

The Uncertainty Model of Boredom and Self-Control Failure:
How Ambient Uncertainty Influences Affect and Behaviour during Unrelated Goal Pursuit

by

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Author's Declaration

I hereby declare that I am the sole author of this 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.

Abstract

Integrating basic theories of motivation, boredom and self-regulation, in this dissertation, I present the Uncertainty Model of Boredom and Self-Control Failure (UM-B-SCF). The UM-B-SCF proposes that motivational states elicited in one context can influence affect and behaviour during subsequent unrelated goal pursuit. Motivational theory guiding my work suggests that under conditions of goal conflict and uncertainty, the behavioural inhibition system (BIS) is activated causing generalized shifts in cognition, affect and behaviour, which persist until the conflict can be resolved (Corr & McNaughton, 2008; Gray & McNaughton, 2000). According to the UM-B-SCF, the resulting motivational state is conducive to feelings of boredom and self-control failure. Importantly, if uncertainties persist unresolved, the ambient motivational state can carry forward to cause boredom and low self-control in other goals unrelated to the initial conflict. Across seven studies ($N = 1,972$), I found consistent support for the proposed model. People who experienced greater uncertainty, whether due to awareness of death (Studies 2 and 3), the ongoing COVID-19 pandemic (Studies 4 and 5), an uncertain personal relationship (Study 7), or general life circumstances (Studies 1 and 6) perceived unrelated tasks and projects as more boring and difficult to complete. Felt uncertainty about an initial conflict predicted both experiencing (Studies 1, 2, 3, 4, and 6) and anticipating (Studies 2, 3, 5, and 7) more boredom and less self-control in general (Study 1), during a data entry task (Studies 2 and 3), working on daily tasks (Study 4), completing an online survey (Studies 4 and 7), imagining pursuing general (Study 5) and academic or career-related personal projects (Studies 2 and 3), and working toward general (Study 4) and specific academic goals (Study 6) over the course of a month. In Study 6, I assessed between- and within-person variability in uncertainty and found that experiencing more uncertainty on average and feeling more uncertain than usual were both associated with boredom

and difficulties exercising self-control. In all seven studies, the results were consistent with an indirect pathway such that uncertainty predicted greater boredom, and boredom in turn predicted less self-control. Collectively, the results of the present research suggest that ambient uncertainty may be an inconspicuous but influential barrier to effective goal pursuit. Findings are discussed with respect to their implications for understanding the proposed theoretical process, including possible alternative conceptualizations of the model. Possible applications of the findings for alleviating boredom and disengagement are also discussed.

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Dedication

This dissertation is gratefully dedicated to my parents, Nicole and Jim Britton, who have supported and encouraged me through every step of my academic journey.

This is it—your forever student is finally graduating for good.

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Introduction

Despite best intentions, people frequently fail to follow through and accomplish their goals (Dickson et al., 2021; Hofmann, Baumeister, et al., 2012; Hofmann, Vohs, et al., 2012; Norcross & Vangarelli, 1988). When this happens, it is intuitive to blame personality (low grit) or the task (too boring). I contend, however, that beyond such salient barriers to effective goal pursuit, ambient uncertainty—even if caused by circumstances far removed from the present task—is an under-appreciated cause of boredom and self-control failure. With evidence from seven empirical studies with 1,972 participants, I examine how and why various sources of personal uncertainty can cause feelings of boredom conducive to low self-control during subsequent unrelated goal pursuit.

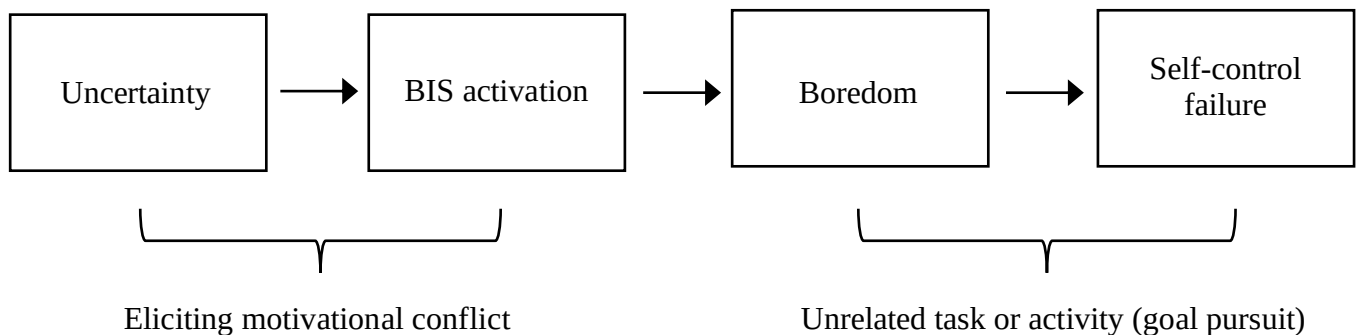
To illustrate this idea, imagine a discussion with your partner about an ongoing issue in your relationship. The discussion ends but you are left feeling conflicted and uncertain about the dilemma. After the discussion, you go back to your desk and try to make progress on a work project. However, when you sit down to work, you find yourself struggling to remain engaged with the task at hand. You can't concentrate, your thoughts wander and finishing it just doesn't seem all that important at the moment; working on the task feels boring. Failing to get engaged, you ultimately end up being unproductive and make little progress towards your goal. You may be quick to blame yourself as lazy (what is wrong with me), or the boring task (no fun) for your current predicament. But you recall being 'in the zone' working on it yesterday, so why does it feel boring and hard to accomplish now? To explain this phenomenon, I argue it is important to consider the ambient motivational states that people bring to any given situation that can influence one's perception and experience.

In this dissertation, I draw on theories of goal conflict, boredom and self-regulation to propose the Uncertainty Model of Boredom and Self-Control Failure (UM-B-SCF). My proposed model outlines how under conditions of heightened uncertainty tasks and activities *unrelated* to the source of uncertainty can seem more boring and difficult to complete, not because of some inherent feature of the task or activity itself, but rather because of the pursuer's ambient motivational state. More specifically, I outline how uncertainty activates the behavioural inhibition system (BIS)—a basic motivational system responsible for resolving goal conflict (Corr & McNaughton, 2008; Gray & McNaughton, 2000)—which causes system-wide changes in cognition and affect that influence fundamental aspects of goal pursuit. Further, because these BIS-related changes so closely mirror the experience of boredom (Danckert et al., 2018; Danckert & Eastwood, 2020; Van Tilburg & Igou, 2012), I propose that the diffuse and lingering motivational state is subjectively perceived as boredom during subsequent goal pursuit that is unrelated to the source of uncertainty.

