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# Exploring the Relation between State and Trait Boredom and Various Measures of Creativity

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Abstract: Popular sentiment suggests that boredom ought to lead to creativity despite a lack of research investigating the relationship explicitly. Across two experiments the relation between boredom and creativity was examined via a mood induction and surveys (Experiment 1) and behavioural tasks (Experiments 1 and 2). Results from Experiment 1 indicated that state boredom was in fact associated with poorer performance on the divergent thinking task and that trait boredom proneness was associated with both diminished belief in one's creative potential and lower levels of engagement of everyday creative pursuits. Results from Experiment 2 again found no relation between state or trait boredom and creativity on a novel creativity task. Clearly, these findings indicate that neither state nor trait boredom promote increased creativity.

Keywords: boredom, creativity, boredom proneness, exploration, exploitation



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## 1. Introduction

Boredom is a negative affective state of wanting, but failing, to satisfy the urge to be engaged, with those who experience the state more frequently and intensely considered to be boredom prone (Eastwood et al., 2012; Tam et al., 2021). For the highly boredom prone, boredom presents a kind of conundrum—a desire to be engaged, coupled with a failure to launch into action (Mugon et al. 2018). Functional accounts of boredom characterize it as a call to action, a self-regulatory signal indicating that our current activity is not fulfilling in some important way, pushing us to find something more meaningful or intense to engage with (Bench and Lench, 2013, 2019; Elpidorou, 2014, 2018). As a call to action then, state boredom may represent a viable trigger for a broad swathe of actions that could be considered 'creative'. However, despite popular sentiment that boredom could (or even ought to) lead to creativity (Zomorodi, 2017), there is a lack of research examining the relation explicitly.

The functional description of boredom suggests that there is nothing inherent about the state to suggest it would necessarily *enhance* creativity. Simply because the cognitive-affective state of boredom is considered to signal a 'call to action' (Elpidorou, 2014, 2018; Bench and Lench, 2013, 2019; Danckert, 2019; Danckert et al., 2018), does not guarantee what kind of action an individual will choose and certainly has little role to play in *improving* any given domain of action choice. In other words, boredom does not solve the problem of what or how to do something, but merely signals to the individual that what they are doing now is not satisfying in some way. To be clear, what we are claiming is that boredom does not *make* one creative; creative practice and training achieves that end (Simonton, 2000). On the other hand, while the popular claim that boredom will make you more creative is illogical, it is plausible that prior pursuit of creative activities may function well to alleviate boredom. For example, for those who have already fostered creative skills, creative outlets may prove to be exceptionally good at eliminating boredom.

It is important to acknowledge the distinction here between the potential influence of state boredom on creativity and the relation between stable trait dispositions of boredom proneness and creativity. It is plausible that engaging in creative pursuits represents one positive response to in-the-moment feelings of boredom. For the trait boredom prone however, research highlights a raft of negative responses to the state (Danckert et al., 2018). It should be noted, however, that responses to boredom do not necessarily have to be positive or negative. On the one hand, state boredom increases prosocial giving (Van Tilburg et al., 2016), while on the other it has been associated with increases in sadistic behaviours (i.e., killing worms; Pfattheicher et al., 2021). The one study we know of to investigate boredom proneness directly, suggested that trait boredom proneness was a positive predictor of curiosity, but was unrelated to creativity (Hunter et al., 2016).

The purpose of the current studies was to examine the relation between state and trait boredom and creativity to determine whether there is any truth to the claim that boredom begets creativity. Specifically, using a partial replication, with the addition of survey data, and a novel behavioural task, the goal here was to determine whether there is a positive relation between either state or trait boredom and elevated performance on task or surveys purported to measure creativity.

## 2. Experiment 1: A Partial Replication of Mann & Cadman (2014)

What little research there is exploring the relation between boredom and creativity suffers from a range of conceptual and methodological challenges. In perhaps the most cited study linking boredom and creativity, Mann and Cadman (2014) induced participants into a bored state by having them copy out phone numbers. They were then asked to complete the Creative Uses Task, a task adapted from the widely used alternative uses task (AUT; Fink et al., 2009), in which people come up with a list of uses for a polystyrene cup. Results showed that those who reported daydreaming while bored also performed better on the Creative Uses Task. It is unclear then whether it was boredom itself, or the response to being bored (i.e., daydreaming), that led to better performance. In addition, this study had no control group in which a mood distinct from boredom was induced, a problem we redress in Experiment 1.

Experiment 1 attempted to partially replicate the Mann and Cadman (2014) study by inducing state boredom and measuring the influence on the Creative Uses Task (CUT). Some changes were made to the study design. First, we used a control group in which a mood distinct from boredom (i.e., interest) was induced (Mann and Cadman's control group had no mood induction). Second, we did not include a metric of daydreaming. Instead, we included all participants in our analyses to avoid any potential bias that exploring only a subset of participants might introduce. Third, we included trait measures of both creativity and boredom proneness. It is uniformly agreed that creativity is a complex, multifaceted construct that manifests in different ways (Abraham, 2016; Dietrich, 2004, 2019; Smith et al., 1995). Although divergent thinking has been the gold standard experimental paradigm for assessing creativity (Dietrich, 2019), the task has significant confounds, not least of which is the notion that it invokes distinct mental processes (Ward et al., 1999). In order to capture more of creativity than just divergent thinking, several self-report measures of creativity were included. Further, the current study engaged a larger sample (Mann and Cadman had two groups of 40 participants, n = 80) to increase the power to find effects should they exist, as well as decreasing the risk of Type 1 errors. To summarize, the current *partial* replication of Mann and Cadman's original study engaged the following modifications:

1. Addition of a control mood induction condition (as compared to the no-induction control group used by Mann and Cadman).

2. Exclusion of a daydreaming measure to avoid the potential confound of this construct in exploring the relation between boredom and creativity.

3. Inclusion of several survey measures of creativity to explore the potential relation between boredom and creativity more fully.

4. Use of a larger sample size (n = 197 compared to n = 80).

Although we have outlined the flawed logic of the notion that boredom begets creativity, our hypothesis here remained aligned to the Mann and Cadman findings, such that state boredom would lead to better performance on the Creative Uses Task. Furthermore, if there is indeed a positive relation between state boredom and creativity that should be evident in positive correlations with these metrics and scores on the creativity surveys. Any hypotheses regarding trait boredom proneness were necessarily speculative, however it was hypothesized that given past work showing maladaptive responses associated with the trait, that the highly boredom prone would perform more poorly on the Creative Uses Task and have negative correlations with the creativity survey measures.

2.1. Method

*2.1.1. Participants*

It was decided a priori that as many participants as possible would be recruited to the study over the course of four months (a single term). 197 undergraduate students (159 female, 29 male, 7 non-binary, 1 two-spirited, 1 undisclosed) were recruited on an online recruitment site for undergraduate students and received 0.5 course credit in return for participation (age range 18 to 51 years, $M = 21$, $SD = 4.2$). Participants were randomly assigned to either a boredom or interest mood induction (boredom induction $n = 98$; 76 female, 17 male, 3 non-binary, 1 two-spirited, 1 undisclosed; mean age = 20.5 years; interest induction $n = 99$; 83 female, 12 male, 4 non-binary, mean age = 21.2 years). Informed consent was obtained from all participants prior to the study commencing and the study was approved by the University of Waterloo's Research Ethics Board.

Power calculations indicated that with an effect size of 0.08 (Mann and Cadman's effect size) and the current sample size, the current study had power of $1 - \beta = 0.139$ (in comparison to Mann and Cadman's power of $1 - \beta = 0.098$; power calculated using G*Power 3.1; Faul et al., 2009). Thus, while the current study remains underpowered to detect small effect sizes, it was deemed a reasonable sample size for replication purposes.

*2.1.2. Materials*

Because creativity is a complex concept, three different creativity scales were chosen in order to broadly measure the construct. First, the Short Scale of Creative Self was employed as a measure of self-perceptions of creativity (Karwowski, 2011). Next, a more direct measure of everyday engagement in creative behaviours was captured by the Creative Behaviors Inventory (Dollinger, 2003), and finally, the Kaufman Domains of Creativity Scale was used to measure creativity across more specific domains (see below for details; Kaufman, 2012).

