Examining the relation between boredom and creativity

by

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A thesis

presented to the University of Waterloo

in fulfilment of the

thesis requirement for the degree of

Master of Arts

in

Psychology

Waterloo, Ontario, Canada, 2022

Author's Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Statement of Contributions

The experiments presented here were conducted in collaboration with my supervisor Dr. James Danckert.

Abstract

Popular sentiment expresses that boredom leads to creativity despite a lack of research investigating the relationship explicitly. Across two experiments this thesis examined the relations between both state and trait boredom and creativity. Experiment 1 explored these relations by inducing boredom and having participants complete a divergent thinking task. In addition, trait level self-reported creativity and boredom proneness were measured. Results indicated that state boredom was in fact associated with poorer performance on the divergent thinking task and trait boredom proneness was associated with diminished belief in creative potential and lower levels of engagement of everyday creative pursuits. Experiment 2 utilized a novel, creative foraging task and again found no relation between state or trait boredom and creativity. Overall, the findings of these studies suggests that neither state boredom nor trait boredom proneness leads to or promotes creative output, although further research is needed in order to determine how boredom may be associated (or not) with creativity and creative behaviours.

Acknowledgements

I would like to thank my supervisor, Dr. James Danckert, for all his valuable feedback, guidance, support and understanding throughout this process. I would also like to extend thanks to my readers Dr. Michael Dixon and Dr. Colin Ellard.

Additionally, I would like to thank my fiancé, Nick, for his endless support and encouragement in everything I do.

This research was conducted at the University of Waterloo and was supported by the National Sciences and Engineering Research Council.

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Introduction

Boredom is a negative affective state of wanting, but failing, to satisfy the urge to be engaged (Eastwood et al. 2012). Those who experience boredom more frequently and more intensely are said to be highly boredom prone (Tam et al., 2021). For the highly boredom prone, the state of boredom presents a kind of conundrum – a desire to be engaged, coupled with a failure to launch into action (Mugon et al. 2018).

Bench and Lench (2013) suggest that although state boredom is a short-lived emotion, it is functional in that it encourages the pursuit of novel experiences. As a call to action then, the state of boredom may represent a viable trigger for a broad swathe of actions including those that might be considered 'creative'. There is evidence that novelty is often sought out as a way to alleviate boredom (Bench & Lench 2019), and creative activities often involve novelty (either as a process or an outcome). Despite popular sentiment that boredom could (or even ought to) lead to creativity, there is a lack of research to examine explicitly the relation between boredom and creativity. There is nothing inherent about boredom that would suggest it would necessarily *enhance* creativity. That is, there is a logic problem here: boredom does not *make* one creative; creative practice and training achieves that end. On the other hand, while the popular claim that boredom will make you more creative is perhaps illogical, it is plausible that the pursuit of creative activities may function well to alleviate boredom. Rather than boredom making a person creative, it is much more likely that cultivating creative outlets can alleviate boredom as they represent engaging activities that by their nature have no room for boredom.

What little research there is exploring the relationship 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 from a phonebook. 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 are asked to come up with a list of uses for a polystyrene cup. Results showed that those who reported daydreaming during the boredom induction also tended to perform 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 higher levels of creativity. Similarly, Gasper and Middlewood (2014) found that participants in approach-oriented states (in this instance elation & boredom were averaged together under the umbrella of "approach" states), performed better on two measures of associative thought when contrasted with those in avoidance states (i.e., distress and relaxation). Boredom was not measured explicitly in this study, and it is difficult to disentangle the influence of the state when it is grouped with the distinct experience of elation.

A more recent study examined boredom, novelty and trait creativity during COVID-19 quarantine (Liang et al., 2020). In this study, novelty-seeking behaviour was divided into what the authors referred to as novelty input and novelty output. Novelty input was defined as obtaining novel information via activities such as browsing the internet, whereas novelty output was defined as engagement in a creative activity, such as creative writing. No relationship was found between boredom and either novelty input or novelty output (Liang et al., 2020). Nevertheless in this same study, it was found that trait creativity moderated the relationship between novelty output and state boredom. That is, for individuals with high trait creativity, novelty output negatively predicted their state boredom, whereas for those who were low in trait creativity, novelty output did not predict state boredom. This supports the notion that creativity works well to eliminate (or perhaps even prevent boredom) given that higher creativity was associated with both more novel outputs and lower boredom. Finally, a recent study from Brosowsky and colleagues (2022) examined the influence of pursuing creative outlets on mental well-being during the pandemic. Using measures of depression and anxiety, general optimism for life, self-esteem, and positive and negative affect as metrics of mental well-being, the study showed that those who pursued more creative outlets (in everyday settings and tasks) during the pandemic had higher levels of mental well-being. With respect to trait boredom proneness, those higher in boredom proneness were less likely to engage in creative pursuits. In other words, the highly boredom prone failed to effectively utilize creative outlets to alleviate their 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. State boredom functions as an in-the-moment call to action (Elpidorou, 2014). As such, it is plausible that engaging in creative pursuits represents one positive response to being bored. A defining feature of trait boredom proneness, on the other hand, is the failure to launch into action (Mugon et al., 2018). When actions are engaged in as a response to boredom by the highly boredom prone, they are rarely adaptive. That is, high levels of boredom proneness are associated with elevated drug and alcohol abuse (Lee et al., 2007; LePera, 2011), binge eating (Abramson & Stinson, 1977), problem gambling (Mercer &

Eastwood, 2010), and risk-taking behaviours (Kılıç et al., 2019). In contrast, the response to state boredom does not necessarily have to be positive or negative. Bench and Lench (2019) induced boredom in participants by having them view either positive or negative image sets ten times (for a total duration of about 12.5 minutes). Results showed that those who were bored by viewing positive images were more likely to choose a negative novel experience afterwards, while those who were bored by viewing negative images were more likely to choose a positive novel experience afterwards. In other words, the response to boredom depends on the context in which boredom arose. Indeed, at least one study has shown that state boredom, induced by a repetitive task, can increase prosocial giving behaviours such as intentions to donate to charities (Van Tilburg et al., 2016). In contrast, the state of boredom has been shown to lead to more overtly negative actions such that participants induced into a state of boredom were more likely to engage in sadistic behaviours such as killing worms (Pfattheicher et al., 2021). So, while trait boredom proneness represents a persistent self-regulatory failure to respond adaptively to boredom, state boredom represents an in-the-moment self-regulatory signal to act, with the choices of those actions being highly context dependent.

The overarching purpose of this thesis was to examine the relation between both state and trait boredom and creativity. Experiment 1 represents a partial replication of the Mann and Cadman (2014) study via a variety of surveys and a divergent thinking task which taps into a capacity thought to reflect creative ability (Plucker & Renzulli, 1999; Silvia et al., 2008), to explore the relation between state and trait boredom and creativity. Because creativity is complex, three different creativity scales were chosen in order to measure self-perceptions of creativity (Short Scale of Creative Self; Karwowski, 2011), creative behaviours (Creative

Behaviors Inventory; Dollinger, 2003), and creativity in more specific domains (Kaufman Domains of Creativity Scale; Kaufman, 2012).

Divergent thinking is widely considered to be a key aspect of creativity (Plucker & Renzulli, 1999; Silvia et al., 2008) and is measured via a range of creative tasks, perhaps the most famous of which is the Alternate Uses Task (Fink et al., 2009). Participants are given an object in this task, such as a polystyrene cup, and are asked to list as many uncommon or original uses as possible. Creativity on this task is measured both by the number of responses generated and the extent to which those ideas can be considered original or creative (Vartanian et al., 2019; Guilford, 1971). In addition to measuring state boredom and divergent thinking using the Creative Uses Task (see below), measures of trait boredom proneness were included.

Experiment 2 examined how trait and state boredom relate to creative behaviours using a novel task in which participants were required to 'forage' for shapes (see below for a full description of the task). One prominent theory of the creative process splits creativity into four stages: preparation (involving conscious voluntary thoughts), incubation (involving unconscious, involuntary thoughts and mental exploration), illumination (the part of the process in which the final 'click' of an idea happens), and verification (the stage in which the idea is consciously worked through and tested; Wallas, 1926; Sadler-Smith, 2015). With respect to the task used in Experiment 2, the incubation stage of creativity involves exploratory behaviour, which may be the mechanism by which state boredom leads to creativity. That is, state boredom signals the need to act, to explore one's environs for something more engaging to pursue. Creativity demands just such exploratory behaviour, thereby satisfying the need signaled by boredom (although it should be noted that creativity is only one of many potential exploratory behaviours). The novel task used in Experiment 2, called the Creative Foraging Task, was specifically designed with creative exploration in mind. Hart and colleagues (2017) defined creative exploration as the act of searching for novel and valuable elements within a set of well-defined constraints. In the Creative Foraging Task, the goal is two-fold, both to find as many solutions as possible, and to find novel solutions (Hart et al., 2017). This allows both creativity and exploratory/exploitative behaviours to be measured. Exploration is defined as seeking a goal to engage with, while exploitation is defined as maximising the resources/outcomes of an activity (Kurzban et al., 2013). Exploration and exploitation are important to measure for two reasons; first, as mentioned above, exploration represents a key component of creative activities. Second, functional accounts of boredom suggest that it signals the need to explore one's environs for more engaging activities. As such, exploratory behaviour may represent the key mechanism linking boredom and creativity. The overarching aim of this thesis was to examine the relation between state and trait boredom and creativity to determine whether there is indeed any truth to the claim that boredom begets creativity.