BIS activation inhibits and draws attention away from currently active goals and decreases their incentive value in order to facilitate resolution of a focal conflict (Gray & McNaughton, 2000; McNaughton & Corr, 2004). If this motivational state persists, it can carry forward to affect subsequent goal pursuit. As a result, even previously engaging activities can lose their appeal when ambient uncertainties are in the air, resulting in failure of self-control and decrements in task persistence and performance. In sum, the UM-B-SCF posits that uncertainty causes activation of the BIS, which diffusely affects cognitive, affective and behavioural processes to cause boredom and low self-control during unrelated goal pursuit (see Figure 1 for an overview of the proposed theoretical model).

Figure 1

Uncertainty Model of Boredom and Self-Control Failure Process Diagram



Uncertainty, Conflict and the Behavioural Inhibition System (BIS)

The BIS is an evolutionarily old system humans share with other vertebrates that is activated by motivational conflict and uncertainty about how to interpret and respond to a given situation (Gray & McNaughton, 2000; Hirsh et al., 2012). Approach-avoidance varieties of motivational conflict occur when an individual is approach-oriented (i.e., wants to move toward something) but detects a potential obstacle in the way. The obstacle could be any frustration, threat, or expectancy violation significant enough to cause uncertainty about whether or not continued approach is a good idea. The uncertainty cues the BIS to emit outputs that result in a stance of passive avoidance characterized by a more cautious and hesitant approach (e.g., continuing to pursue a relationship with someone, while at the same time being hesitant and wary of the possibility of rejection). Approach-approach conflicts can produce the same motivational predicament insofar as choosing one alternative entails frustration of others (e.g., having to choose between two equally appealing job opportunities, knowing that selecting one means forgoing the other) (Iyengar & Lepper, 2000; McNaughton & Corr, 2004; Schwartz, 2000). The BIS is activated in either case because goal pursuit becomes ambivalent. In contrast, situations that signal unequivocal danger or failure, instead elicit a fight-or-flight response that does not

involve BIS activation (Gray & McNaughton, 2000; Grupe & Nitschke, 2013; McNaughton & Corr, 2004). BIS activation therefore arises whenever there are concurrently plausible but conflicting goals—in circumstances that are fundamentally uncertain (DeYoung, 2013; Hirsh et al., 2012).

Once a conflict is detected, the BIS triggers four simultaneous outputs designed to facilitate conflict resolution (Corr & McNaughton, 2008; Gray & McNaughton, 2000). One output inhibits ongoing behaviour—the ‘behavioural inhibition’ from which the system gets its name—preventing either of the conflicted goals from gaining immediate control over one’s actions. Another output involves autonomic arousal that heightens reactivity to novel or potentially threatening stimuli. The arousal prepares the individual to quickly shift from passive avoidance to active avoidance should changing conditions necessitate this (e.g., if a potential threat becomes an unambiguous source of danger or frustration) or eager approach if an alternative is detected that seems less uncertain. Another output is increased diffuse attention to the perceptual world, and in particular, cues of potential threat or novelty. This involves scanning of the external environment and internal memory stores to assess the risks of continued goal pursuit and identify potential alternatives. Finally, the BIS orients perception toward negatively valenced information and biases people to expect and detect further threats, which increases negative affect and tilts motivation in favor of avoidance. As a result, there is widespread dampening of the subjective value of all goals. Together these outputs are aversive but adaptive to the extent that they facilitate either resolution of the motivational conflict in favor of approach/avoidance or substitution with a more viable alternative goal (Gray & McNaughton, 2000; Hirsh et al., 2012). Once the conflict is resolved, BIS activity diminishes allowing active

approach motivation to resume. Successfully responding to conflicts when they arise is therefore critical for an individual's survival and productivity (Hirsh et al., 2012; Peters et al., 2017).

For various reasons a motivational conflict may nevertheless persist unresolved, impeding an individual's capacity to pursue and realize their goals. For example, a persistent motivational conflict may occur when abandonment of a conflicted goal has widespread implications for other goals (FeldmanHall & Shenhav, 2019; Heine et al., 2006; Hirsh et al., 2012), when there is a high degree of commitment or prior investment in a conflicted goal (Klinger et al., 2018; Wrosch et al., 2003), when there is a lack of or overabundance of perceived alternatives (Hayes et al., 2016; Iyengar & Lepper, 2000), or because of dispositional factors like being highly neurotic or cognitively inflexible (DeYoung, 2015; Mansell, 2005). If conflict resolution were delayed, the individual would remain in a prolonged state of uncertainty and chronic BIS activation. Moreover, and crucially for the argument in this dissertation, the four outputs of the BIS would continue to produce goal-system-wide changes in inhibition, arousal, attention, and affect so long as the conflict persisted.

Human goal systems are highly complex and involve managing the pursuit of multiple goals simultaneously (Kruglanski et al., 2002; Kung & Scholer, 2021; Louro et al., 2007), many of which are focused on long-term outcomes (Martin, 1999; Van den Bos et al., 2015). In this context, ambient uncertainty and BIS activation could have widespread consequences for goal pursuit that extends beyond the unresolved conflict. Specifically, the blunt BIS-mediated processes that are recruited to help resolve a focal motivational conflict cut across the entire goal system and therefore can also bring collateral damage by disrupting unrelated goals that were going fine before these processes were triggered (Jonas et al., 2014; McGregor et al., 2010). Indeed, diffuse vigilance and heightened sensitivity to possible signs of conflict are likely to

leave people highly distractible, restless, and unable to maintain sustained attention on any single goal (DeYoung & Gray, 2009; Hirsh & Inzlicht, 2008). Additionally, negative affective bias and a tendency toward avoidance can lead to rumination and generalized disengagement, leaving people feeling stuck and uninspired about what to do (DeYoung, 2015; Hirsh et al., 2012; Klinger et al., 2018).