*Short Scale of Creative Self* (SSCS; Karwowski et al., 2018). The SSCS consists of two scales: the Creative Personal Identity (CPI) and Creative Self-Efficacy (CSE) scales. The CPI measures how important creativity is to one's self-image and includes items such as "My creativity is important for who I am", whereas the CSE measures the belief that one has the *potential* to be creative and includes items such as "My imagination and ingenuity distinguishes me from my friends". Participants indicated the extent to which each of the statements describes them using a 5-point Likert scale with anchors of: definitely not, somewhat not, neither yes or no, somewhat yes, and definitely yes. Both the CPI and the CSE were found to be internally consistent (CPI: $\alpha = .81$, CSE: $\alpha = .79$; Karwowski et al., 2018)

*Creative Behaviors Inventory* (CBI; Dollinger, 2003). The CBI consists of 28 items and measures engagement in everyday creative behaviours. For each item participants indicate which of four responses best describes the frequency of the behaviour in their adolescent and adult life (i.e., never did this, did this once or twice, did this 3-5 times, or did this more than 5 times). The scale includes items such as “Designed and made your own greeting cards” and has a coefficient alpha = .89 (Dollinger, 2003).

*Kaufman Domains of Creativity Scale* (K-DOCS; Kaufman, 2012). The K-DOCS consists of 50 items and measures self-beliefs of creativity across five domains. The Everyday domain measures everyday creativity, including behaviours such as the ability to teach or help others. Scholarly creativity measures creative analysis, debate and scholarly pursuits. Performance creativity measures one’s capacity for public presentations (e.g., music, acting, etc.). Scientific creativity measures mechanical ability and interest in science and math. Artistic creativity measures creativity in a more traditional sense (e.g., drawing, painting, etc.). Participants rated how creative they perceive themselves to be within each domain in comparison to people of approximately the same age and life experience. For acts they had not specifically done, participants estimated their creative potential based on their performance on similar tasks. Items were rated on a 5-point Likert scale with anchors of much less creative, less creative, neither more or less creative, more creative, and much more creative (coefficient alpha values ranging from .83 to .87 for the subscales (Kaufman, 2012).

*Mood Inductions.* To induce state boredom participants watched a previously validated short movie of two men hanging laundry, occasionally asking one another for a clothes peg (Merrifield and Danckert, 2014). In the original study, boredom was reliably induced with video durations as short as two minutes and fifty-one seconds. Here, participants watched the video for 3 minutes and 50 seconds.

To induce interest, participants watched a previously validated video clip from the BBC documentary Planet Earth (Merrifield and Danckert, 2014). The video consisted of descriptions of a variety of sea creatures for 4 minutes and 13 seconds. The interesting video was slightly longer to allow the video to finish at the end of a scene.

Video mood inductions were chosen (as opposed to transcribing phone numbers as in Mann and Cadman, 2014) so that an equivalent method could be used to induce both boredom and interest (it is hard to imagine an engaging or interesting transcription induction!).

*Creative Uses Task (CUT).* The CUT asks participants to come up with as many *creative* and *original* uses for a feather within a three-minute time limit. Participants were instructed to emphasize the creative quality of answers over mere quantity of responses (Nusbaum et al., 2014). The full instructions were as follows:

> For this task, you'll be asked to come up with as many original and creative uses for a FEATHER as you can. The goal is to come up with creative ideas, which are ideas that strike people as clever, unusual, interesting, uncommon, humorous, innovative, or different. Your ideas don't have to be practical or realistic; they can be silly or strange, even, so long as they are CREATIVE uses rather than ordinary uses. You can enter as many ideas as you like. The task will take 3 minutes. You can type in as many ideas as you like until then, but creative quality is more important than quantity. It's better to have a few really good ideas than a lot of uncreative ones.

Upon completion participants chose up to three responses they deemed to be their most creative (i.e., the top-scoring method; Silvia et al., 2008). These responses were then scored by three independent raters blind to group membership. The raters independently rated each chosen response on a scale of 1 to 5, 1 being the least creative and 5 being the most creative using the same instructions given to participants. Scores from the three raters were averaged for each individual participant's response. The highest score for each individual was then used as their final score on the Creative Uses Task.

Answers that were considered inappropriate given the instructions (e.g., a question instead of a use for a feather) were scored a 1. For responses of which the highest and lowest rated scores differed by more than one, the raters were asked to discuss the response and come to an agreed upon score. Weighted Cohen's Kappa was calculated between each of the raters and ranged from .51 to .64, which according to Landis and Koch (1977) translates to moderate to substantial agreement.

*State Boredom*. Participants we asked, "How bored are you right now?" and responded on a visual analogue scale from 0 – 100 with anchors of "Not at all bored" on the far left and "Extremely bored" on the far right. Participants completed this prompt before and after the mood induction.

*Shortened Boredom Proneness Scale* (sBPS; Struk et al., 2017). The sBPS was used to measure trait boredom proneness. Participants rate their agreement with eight items (e.g., "I find it hard to entertain myself") on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). Responses are summed with higher values indicating higher levels of boredom proneness. Struk and colleagues (2017) report an internal consistency of .88.

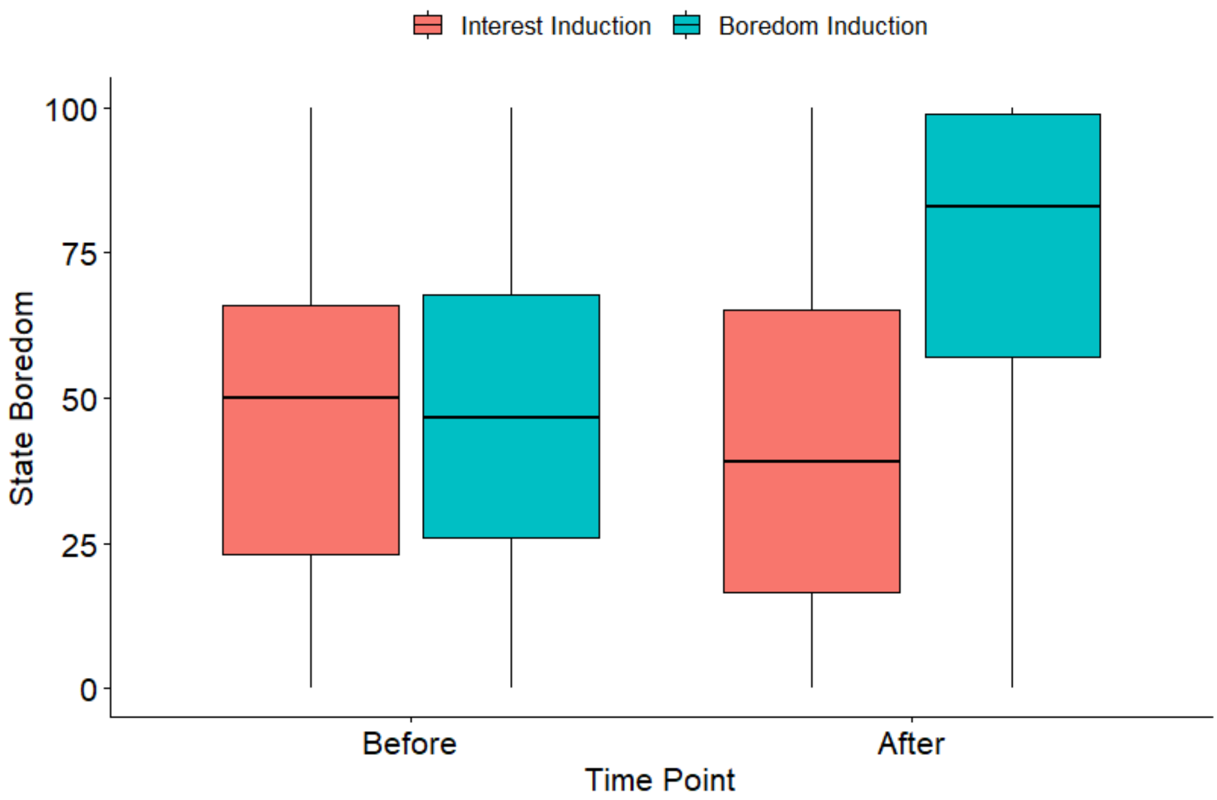
*2.1.3. Procedure*

Due to the constraints of the pandemic this study was administered online. After participants gave consent, they began by rating their current state boredom. Participants were then randomly assigned to watch either the boring or interesting video which was followed by another state boredom rating. Next, participants completed the Creative Uses Task. Upon completion they were shown their responses and were asked to choose up to three of their most creative answers. On average, participants made 9.26 ($SD$ = 4.55) responses and chose 2.24 responses ($SD$ = 0.89) to submit. Participants then completed the three creativity questionnaires in the following order: Short Scale of Creative Self, Creative Behaviors Inventory, and the Kaufman scale. The Boredom Proneness Scale had been completed prior to the study online as a part of a larger study.