Experiment 1: Self-Reported Creativity, Divergent Thinking, and Boredom

The purpose of Experiment 1 was to partially replicate the Mann and Cadman (2014) study by inducing state boredom and measuring the influence of varying levels of boredom on creativity using the Creative Uses Task (CUT). A partial replication was chosen in order to overcome some of the shortcomings of the original study. First, while Mann and Cadman induced boredom in one group of participants, their control group had no opposing induction. That is, the control group simply performed the Creative Uses Task with no preceding mood induction. In prior work on state boredom, it has been critical to induce contrasting mood states (e.g., sadness, interest) in control groups to ensure that any effects are genuinely related to the induction of boredom and not some generic effect of undergoing any mood induction (e.g., Merrifield & Danckert, 2014). The current experiment used a between subjects' design, inducing the states of boredom and interest in separate groups with each group watching previously validated, comparable (in terms of time) mood inducing videos (Merrifield & Danckert, 2014). Second, Mann and Cadman (2014) only examined creativity among participants who reported engaging in daydreaming during the boredom induction. This makes it difficult to disentangle the influence of boredom versus daydreaming on creative output. Additionally, the original study does not address either trait creativity or trait boredom. It is uniformly agreed that creativity is a complex, multifaceted construct that can manifest in many different ways (Abraham, 2016; Dietrich, 2004; Dietrich, 2019; Smith, Ward, & Finke, 1995). Despite the fact that divergent thinking has been considered the standard experimental paradigm for assessing creativity (Dietrich, 2019), the task has significant confounds, not least of which is the notion that it invokes several distinct mental processes (Ward et al., 1999). In addition, convergent thinking has been shown to result in creative idea production (Runco, 2004; Simonton, 2015). In order to capture more of creativity than just divergent thinking, several distinct self-report measures of creativity were included in the current study. The included measures tap into concepts such as self-perception of creativity (Creative Personal Identity), creative efficacy (Creative Self-Efficacy), a broad multidimensional metric of creativity (Kaufman's Domains of Creativity Scale), and everyday acts of creativity (Creative Behavior Inventory) which has been shown to be important for mental health (Brosowsky et al., 2022). Both state and trait boredom were measured to determine the distinct relation between the in-the-moment feeling state and the trait disposition with creativity. As mentioned previously, state boredom functions as a call to action (Elpidorou, 2014) which makes it plausible for creativity pursuits to be an adaptive response to boredom. On the other hand, boredom proneness can be cast as a failure to launch into action (Mugon et al., 2018). Creative or destructive actions may be equally likely avenues to cope with boredom for the highly boredom prone, making one option (i.e., creativity) no more likely than another. Further, the current study engaged a larger sample (Mann & Cadman had 80 participants split into two groups; the current study has 197 participants split into two groups) to increase the power to find effects should they exist.

In the current study, state boredom was hypothesized to lead to better performance on the Creative Uses Task, an effect that would be moderated by trait boredom proneness such that those who are highly boredom prone would perform worse on the Creative Uses Task when bored, while those who are not boredom prone would perform better on the Creative Uses Task when bored.

Method

Participants

197 undergraduate students (159 female, 29 male, 7 non-binary, 1 two-spirited, 1 undisclosed) were recruited on SONA (an online recruitment site for undergraduate students) and received 0.5 course credit in return for participation. The participants ages ranged from 18 to 51 years (*M* = 21, *SD* = 4.2). Participants were randomly assigned to either a boredom or interest mood induction condition. There were 98 participants in the boredom induction condition (76 female, 17 male, 3 non-binary, 1 two-spirited, 1 undisclosed) with a mean age of 20.5 years. The interest induction condition was made up of 99 participants (83 female, 12 male, 4 non-binary) with a mean age of 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.

It was decided a priori that as many participants as possible would be collected over the course of a single term (Winter 2022). This led to a sample size of 98 participants in the boredom condition and 99 participants in the interest condition. 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). While the current study is still underpowered to detect such a small effect size, it was deemed a reasonable sample size for replication.

Materials

State Boredom. Participants we asked, “How bored are you right now?” and were provided a slider bar with “Not at all bored” on the left and “Extremely bored” on the right as anchors. Responses were converted into numbers with zero being “Not at all bored” to one hundred at the “Extremely bored” end of the slider. Participants were asked to respond to this prompt before and after the mood induction.

Shortened Boredom Proneness Scale (sBPS; Struk et al., 2017). 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.

Mood Inductions. To induce feelings of state boredom participants were asked to watch a previously validated short movie of two men hanging laundry, occasionally asking one another for a clothes peg (Merrifield & 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. The length of the video was chosen to ensure participants were successfully induced into boredom without having to watch a video for an extended period of time.

To induce interest, participants were asked to watch a previously validated video clip from the BBC documentary Planet Earth (Merrifield & Danckert, 2014). The video consisted of descriptions of a variety of sea creatures for 4 minutes and 13 seconds. Participants were able to continue on to the study, by clicking on an advance arrow at the bottom of the screen, after 3 minutes and 50 seconds of the video had elapsed in order to keep induction times equivalent[1]. The interesting video was slightly longer to allow the video to finish at the end of a scene.

Creative Uses Task (CUT). The Creative Uses Task is an adaptation of the Alternative Uses Task (AUT; Fink et al., 2009) in which a participant is given an object, in this case a feather, and is asked to list alternative or creative uses for the object with a 3-minute time limit. The difference between the Creative Uses Task and the Alternate Uses Task lies in the instructions. In the Creative Uses Task, participants were instructed to come up with as many *creative* and *original* uses for a feather. It was also specified that the creative quality of answers was to be considered more important than the mere quantity of responses (Nusbaum et al., 2014). In contrast, the Alternate Uses Task only asks participants to come up with as many *possible* uses for an item with no instruction regarding the quality of answers. The Creative Uses Task was scored by three independent raters blind to any of the participant information or the task condition participants belonged to. The raters were provided with a list of the Creative Uses Task responses that participants deemed to be their most creative responses (participants were instructed to choose up to three of their most creative responses; see Procedure). Only the responses participants identified as their most creative were rated in accordance with what is known as the top-scoring method (Silvia et al., 2008). The top-scoring method is one in which participants are asked to choose their own best creative ideas which are then scored by independent raters for creativity (Silvia et al., 2008). Another popular method for scoring divergent thinking tasks involves rating responses on originality, uniqueness, and fluency (i.e.,

[1] It was not feasible from the coding of the experiment to determine what percentage of participants exited the video at 3 minutes and 50 seconds. However, given that the mood induction was successful, it is assumed that any participants who watched the additional 23 seconds of the BBC video did not influence results.

the number of responses; Benedek et al., 2013). The problem with this popular scoring method is that fluency contaminates all other scores (Hocevar, 1979a, 1979b; Runco et al., 1987). For example, participants that give more responses are more likely to have higher originality scores (Benedek et al., 2013). The top-scoring method has been found to avoid these problems and to outperform other methods on convergent validity (Benedek et al., 2013; Silvia et al., 2009). Further, it has been found that those better able to discern their creative ideas also had traits that characterize creative people, such as high openness to experience (King et al., 1996; McCrae, 1987; Silvia et al., 2008). Additionally, Silvia (2008) found that participant's choices strongly agreed with the judges' scoring of the responses. Therefore, evaluating participants on their best responses acknowledges creative people can not only come up with creative ideas but also discern which of those ideas are the most creative (Silvia, 2008). 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. The three raters scores were averaged together to get one score for each response and then each participant's highest score was used as their final score on the Creative Uses Task. This method is similar to the method that Mann and Cadman (2014) used. The raters were instructed to rate creativity based on the definition of creativity provided to participants in the instructions, which were:

> *"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."*

Answers that were considered inappropriate given the instructions (e.g., a question instead of a use for a feather) were scored a 1. Weighted Cohen's Kappa was calculated between each of the raters and ranged from .35 to .53, which according to Landis and Koch (1977) translates to fair to moderate agreement.

Short Scale of Creative Self (SSCS; Karwowski, 2011). The SSCS consists of 11 items and is made up of two subscales: the Creative Personal Identity (CPI) and the Creative Self-Efficacy (CSE) scales. The Creative Personal Identity scale measures how important creativity is to one's self-image and includes items such as "My creativity is important for who I am" and "I think I am a creative person". The Creative Self-Efficacy scale measures the belief that one has the potential to be creative and includes items such as "I know I can efficiently solve even complicated problems" and "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 (Appendix A).

Creative Behaviors Inventory (CBI; Dollinger, 2003). The Creative Behaviors Inventory consists of 28 items and measures the everyday creative behaviour of individuals. For each item participants were asked to choose from one of four responses that best describes the frequency of the behaviour in their adolescent and adult life. The four responses they could choose from are: 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 "Assisted in the design of a set for a musical or dramatic production (excluding school or university course work)" (coefficient alpha = .89 (Dollinger, 2003); Appendix B).

Kaufman Domains of Creativity Scale (K-DOCS; Kaufman, 2012). The Kaufman Domains of Creativity Scale (hereafter referred to as the Kaufman scale) consists of 50 items and measures self-beliefs of creativity in five different domains: Self/Everyday, Scholarly, Performance, Mechanical/Scientific, and Artistic. According to Kaufman (2012), the Everyday domain measures everyday creativity including both interpersonal and intrapersonal creativity. In other words, this measures behaviours such as the ability to teach or help others, as well as being able to help oneself work through personal problems and maintaining a balanced life. Scholarly creativity measures creative analysis, debate and scholarly pursuits. That is, it measures abilities in domains such as research, non-fiction writing, debating, as well as integrating critiques while revising work and offering constructive feedback. Performance creativity measures one's capacity for public presentations in a variety of forums, as well as music and writing abilities. For example, these measures include items such as "Making up lyrics to a funny song" and "Shooting a fun video to air on YouTube". Scientific creativity measures mechanical ability and interest in science and math. More specifically, this measures things such as fixing a computer, solving math puzzles, and building things. Finally, Artistic creativity measures creativity in a more traditional art sense, including activities such as drawing, painting, and sculpting. Participants were instructed to rate how creative they perceive themselves to be within each domain in comparison to people of approximately the same age and life experience. For acts that they had not specifically done, participants were instructed to estimate their creative potential based on their performance on similar tasks. These 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); Appendix C).