Ambient Uncertainty and Boredom

Existing theories and research on uncertainty management have been primarily concerned with affective and behavioural responses to the immediate source of motivational conflict and uncertainty. This research shows that the psychological processes that characterize states of chronic uncertainty can have significant negative impacts on emotional well-being, causing anxious feelings and, in more extreme cases, anxiety disorders (Emmons & King, 1988; Grupe & Nitschke, 2013; Klinger, 1977; Mansell, 2005; Peters et al., 2017). In this dissertation, I argue that these same psychological processes can produce different emotional responses in the context of other goals that are not directly related to the uncertain predicament (Anderson et al., 2019; Morriss et al., 2022). I contend that while uncertainty (and hence BIS activation) is experienced as anxiety in the context of the focal motivational conflict, it can be experienced as boredom in the context of other, peripheral goals (i.e., those not directly implicated in the BIS-activating conflict). This understanding of boredom rests on the premise that BIS activation causes blunt and system-wide activation of the four outputs (inhibition, heightened arousal, diffuse attention, and negative biasing) that persist until the focal conflict is resolved. It helps explain why, counterintuitively, boredom is often associated with high arousal (Barbalet, 1999; Danckert et al., 2018; London et al., 1972; Martin et al., 2006; Merrifield & Danckert, 2014) and co-occurs

with other high arousal feelings like anxiety, frustration, restlessness and irritability (Barbalet, 1999; Fahlman et al., 2013; Harris, 2000; M. Martin et al., 2006; Van Tilburg & Igou, 2012).

An early case study reported by Stanley J. Gray (1952) exemplifies this idea about the system-wide implications of ambient uncertainty and BIS activation. Gray describes a man whose work output suddenly began to suffer with the worker's supervisor noting variability such that he would have "off days." Upon initial investigation the man simply reported that he found his work uninteresting and boring. However, further investigation revealed that the man's mother was ill and he was not able to provide proper care for her; it was uncertain whether she would recover. This issue in his personal life made his job "almost unendurable." After learning this, the man's company arranged for his mother to receive the care she needed and he once again became proficient and engaged in his job. In describing the reasons a person may feel bored at work Gray goes on to write:

... Anything that causes him to become dissatisfied may spread to his job and make him become dissatisfied with it, too. The dissatisfied worker becomes inefficient and bored with his work *even when his dissatisfaction has nothing to do with his job* [emphasis added] (Gray, 1952, p. 256).

Although Gray uses the rather broad term dissatisfaction, the example he describes clearly maps on to a state of ambient uncertainty. This case study illustrates how if such a state persists unresolved it can, in turn, affect an individual's ability to engage with everyday tasks and activities. Thus, the motivational state that people bring to a given situation can have far-reaching consequences for perception and behaviour.

I argue that boredom in this context occurs because the blunt outputs of the BIS impede all single-minded goal pursuit, which is in turn conducive to the experience of boredom. To

facilitate resolution of the uncertainty-eliciting conflict, people become highly distractible and unable to maintain focused attention on the current task or activity. Furthermore, the incentive value of ongoing activities decreases. These are both processes that have been identified as central to the experience of boredom (e.g., Eastwood et al., 2012; Van Tilburg & Igou, 2011; Westgate & Wilson, 2018). Despite wanting to engage and be productive, people feel stuck and unable to launch into sustained and effective action (Danckert & Eastwood, 2020; Eastwood et al., 2012; Mugon et al., 2018). In sum, there is converging empirical and theoretical reason to believe that ambient uncertainty and BIS activation arising from a focal goal conflict may play a role in the experience of boredom in other, unrelated goals. Indeed, boredom proneness has been associated with BIS activity (Mercer-Lynn et al., 2013, 2014) and anxiety more generally (Barbalet, 1999; Lee & Zelman, 2019; LePera, 2011; Sommers & Vodanovich, 2000).

Attentional Theories of Boredom

To further explain how ambient uncertainty is conducive to boredom, it is useful to consider how leading theories of boredom relate to the outputs of the BIS. Many purport that attentional difficulties cause boredom. These attentional accounts suggest that boredom is an affective consequence of being unable to maintain focused attention on a current task or activity (Eastwood et al., 2012; Fisher, 1993, 1998; Hamilton, 1981; Leary et al., 1986; Tam et al., 2021). Eastwood and colleagues (2012) define boredom as “the aversive state of wanting, but being unable to engage in a satisfying activity” (p. 483). This inability to engage attention is signaled by increased effort needed to stay focused on the present task and an increase in task-unrelated mind wandering (Danckert & Eastwood, 2020; Eastwood et al., 2012; Fisher, 1993; Leary et al., 1986; Pekrun et al., 2010; Tam et al., 2021). Many theories also highlight how attentional disengagement and boredom typically occur when there is a mismatch between the demands of a

task and the cognitive resources of the performer (Eastwood et al., 2012; Fisher, 1993; Pekrun et al., 2010; Westgate & Wilson, 2018). There is strong evidence to support these attentional theories, with numerous studies demonstrating a robust relationship between inattention and boredom. Indeed, evidence from correlational (e.g., propensity to experience attention lapses is associated with boredom proneness; Carriere et al., 2008; Cheyne et al., 2006), experimental (e.g., distracting people from a task causes increased boredom; Damrad-Frye & Laird, 1989), and neurophysiological studies (e.g., similar neurophysiological activity occurs under conditions of inattention and boredom; Merrifield & Danckert, 2014; Danckert & Merrifield, 2018) all support the conclusion that deficits in attention are central to boredom.

According to the UM-B-SCF, one reason this prominent link exists is because changes in attention and arousal that elicit boredom are outputs of the BIS, which is chronically activated during states of ambient uncertainty. This includes the diffusion of attention to scan the external environment and internal memory stores for potential threats and alternative opportunities for engagement (Corr & McNaughton, 2008; Gray & McNaughton, 2000). Because of these system-wide changes, attentional resources are also diverted away from other active goals that are unrelated to the ongoing conflict. Additionally, increased arousal heightens sensitivity to novel or unexpected stimuli leaving people more vulnerable to distraction. Thus, individuals may be more at risk of experiencing boredom because they have less attentional resources to devote to any single task and are more susceptible to task-unrelated thoughts and disruptions (Eastwood et al., 2012; Fisher, 1993, 1998). As Klinger (1977) describes, “a person working on a mental task who is in the grip of a very strong concern about something else will have trouble keeping his or her mind on what he or she is doing” (p. 61). Consistent with this idea, a study by Roberts and colleagues (2013) found that cueing an unresolved (compared to resolved) personal goal resulted

in more intrusive ruminative thoughts about that goal during a subsequent sustained attention-to-response task. This demonstrates how when an unrelated goal conflict is made salient, it can impede a person's ability to maintain attention on the present task. Furthermore, if people attribute their uncertainty-induced inattention to the activity itself, an otherwise well-matched and engaging task may be perceived as boring (Damrad-Frye & Laird, 1989; Eastwood et al., 2012).