2.2. Results

A mixed design ANOVA with mood induction (boredom vs. interest) as the between-subjects variable and state boredom before and after the induction as the within-subjects variable showed a significant interaction between mood induction and state boredom, $F(1,195) = 67.52$, $p < .001$. Simple main effects indicated that the conditions did not significantly differ on boredom before the manipulation ($F(1,195) = 0.00$, $p = .954$), but were significantly different post mood induction ($F(1,195) = 60.29$, $p < .001$). This manipulation check indicates that those in the boring condition were significantly more bored after the video than those in the interesting condition (Figure 1).

Figure 1. A Box and Whisker Plot of State Boredom before (Left) and after (Right) by Mood Induction (Interest in Red and Boredom in Blue).




Boredom proneness was not significantly different between males ($M$ = 32.21, $SE$ = 1.70) and females ($M$ = 34.99, $SE$ = 0.80; M difference = 2.78, BCa 95% CI [-1.160, 6.733], $t(186)$ = 1.39, $p$ = .165, $d$ = 0.28), as such all further comparisons collapsed across gender. To ensure there were no issues of sampling error (i.e., we wanted to ensure that prior to completing the Creative Uses Tasks our groups did not differ on measures of boredom proneness of creativity as measured by the surveys employed here), independent samples t-tests compared all creativity measures (and boredom proneness) across the two mood inductions to ensure both groups were equivalent on these measures prior to exploring the effects of the mood inductions themselves. Results showed no difference in boredom proneness across the mood induction groups (boredom condition $M$ = 35.26, $SE$ = 1.01; interest condition $M$ = 34.28, $SE$ = 1.00; M difference = 0.98, BCa 95% CI [-0.184, 0.379], $t(195)$ = 0.68, $p$ = .495, $d$ = 0.28). Similarly, there were no differences between the mood induction groups on any of the self-reported creativity indices (all $t$'s<0.83, all $p$'s>.132). Nevertheless, for transparency, we present the correlations among all measures for the two mood induction groups separately (Table 1a for the boredom mood induction group and Table 1b for the interest mood induction group) before showing the same correlations collapsed across groups (Table 1c).

When considering the correlations collapsed across groups, state boredom before and after the mood induction was significantly positively correlated such that those who reported higher levels of state boredom pre-induction, also reported higher levels post-induction. In addition, those high in trait boredom proneness reported higher levels of state boredom pre-induction. This difference was not evident post-induction suggesting that those lower in boredom proneness before the induction attained similar levels of state boredom relative to the highly boredom prone by the end of the induction. Age was negatively correlated with both state (prior to induction) and trait boredom indicating that older participants were less bored and less boredom prone. State boredom after the mood induction was also significantly positively correlated with boredom proneness, although to a significantly lesser extent than the relation between trait and state boredom prior to the mood induction ($Z$ = 3.13, p = .002; DeCoster, 2007).

There was a significant negative correlation between the Creative Uses Task scores and state boredom before the mood induction, such that those who were more bored before the induction were more likely to have lower (i.e., less creative) scores on the Creative Uses Task (Table 1). The correlation between state boredom after the induction and Creative Uses Task scores was also negative although non-significant (Table 1). Boredom proneness was not significantly related to Creative Uses Task scores (Table 1).

Boredom proneness was significantly negatively associated with Creative Self-Efficacy, such that those high in boredom proneness were more likely to have low creative self-efficacy ratings (Table 1). The only other creativity measure that boredom proneness was significantly related to was the Everyday section of the Kaufman scale. Again, boredom proneness was negatively correlated, such that those more prone to boredom scored lower (i.e., less creative) on the Kaufman Everyday creativity subscale. State boredom before or after the mood inductions did not correlate with any of the self-report measures of creativity.

All self-reported creativity measures were significantly correlated with one another (Table 1). When considering the Creative Uses Task, performance was significantly related to all but the Kaufman scale (Table 1). It should be noted, however, that the correlations between the Creative Uses Task and the self-reported creativity measures were small, especially in comparison to the moderate correlations between the various self-report measures themselves.

Creative Uses Task scores were distributed normally with acceptable values of both skewness, 0.09, and kurtosis, 2.18. Homogeneity of variance was tested using Levene's test, with variances being equal for the boring and interest conditions, $F(1, 195) = 0.33$, $p = .57$. Using an independent t-test the difference between scores on the Creative Uses Task between mood induction groups (M difference = 0.07, BCa 95% CI [-0.205, 0.357], was not significant ($t(195) = 0.53$, $p = .595$, $d = 0.08$; boredom induction $M = 2.88$, $SE = 0.1$; interest induction $M = 2.81$, $SE = 0.1$).

Table 1a: Correlation Table for the Boredom Induction

| | State Boredom After | Age | sBPS | Gender (n = 93) | CUT | CPI | CSE | CBI | K-DOCS Every. | K-DOCS Schol. | K-DOCS Perf. | K-DOCS Sci. | K-DOCS Arts |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| State Boredom Before | .49*** | -.07 | .44*** | -.19. | -.19. | .04 | -.07 | -.03 | -.10 | -.10 | -.12 | -.10 | -.03 |
| State Boredom After | | .06 | .1 | .06 | -.12 | -.03 | -.10 | -.18. | -.08 | -.12 | -.04 | -.13 | -.10 |
| Age | | | -.12 | .06 | .15 | .15 | .02 | .04 | -.06 | -.08 | -.08 | -.04 | -.02 |
| sBPS | | | | -.17 | .08 | -.03 | .06 | .18. | -.07 | .04 | -.02 | -.02 | -.01 |
| Gender (n = 93) | | | | | .04 | .04 | .09 | -.22* | .19. | .12 | .23* | .29** | .04 |
| CUT | | | | | | .11 | .08 | .22* | .09 | .09 | .07 | .18. | .09 |
| CPI | | | | | | | .59*** | .39*** | .25* | .25* | .29** | .25* | .45*** |
| CSE | | | | | | | | .41*** | .42*** | .37*** | .33*** | .36*** | .47*** |
| CBI | | | | | | | | | .17 | .19. | .16 | .19. | .29** |
| K-DOCS Every. | | | | | | | | | | .53*** | .43*** | .36*** | .53*** |
| K-DOCS Schol. | | | | | | | | | | | .49*** | .53*** | .49*** |
| K-DOCS Perf. | | | | | | | | | | | | .64*** | .58*** |
| K-DOCS Sci. | | | | | | | | | | | | | .56*** |

Significance codes: <.001 '***', <.01 '**', <.05 '*', <0.1 '.'

Note: Gender only includes female and male for these correlations. Abbreviation in the table are as follows: Creative Uses Task (CUT), Creative Personal Identity (CPI), Creative Self-Efficacy (CSE), Creative Behavior Inventory (CBI), Everyday subscale of Kaufman's scale (K-DOCS Every.), Scholarly subscale of Kaufman's scale (K-DOCS Schol.), Performance subscale of Kaufman's scale (K-DOCS Perf.), Science subscale of Kaufman's scale (K-DOCS Sci.), and Arts subscale of Kaufman's scale (K-DOCS Arts).