Procedure

This study was administered entirely online. After participants consented to participate in the study, they began by rating their current state boredom on a sliding scale. Following this, participants were randomly assigned to watch either a boring or an interesting video for approximately four minutes. The video was followed by another state boredom rating, as well as a question asking whether the participant engaged in multitasking during the video. After completing this, participants read the instructions for the Creative Uses Task and then had three minutes to come up with creative uses for a feather. Participants were then shown their responses to the Creative Uses Task and asked to choose up to three of their most creative answers. On average, participants made 9.26 responses and chose 2.24 responses (SD = 0.89) to submit as their best. Finally, participants then completed the three creativity questionnaires in the following order: Short Scale of Creative Self, Creative Behaviors Inventory, and the Kaufman scale.

Results

An ANOVA was used to check whether the manipulation of the mood inductions were successful (Table 1). In this mixed design ANOVA, mood induction was the between-subjects variable (boredom vs. interest) and state boredom before and after the manipulation was the within-subjects variable. There was 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 ($F(1,195) = 0.00$, $p = .954$), whereas the conditions were significantly different on state boredom after the manipulation ($F(1,195) = 60.29$, $p < .001$). In other words, those in the boring condition were significantly more bored after the video than those in the interesting condition (Figure 1).

Table 1: *Means and standard deviations of the conditions for state boredom before and after the manipulation*

	Boredom Before Manipulation		Boredom After Manipulation	
	M	SD	M	SD
Boredom Condition	46.24	27.20	73.26	29.24
Interest Condition	46.47	28.06	40.90	29.25

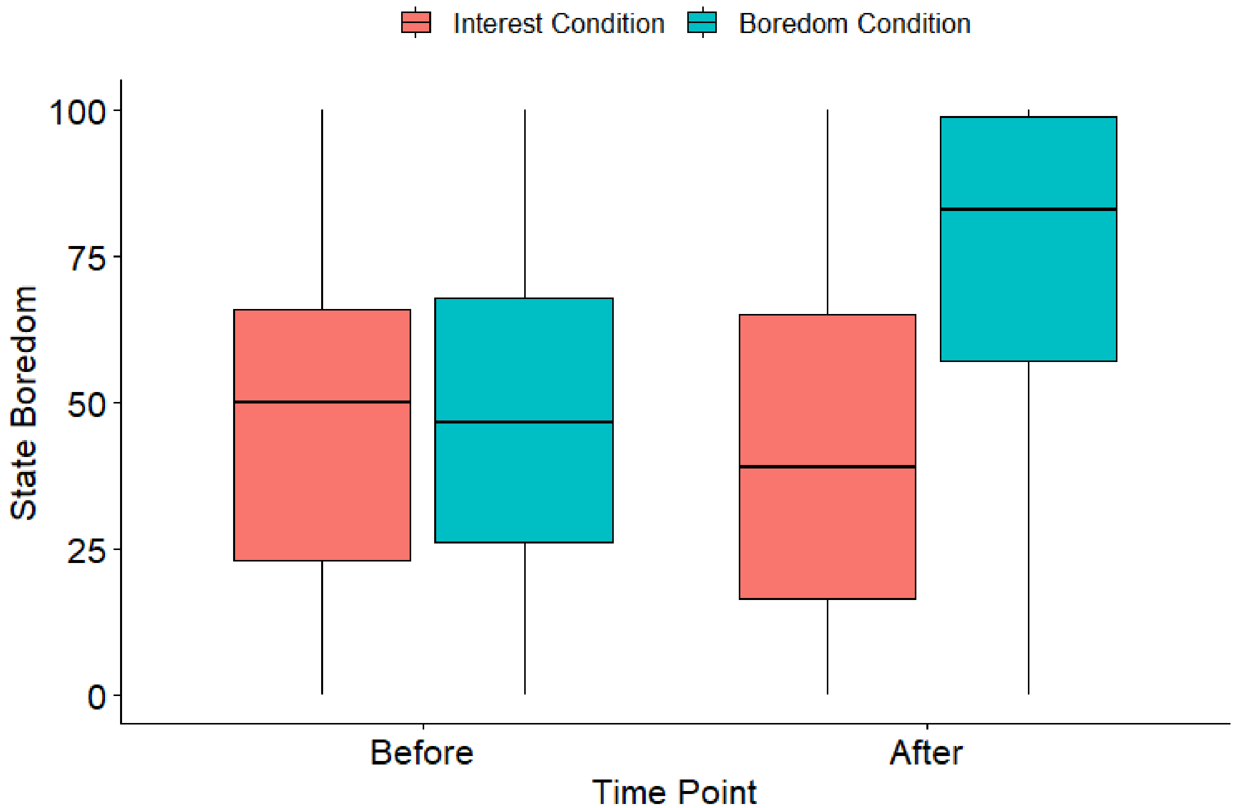

Figure 1. A box and whisker plot of boredom before (left) and after (right) by condition (interest condition in red and boredom condition in blue).

The means and standard deviations of all the creativity measures, as well as trait boredom were examined by condition and gender to ensure both groups were equivalent on these measures before exploring any effects of the mood inductions (Table 2). 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. 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). There were no differences between the mood induction conditions on any of the self-report creative indices (all t's<0.83, all p's>.132y).

Table 2. Mean and standard deviations for males and females divided by condition

	Boredom Condition (n = 98)				Interest Condition (n = 99)			
	Female		Male		Female		Male	
	M	SD	M	SD	M	SD	M	SD
CUT	2.81	0.83	2.78	0.83	2.80	1.00	2.83	0.66
CPI	3.32	0.90	3.41	0.84	3.37	0.97	3.07	1.06
CSE	3.46	0.70	3.62	0.58	3.38	0.77	3.56	0.56
CBI	1.84	0.54	1.55	0.36	1.93	0.55	1.82	0.61
K-DOCS Everyday	3.30	0.60	3.58	0.36	3.40	0.64	3.45	0.46
K-DOCS Scholarly	2.95	0.78	3.18	0.72	3.15	0.70	3.01	0.71
K-DOCS Perform.	2.71	1.04	3.32	0.86	2.69	1.02	2.62	0.91
K-DOCS Science	2.47	0.95	3.23	1.04	2.47	0.95	3.16	0.82
K-DOCS Arts	3.17	0.86	3.25	0.81	3.39	0.92	2.78	1.04
sBPS	35.79	9.68	31.41	10.95	34.27	10.36	33.33	5.97

Note: Abbreviation in the chart 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 Science), and Arts subscale of Kaufman's scale (K-DOCS Arts).

State boredom before the mood induction was significantly positively related to state boredom after the induction such that those who reported higher levels of state boredom pre-induction, also reported higher levels post-induction (Table 3). In addition, those high in trait boredom proneness reported higher levels of state boredom pre-induction (Figure 2). This difference was not evident in the post-induction ratings suggesting that those lower in boredom proneness before the induction attained similar levels of state boredom relative to those high in boredom proneness, by the end of the induction. State boredom before the induction was also significantly negatively correlated with age, indicating that older participants were less bored prior to the induction. State boredom after the mood induction was also significantly positively correlated with boredom proneness, although to a significantly lesser extent (Z = 3.13, p = .002; DeCoster, 2007) than state boredom prior to the induction. Age was significantly negatively correlated with boredom proneness, indicating boredom proneness diminishes with age, a finding common in the literature (Essed et al. 2006; Hill, 1975; Isacescu et al. 2016; Vodanovich & Kass, 1990).

Table 3: *Correlation table for state boredom, boredom proneness, and age.*

	State Boredom Before	State Boredom After	sBPS
State Boredom After	.45 ***		
BPS	.4 ***	.18 *	
Age	-.14 *	-.13 .	-.2 **

Significance codes: 0 ‘***’, .001 ‘**’, .01 ‘*’, 0.05 ‘.’