Meaning/Functional Theories of Boredom

Other prominent theories focus on the functional value of boredom as an emotional signal of meaninglessness, i.e., that an activity lacks purpose or value (Barbalet, 1999; Danckert & Eastwood, 2020; Elpidorou, 2014; Pekrun, 2006; Van Tilburg & Igou, 2012; Westgate & Wilson, 2018). The more congruent an activity is with a valued goal, increasing its perceived meaning, the less boring it will seem. On the other hand, the perception that one's current activity is unsatisfying and pointless causes discomfort and, in some cases, distress (Barbalet, 1999; Bench & Lench, 2013; Danckert & Eastwood, 2020; Elpidorou, 2014; Van Tilburg & Igou, 2011, 2012). The functional aspect of these theories argues that boredom not only signals that one's current activity is devoid of meaning but also motivates people to seek out activities that can restore meaningful engagement. From this perspective, boredom is a call to action, prompting an individual to re-evaluate and do something different than what they are currently doing (Bench & Lench, 2013; Elpidorou, 2014; Westgate & Wilson, 2018). These theories are supported by correlational research showing that low perceived meaning is associated with boredom (e.g., Fahlman et al., 2009; Van Tilburg & Igou, 2012; Westgate & Wilson, 2018), as well as experience sampling studies that have found low meaningfulness of activities to predict state boredom in daily life (Chan et al., 2018). Additionally, research in academic settings has

found that students experience more achievement-related boredom when activities or tasks lack intrinsic value (Pekrun, 2006; Pekrun et al., 2010). People also feel less bored when the perceived value of a task is increased by providing incentives such as pay, praise or external rewards (e.g., telling people that money will be donated to charity based on successful performance; Barbalet, 1999; Westgate & Wilson, 2018).

Like the link between attention and boredom, the UM-B-SCF posits that the link between meaninglessness and boredom can similarly be explained by how the outputs of the BIS jointly promote these perceptions. In a state of lingering goal conflict and ambient uncertainty, people are more negatively biased and there is a shift in motivational priorities in favor of avoidance relative to approach (Corr & McNaughton, 2008; Gray & McNaughton, 2000). As a result, there is a system-wide muting of enthusiasm for all goals, accompanied by an increase in assessment and rumination. Thus, a task or activity that seemed relatively meaningful at one time may lose its significance based on shifting motivational priorities and attendant appraisals, which in turn influence whether it is perceived as boring (Tam et al., 2021; Westgate & Wilson, 2018). Furthermore, the system-wide devaluation of goals can make it difficult for people to articulate what it is they want to do because everything seems unappealing and pointless. Consistent with this idea, Mugon and colleagues (2018) suggest that boredom proneness is associated with ruminative inaction due to “an inability to appropriately discriminate value (i.e., everything is tarred with the same gray brush) (p. 1).”

To facilitate conflict resolution, the generalized changes in inhibition, affect, and cognition produced by the BIS promote goal reassessment and switching. It follows that in states of ambient uncertainty, any current task or activity that does not help to resolve the lingering motivational conflict will seem less meaningful (i.e., less appealing and important) and therefore

more boring. This parallels functional theories of boredom that emphasize its role as a call to action, which helps restore meaningful engagement. One extreme example of this phenomenon comes from research on stressful life events (e.g., being diagnosed with an illness, a divorce, losing one's job), which tend to trigger periods of intense uncertainty. The motivational significance of one's current pursuits is called into question and people often fall into periods of stagnation and rumination, during which they try to determine what is truly important in their lives (Hirsh et al., 2012; Park, 2010). Similarly, this ambient uncertainty account may help explain the widespread feelings of “languishing”—described as a sense of stagnation and emptiness—brought about by the COVID-19 pandemic, which has been a source of profound uncertainty for many people (Grant, 2021).

Ambient Uncertainty, Boredom, and Self-Control Failure

The foregoing sections linked personal uncertainty and BIS-activation to boredom. The final link in the UM-B-SCF is between boredom and self-control failure, both of which occur during unrelated tasks in contexts that can be far removed from the source of uncertainty. Existing evidence provides strong support for a general relationship between boredom and poor self-control. Correlational studies have demonstrated that boredom proneness is associated with low trait self-control (Isacescu et al., 2017; Isacescu & Danckert, 2018; Struck et al., 2016), a tendency to procrastinate (Blunt & Pychyl, 1998; Vodanovich & Rupp, 1999), as well as various impulsive behaviours that reflect a lack of self-control including aggression (Dahlen et al., 2004), pathological gambling (Blaszczynski et al., 1990), and problematic substance use (LePera, 2011). Further support for the link between boredom and self-control difficulties comes from behavioural studies which have demonstrated that boredom while completing various tasks, particularly those that require sustained effort and attention, is associated with performance

decrements (Cantor, 1968; Kurzban et al., 2013; Pattyn et al., 2008; Sawin & Scerbo, 1995; Thackray et al., 1977). Additionally, research in academic settings has found that boredom is associated with reduced effort, poor self-regulation of learning, and lower academic achievement (Daniels et al., 2009; Pekrun, 2006; Pekrun et al., 2010). For example, Jarvis and Seifert (2002) found that students who were bored in school invested less effort in their school work—what the authors refer to as being “work avoidant”. Furthermore, in a series of studies Pekrun and colleagues (2010) found that boredom was associated with worse academic performance, assessed based on self-report (Studies 1 and 2), students’ GPA (Studies 3 and 4) and course grades (Study 5), as well as over time (i.e., lower grades at end of a year-long course; Study 5).

The UM-B-SCF extends prior work by offering a motivational account for why boredom and self-control failure often go hand in hand. According to the proposed motivational perspective, the link between boredom and self-control failure exists because boredom is an emotional signal of ambient uncertainty and BIS-activation. In a state of ambient uncertainty, the diffuse outputs of BIS-activation disrupt all goal-directed behaviour (Corr & Cooper, 2016; Gray & McNaughton, 2000) and heighten negative appraisals, rumination, and behavioural disengagement (Bennett & Bacon, 2019; Gray & McNaughton, 2000). Additionally, the heightened awareness of appealing potential alternatives can diminish the benefits of persistence and increase the effort or cost of staying engaged (Bench & Lench, 2013; Milyavskaya, Inzlicht, et al., 2019). When in the context of the focal goal conflict, these outputs allow the individual to step back and evaluate the options available for resolving it. When the diffuse BIS outputs spill over to other unrelated goals, however, persistence and success can suffer with no functional benefit (i.e., where there was no serious conflict or uncertainty in the first place).