Table 1b: Correlation Table for the Interest Induction

| | State Boredom After | Age | sBPS | Gender (n = 95) | CUT | CPI | CSE | CBI | K-DOCS Every. | K-DOCS Schol. | K-DOCS Perf. | K-DOCS Sci. | K-DOCS Arts |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| State Boredom Before | .56*** | -.20* | .36*** | .11 | -.21* | -.17. | -.18. | .05 | -.02 | .05 | .13 | .13 | .00 |
| State Boredom After | | -.22* | .26* | -.07 | -.21* | -.01 | -.06 | .23* | -.03 | .21* | .25* | .20* | .21* |
| Age | | | -.26* | -.10 | .18. | .28** | .26* | .16 | .06 | .06 | .10 | .19. | .14 |
| sBPS | | | | -.03 | -.06 | -.20* | -.37*** | -.03 | -.22* | -.05 | .03 | -.06 | -.03 |
| Gender (n = 95) | | | | | .00 | -.10 | .08 | -.07 | .03 | -.07 | -.02 | .24* | -.22* |
| CUT | | | | | | .28** | .27** | .10 | .03 | .10 | .06 | .04 | .10 |
| CPI | | | | | | | .66*** | .55*** | .24* | .35*** | .36*** | .21* | .49*** |
| CSE | | | | | | | | .50*** | .49*** | .46*** | .33*** | .32** | .36*** |
| CBI | | | | | | | | | .38*** | .46*** | .43*** | .38*** | .49*** |
| K-DOCS Every. | | | | | | | | | | .52*** | .35*** | .29** | .38*** |
| K-DOCS Schol. | | | | | | | | | | | .57*** | .50*** | .55*** |
| K-DOCS Perf. | | | | | | | | | | | | .52*** | .67*** |
| K-DOCS Sci. | | | | | | | | | | | | | .44*** |

Significance codes: <.001 '***', <.01 '**', <.05 '*', <0.1 '.'

Note: Gender only includes female and male for these correlations. Abbreviation in the table are as follows: Creative Uses Task (CUT), Creative Personal Identity (CPI), Creative Self-Efficacy (CSE), Creative Behavior Inventory (CBI), Everyday subscale of Kaufman's scale (K-DOCS Every.), Scholarly subscale of Kaufman's scale (K-DOCS Schol.), Performance subscale of Kaufman's scale (K-DOCS Perf.), Science subscale of Kaufman's scale (K-DOCS Sci.), and Arts subscale of Kaufman's scale (K-DOCS Arts).

Table 1c: Correlation Table Collapsed Across Mood Induction Groups

| | State Boredom After | Age | sBPS | Gender (n = 188) | CUT | CPI | CSE | CBI | K-DOCS Every. | K-DOCS Schol. | K-DOCS Perf. | K-DOCS Sci. | K-DOCS Arts |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| State Boredom Before | .45 *** | -.14 * | .4 *** | -.05 | -.2 ** | -.07 | -.13 . | .01 | -.05 | .02 | 0 | .02 | -.01 |
| State Boredom After | | -.13 . | .18 * | .04 | -.12 . | -.03 | -.05 | -.02 | -.08 | -.01 | .12 . | .03 | .01 |
| Age | | | -.2 ** | -.04 | .16 * | .23 ** | .16 * | .12 . | .03 | .01 | .02 | .09 | .09 |
| sBPS | | | | -.1 | .01 | -.12 . | -.16 * | .06 | -.15 * | -.01 | 0 | -.04 | -.03 |
| Gender (n = 188) | | | | | .02 | -.03 | .09 | -.15 * | .11 | .03 | .12 | .27 *** | -.09 |
| CUT | | | | | | .2 ** | .18* | .15 * | .06 | .09 | .07 | .1 | .09 |
| CPI | | | | | | | .63 *** | .48*** | .24 *** | .3 *** | .32 *** | .23 ** | .47 *** |
| CSE | | | | | | | | .45 *** | .46 *** | .41 *** | .33 *** | .34 *** | .4 *** |
| CBI | | | | | | | | | .29 *** | .33 *** | .29 *** | .28 *** | .41 *** |
| K-DOCS Every. | | | | | | | | | | .53 *** | .38 *** | .32 *** | .45 *** |
| K-DOCS Schol. | | | | | | | | | | | .52 *** | .51 *** | .52 *** |
| K-DOCS Perf. | | | | | | | | | | | | .58 *** | .62 *** |
| K-DOCS Sci. | | | | | | | | | | | | | .5 *** |

Significance codes:<.001 ‘***’, <.01 ‘**’, <.05 ‘*’, <0.1 ‘.’

Note: Gender only includes female and male for these correlations. Abbreviation in the table are as follows: Creative Uses Task (CUT), Creative Personal Identity (CPI), Creative Self-Efficacy (CSE), Creative Behavior Inventory (CBI), Everyday subscale of Kaufman’s scale (K-DOCS Every.), Scholarly subscale of Kaufman’s scale (K-DOCS Schol.), Performance subscale of Kaufman’s scale (K-DOCS Perf.), Science subscale of Kaufman’s scale (K-DOCS Sci.), and Arts subscale of Kaufman’s scale (K-DOCS Arts).

2.3. Discussion

Our attempt to partially replicate the Mann and Cadman (2014) study clearly failed to show any *positive* relation between state or trait boredom and measures of creativity. In fact, higher state boredom before the task, regardless of intervention, was associated with poorer performance on the Creative Uses Task ($r = -0.20$, $p < 0.001$, Table 1c). This failure to find any positive relation between state boredom and creativity occurred despite the fact that we more than doubled the sample size and included an appropriate control mood induction. In addition, state and trait boredom showed no positive relations to self-report measures of creativity. Taken together, this is clear evidence that neither state nor trait boredom lead to or are associated with *increased creativity*. It is worth noting that the mood induction itself was clearly successful (i.e., people were indeed bored by watching a movie of two men hanging laundry: Figure 1).

Interestingly, higher trait boredom proneness was associated with lower levels of engagement in everyday creative pursuits (i.e., negative correlation with the Everyday subscale of the Kaufman scale; Table 1), replicating findings from the influence of boredom proneness on creativity and mental health during the pandemic (Brosowsky et al., 2022). In that study, those who did report engaging in more everyday creative acts also reported higher levels of mental well-being and were lower in boredom proneness. Taken together with the current study in which there is only a negative relation between boredom proneness and everyday measures of creativity, this supports the argument that while it does not seem logical that boredom could make one creative, it is plausible that turning to creative outlets could successfully eliminate boredom, perhaps only for those who are generally low in boredom proneness. Additionally, higher boredom proneness was found to be associated with lower levels of belief that one has the potential to be creative (i.e., lower creative self-efficacy; Table 1). This may suggest that for the boredom prone there is a more general challenge to the perceived sense of agency (Danckert and Eastwood, 2020). These results are also consistent with the theoretical account of boredom proneness as a failure to launch into action (Mugon et al., 2018). Finally, scores on the Kaufman scale, which purports to measure a broad range of creative domains, also failed to show any relation to the Creative Uses Task (Table 1). One element of this scale that sets it apart from the others included here is that participants rate how creative they are in comparison to others. It is possible that participants underestimate their capacity for creativity when considering others. It is also possible that the broad domains captured by the Kaufman scale do not capture the more narrowly defined facet of divergent thinking measured by the Creative Uses Task. In part, this challenge of specificity of measures (i.e., a focus only on divergent thinking in the Creative Uses Task) motivated Experiment 2 in which creative exploratory behaviours were examined to further explore any potential relation between boredom and creativity.