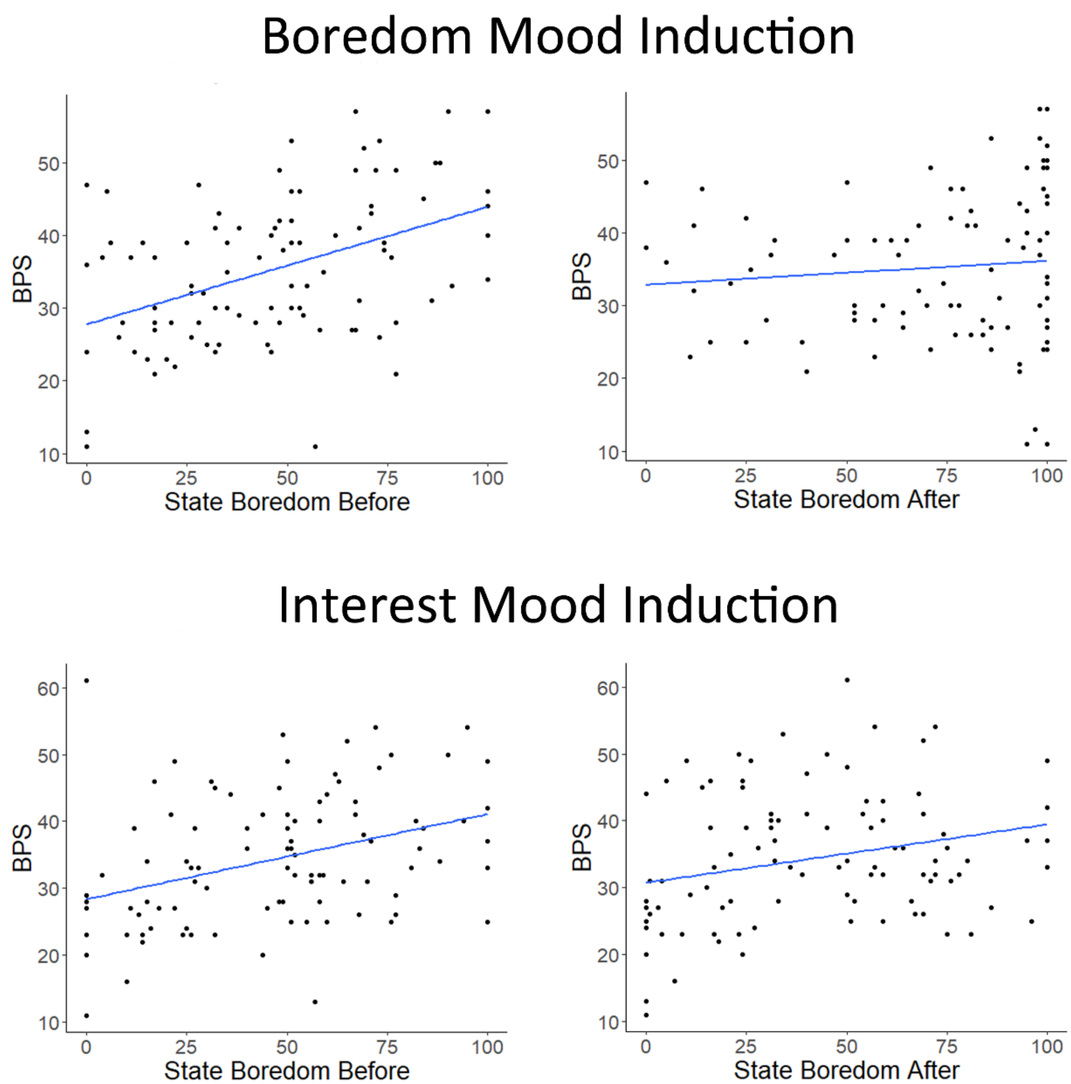

Figure 2. Top left: A scatter plot depicting the relationship between state boredom before the manipulation and boredom proneness for those in the boredom condition. Top right: A scatter plot depicting the relationship between state boredom after the manipulation and boredom proneness for those in the boredom condition. Bottom left: A scatter plot depicting the relationship between state boredom before the manipulation and boredom proneness for those in the interest condition. Bottom right: A scatter plot depicting the relationship between state boredom after the manipulation and boredom proneness for those in the interest condition.

There was a significant negative correlation between the Creative Uses Task scores and state boredom before the mood induction, $r = -0.18$, $p = .012$, 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. The correlation between state boredom after the induction and Creative Uses Task scores was negative but non-significant ($r = -0.13$, $p = 0.07$). Boredom proneness was not significantly related to Creative Uses Task scores, $r = -0.01$, $p = 842$.

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 4). 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 who are more prone to boredom scored lower (i.e., less creative) on the Kaufman Everyday creativity subscale. State boredom measures taken either before or after the mood induction videos did not correlate with any of the self-report measures of creativity.

Table 4: *Correlation table for creativity measures with state and trait boredom, age and gender*

	State Boredom Before	State Boredom After	sBPS	Age	Gender N = 188
CUT	-.18*	-.13 .	-.01	.2 **	0
CPI	-.07	-.03	-.12 .	.23 **	-.03
CSE	-.13 .	-.05	-.16 *	.16 *	.09
CBI	.01	-.02	.06	.12 .	-.15 *
K-DOCS Everyday	-.05	-.08	-.15 *	.03	.11
K-DOCS Scholarly	.02	-.01	-.01	.01	.03
K-DOCS Performance	0	.12 .	0	.02	.12
K-DOCS Science	.02	.03	-.04	.09	.27 ***
K-DOCS Arts	-.01	.01	-.03	.09	-.09

Significance codes: 0 '***', .001 '**', .01 '*', 0.05 '.'

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 Science), and Arts subscale of Kaufman's scale (K-DOCS Arts).

All the self-reported creativity measures were significantly correlated with one another (Table 5). When considering the Creative Uses Task, performance was significantly related to all but the Kaufman scale (Table 5). 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 several self-report creativity measures.

Table 5: *Correlation table of creativity measures*

	CUT	CPI	CSE	CBI	K-DOCS Every.	K-DOCS Schol.	K-DOCS Perf.	K-DOCS Science
CPI	.22 **							
CSE	.19 **	.63 ***						
CBI	.17 *	.48 ***	.45 ***					
K-DOCS Every.	.07	.24 ***	.46 ***	.29 ***				
K-DOCS Schol.	.1	.3 ***	.41 ***	.33 ***	.53 ***			
K-DOCS Perf.	.08	.32 ***	.33 ***	.29 ***	.38 ***	.52 ***		
K-DOCS Science	.11	.23 **	.34 ***	.28 ***	.32 ***	.51 ***	.58 ***	
K-DOCS Arts	.1	.47 ***	.4 ***	.41 ***	.45 ***	.52 ***	.62 ***	.5 ***

Significance codes: <.001 '***', <.01 '**', <.05 '*', <0.1 '.'
Note: 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 Science), and Arts subscale of Kaufman's scale (K-DOCS Arts).

Creative Uses Task scores were distributed normally with acceptable values of both skewness, -0.12, and kurtosis, 2.37. Homogeneity of variance was tested using Levene's test, with variances being equal for the boring and interest conditions, $F(1, 195) = 1.80$, $p = .18$. Using an independent t-test the difference between scores on the Creative Uses Task between conditions (M difference = 0.04, BCa 95% CI [-0.214, 0.285], was not significant ($t(195) = 0.28$, $p = .781$, $d = 0.04$; boredom induction $M = 2.83$, $SE = 0.08$; interest induction $M = 2.79$, $SE = 0.1$).

To determine whether boredom proneness moderated the relationship between state boredom and the Creative Uses Task, two moderation analyses were performed. Condition (i.e., mood induction) was included as a variable in order to determine whether boredom proneness was a moderator in one of the inductions but not the other. The first moderation analysis included state boredom before the manipulation (Table 6), whereas the second included state boredom after the manipulation (Table 7). The predictor variables of state boredom and boredom proneness were scaled using grand mean centering, in order to represent the effect of one predictor when the other predictor was centered on its mean value. Both regressions showed no interaction between state boredom and boredom proneness, indicating that boredom proneness did not moderate the relationship between state boredom and the Creative Uses Task. Additionally, both regressions showed no interaction between state boredom, boredom proneness and mood induction, indicating that boredom proneness did not moderate the relationship between state boredom and Creative Uses Task scores in either condition. State boredom post induction did negatively predict Creative Uses Task scores (Table 7). In other words, higher state boredom post induction was associated with *lower* Creative Uses Task scores.

Table 6: *Regression analysis with pre induction boredom predicting Creative Uses Task Performance*

Predictors	Estimate	*SE*	95% Cl		*t*	*p*
			Lower	Upper		
(Intercept)	2.79	0.093	2.61	2.98	29.89	<.001*
SB Before	-0.01	0.003	-0.01	0.00	-1.66	.098.
BPS	-0.00	0.010	-0.02	0.02	-0.27	.786
Condition	0.01	0.134	-0.25	0.28	0.08	.938
SB Before x BPS	-0.00	0.000	-0.00	0.00	-0.11	.911
Condition x BPS	0.02	0.014	-0.01	0.04	1.24	.216
SB Before x Condition	-0.00	0.005	-0.01	0.01	-0.49	.623
SB Before x Condition x BPS	0.00	0.000	-0.00	0.00	0.35	.725
R^2/R^2 adjusted	.05/.01					

Significance codes: <.001 '*"

Table 7: *Regression analysis with post induction boredom predicting Creative Uses Task Performance*

Predictors	Estimate	SE	95% Cl		t	p
			Lower	Upper		
(Intercept)	2.67	0.102	2.47	2.87	26.19	<.001***
SB After	-0.01	0.003	-0.01	-0.00	-2.22	.028*
BPS	-0.00	0.012	-0.03	0.02	-0.17	.865
Condition	0.18	0.144	-0.10	0.47	1.27	.206
SB After x BPS	0.00	0.000	-0.00	0.00	0.10	.920
Condition x BPS	-0.01	0.017	-0.04	0.03	-0.46	.647
SB After x Condition	0.00	0.004	-0.00	0.01	0.97	.332
SB After x Condition x BPS	0.00	0.000	-0.00	0.00	1.20	.234
R^2/R^2 adjusted	.05/.02					

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

Creative Self-Efficacy was significantly correlated with both trait boredom proneness and age (Table 4). Furthermore, trait boredom proneness was also significantly related to age (Table 4). In order to determine whether trait boredom proneness was related to Creative Self-Efficacy over and above the effect of age, a hierarchical regression was performed with age entered in the first step and boredom proneness in the second step (Table 8). In the first step, age positively predicted Creative Self-Efficacy such that older individuals exhibited greater belief in their creative capacities. When boredom proneness was entered in the next step of the regression, results indicated that trait boredom proneness did indeed account for additional variance in the model, although in the opposing direction (i.e., higher boredom proneness was associated with lower creative self efficacy). It should be noted the amount of variance accounted for by either age or boredom proneness was very small.

