exploratory analysis.

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 Only the five items about self-reflection were analyzed, and the total scores were calculated by the average of sums of each Likert point, which range from 1 to 4.

### Reappraisal frequency

Reappraisal frequency was assessed using the 10-item Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). ERQ is a self-report that questionnaire assesses the emotional experience – how they feel on the inside, as well as behavioural expression – how they show their emotions through their behaviours and communication (Gross, 2002). Six items measure cognitive reappraisal while four items measure expressive suppression. Participants were asked to rate the statements on a 7-point scale (1 = strongly disagree, 7 = strongly agree; see Appendix B for the full questionnaire). An example of a Likert statement is “When I want to feel more positive emotion (such as joy or amusement), I change what I’m thinking about.” Only the six items on the reappraisal subscale were analyzed, and the total scores were calculated by the average of sums of each Likert point, which range from 1 to 7.

### Depression

We chose to measure trait depression instead of state depression, in contrast to some other studies (e.g. Verhaeghen et al., 2005). The rationale is that creativity is theorized to be a stable dispositional trait rather than a temporary state (e.g. Feist, 1998; Puryear et al., 2017; Zhang et al., 2020). If creative individuals have greater tendency toward depression, it would be revealed in trait depression as both variables are relatively permanent and consistent. Measuring trait depression also allows us to assess the normal variations of depression in the general population, making this study an epidemiological study rather than a diagnostic one.

Trait susceptibility to depression was measured using the 18-item Maryland Trait and State Depression – Trait Scale (MTSD-T; Chiappelli et al., 2014). It is a self-report that measures the severity of depressive symptoms in their adult lives according to the diagnostic symptoms of DSM-V (see Appendix D for the full questionnaire). Participants were asked to indicate how often they generally feel in most of their adult life (in your whole life since age 12), excluding the past one week on a 5-point scale (0 = never, 4 = experienced many times in a month for almost every month of my adult life). An example of a Likert statement is “It has been hard for me to feel happy throughout my life.” Each point on the Likert scale will add up to form a total score that ranges from 0 to 72.

### Data Quality Check

Since responses are collected through an online survey rather than a controlled environment, attention check questions were added to each questionnaire section to ensure participants’ paid attention to the study instructions. An example of an attention check “This is an attention check. Please select “strongly disagree” for this question.” There was one attention check question per questionnaire (RRS, ERQ, and MTSD-T respectively). Subjects who failed to answer them according to instructions were excluded in the analysis.

## Procedure

Participants completed an online questionnaire via MTurk and Qualtrics which took 13-15 mins. They first completed a timed creative thinking test with four questions and 2 minutes per question. Then, they answered questions about how they usually react to emotional situations and their emotional states. Participants were guaranteed anonymity. After completion of the questionnaires, each participant received ?? as financial compensation. The present study was approved by the Departmental Research Ethics Committee, Department of Psychology at The University of Hong Kong.

## Analysis Plan

### Creativity & Depression

To test the relationship between creativity and depression (see Hypothesis 1), we used linear regression to analyze our results. The independent variable (IV) is creativity whereas the dependent variable (DV) is depression.

### Rumination

### To test self-reflective rumination as a confounding variable for creativity and depression (see Hypothesis 2), we added self-reflective rumination as a covariate to the multiple regression of creativity (IV) and depression (DV). We tested whether the r2 of creativity and depression has reduced when self-reflective rumination is controlled, compared to the analysis with just creativity and depression in our first hypothesis.

### Reappraisal frequency

To test reappraisal frequency as a suppressing variable for creativity and depression (see Hypothesis 3), we added reappraisal frequency as a covariate to the existing multiple regression of creativity (IV), self-reflective rumination (IV), and depression (DV). We tested whether the r2 of creativity and depression has reduced further, or even becomes negative when reappraisal frequency is controlled, compared to our second analysis with creativity, rumination, and depression.

### Exploratory analysis

If creativity is found to be associated with depression, reappraisal, or rumination, we will conduct additional exploratory analyses using separate measures of creativity: fluency, flexibility, originality. We will compute a correlation matrix using the variables of fluency, flexibility, originality, reappraisal frequency, self-reflective rumination, and depression.

We will also conduct exploratory analyses regarding the moderation effects of gender between rumination and depression, and between reappraisal frequency and depression. Several studies investigated gender moderation on ERS and depression and found evidence for rumination and reappraisal. They found that women tend to ruminate more than men, which accounted for greater depression (Johnson & Whisman, 2013; Krause et al., 2018; Nolen-Hoeksema, 2012). They also found a similar moderating effect with reappraisal frequency, where women reported greater use of reappraisal compared to men, which was negatively related to depressive symptoms in women only (Preston et al., 2021). But, the present literature is inconsistent as several studies failed to replicate similar results (Masumoto et al., 2016; Perchtold et al., 2019; Trives et al., 2016). Because of this, we will only examine gender as an exploratory analysis.