## 3. Experiment 2: Creative Foraging

While the Creative Uses Task is an accepted measure of divergent thinking, this is likely not the only facet of creativity (Abraham, 2016; Dietrich, 2004, 2019; Smith, Ward, and Finke, 1995). If boredom is a call to action, then more nuanced metrics may be needed to explore any potential relation between boredom and creativity. To do this, Experiment 2 employed a novel behavioural task that engages creative processes in an exploratory manner (Hart et al., 2017), beyond divergent thinking. Hart and colleagues (2017) style their task as one of 'creative foraging'. That is, in many situations we need to balance the competing drives of exploiting known resources and exploring the world for novel resources – a balance well captured in foraging behaviour (Danckert, 2019; Struk et al., 2019). Their task examines this balance in a setting in which participants create shapes from simple stimuli (see below). The balance between exploratory and exploitative behaviour is also critical in the context of boredom research as it has been proposed that the highly boredom prone struggle with phases of both exploitation (i.e., exhibiting deficiencies in sustained attention) and exploration (i.e., failing to launch into action; Danckert, 2019; Hunter and Eastwood, 2018; Malkovsky et al., 2012; Mugon et al., 2018; Struk et al., 2020). In addition, the creative foraging task is participant driven in that participants are free to discover novel solutions and as such, is a good metric of creativity. Finally, the task produces several metrics suitable for exploring individual differences (see below).

The Creative Foraging Task has participants make shapes from a set of identical, horizontally aligned squares (Figure 2). At any point participants can 'save' shapes to a gallery before moving on to create their next shape. The original work used factor analysis from a large sample of created shapes to determine 'categories' that most participants settle on, ranging from alphanumeric shapes to categories that resemble real-world objects (e.g., planes), to categories of similar abstract shapes. This allows for the measurement of a range of metrics including the number of categories/shapes attempted, the number of unique (relative to the group) shapes made, and the number of moves taken between shapes. In contrast to the Creative Uses Task, the Creative Foraging Task captures the intermediate steps leading from one solution to another and thus allows insight into the processes of both exploration and exploitation (Hart et al., 2017). It was hypothesized that greater state boredom would be associated with more exploratory behaviours (in this case, higher Median Exploration, as described below) given the functional characterization of state boredom as a call to action – pushing us to explore the environment for something to engage with (Elpidorou, 2014). There was no a priori hypotheses regarding state boredom and exploitative behaviour. It was also hypothesized that high boredom prone individuals would explore less than low boredom prone individuals. Again, there was no a priori directional hypothesis regarding boredom proneness and exploitative behaviours. This somewhat counterintuitive hypothesis was derived from the notion that the highly boredom prone fail to launch into action (Mugon et al., 2018). Finally, it was hypothesized that state boredom would be negatively related to creativity. That is, the task provides metrics for exploratory behaviours (e.g., the number of steps taken between categories) and creativity (i.e., the uniqueness of shapes created) separately, with state boredom expected to have opposing effects on these metrics. We should note that there are additional metrics (e.g., explore/exploit optimality – see below) for which it is difficult to develop directed hypotheses given that these newly developed measures are somewhat open to interpretation (a point we deal with in more detail in the Discussion).

### 3.1. Method

#### *3.1.1. Participants*

Participants were recruited on an online recruitment site for undergraduate students and received 0.5 course credit in return for participation. The initial sample consisted of 264 participants (217 female, 47 male) with ages ranging from 17 to 42 years (*M* = 21, *SD* = 3.2). 116 participants were excluded for the following reasons: having fewer than 80 steps in the task (a minimum of 80 steps are required to calculate valid metrics), performing the task for less than 10 minutes, taking a break during the task of longer than 1.5 minutes, or providing an incorrect ID number. These excluded participants did not drop out but were removed at the time of preprocessing due to their capacity to their diminished capacity to contribute to the computation of the task metrics. The final sample included 148 undergraduate students (119 female, 29 male), with ages ranging from 17 to 42 years (*M* = 21, *SD* = 3.7). Informed consent was obtained from all participants prior to the study commencing and the study was approved by the University of Waterloo's Research Ethics Board.

*3.1.2. Materials*

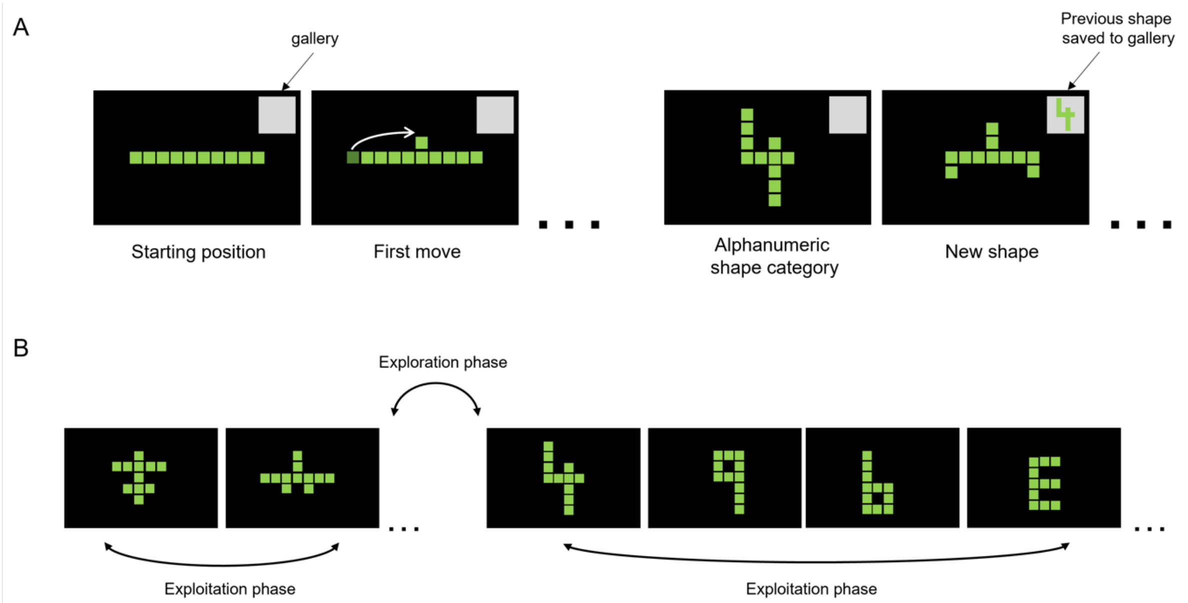
*State Boredom Scale*. Participants were asked "On a scale of 1 to 9, how bored are you right now? (1 being not at all bored and 9 being extremely bored)." Participants were asked this both before and after completing the creative foraging task.

*Shortened Boredom Proneness Scale* (sBPS; Struk et al., 2017). As in Experiment 1, participants completed the sBPS prior to being recruited to the study as a part of a screening procedure administered to large undergraduate samples at the University of Waterloo.

*Creative Foraging Task* (Hart et al., 2017). The Creative Foraging Task was developed by Hart and colleagues (2017) and is designed to be administered online. Participants are shown ten identical, horizontally aligned squares and are asked to move the squares to create shapes. Movements are constrained such that only the squares at the ends of the horizontal array are movable in the first instance, and thereafter, only squares on the perimeter of previously constructed shapes can be moved (Figure 2A). Participants can save shapes to a 'gallery' which they can review at the end of the task to choose their favourite shape. Participants were instructed to save shapes that they liked to the gallery and were told that they must save at least five shapes.

The task allows for several metrics associated with exploratory and exploitative behaviours. These include the number of individual shapes of a given category saved to a gallery (Figure 2A), a reflection of exploitative behaviour given that the participant is presumably attempting to find as many shapes as possible of a given kind (e.g., exploiting the discovered 'planes' category). To examine exploratory behaviour the researcher can determine the number of 'steps' (i.e., how many squares are moved from one shape to now make another) taken between categories. The specific metrics one can extract from the Creative Foraging Task are described further below. The data from the Creative Foraging Task was preprocessed by the original authors of this task using an analysis pipeline they created. All following data analyses were conducted on the preprocessed data.