Table 8: *Hierarchical regression analyses between BPS and Creative Self-Efficacy*

	Predictors	Estimate	SE	95% CI		*t*	*p*
				Lower	Upper		
Step 1	(Intercept)	2.88	0.264	2.36	3.40	10.89	<.001 ***
	Age	0.03	0.012	0.00	0.05	2.19	.030 *
	R^2/R^2 adjusted	.02/.02					
Step 2	(Intercept)	3.35	0.355	2.65	4.05	9.44	<.001 ***
	Age	0.02	0.013	-0.00	0.05	1.76	.079 .
	BPS	-0.01	0.005	-0.02	-0.00	-1.98	.050 *
	R^2/R^2 adjusted	.04/.03					

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

Discussion

The aim of this experiment was to partially replicate Mann and Cadman's (2014) study which ultimately claimed that boredom begets creativity. Contrary to their findings, the current study found that higher state boredom was associated with poorer performance on the Creative Uses Task. This is evidenced by both a negative correlation between state boredom before the manipulation and the Creatives Uses Task, as well as the finding that state boredom after the task negatively predicted Creative Uses Task scores when accounting for condition and boredom proneness (Tables 4 and 7). This is clear evidence that state boredom does not lead to increased creativity, at least as it is measured on the Creative Uses Task. This is despite the fact that the boredom mood induction was clearly successful (i.e., that people were indeed bored by the induction of watching two men hang laundry: Figure 1).

Despite that state boredom after the mood induction had a negative impact on performance on the Creative Uses Task, trait boredom proneness did not moderate the relationship. It seems fairly clear from these results that neither state nor trait boredom led to improved performance on a classic measure of creativity.

With respect to boredom proneness and self-reported creativity measures, higher boredom proneness was associated with *lower* levels of engagement in everyday creative pursuits (i.e., a negative correlation with the Everyday subscale of the Kaufman scale; Tables 5). 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 ratings; Table 5). Finally, as outlined above, boredom proneness showed no relation to performance on the

Creative Uses Task (Table 4). Taken together, these results suggest that trait boredom proneness is not associated with higher levels of creativity. This is consistent with the theoretical account of boredom proneness as a failure to launch into action (Mugon et al., 2018).

Interestingly, scores on the Kaufman scale, which purports to measure a broad range of creative domains, failed to show any relation to the Creative Uses Task (Table 5). One element of this scale that sets it apart from the others included here is that participants are asked to rate how creative they are *in comparison to others*. It is possible that participants underestimate their capacity for creativity when considering others which might explain the lack of any relation with the Creative Uses Task. Further, it is also possible that the broad domains captured by the Kaufman scale do not capture the more narrowly defined component 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 a task that examine creative exploratory behaviours was used to further explore any potential relation between boredom and creativity.

Experiment 2: Creative Foraging

In Experiment 1, the majority of self-report creativity measures showed no relation to either state or trait boredom. In addition, trait boredom proneness exhibited no relation to the Creative Uses Task, while only state boredom was related to the Creative Uses Task (in a direction opposite to previous work). It is possible that this is because these measures and the task itself may not be the most sensitive measures of creative capacity. If boredom is a call to action, then more sophisticated metrics may be needed to explore any potentially nuanced relation between boredom and creativity. To do this, Experiment 2 employed a novel task that engages creative processes in a kind of foraging environment (Hart et al., 2017). This task was chosen for several reasons. First, it has been suggested that state boredom signals rising opportunity costs (Danckert, 2019; Struk et al., 2020). That is, any activity one engages in comes with the cost of foregoing other, potentially more rewarding activities (Kurzban et al., 2013). Foraging tasks of various kinds tap into the manner in which opportunity costs – the balance between exploiting known resources and exploring the environs for new resources – are managed (Charnov, 1976). This is 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 & Eastwood, 2018; Malkovsky et al., 2012; Mugon et al., 2018; Struk et al., 2020). Second, the task used in Experiment 2 is participant driven in that it allows the participant freedom to discover creative novel solutions and as such, is a good metric of creativity. Finally, the task produces several metrics suitable for exploring individual differences (see below for full task description).

The Creative Foraging Task has participants make shapes from a set of identical squares that are horizontally aligned. 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 process of exploration (Hart et al., 2017).

The purpose of Experiment 2 was to investigate the influence of both state and trait boredom on creativity using a novel task which provides a good metric of exploratory and exploitative behaviours. It was hypothesized that greater state boredom would be associated with more exploratory behaviours 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). The second hypothesis was that high boredom prone individuals would explore less than low boredom prone individuals. This was derived from the notion that the highly boredom prone fail to launch into action, which results in diminished exploratory responses (Mugon et al., 2018). Based on the results of Experiment 1, the third hypothesis was that state boredom would be negatively related to creativity. That is, the task provides separate metrics for exploratory behaviours (e.g., the number of steps taken between categories) and creativity (i.e., the uniqueness of shapes created). It was hypothesised that state boredom would have opposing effects on these metrics.

Method

Participants

Participants were recruited on SONA (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), having a task lasting for less than 10 minutes, taking a break during the task of longer than 1.5 minutes, or providing an incorrect ID number. 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. The study was approved by the University of Waterloo's Research Ethics Board.

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. They are constrained in that they are only able to move squares at the ends of the horizontal array in the first instance, and thereafter, only squares on the perimeter of previously constructed shapes (Figure 3). During the task participants can save shapes to a 'gallery' which they can review at the end of the task in order 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 to be collected that can be associated with either exploratory or exploitative behaviours. In the original work, factor analyses indicated that people generally produced similar categories of shapes ranging from alphanumeric characters to things that resemble a class of objects (e.g., planes; Figure 3). With this in hand a researcher can determine a number of things, including how many individual shapes of a given category a participant saves to their gallery. This is taken to reflect exploitative behaviour in 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. As will become obvious below, this metric may be open to interpretation; fewer steps between categories may at first blush appear to be indicative of “less” exploratory behaviour. But it could alternatively reflect more “efficient” exploratory behaviour. The specific metrics one can extract from the Creative Foraging Task are described further below.

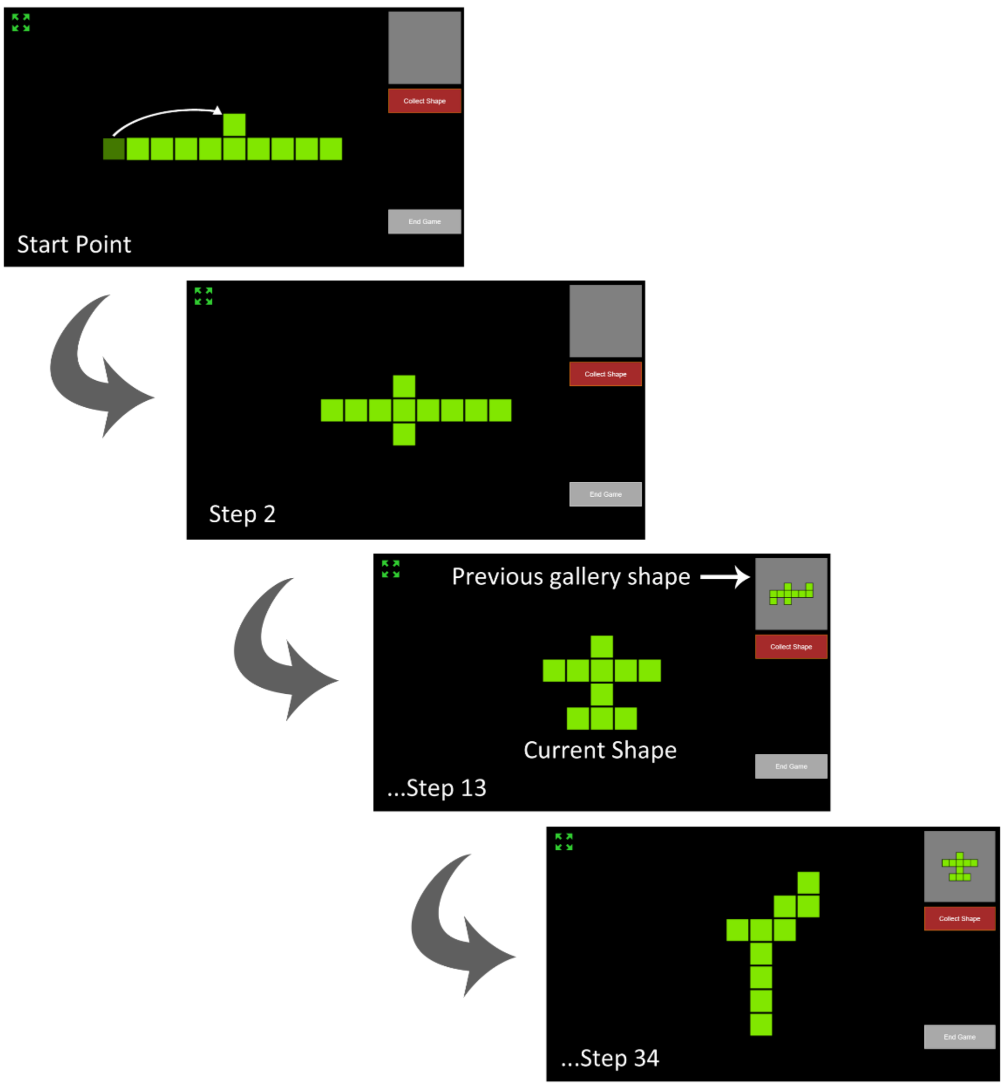

Figure 3. Schematic representation of the Creative Foraging Task in which participants move squares to create shapes and save those shapes to a gallery (upper right grey square in each frame). This figure is adapted from Hart et al., 2017.

Creative Foraging Task Measures

Clusters. A cluster is a bout of exploitation a participant performs in the task as indicated by multiple shapes being made within one category (e.g., alphanumeric symbols). In other words, more exemplars within a category is taken to reflect exploitation of that category.

Median Exploration The median exploration score is the median number of steps or moves between two categories, which is then averaged across all exploration phases in the task for each participant (Figure 4).

Median Exploitation. The median exploitation score is the median number of steps or moves between the first and last chosen shapes *within* each cluster, which is then averaged across all the clusters of exploitation in the task for each participant (Figure 4).