We will perform two separate moderation analyses using rumination (IV), gender (moderator), and depression (DV) in the first analysis, and reappraisal frequency (IV), gender (moderator), and depression (DV) in the second analysis. This data could explain some possible variance in our model.

### Inference criteria

We will use the standard *p*<.05 criteria for the regression analyses. We will also use the Bayesian inferential tests as an inferential method if our results show p>.05. We will perform the analysis using creativity (IV), self-reflective rumination (IV) and reappraisal frequency (IV) and depression (DV). By convention, a Bayes factor greater than 3 represents substantial evidence for the alternative hypothesis over the null, and B smaller than .33 supports the null over the alternative hypothesis. Any value between .33 to 3 suggests weak or anecdotal evidence (Dienes, 2014).

# Results

## Creativity and Depression

To test the overall relationship between creativity and depression (see Hypothesis 1), we performed a linear regression using creativity score as the predictor (IV) and the MTSD-T depression score as the dependent measure (DV). We found that overall there was a [weak/ strong; positive/negative; no] relationship between creativity and depression, r2 = ???, F(??, ??) = ??, *p* = ???.

To test self-reflective rumination as a confounding factor for creativity and depression (see Hypothesis 2), we added self-reflective rumination (IV) to our previous multiple regression consisting of creativity (IV) and depression (DV), and observed how the relationship between creativity and depression changed when self-reflective rumination is controlled.

Our results show that the relationship between creativity and depression [become more positive/ negative/ remained unchanged] when self-reflective rumination is controlled, r2 = ???, F(??, ??) = ??, *p* = ???. This shows that reappraisal frequency [is/ is not] a confounding factor for creativity and depression.

## Reappraisal frequency

 To test reappraisal frequency as a suppressing variable for creativity and depression (see Hypothesis 3), we used the same approach as the rumination analysis. We added reappraisal frequency (IV) to our existing multiple regression model consisting of creativity (IV), self-reflective rumination (IV), and depression (DV) from our previous analyses.

 When reappraisal frequency is controlled, our results indicate that the relationship between creativity and depression has [become more positive/ negative/ remained unchanged], r2 = ???, F(??, ??) = ??, *p* = ???. This shows that reappraisal frequency [has/ has not] suppressed the overall relationship between creativity and depression.

## Exploratory analysis: Creativity measures

[If creativity is found to be associated with reappraisal, rumination, or depression, we will conduct additional exploratory analyses using separate measures of creativity: fluency, flexibility, originality.]

## Exploratory analysis: Gender

[We will repeat the main analyses using gender as a moderator and report any effects or trends.]

# Discussion

## Overall relationship between creativity and depression

[Summarize the finding]

[If positive association, compare to previous studies that found no relation.]

[If no overall association, discuss possible reasons why: mediating or moderating factors, different measures.]

[Discuss trait depression (our study) vs state depression in other previous studies.]

## Rumination

[Summarize the finding of whether self-reflective rumination is a confounding factor for creativity and depression, and how the relationship between creativity and depression changes when self-reflective rumination is added to the model.]

[If association is found, discuss possible implications.]

[If no association, discuss how rumination is related to creativity and depression separately. Compare with Verhaeghen et al. (2005), discuss possible reasons why: different measures, samples]

##

[Summarize the finding of whether reappraisal frequency is a suppressing variable between creativity and depression, and how the relationship between creativity and depression changes when reappraisal frequency is added to the model.]

[If a suppressing

[If no effect is found, discuss how reappraisal frequency is related to creativity and depression separately.]

## Exploratory analysis: Creativity measures

[Our study measured divergent thinking, not other creativity measures – possible implications]

[If exploratory analyses found anything interesting, discuss here]

[Limitation of our study: shorter than standard Torrance test, online version might add variability.]

## Exploratory analysis: Gender

[If gender is found to be a moderator between rumination and depression; or between reappraisal frequency and depression, we will compare the results with previous studies and discuss implications. We will discuss how this informs the variance in our main hypotheses.]

## Conclusion

[Briefly summarize conclusions for the three main questions, and any other notable findings.]