Figure 2. A) Schematic Representation of the Creative Foraging Task in which Participants Move Squares to Create Shapes and Save those Shapes to a Gallery (Upper Right Grey square in Each Frame). B) Examples of Exploitative and Exploratory Phases.




Note: The exploitative phases are indicated by sequential production of within category shapes (e.g., two 'planes' shown on the left phase and four alphanumeric characters shown in the right phase). Exploration phases are defined as the number of moves taken between discovered categories of shapes, with a 'move' indicated by moving a single square.

*Clusters*. A cluster is a bout of exploitation, or one phase of exploitation, indicated by multiple shapes made within a single category (e.g., how many saved shapes were made within the alphanumeric symbols category?). The shape categories were calculated using a network community approach (see Hart et al., 2017 for details).

*Median Exploration*. The median exploration score is the median number of moves made between two categories, averaged across all exploration phases (Figure 2B). That is, the number of moves a participant makes between saving shapes in two distinct categories is taken to reflect an exploration of 'shape space'. In other words, if a participant goes from the 'planes' category to the 'numbers' category in 2 moves that would indicate a brief exploratory phase (and vice versa).

*Median Exploitation*. The median exploitation score is the median number of moves between the first and last chosen shapes *within* a cluster, averaged across all clusters (Figure 2B). That is, the number of moves made while a participant saves shapes from within the same category is taken to reflect a phase in which that category is being exploited. A small number would indicate a relatively brief exploitative phase.

*Exploration Optimality*. Exploration optimality is the median ratio between the minimum number of moves possible between two consecutively chosen shapes during an exploration phase and the number of moves the player actually took (median shortest path/actual path). This ratio is then averaged across all exploration phases. Lower scores indicate that a participant took more steps than optimal to move between shapes during the exploration phase.

*Exploitation Optimality.* Exploitation optimality is the median ratio between the minimum number of moves possible between two consecutive shapes during an exploitation phase and the number of moves the participant actually took (median shortest path/actual path), averaged across all exploitation bouts. Lower scores reflect the fact that a participant took more steps than optimal to move between two consecutive shapes within an exploitation phase.

*Creativity.* Two measures were taken to reflect creativity. The first, labelled originality, is the mean uniqueness score of all shapes a participant saved compared to all other participants, calculated as the minus log of the frequency of shapes created by all participants in the dataset (*Originality = -Log[frequency]*). Second, uniqueness is taken as the number of shapes that only that participant discovered compared to all other participants.

*Galleries.* Galleries is the number of shapes a participant saved to the gallery. When this paper makes reference to shapes produced, this refers to shapes a participant saved to the gallery.

*Total Moves.* The total number of squares a participant moved during the entire task.

*Average Speed.* The total number of moves divided by the total task time for each participant.

*3.1.3. Procedure*

After participants gave consent, they began by rating their current state boredom followed by basic instructions of how the Creative Foraging Task worked. Then participants were provided with these instructions prior to starting the Creative Foraging Task:

> Despite the simple rules of the game there are many beautiful and interesting shapes to discover. Your task is to move in each stage one cube in order to reach a new shape. You can save the shapes that you like in the 'Shape Gallery', by clicking the red button at the top-right corner of the screen. You have to save at least five shapes to the gallery.

Participants were told that the length of the game was 12 minutes and the task simply ended automatically this time had elapsed. Upon completion of the task participants again gave state boredom ratings.

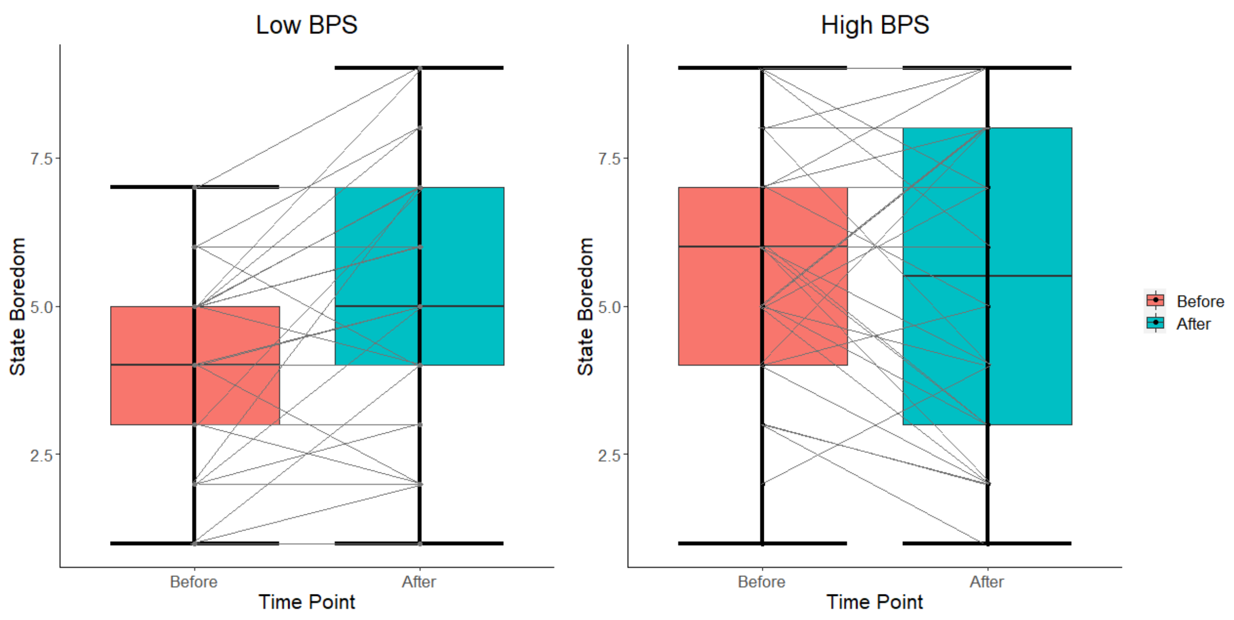
3.2. Results

Two measures, median exploration and median exploitation, were not normally distributed. Median exploration had a skew of 5.16 and kurtosis of 39.03. Median exploitation had a skew of 4.72 and kurtosis of 36.81. Outliers in both measures were removed using the interquartile range criterion (IQR) which removes scores above and below the third quartile plus 1.5 times the difference between the third and first quartile. This removed thirteen outliers (final sample *n* = 135; mean age = 21 years). After removing outliers, median exploration had a skew of 0.68 and kurtosis of 2.75; median exploitation had a skew of 0.86 and kurtosis of 3.04.

As for clusters, the current sample had a median of 7, a mean of 8.57 and a standard deviation of 5.58. Using a network community approach (as described in Hart et al., 2017), it was found that there were 14 unique shape categories that were discovered by the vast majority of the participants. By subtracting these 14 shape categories from the number of clusters we were able to determine the number of unique shape categories made by each participant (median = 4, mean = 5.65, SD = 4.79).

As in Experiment 1, trait boredom proneness ($M$ = 35.5, $SD$ = 10.2) was significantly correlated with state boredom before the task, $r$ = .27, $p$ = .002, but not after the task, $r$ = .01, $p$ = .952. To test whether high and low boredom prone groups significantly differed on the state boredom before and after the task a mixed design ANOVA was performed. To create high and low boredom prone groups a tertile split of scores on the sBPS was calculated with the high boredom prone group defined as the upper tertile and the low boredom prone group defined as those scoring in the lower tertile. A mixed design ANOVA, with boredom proneness groups as the between-subjects variable and state boredom before and after the task as the within-subjects variable, showed that there was a significant interaction between the boredom proneness groups and state boredom, $F(1,63) = 7.914$, $p$ = .026. Simple main effects indicated that the low and high boredom proneness groups significantly differed on state boredom before the task ($F(1,65)$ = 10.27, $p$ = .002), but not after the task ($F(1,63)$ = 0.35, $p$ = .557; Figure 3). As was the case in Experiment 1, the low boredom prone group became more bored over the course of the task to reach a similar level of state boredom to the high boredom prone group by the end of the task. Trait boredom proneness was not significantly related to any other task measures.