In any task that requires self-control, having to continuously redirect one's attention to the present activity is in itself an act of effortful control (Tam et al., 2021) that involves some conflict—between what one might prefer to do and what one is forcing oneself to do (Hockey, 2013; Inzlicht & Schmeichel, 2012). Indeed, in a study by Milyavskaya and colleagues (2019) participants reported increasing fatigue and effort exerted over the course of a boring task that only involved passively viewing numbers. Such relatively trivial conflicts may not typically reach the threshold for BIS activation, but if the BIS is already partially activated by some other source of ambient uncertainty then the cumulative uncertainty may be enough to arouse BIS outputs. Consistent with this idea, Alquist and colleagues (2018) found that people who wrote about an unresolved personal dilemma performed significantly worse on a subsequent (self-control-requiring) anagram task compared to people who wrote about a personal value, and this effect was mediated by increased anxious uncertainty. People who wrote about a personal dilemma were also more likely to drop out of the study altogether after the manipulation, an indication of total disengagement with the task. Across three studies, Alquist (2010) similarly found that people who were made to feel uncertain by an ambiguous task (Study 1) or the possibility of having to give a speech (Studies 2 and 3) performed significantly worse on a subsequent, unrelated self-control task. Conversely, other research has shown that reducing state BIS activation can increase task persistence and performance (Tran, 2018).

Further support for the proposed model comes from recent research that has found evidence for an indirect relationship between anxiety (commonly associated with goal conflict and uncertainty) and poor self-control through boredom. For example, using structural equation modeling Elhai and colleagues (2018) found that anxiety predicted problematic smartphone use indirectly through boredom proneness. The authors suggest that the attentional difficulties and

negative affect involved in anxiety are likely conducive to experiencing boredom and that problematic smartphone use is an easily accessible way to manage boredom. In another study, Dubovi and Adler (2022), found that COVID-19-induced state anxiety predicted emotional and behavioural disengagement in online learning activities and there was evidence of an indirect pathway through boredom. These studies are consistent with the proposed UM-B-SCF, which suggests that boredom is an emotional response and self-control failure is a behavioural consequence of ambient uncertainty and BIS activation. The UM-B-SCF also extends this work by offering a basic motivational account for why anxious states can have such widespread repercussions for other ongoing goals.

The Uncertainty Model of Boredom and Self-Control Failure

In summary, the UM-B-SCF proposes that under conditions of heightened uncertainty, the BIS is activated in order to help resolve the experienced conflict. Crucially, BIS activation is a blunt response that can spill over to affect motivation on all other ongoing goals. Boredom is the emotional signal of lingering BIS activation that people notice when trying to focus on goals that are not directly related to the source of uncertainty. The main job of BIS activation is to help people disengage from conflicted goals to find something better to do, which is why it and its emotional marker are conducive to reduced persistence and poor performance. A key aspect of the proposed model is distinguishing between an eliciting event or source of uncertainty that activates the BIS, and the broader affective and behavioural consequences of this ambient motivational state for goals beyond the focal conflict. Thus, the UM-B-SCF focuses on experiences of boredom and disengagement as stemming from general perceptual and motivational shifts as opposed to the inherent qualities of the task or activity. By highlighting

these more diffuse consequences, the UM-B-SCF helps to explain why pursuing the same goal can feel different depending on what is going on in the broader context of a person's life.

Previous treatments of the causes of boredom (e.g., Fisher, 1993; Mercer-Lynn et al., 2014) and self-control failure (e.g., Hofmann et al., 2012; Inzlicht et al., 2021) have identified several different influences that may be at play, including various external (features of the task or environment), internal (characteristics of the person), and interactive (task/environment x person) factors. It is therefore important to note that I am not suggesting that the present model provides a comprehensive explanation of all boredom experiences and associated failures of self-control. Rather, the goal of this dissertation is to elucidate, what I argue, may be a source of boredom and self-control failure that has received little attention in research to date—namely, ambient uncertainty and concomitant BIS activation. People tend to attribute boredom to the task or environment, but rarely look inward (Fenichel, 1951; Fisher, 1993). If people are unable to accurately identify why they feel bored and are struggling to accomplish their goals, this will likely result in misdirected attempts to remedy the problem (Danckert & Eastwood, 2020; Fisher, 1993). Accordingly, by illuminating an alternative source of boredom and self-control failure the proposed model could have important implications for finding an effective solution.

The Present Research: Overview of Studies

In this dissertation, I present seven studies intended to test some of the basic tenets of the UM-B-SCF. Specifically, I examine how ambient uncertainty about unrelated topics influences the extent to which people perceive current goals as boring, and in turn, struggle to exercise self-control in pursuit of them. In Study 1, to provide initial correlational evidence in support of the conceptual model I examined trait-level relationships between uncertainty sensitivity, boredom

proneness, and self-control. I expected that uncertainty sensitivity would be associated with boredom proneness and boredom proneness would in turn be associated with low self-control.

In Studies 2 and 3, I manipulated uncertainty using a mortality salience manipulation (i.e. thinking about what happens when you die). I then assessed people's perceptions of boredom and self-control when imagining pursuing their real-life personal projects and when actually completing a data entry task. I predicted that people in the mortality salience condition would perceive their personal projects and the data entry task as more boring and this would in turn be associated with less imagined self-control completing one's projects and worse performance on the data entry task.

In Studies 4 and 5, I assessed how uncertain people were feeling about the COVID-19 pandemic (Study 4) and manipulated COVID-19-related uncertainty by having people reflect on how it had affected their life (Study 5). I then assessed boredom and self-control while working on daily tasks (Study 4) and personal projects (Study 5), while completing the online survey (Study 4), and working on goals over the following month (Study 4). I predicted that the more uncertain people were feeling about the pandemic the more boring they would find these tasks and activities, which would in turn predict lower self-control.