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 between the two shapes (median shortest path/actual path; Figure 4). This ratio is then averaged across all exploration phases in the task for each participant. Lower scores on this measure reflect the fact that a participant took more steps than optimal to move between shapes created 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 between the shapes (median shortest path/actual path; Figure 4). Again, this is then averaged across all the exploitation bouts a participant has in a game. Lower scores on this measure reflect the fact that a participant took more steps than optimal to move between two consecutive shapes in the exploitation phase.

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

Galleries. Galleries is the number of shapes a participant saved to the gallery.

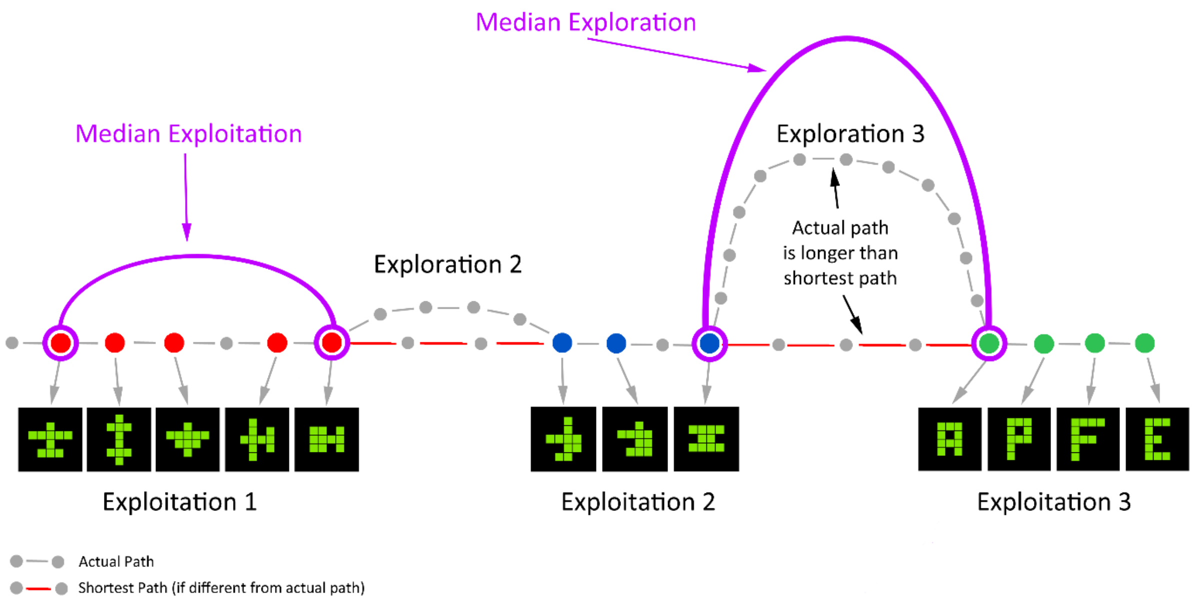

Figure 4: The coloured dots in this figure (red, blue, and green) represent chosen shapes that were saved to the gallery. The different colours simply represent different bouts of exploitation (i.e., separate shape categories). Grey dots represent each move a player made between saving shapes to the gallery. The path with the red lines is the shortest possible path a player *could have taken* (but didn't in this example) between two chosen shapes. The purple lines demonstrate the median exploitation (left) and median exploration metric (right) by showing that they represent the number of steps between the points indicated by the purple lines. This figure is adapted from Hart et al., 2017.

Procedure

This study was administered online using the SONA platform. After participants consented to participate in the study and began by rating their current state boredom on a scale of 1 to 9. Following this they received instructions for the Creative Foraging Task which they were asked to spend 12 minutes performing, although it should be noted that some participants exited the task up to 2 minutes early. Participants who exited the task more than 2 minutes prior to the end were excluded from the dataset due to lack of data. After completing the Creative Foraging Task participants were again asked to rate their current state boredom.

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 of these 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 procedure 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.

Trait boredom proneness (*M* = 35.5, *SD* = 10.2) was significantly correlated with state boredom before the task, *r* = .27, *p* = .002, but not with state boredom after the task, *r* = .01, *p* = .952. This indicated that prior to the task, those who were highly boredom prone also reported higher levels of state boredom, as was the case in Experiment 1.

To test whether the 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 the high and low boredom prone groups a tertile split was calculated with the high boredom prone group defined as the upper tertile on the sBPS and the low boredom prone group defined as those scoring in the lower tertile. This was preferred over a median split where the ‘middle’ scores on the sBPS may contaminate both high and low boredom groups. In the ANOVA, the boredom proneness groups were the between-subjects variable and state boredom before and after the task was the within-subjects variable. The analysis found that there was a significant interaction between the boredom proneness groups and state boredom, $F(1,63) = 7.914$, $p = .026$. The simple main effects indicate that the low and high boredom proneness groups significantly differed on state boredom before the task ($F(1,65) = 10.27$, $p = .002$), but did not significantly differ on state boredom after the task ($F(1,63) = 0.35$, $p = .557$). This shows that the low boredom prone group was significantly less bored than the high boredom prone group, which is to be expected as they are not very prone to boredom (Figure 5). This confirms that the low boredom prone group became more bored on average over the course of the task to the point where after the task the low and high boredom groups did not significantly differ on state boredom after the task. Trait boredom proneness was not significantly related to any of the other task measures.

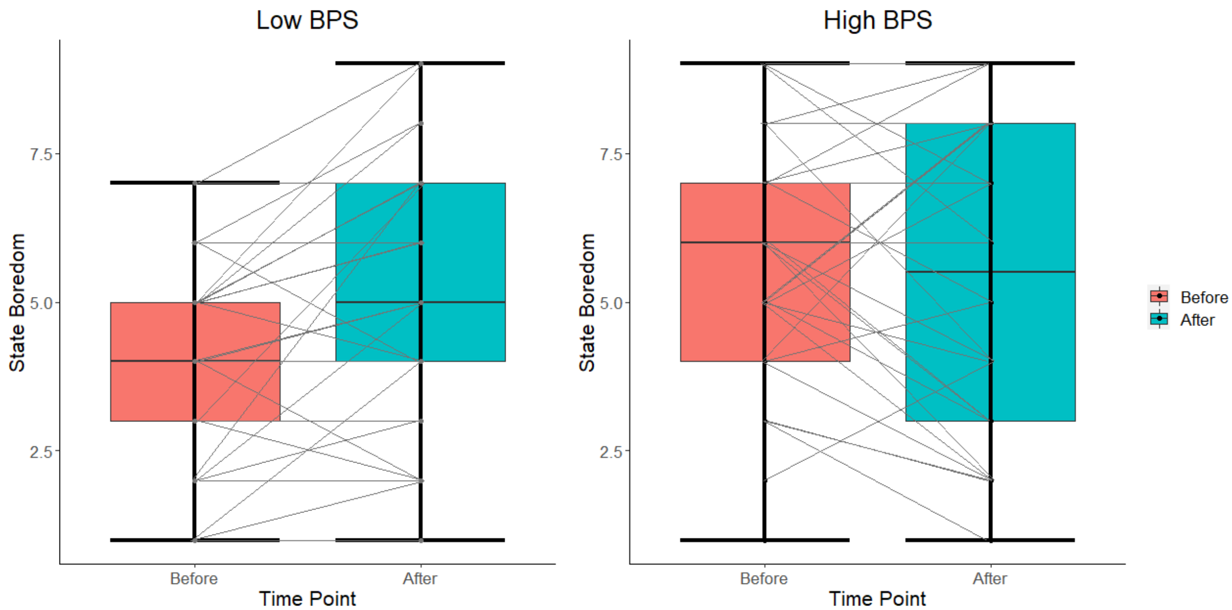

Figure 5. Left: A box and whisker plot overlayed with individual data points (grey lines) showing the difference in state boredom before and after the task for the low boredom prone individuals. Right: A box and whisker plot overlayed with individual data points (grey lines) showing the difference in state boredom before and after the task for the high boredom prone individuals.

State boredom was measured both before (*M* = 4.9, *SD* = 2.1) and after the task (*M* = 5.5, *SD* = 2.2). State boredom before the task was only correlated with trait boredom proneness, as mentioned above, and was not correlated with any other measures. State boredom *after* the task on the other hand was related to several task measures. State boredom was associated with both median exploration and exploitation (Table 9 and Figure 6). This indicates that those who were more bored after the task had made fewer steps or moves in both the exploration and exploitation phases. State boredom was also related to exploitation but not exploration optimality (Table 9 and Figure 7). This indicates that the 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) in the exploitation phases but not the exploration phases. Additionally, state boredom by the end of the task was significantly negatively correlated with the total time spent in the task (meaning participants quit the task early, between the 10-minute and 12-minute mark), positively correlated with the number of shapes saved to the galleries, and the number of clusters 'discovered' or used (Table 9 and Figure 8).

Table 9: *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.