Figure 3. Left: A Box and Whisker Plot Overlayed with Individual Data Points (Grey Lines) Showing the Difference in State Boredom before and after the Task for the Low Boredom Prone Individuals. Right: A Box and Whisker Plot Overlayed with Individual Data Points (Grey Lines) Showing the Difference in State Boredom before and after the Task for the High Boredom Prone Individuals.



State boredom before the task (*M* = 4.9, *SD* = 2.1) was only correlated with trait boredom proneness, as mentioned above, and was not correlated with any other measures. State boredom after the task (*M* = 5.5, *SD* = 2.2) on the other hand was related to several task measures. First, state boredom was negatively associated with both median exploration and exploitation (Table 2), indicating that those who were more bored by the task had made fewer steps or moves in both the exploration and exploitation phases. In contrast, state boredom was positively related to exploitation, but not exploration, optimality (Table 2), indicating that participants who were more bored by the end the task were more efficient in the paths chosen between saved shapes (i.e., shorter paths between shapes were associated with more boredom) within a cluster. Additionally, state boredom by the end of the task was significantly negatively correlated with the total time spent in the task, meaning more bored participants quit the task early. Finally, post task boredom was positively correlated with the number of shapes saved to the galleries, and the number of clusters 'discovered' or used (Table 2).

Table 2: Correlations between Boredom Measures and Creative Foraging Task Metrics

| | SB Before | SB After | sBPS |
|---|---|---|---|
| Median Exploration | -.10 | -.28** | -.03 |
| Median Exploitation | -.12 | -.29*** | -.04 |
| Explore Optimality | .01 | .13 | -.02 |
| Exploit Optimality | .07 | .25** | -.09 |
| Total Time | -.06 | -.19* | .02 |
| Galleries | .01 | .22* | .10 |
| Clusters | .05 | .23** | .13 |
| Originality | -.06 | -.02 | .13 |
| Uniqueness | -.04 | .03 | .14 |
| Total Moves | -.01 | -.12 | .14 |
| Average Speed | -.10 | -.10 | .14 |

Significance codes: <.001 '***', <.01 '**', <.05 '*', <0.1 '.'
Note: SB stands for state boredom.

The two measures of creativity, originality and uniqueness, were not significantly correlated with either trait boredom, or state boredom before or after the task (Table 2). In an exploratory analysis, it was found that originality and uniqueness were significantly correlated with several of the other task measures (Table 3). Both originality and uniqueness were negatively correlated to median exploratory and exploitative behaviours, suggesting that higher creativity was associated with fewer moves in both phases. Further, both originality and uniqueness were positively related to exploration, but not exploitation optimality (Table 3), indicating that more creative shape construction was associated with shorter paths between shapes in the explore phases. Higher scores in originality and uniqueness were also related to more saved shapes (galleries) and more bouts of exploitation (i.e., more clusters; Table 3).

Table 3: Correlations between Originality/Uniqueness and Task Metrics

| | Originality | Uniqueness |
|---|---|---|
| Median Explore | -.24 ** | -.20 * |
| Median Exploit | -.27 ** | -.26 ** |
| Explore Optimality | .23 ** | .24 ** |
| Exploit Optimality | .14 | .10 |
| Total Time | .10 | .11 |
| Galleries | .38 *** | .40 *** |
| Clusters | .39 *** | .41 *** |
| Total Moves | .10 | .11 |
| Average Speed | .09 | .10 |

Significance codes: <.001 '***', <.01 '**', <.05 '*', <0.1 '.'

Correlations between all the task metrics are shown in Table 4. As would be expected, many of these metrics are significantly correlated (e.g., originality and uniqueness show a very strong positive relation). The negative correlation between the amount people explored and the optimality of that behaviour indicates that more exploration was associated with longer movement paths (which, given the way optimality is calculated is considered to be less optimal). The same can be said of the relation between the amount of exploitation (i.e., median exploit in Table 4) and exploitation optimality. Spending more time exploiting a category will mean more moves are taken in that phase and the optimality metric favours fewer moves. Notably, time spent on the task only correlated (positively) with the total number of moves made and did not affect the number of shapes saved (represented in the Galleries variable in Table 4).

Table 4: Correlations between Task Metrics

| | Median Exploit | Explore Optimality | Exploit Optimality | Total Time | Galleries | Clusters | Originality | Uniqueness | Total Moves | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|
| Median Explore | .71*** | -.48*** | -.69*** | .05 | -.62*** | -.63*** | -.24** | -.20* | .11 | .11 |
| Median Exploit | | -.46*** | -.56*** | .01 | -.53*** | -.58*** | -.27** | -.26** | .15. | .15. |
| Explore Optimality | | | .56*** | -.08 | .40*** | .41*** | .23** | .24** | -.21* | -.20* |
| Exploit Optimality | | | | -.08 | .45*** | .44*** | .14 | .10 | -.27** | -.26** |
| Total Time | | | | | .11 | .12 | .10 | .11 | .24** | .15. |
| Galleries | | | | | | .97*** | .38*** | .40*** | .33*** | .33*** |
| Clusters | | | | | | | .39*** | .41*** | .31*** | .31*** |
| Originality | | | | | | | | .94*** | .10 | .09 |
| Uniqueness | | | | | | | | | .11 | .10 |
| Total Moves | | | | | | | | | | 1.00*** |

Significance codes: <.001 '***', <.01 '**', <.05 '*', <0.1 '.'

3.3. Discussion

Results from Experiment 2 showed no relation with either state or trait boredom proneness and creativity, characterized by the uniqueness and originality of the shapes made. With respect to other performance metrics, results showed that higher state boredom by the end of the task was negatively related to both exploration and exploitation (Table 2), suggesting that higher state boredom was related to shorter paths taken in both instances. It should be noted that there is some ambiguity in what these metrics actually measure. Fewer steps could be indicative of lower levels of exploration or exploitation (whatever 'lower levels' might mean), but may also represent more efficient behaviour, in that participants take fewer steps as they move from one shape/category to the next. If the first instance were the case, that fewer steps was indicative of less exploring and exploiting behaviour, then those reporting higher state boredom might be moving through the task without stopping to either explore different categories of shapes or exploit any given category. In contrast, if the second explanation was the case, that fewer steps represented greater efficiency, then those reporting higher boredom could be seen to be taking a "get on with it" approach, meaning that they were moving from one shape to the next and one category to the next more effectively. The finding that those who were more bored after the task saved more shapes to the gallery supports the notion that fewer steps was indicative of greater exploitative efficiency. The interpretation of the relation between higher state boredom by the end of the task and lower levels of exploratory behaviour is more nuanced. State boredom by the end of the task was also related to time spent in the task such that higher reported levels of boredom were associated with exiting the task early (Table 2). While this does not explicitly relate to exploration, it may be the case that more efficient exploratory behaviours meant that participants felt they had exhausted the possibilities in the task earlier than those who were low in state boredom. Clearly, more work is needed to examine the relation between in-the-moment feelings of boredom and exploratory behaviour.

When considering the number of bouts of exploitation undertaken, it can be inferred that this in turn reflects the amount exploration phases in the task – that is, more stand-alone bouts of exploitation also means the participant has a higher number of clusters (and one must explore cluster space to find those distinct clusters). In this context, those who were more bored at the end of the task exhibited more episodes of exploitation suggesting that they also moved rapidly from one cluster to the next. This supports the conception of boredom as a call to action in that boredom prompted movement between clusters, with exploitation of shapes within a category also completed swiftly to enable the participant to move on to the next discovered category. This is further supported by the optimality data. Here, higher levels of state boredom post task were associated with higher optimality scores in both the exploitation and exploration phases. For exploitation episodes, optimality suggests that participants took the shortest path from one shape to the next within a category. For exploration episodes, this metric suggests that participants took the shortest path between newly explored shape categories before settling on a new category to exploit. Taken together, the data suggests that state boredom experienced during the task (presuming that higher post-task boredom ratings reflected rising in-task boredom) pushes participants to both explore for more categories and to exploit those categories more efficiently. Future work of this kind could measure boredom throughout the task as well as before and after to allow for a more fine-grained temporal analysis of boredom and the task metrics. This would reveal whether boredom is causing certain behaviours in the task or whether behaviours in the task are resulting in more or less boredom.