In Study 6, I had students nominate two academic goals that they wanted to make progress on over the first four weeks of the semester. In each week over the course of those four weeks, I assessed students' general life uncertainty, as well as their boredom, self-control and progress working on their nominated goals. I also assessed academic performance based on students' course grades at the end of the semester. I predicted that weeks with higher-than-average experienced uncertainty and higher average uncertainty over the month-long period would be associated with more boredom working on academic goals, and this would in turn be

associated with less self-control and less progress on those goals. Additionally, I predicted that people who felt more uncertain during the first month of the semester would find their academic goals more boring and this would in turn predict lower course grades at the end of the semester.

Finally, in Study 7 I used a within-subjects design and manipulated uncertainty by having participants reflect on an uncertain personal relationship. I then assessed how boring participants expected the remainder of the study to be and how much self-control they anticipated having while completing it. I predicted that after writing about an uncertain relationship (compared to something they wanted to approach or a personal value), participants would perceive the remainder of the study as more boring and in turn would anticipate having less self-control completing it.

Open Science Practices and Analytic Approach

I pre-registered my hypotheses and analysis plan for each study on OSF (links provided in the respective study) either before data collection began or while it was underway, but before looking at any of the data or performing any analyses. Any exploratory analyses that were not pre-registered are labelled as such. Additional measures and manipulation conditions not reported in the present research were included in some of the studies. In these cases, this is noted in the study method and the additional measures and/or manipulations are listed in Appendix A.

Here I outline my general analytic approach and conventions for reporting results that are applicable across all studies presented in this dissertation. All analyses were performed using R Statistical Software (v 4.1.2; R Core Team, 2021). I used the *lm* and *glm* functions from the *stats* package (R Core Team, 2021), which is part of base R, to fit regression models with continuous and binary outcomes respectively. I used the *lmer* function from the *lme4* package (Bates et al., 2015) for multi-level modelling and the *sem* function from the *lavaan* package (Rosseel, 2012)

for path analyses. For all independent-samples t tests, I used Welch's t test. Statisticians recommend using Welch's t test by default since it is more reliable than Student's t test when the homogeneity of variances assumption is violated, and produces the same results when variances are equal (Delacre et al., 2017; Moser & Stevens, 1992). When presenting results, square-bracketed values indicate 95% confidence intervals (CIs) unless otherwise indicated.

Study 1

The purpose of Study 1 was to find initial correlational evidence of the UM-B-SCF by examining trait-level relationships between uncertainty sensitivity, boredom proneness, and self-control. I collected data on these individual differences across several independent samples over the course of six years: three samples included in my Master's thesis (Britton, 2018), five samples included in this dissertation and two additional samples not reported elsewhere that were collected in an undergraduate Psychology course at the University of Waterloo. To increase statistical power and precision, I combined the 10 samples in an integrative analysis to test associations with the pooled data. I pre-registered my hypotheses and analysis plan specifically related to these trait-level associations for 6 of the samples after having established the pattern of associations in the initial study (see Table 1 for details of each sample). My main hypotheses were that: (1) people higher in uncertainty sensitivity would report greater boredom proneness, (2) people who were more prone to boredom would report having less self-control, and (3) uncertainty sensitivity would predict lower self-control indirectly through its association with boredom proneness.

Method

Participants

An overview of the data sources and demographic characteristics for each sample is presented in Table 1. Exclusion criteria for the individual samples are described in the reporting of the respective studies; for all studies that are not reported elsewhere, no exclusion criteria were applied. The pooled sample consisted of 1,724 people ($M_{\text{age}} = 22.86$, $SD_{\text{age}} = 8.09$, range = 17 to 73; 66.41% female, 33.06% male, 0.53% other; 56.57% non-white).

Procedure and Measures

For each of the studies, the trait measures of interest were embedded within a larger battery of assessments. All items were self-reported on a scale ranging from 1 (strongly disagree) to 5 (strongly agree) and a mean score was calculated with higher scores indicative of having a higher level of the respective trait.

Uncertainty Sensitivity. Uncertainty sensitivity was measured with the 15-item Anxious Uncertainty Sensitivity Scale (AUSS; Prentice, 2016). The scale measures propensity to experience uncertainty and goal conflict as anxiety-provoking, including tendencies toward vigilant risk assessment and passive avoidance. It includes items that assess primarily uncertainty sensitivity, but also BIS, and prevention focus (see Britton, 2018 for a detailed description of the scale items). Example items are, “When I can't clearly discern situations, I get apprehensive,” and “When making a decision, I am deterred by the fear of making a mistake.” Cronbach’s alpha reliability for the current study was .94.

Boredom Proneness. Boredom proneness was measured with the 10-item Multidimensional Trait Boredom Scale-Disengage (MTBS-D; Gerritsen et al., 2014). The MTBS-D is a trait version of the Disengagement factor of the Multidimensional State Boredom Scale (Fahlman et al., 2013). Example items are, “In general, I feel bored,” and “I often wish I were doing something more exciting.” Cronbach’s alpha reliability for the current study was .91.

Trait Self-Control. Trait self-control was measured with the 13-item Brief Self-Control Scale (BSCS; Tangney et al., 2004). The BSCS is a general measure of self-control that assesses ability to control one’s thoughts, impulses and behaviour to facilitate successful goal pursuit. Example items are, “People would say I have iron self-discipline,” and “I have a hard time breaking bad habits” (reverse-scored). Cronbach’s alpha reliability for the current study was .87.

Table 1*Data Collection Information and Demographic Characteristics for Individual Samples*

	1	2	3	4	5
Year collected	2016	2017	2018	2018	2018
Semester collected	Fall	Winter	Winter	Spring	Fall
Population	Undergrad	Undergrad	Undergrad	Undergrad	Undergrad
Source	Psych class	Psych class	Subject pool	Psych class	Psych class
Reported in	Masters S1	Masters S1	Masters S2	—	—
Pre-registration	—	osf.io/rmz6y	osf.io/j8a2y	osf.io/kh7au	—
Total N	76	69	210	77	99
Mean age (<i>SD</i>)	21.21 (1.62)	21.35 (1.18)	21.38 (5.20)	22.08 (4.22)	21.33 (1.99)
Gender (% female)	76.00%	76.12%	58.85%	75.32%	73.74%
Race (% non-white)	57.33%	58.82%	74.76%	60.53%	58.06%
	6	7	8	9	10
Year collected	2018	2019	2019	2020	2021
Semester collected	Fall	Winter	Fall	Spring	Fall
Population	Undergrad	Undergrad	Undergrad	General	Undergrad
Data source	Subject pool	Psych class	Subject pool	MTurk	Psych class
Reported in	Dissertation S2	Dissertation S7	Dissertation S3	Dissertation S4	Dissertation S6
Pre-registration	osf.io/zduw2	—	osf.io/du7pn	osf.io/j5efa	—
Total N	383	52	436	200	122
Mean age (<i>SD</i>)	19.85 (2.92)	21.65 (1.59)	20.06 (3.75)	39.71 (12.19)	21.25 (1.76)
Gender (% female)	65.01%	68.63%	70.87%	46.73%	76.23%
Race (% non-white)	59.32%	57.69%	55.45%	28.50%	61.48%