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| ***Table 1 - Research plan*** |  |  |
| **Question** | Is increased creativity associated with higher depression? | Does the relationship between creativity and depression change when self-reflective rumination is controlled?  | Does the relationship between creativity and depression change when reappraisal frequency is controlled? |
| **Hypothesis** | (1) Creativity is positively associated with depression. | (2) When self-reflective rumination is controlled, the positive association between creativity and depression will be reduced.  | (3) When reappraisal frequency is controlled, the positive association between creativity and depression will be reduced or even become negative.  |
| **Sampling plan** | Since no studies have tested the same hypotheses, we do not have a good prior estimate of effect sizes and it is not practical for us to target arbitrarily chosen small effect sizes. We have chosen a sample size based on the limits concerning the funding and time.N=200. The sample size could have 80% power to detect small to medium effects of r>.19, or 95% power to detect medium effects of r>.25. A sample size of N=200 could detect small to medium effect sizes, or could show trends that could be used as the basis for further study. The width of the 95% confidence intervals for correlation estimates would range from.28 for small correlations (r<.2) to .21 for medium correlations (r=.5). This would provide some information even if effects are too small to detect. |
| **Analysis Plan** | We will perform a linear regression analysis, with creativity as the independent variable (IV) and depression scores as the dependent variable (DV).  | We will perform a linear regression analysis, with creativity (IV), self-reflective rumination (IV) and depression (DV).  | We will perform a linear regression analysis, with creativity (IV), self-reflective rumination (IV), reappraisal frequency (IV) and depression (DV). |

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| **Hypothesis** | (1) Creativity is positively associated with depression. | (2) When self-reflective rumination is controlled, the positive association between creativity and depression will be reduced.  | (3) When reappraisal frequency is controlled, the positive association between creativity and depression will be reduced or even become negative.  |
| **Rationale for sensitivity** | The sample size provides 80 % power to detect an overall correlation r>.19 or 95% power to detect r>.25. A meta-analysis of the relationship between creativity and mood disorders found an overall effect size of r=.64 (Taylor, 2017). | Verhaeghen et al (2005) reported a correlation of r=.24 between self-reflective rumination and depression. They also reported correlations between rumination and creativity measures (including fluency, originality, elaboration) ranging from r = .09-.35 in a large path model, which would likely be larger than r=.09 if the overall score of creativity was taken into account instead of the independent creativity measures.Our target sample size of N=200 provides 95% power to detect a medium effect of r>.25, and over 80% power to detect medium effects of r >.19. | Based on previous studies, the relationship between reappraisal frequency and depression is expected to be a small-to-moderate effect (Aldao et al., 2010). There is no prior data on the relationship between creativity and reappraisal frequency. Our target sample size of N=200 provides 95% power to detect a medium effect of r>.25, and over 80% power to detect small effects of r >.19.  |

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| **Hypothesis** | (1) Creativity is positively associated with depression. | (2) When self-reflective rumination is controlled, the positive association between creativity and depression will be reduced.  | (3) When reappraisal frequency is controlled, the positive association between creativity and depression will be reduced or even become negative.  |
| **Interpretation given different outcomes** | We will follow the standard NHST to interpret the significance of our results.Creativity may or may not have an overall association with depression. If p>.05, we will compute the Bayesian inferential tests using creativity (IV) and depression (DV). We will report the Bayes factor and the 95% CIs of the estimated posteriors for the effects. This will provide some information about the strength of evidence if we observe non-significant trends. | We will follow the standard NHST criteria to observe whether the overall relationship between creativity and depression is positively associated when self-reflective rumination is introduced.We will also observe if the r2 of creativity and depression is reduced when self-reflective rumination is controlled, compared to the analysis with just creativity and depression in our first hypothesis.If p>.05, we will follow the same approach and compute the Bayes factor and 95% CIs using creativity (IV), self-reflective rumination (IV) and depression (DV).  | We will follow the same approach as rumination: use the standard NHST and observe how the relationship of creativity and depression has changed when reappraisal frequency is introduced to our model. We will observe whether the r2 of creativity and depression will be reduced when both reappraisal frequency and rumination are controlled, compared to the analysis with just creativity, rumination, and depression in our second hypothesis. We expect that the r2may even become negative when reappraisal frequency is added.If p>.05, we will use the same approach and compute the Bayes factor and 95% CIs using creativity (IV), self-reflective rumination (IV), reappraisal frequency (IV) and depression (DV).  |

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| **Hypothesis** | (1) Creativity is positively associated with depression. | (2) When self-reflective rumination is controlled, the positive association between creativity and depression will be reduced. | (3) When reappraisal frequency is controlled, the positive association between creativity and depression will be reduced or even become negative. |
| **Theory that could be shown wrong by the outcomes** | Previous findings have been mixed. The results from this study could support previous findings that creativity is linked to depression or could support previous findings that there is no overall association. | Verhaeghen et al. (2005; 2014) measured state depression instead of trait depression, and used different measures of creativity. If the expected relations are not observed, it could be due to these differences in measures. | No previous studies have investigated the relation between creativity and reappraisal frequency. It is possible that reappraisal frequency is unrelated to creativity, such that when reappraisal frequency is controlled, the overall association between creativity and depression remains unchanged. This would inform us that the reappraisal frequency is not masking a negative relationship between creativity and depression. |