## 4. General Discussion

The notion that boredom begets creativity is rife in popular culture (Thorp, 2020; Thompson, 2017; Zomorodi, 2017). Despite this, research explicitly examining the relation has been flawed in multiple ways (e.g., low samples sizes, combining distinct affective states, confounding variables; Gasper and Middlewood, 2014; Larson, 1990; Mann and Cadman, 2014;). In addition, recent work has suggested that there may not be any reliable relation between creativity and boredom proneness, perhaps highlighting the logical contortions of the claim (Brosowsky et al., 2022; Hunter et al., 2016; Liang et al., 2020; see also Haager et al., 2018 who showed that any relation between boredom and increased fluency was accounted for by practice effects). When bored, seeking creative outlets may provide a wonderful salve, but one can't hope that the mere experience of boredom will lead to the magical appearance of creative skills. The experiments presented here more directly tested the relation between state/trait boredom and creativity and found conclusively that boredom does not make us more creative. If anything, the effects of state and trait boredom lie in the opposite direction.

The attempted *partial* replication of findings from Mann and Cadman (2014) in Experiment 1 clearly failed to show any *positive* relation between boredom, boredom proneness and any measure of creativity, either on the Creative Uses Task or on a wide range of self-report measures of creativity. Higher reports of state boredom were in fact, associated with poorer performance on the Creative Uses Task. While measures of daydreaming were not taken (as they were by Mann and Cadman, 2014), it seems unlikely that this omission drove the current results. That is, it may be the case that higher levels of daydreaming do indeed lead to more creative responses on the Creative Uses Task. For Mann and Cadman, their induction of boredom may have caused daydreaming, but what is clear from the current results, is that state boredom alone does not improve creative output. It is worth mentioning that the effect size evident in Mann and Cadman's (2014) work was very small (d = 0.08). So, while the current study was more strongly powered than Mann and Cadman's it is possible that a much larger sample size (G*Power calculated a sample in the range of 3,000) would detect a very small relation between boredom and creativity. Even so, such a small effect, although statistically significant would be rendered practically irrelevant.

In addition, it was found that trait boredom proneness was not associated with higher levels of creativity on the Creative Uses Task. As mentioned above, other recent work has shown that those higher in trait boredom proneness tended to engage in fewer creative outlets during the pandemic (Brosowsky et al., 2022; see also Hunter et al., 2016). This fits with an account of boredom proneness that highlights the conundrum for these individuals—that while they experience the desire to be engaged, they fail to launch in action (Mugon, et al., 2018). The story may not be quite that simple, given research suggesting that boredom prone individuals do launch into what might be considered maladaptive actions (i.e., higher rates of alcohol and drug use, problematic gambling, increased risk taking, etc.; Kılıç et al., 2019; Lee et al., 2007; LePera, 2011; Mercer and Eastwood, 2010). Given that engagement in creative outlets would generally be considered adaptive, this work raises the question of why the highly boredom prone might fail to launch into adaptive outlets for engagement (e.g., creative outlets) while seemingly having less difficulty launching into maladaptive behaviours.

Beyond the Creative Uses Task, the results of Experiment 1 showed that higher levels of trait boredom proneness were associated with lower levels of belief that one has the potential to be creative (Creative Self-Efficacy). This may represent one determinant of the highly boredom prone individual's failure to launch into creative actions despite the desire to be engaged (Mugon et al., 2018). That is, if the highly boredom prone individual does not believe they will be effective in goal pursuit (creative or otherwise) they may decide that it is not worth the effort to engage. This is supported by the negative relation between boredom proneness and the pursuit of everyday creative activities seen here and in prior work (Brosowsky et al., 2022). Recent work exploring the relation between boredom and self-esteem shows that those high in boredom proneness tend to be lower in self-esteem (Mugon et al., 2020). Previous research has shown that self-esteem is predictive of creative performance (Goldsmith and Matherly, 1988) and self-perceived creativity (Karwowski, 2009). It has even been proposed that high self-esteem is necessary for high creative achievement (Yau, 1991). While self-esteem and one's sense of self-efficacy are not redundant concepts, it is plausible that the highly boredom prone struggle with engaging in meaningful pursuits as they do not believe that their actions will reliably achieve their aims.

The results of Experiment 2 largely confirmed those of Experiment 1, in which there was no relation between state or trait boredom proneness and the explicit metrics of creativity (i.e., uniqueness and originality of shapes created). It is perhaps worth noting that the task itself was potentially seen to be boring, as ratings of state boredom increased by the end of the task. In addition, this task took four times longer to complete than the Creative Uses Task. It may be the case that time on task led to increased boredom ratings as opposed to the intrinsic nature of the task itself. Nevertheless, in-the-moment feelings of boredom prior to or after the task were unrelated to metrics of creativity.

Aside from creativity, the results of Experiment 2, showed that state boredom was negatively associated with exploration and exploitation metrics. The interpretation of these metrics may be somewhat ambiguous, perhaps more indicative of efficiency within the exploration/exploitation phases, as opposed to lower/higher levels. Further research could make use of more traditional foraging environs (e.g., Struk et al., 2019) to determine the potential influence of state and trait boredom on exploratory and exploitative behaviours. What is crystal clear from these two studies, however, is that there is no support for the claim that state and trait boredom beget creativity.

### 4.1 Limitations and Future Directions

In Experiment 1, it is important to note that the agreement between raters on scores for the Creative Uses Task was lower than that of Mann and Cadman's (2014). Creativity is a notoriously subjective and difficult construct to score with high levels of agreement despite taking care to do so. Future work could engage more raters in the hopes of reaching stronger agreement. Further, the methods of this study differ slightly from that of Mann and Cadman's (2014), for a number of reasons stated in the Introduction. While these reasons for change were well motivated, it nevertheless means that this can only be considered a partial replication of that study. We don't see any reason why a stricter replication should yield positive results, although it is worth noting the absence of any measure of daydreaming. It is plausible that the results originally found by Mann and Cadman depended on this metric. That is, those who reported higher levels of daydreaming during the boredom mood induction were the same participants who also performed better on the creative uses task. It seems likely then that daydreaming, and not boredom per se, drove this effect. Future research could examine this hypothesis directly.

In Experiment 2 we chose not to include a mood induction which would have allowed for a more direct examination of the influence of state boredom. This choice was based on the length of time the Creative Foraging Task involves (12 minutes) in comparison to the Creative Uses Task (3 minutes). It is well known that mood inductions tend to rapidly wane in efficacy. While this is not problematic for the shorter task, it could have been problematic for the longer task. In addition, the task itself turned out to be felt as boring, making any prior control mood induction less useful (i.e., an interest mood induction would have been swamped by in-task boredom making it difficult to disentangle from the boredom mood induction group).

In Experiment 2, the nature of the Creative Foraging Task, while unique and fecund, is limited in a few important ways. Most notably, only those shapes that a participant decides to save to the gallery are recorded, despite a new shape being created every time one square was moved in the task. However, it is also true that simply moving one square may not be indicative in the participant's mind that a new shape has been created. The particular metric, number of shapes created (but not necessarily saved) may prove invaluable both as a covariate of other metrics (e.g., would those who create fewer shapes exploit categories less?) and as a measure of interest itself. Future work could measure this more directly. Another limitation regarding the Creative Foraging Task involved the optimality measures. These measures assume that when exploring or exploiting, taking the shortest path between shapes is optimal. One could argue that 'pure' exploration would involve more steps. It is the 'discovery' of a new shape (and potentially a new category) that terminates exploratory behaviour in this task. Under different circumstances (e.g., a foraging task; Struk et al., 2019), longer exploration paths may be considered optimal.

What seems clear from the current work is that there is no strong evidence for a positive relation between either state or trait boredom and the propensity for creative behaviours.

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