Data Analysis

Integrative data analysis is a form of meta-analysis where multiple datasets are analyzed simultaneously, as opposed to estimates aggregated at the study-level (Curran & Hussong, 2009). Each of the independent samples is pooled together and analyses are conducted using the aggregated data, accounting for potential sources of between-sample heterogeneity. In the present study, I treated the sample as a fixed rather than random effect since there were only 10 samples and intra-class correlations indicated that only a small proportion of the variance in the outcomes was accounted for by the sample clustering (ICCs ranged from .04 - .11). As a result, estimates of the random variability both within and between studies would likely be unreliable (Curran & Hussong, 2009). I therefore controlled for the sample by including in each model a set of dummy codes specifying sample membership as a fixed characteristic of each individual. By including sample membership as a covariate, this approach effectively removes all between-sample sources of variability from the model.

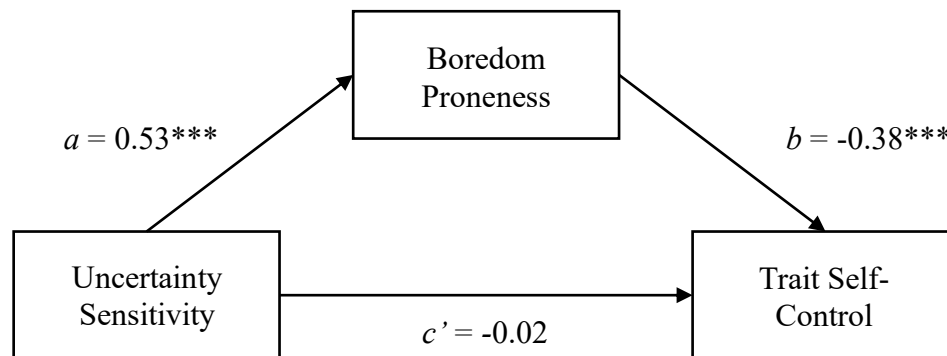
Results

I first regressed boredom proneness on uncertainty sensitivity. As expected, people higher in uncertainty sensitivity reported being more prone to boredom, $b = 0.53$ [0.49, 0.57], $SE = 0.02$, $t(1703) = 24.56$, $p < .001$. Next, I regressed self-control on boredom proneness. Also consistent with my predictions, people who were more prone to boredom reported having lower levels of self-control, $b = -0.38$ [-0.42, -0.35], $SE = 0.02$, $t(1698) = -21.85$, $p < .001$. Finally, I modelled the indirect path from uncertainty sensitivity to self-control through boredom proneness. The indirect pathway was significant, $ab = -0.20$ [-0.23, -0.17], $SE = 0.01$, $z = -14.76$, $p < .001$. After accounting for the shared variance between uncertainty sensitivity and boredom

proneness, there was no evidence of a direct association between uncertainty sensitivity and self-control, $b = -0.02 [-0.06, 0.03]$, $SE = 0.02$, $z = -0.77$, $p = .442$. See Figure 2.

Figure 2

Trait-Level Path Model



Note. All coefficients are estimated controlling for sample membership.

*** $p < .001$.

Discussion

The regression analyses yielded the predicted associations between uncertainty sensitivity, boredom proneness, and self-control within a large sample of individuals, providing initial support for the UM-B-SCF. Specifically, uncertainty sensitivity was associated with being more prone to boredom and people who were more prone to boredom tended to have lower self-control. The pattern of associations was also consistent with an indirect pathway between uncertainty sensitivity and self-control through boredom proneness. However, it is important to note that when responding to trait-level measures like the ones in the present study, people may use their feelings and behaviours across any number of situations and activities as a reference in making these global judgements (Fleeson & Jayawickreme, 2015). As a result, it is not possible to ascertain based on these results whether ambient uncertainty elicited in one context had downstream consequences on affect and behaviour during unrelated goal pursuit, which is a core

tenet of the UM-B-SCF. Thus, having found evidence in support of these general associations, it was necessary to extend these findings in subsequent studies by explicitly testing whether ambient uncertainty aroused in one context can lead people to feel bored and have less self-control when pursuing goals unrelated to the source of uncertainty.

Study 2

Study 2 extended the findings of Study 1 by experimentally inducing uncertainty with a classic mortality salience manipulation that has been widely used in research on terror management theory (TMT; Greenberg et al., 1993, 1997; Greenberg & Arndt, 2011; Pyszczynski et al., 1999). TMT posits that humans possess an instinctive drive for self-preservation that is at odds with the awareness of their inevitable death, and this predicament creates the potential for deep existential anxiety (Greenberg et al., 1997). Although it is not emphasized within the TMT framework, other researchers have highlighted the essential motivational conflict implied by the incompatible desires to achieve our goals and actualize our possible future selves, and the inevitability of our impending death (Jonas et al., 2014; Martin, 1999; McGregor et al., 1999, 2001). Consequently, it has been argued that more so than fear of death or terror of creaturely annihilation, mortality salience activates uncertainty thoughts and can be conceived as an indirect manipulation of uncertainty salience (Van den Bos, 2009; Van den Bos et al., 2005). Indeed, previous research has shown that mortality salience causes uncertainty-related feelings and produces defensive reactions similar to other uncertainty salience manipulations (e.g., McGregor et al., 2001; Van den Bos et al., 2005).