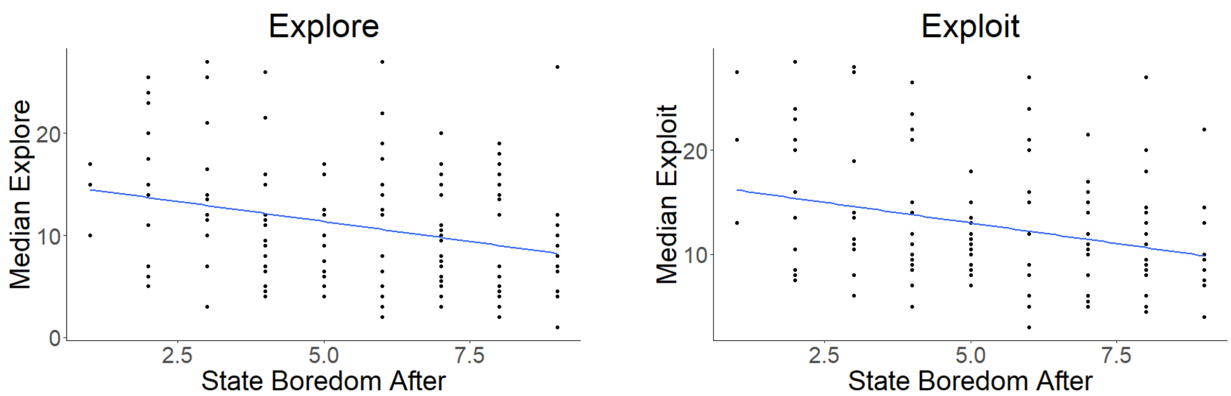

Figure 6. Left: Scatterplot depicting the relationship between state boredom after the task and median exploration. Right: Scatterplot depicting the relationship between state boredom after the task and median exploitation.

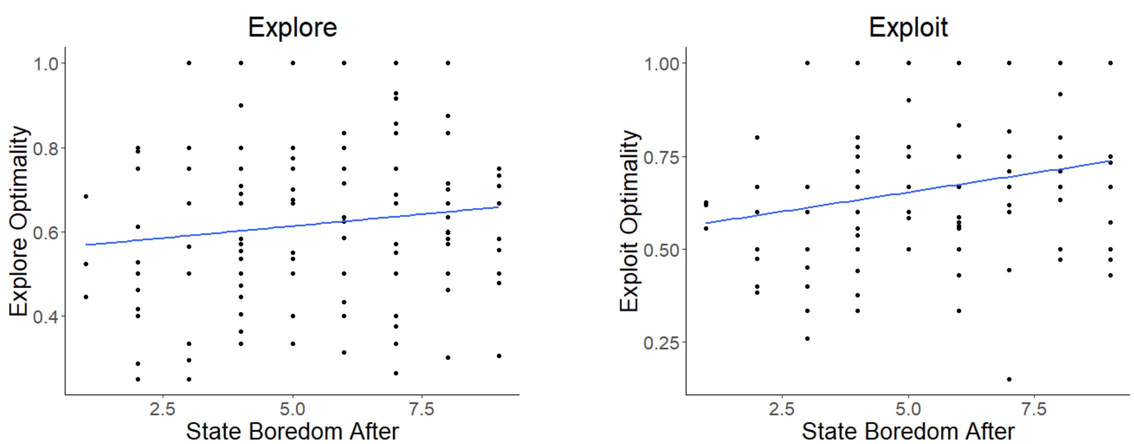

Figure 7. Left: Scatterplot depicting the relationship, although not statistically significant, between state boredom after the task and exploration optimality. Right: Scatterplot depicting the significant the relationship between state boredom after the task and exploitation optimality.

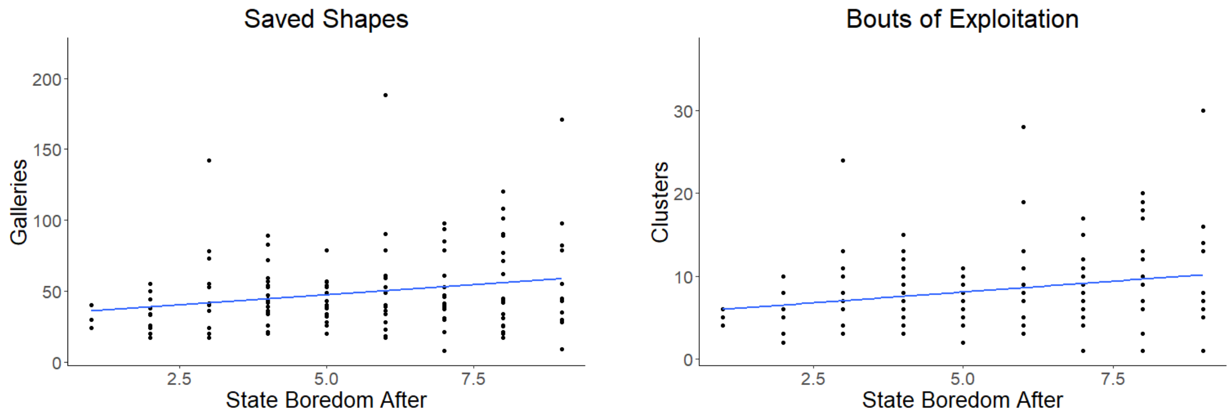

Figure 8. Left: Scatterplot depicting the relationship between state boredom after the task and galleries (number of saved shapes). Right: Scatterplot depicting the relationship between state boredom after the task and bouts of exploitation.

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 9). Although trait boredom proneness and uniqueness were trending in a positive direction, the relation was not significant (Table 9 and Figure 9). In an exploratory analysis, it was found that originality and uniqueness were significantly correlated with several of the task measures (Table 10). 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 10). This indicates 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 (clusters) (Table 10).

Table 10: *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 '.'

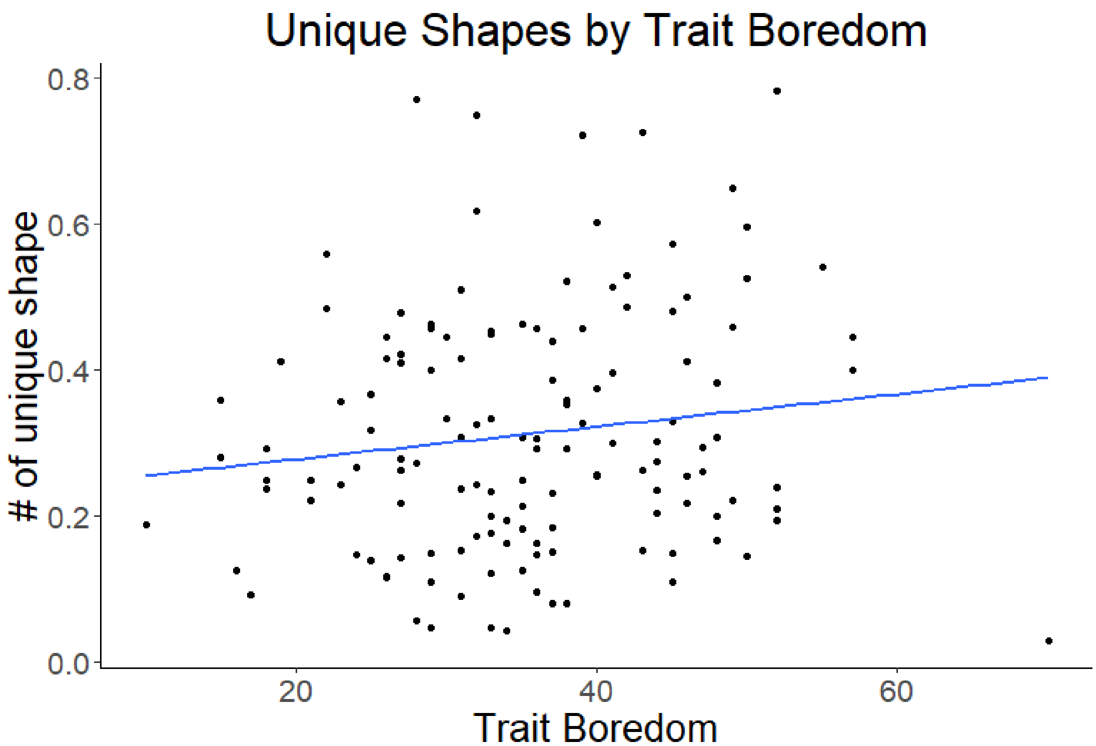

Figure 9. Scatterplot depicting the relationship between the number of unique shapes and boredom proneness.

Discussion

The current experiment aimed to use a novel task to explore the relation between state boredom, boredom proneness and creativity in the hopes that more nuanced metrics would reveal any relation should one exist. In general, the results showed no relation with either state or trait boredom proneness and creativity. This was evident when assessing the uniqueness and originality of the shapes made. The logic of including this particular task stems from the functional account of state boredom as a call to action (Elpidorou, 2014). It is this account that substantiates the popular claim that boredom begets creativity. Despite the fact that no evidence was found that boredom was related to creativity of responses, the task also allowed for interrogation of exploratory and exploitative behaviours in the context of boredom.

Two metrics of focus for exploratory and exploitative behaviours were the median exploration and exploitation measures. Median exploration represents the number of steps it took a participant to move between two categories. Similarly, median exploitation represents the number of steps taken to move between two shapes *within* a category during an exploitation phase. Results showed that state boredom after the task was negatively related to both measures (Table 9 and Figure 6), 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 measure. Fewer steps could be indicative of lower levels of exploration or exploitation (whatever 'lower levels' might mean in that case), but it may also represent *more efficient* behaviour in that participants are taking fewer steps as they move more efficiently 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 9). 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.

Another metric of focus was the number of bouts of exploitation participants undertook. Although no explicit metric counting the number of bouts of exploration is calculated, it is presumed that the number is roughly equal to the number of bouts of exploitation given that between each bout of exploitation the participant is presumably exploring for the next category. This metric can be interpreted as an indication of how frequently or rapidly a participant moves from one category to another. Those who were more bored at the end of the task exhibited more episodes of exploitation suggesting that they were moving rapidly from one given category to the next. This supports the conception of boredom as a call to action – they are taking a “get on with it” approach, exploiting shapes rapidly within a category and then moving quickly to the next discovered category. This is further supported by the optimality data. Results showed that higher state boredom after the task was associated with higher optimality scores in both the exploitation and exploration phases. For exploitation episodes optimality suggests that the participant takes the shortest path from one shape to the next within a category. For exploration episodes, optimality suggests that the participant takes the shortest path between newly explored shapes (before they eventually settle on a new category to exploit). Taken together, the data suggests that boredom experienced during the task (presuming that higher post-task boredom ratings reflected higher, or at least rising, in-task boredom) pushes participants to both explore for more categories and to exploit those categories more efficiently.

Despite the fact that the current task was chosen to provide more nuanced metrics of exploration and creativity, it was also evident that the task was not perceived to be particularly engaging. That is, self-reported state boredom rose as the task wore on (Figure 5). Perhaps what is needed to fully explore the relation between boredom and creativity is a genuinely engaging task that also taps into the multifaceted nature of this complex behaviour (i.e., creativity).

General Discussion

The notion that boredom begets creativity is rife in popular culture (Thorp, 2020; Thompson, 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; Mann & Cadman, 2014; Gasper & Middlewood, 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; Liang et al., 2020). 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 aim of this thesis was to more directly test the relation between state and trait boredom and creativity as evidenced by either self-report (Experiment 1) or on traditional and non-traditional tasks thought to tap into important components of the creative process (Experiments 1 and 2). Taken together, the results of these experiments suggest that in-the-moment feelings of boredom do not make us more creative, if anything the effects of state and trait boredom lie in the opposite direction.

The partial replication attempt of Experiment 1 found that higher reports of state boredom were associated with *poorer* performance on the Creative Uses Task. While measures of daydreaming were not taken (as they were in the Mann & Cadman, 2014 paper), 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).[2] So while the current study was more strongly powered than Mann and Cadman's (n = 99/98 per group in the current study, n = 40 per group in Mann & Cadman's) it is possible that a much larger n (G*Power calculated a sample in the range of 3,000) would detect a relation between boredom and creativity. Even so, such a small effect might be rendered statistically significant but 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

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[2] Mann & Cadman (2014) did not report effect sizes. These were calculated based on the means, standard deviations and sample sizes reported.

during the pandemic (Brosowsky et al., 2022). 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.; Lee et al., 2007; LePera, 2011; Mercer & Eastwood, 2010; Kılıç et al., 2019). 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 while having no difficulty launching into maladaptive behaviours. Clearly this is a topic for further research.

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 that they will be effective in goal pursuit (creative or otherwise) they may then decide that it is not worth the effort to engage. This is supported by the negative relation between boredom proneness and the everyday pursuit of creative activities (Kaufman scale). That is, the highly boredom do not engage with creative outlets in their everyday experiences (see also Brosowsky et al., 2022). Recent work exploring the relation between boredom and self-esteem indeed showed 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 & 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. This would be a fruitful avenue for further research.

Experiment 2 further investigated the relation of state and trait boredom to creativity using a more sophisticated and nuanced measure that also provided metrics of exploratory and exploitative behaviours. Confirming the results of Experiment 1, here the results showed no relation between state or trait boredom proneness and the explicit metrics of creativity (i.e., uniqueness and originality of shapes created). Furthermore, the task itself was potentially seen to be boring as ratings of state boredom increased by the end of the task. It is important to note that the Creative Uses Task only takes three minutes to complete, whereas the Creative Foraging Task takes four times longer. 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 these metrics of creativity.

Apart from creativity, in Experiment 2, exploration and exploitation behaviours were also investigated. State boredom was found to be associated negatively associated with median exploration, median exploitation and positively associated with exploitation optimality. Some of the task measures such as median exploration/exploitation and exploration/exploitation optimality are ambiguous, and it is not clear whether scores are indicative of more/less exploring/exploiting or rather if they indicate efficiency. The findings of this experiment suggest that these metrics are indicative of efficiency such that those who report higher state boredom after the task were more efficient at the task, taking fewer steps to explore and exploit object categories. Although, more research is needed in order to determine this and further understand the relation between boredom and exploratory and exploitative behaviours.

In conclusion, this thesis failed to find any support for the claim that state and trait boredom beget creativity. Further research involving engaging creative tasks is needed to determine whether context mediates any potential relation between boredom and creativity.

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Appendices

Appendix A

Short Scale of Creative Self (Maciej Karwowski, 2011)

Below you will find several sentences used by people to describe themselves. Please decide to what extent each of these statements describes you. There are no good or wrong answers.

1. **I think I am a creative person**

   Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

2. **My creativity is important for who I am**

   Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

3. **I know I can efficiently solve even complicated problems;**

   Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

4. **I trust my creative abilities;**

   Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

5. **My imagination and ingenuity distinguishes me from my friends;**

   Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

6. **Many times I have proved that I can cope with difficult situations;**

   Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

7. **Being a creative person is important to me**

   Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

8. **I am sure I can deal with problems requiring creative thinking;**

   Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

9. **I am good at proposing original solutions to problems.**

   Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

10. **Creativity is an important part of myself**

    Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

11. **Ingenuity is a characteristic that is important to me**

    Definitely not – somewhat not – neither yes or no – somewhat yes – definitely yes

Scoring: Creative Self-efficacy: average items: 3, 4, 5, 6, 8, 9

Creative Personal Identity: average items: 1, 2, 7, 10, 11

Appendix B

Creative Behavior Inventory.

The inventory is simply a list of activities and accomplishments that are commonly considered to be creative. For each item, indicate the answer on the scantron that best describes the frequency of the behavior in your adolescent and adult life. Be sure to answer every question. In some cases, you should count activities that you have done as a school-related assignment. In other cases, you should not. To avoid confusion, the phrase "excluding school or university course work" makes it explicit when NOT to count such work. (If you volunteered to do something at school but it was not to fulfill a requirement, this would not be relevant.)

Here is the scale: A = Never did this B = Did this once or twice C = 3-5 times D = More than 5 times

1. Painted an original picture (excluding school or university course work)

2. Designed and made your own greeting cards

3. Made a craft out of metal (excluding school or university course work)

4. Put on a puppet show

5. Made your own holiday decorations

6. Built a hanging mobile (excluding school or university course work)

7. Made a sculpture (excluding school or university course work)

8. Had a piece of literature (e.g, poem, short stories, etc.) published in a school or university publication

9. Wrote poems (excluding school or university course work)

10. Wrote a play (excluding school or university course work)

11. Received an award for an artistic accomplishment

12. Received an award for making a craft

13. Made a craft out of plastic, plexiglass, stained glass or a similar material (excluding school or university course work)

14. Made cartoons

15. Made a leather craft (excluding school or university course work)

16. Made a ceramic craft (excluding school or university course work)

17. Designed and made a piece of clothing (excluding school or university course work)

18. Prepared an original floral arrangement

19. Drew a picture for aesthetic reasons (excluding school or university course work)

20. Wrote the lyrics to a song (excluding school or university course work)

21. Wrote a short story (excluding school or university course work)

22. Planned and presented an original speech (excluding school or university course work)

23. Made jewelry (excluding school or university course work)

24. Had artwork or craft work publicly exhibited

25. Assisted in the design of a set for a musical or dramatic production (excluding school or university course work)

26. Kept a sketch book (excluding school or university course work)

27. Designed and constructed a craft out of wood (excluding school or university course work)

28. Designed and made a costume

Appendix C

Kaufman Domains of Creativity Scale (K-DOCS)

Instructions: Compared to people of approximately your age and life experience, how creative would you rate yourself for each of the following acts? For acts that you have not specifically done, estimate your creative potential based on your performance on similar tasks.

1 = Much less creative; 2 = Less creative; 3 = Neither more nor less creative; 4 = More creative; 5 = Much more creative

1. Finding something fun to do when I have no money
2. Helping other people cope with a difficult situation
3. Teaching someone how to do something
4. Maintaining a good balance between my work and my personal life
5. Understanding how to make myself happy
6. Being able to work through my personal problems in a healthy way
7. Thinking of new ways to help people
8. Choosing the best solution to a problem
9. Planning a trip or event with friends that meets everyone's needs
10. Mediating a dispute or argument between two friends
11. Getting people to feel relaxed and at ease
12. Writing a nonfiction article for a newspaper, newsletter, or magazine
13. Writing a letter to the editor

14. Researching a topic using many different types of sources that may not be readily apparent
15. Debating a controversial topic from my own perspective
16. Responding to an issue in a context-appropriate way
17. Gathering the best possible assortment of articles or papers to support a specific point of view
18. Arguing a side in a debate that I do not personally agree with
19. Analyzing the themes in a good book
20. Figuring out how to integrate critiques and suggestions while revising a work
21. Being able to offer constructive feedback based on my own reading of a paper
22. Coming up with a new way to think about an old debate
23. Writing a poem
24. Making up lyrics to a funny song
25. Making up rhymes
26. Composing an original song
27. Learning how to play a musical instrument
28. Shooting a fun video to air on YouTube
29. Singing in harmony
30. Spontaneously creating lyrics to a rap song
31. Playing music in public
32. Acting in a play
33. Carving something out of wood or similar material

34. Figuring out how to fix a frozen or buggy computer

35. Writing a compute program

36. Solving math puzzles

37. Taking apart machines and figuring out how they work

38. Building something mechanical (like a robot)

39. Helping to carry out or design a scientific experiment

40. Solving an algebraic or geometric proof

41. Constructing something out of metal, stone, or similar material

42. Drawing a picture of something I've never actually seen (like an alien)

43. Sketching a person or object

44. Doodling/drawing random or geometric designs

45. Making a scrapbook page out of my photographs

46. Taking a well-composed photograph using an interesting angle or approach

47. Making a sculpture or piece of pottery

48. Appreciating a beautiful painting

49. Coming up with my own interpretation of a classic work of art

50. Enjoying an art museum

Scoring:

Items 1-11 comprise Self/Everyday

Items 12-22 comprise Scholarly

Items 23-32 comprise Performance

Items 33-41 comprise Science

Items 42-50 comprise Art