In the present study, I examined the effects of uncertainty (elicited by mortality salience) on boredom and self-control in the context of people's academic or career-related personal projects and during an online data entry task, both of which were unrelated to the source of uncertainty. I hypothesized that increased anxious uncertainty from thinking about death would cause people to rate their current academic or career-related personal projects as more boring and anticipate lower levels of self-control pursuing them. I also hypothesized that increased uncertainty from thinking about death would cause people to be more bored during an unrelated

data entry task and exercise less self-control on the task (i.e., less likely to follow through with their stated intentions and less persistent). These predictions may seem inconsistent with previous threat-and-defense work, which has found that mortality salience can cause people to become more committed and eagerly approach-motivated for their personal projects (McGregor et al., 2001, 2007, 2013). To understand these divergent predictions it is important to highlight a key way the present study differs from this past work. In past studies, people generated their personal projects *after* the mortality salience manipulation and tended to select fun and enjoyable projects that could serve to down-regulate the uncertainty and BIS activation induced by the manipulation (Jonas et al., 2014). In contrast, in the present study, participants nominated their personal projects before the mortality salience manipulation and were specifically instructed to select academic or career-related projects that presumably would not provide the same opportunity to imagine doing something fun and enjoyable. Likewise, I expected that the data entry task would not be experienced as particularly fun or enjoyable and thus would not provide an opportunity for reactive approach motivation (McGregor et al., 2010).

In the present study, I also reasoned that the hypothesized effects might be moderated by boredom proneness, such that the uncertainty manipulation would only be powerful enough to cause boredom and low self-control among people who were dispositionally prone to experiencing boredom. Finally, I predicted that the manipulation would lead to lower self-control indirectly through increased boredom for both imagining personal projects and completing the data entry task. I pre-registered my hypotheses and analysis plan on OSF while data collection was underway, but before looking at any of the data or performing any statistical analyses (pre-registration available at: <https://osf.io/zduw2>, Part 2).

Method

Participants and Power

I conducted an a-priori power analysis in G*Power 3 (Faul et al., 2007) to determine the sample size required to detect a small-to-medium size effect ($f^2 = 0.065$; Cohen, 1988) of the manipulation, controlling for boredom proneness. I expected a moderate effect size based on meta-analytic estimates from previous research examining mortality salience effects on various outcomes (Burke et al., 2010). The results of the analysis (Linear multiple regression: Fixed model, single regression coefficient; two-tailed; two predictors) indicated that a sample of 164 people would provide 90% power to detect the predicted effect. I planned to terminate data collection at the end of the academic semester—assuming I had reached the minimum required sample size—collecting as much data as possible within that timeframe.

Because the study involved deception (see Procedure and Materials section below), I began by removing data from participants who either did not complete the post-study consent form ($n = 34$) or who declined their consent after being debriefed ($n = 11$). Next, I excluded people who scored less than three on a compliance measure that was included at the end of the study ($n = 6$). The measure consisted of four items: “I tried my best to answer all of the questions honestly,” “I just clicked random responses in order to get through this survey as quickly as possible (reverse-scored),” “I conscientiously attempted to follow instructions to the best of my ability,” and “I completed this survey in a single uninterrupted sitting.” The scale anchors ranged from 1 (*none of the time*) to 5 (*all of the time*), meaning that people who scored below three reported unconscientious responding more than half of the time. The final sample consisted of 383 students from the University of Waterloo (133 males, 249 females, 1 other; $M_{age} = 19.85$,

$SD_{age} = 2.92$, $range = 17$ to 49 ; 59.32% non-white), who participated in exchange for course credit.

Procedure

Participants first completed several individual difference measures, including a measure of boredom proneness. Next, they identified three of their current academic or career-related personal projects. All participants then completed a baseline assessment of their data entry performance, which was used to control for pre-existing differences in typing speed. Participants were also ostensibly told that data entry tasks are a reliable way to gauge general academic performance and that they would receive feedback indicating how their performance compared to normative scores. A self-control dilemma—between effortfully persisting on the task and slowing down or giving up—is only possible if participants have a goal to do well (Milyavskaya et al., 2019). These statements were therefore included so that participants would care about their performance and have a goal to do well on the task. Following the baseline assessment, participants were informed that they would complete a second data entry task later in the study and responded to a series of questions about their intentions for completing this subsequent task.

Next, they were randomly assigned to either an uncertainty ($n = 193$) or control condition ($n = 190$), in which they wrote about the experience of dying or dental pain, respectively. Immediately following the manipulation, participants reported the extent to which what they wrote about made them feel uncertain. Participants then imagined pursuing each of the personal projects that they had nominated at the beginning of the study and rated how boring they seemed and their expected self-control while pursuing them. Next, participants completed the main data entry task and responded to a series of follow-up questions about their boredom and self-control

while completing it. Finally, participants were debriefed and provided post-study consent with full knowledge of the study's purpose.

Materials and Measures

Additional measures were included in the present study that are not presented here. A list of these additional measures is available in Appendix A.

Boredom Proneness. I used the same 10-item measure of boredom proneness as described in Study 1. Cronbach's alpha reliability in the current study was .89.

Personal Projects. Participants were instructed to identify and list three of their current academic or career-related personal projects. They read the following prompt and then listed each of their three projects in the text boxes provided.

We are interested in studying the kinds of academic and career-related goals and plans that people have. We call these personal projects. All of us have a number of personal projects at any given time that we think about, plan for, carry out, and sometimes (though not always) complete. We are specifically interested in your academic and career-related personal projects. For example, you might have projects related to mastering coursework, getting certain grades, or attaining or avoiding some outcome. In the space below, please list your three most self-characteristic academic or career-related personal projects.

Baseline Assessment of Data Entry Performance. Participants read the following instructions before beginning the baseline data entry task:

The following task is designed to simulate a data entry task. Performance on data entry tasks such as this one has been found to be a quick and reliable method for gauging general academic performance among undergraduate students, as it tends to be associated with outcomes such as greater reading comprehension and working memory. Please type

as many consecutive numbers as you possibly can in the text box provided starting with the number 1. **Separate each number with a comma and a space (e.g., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, etc.).** Try to enter as many numbers as possible, after a period of time, the screen will automatically advance. For your reference, at the end of the study, we will indicate how your performance compares to normative scores on this task.

On the next page, participants entered numbers in a blank text box for 30 seconds until the screen automatically advanced; they were not aware of how much time would elapse before the screen advanced. As part of the instructions, participants were also told that they could choose to stop or take a break if needed but that if they chose to do so it was recommended that they not engage in other activities as this could be distracting for the remainder of the study. I included this statement to discourage participants who chose not to persist with the task from doing something else in the interim that may be enjoyable or engaging (and hence not boring) like checking social media or reading the news.

Data Entry Intentions. After the baseline assessment, participants were told that later in the study they would be asked to complete a similar data entry task. They were instructed to think about completing this next task and answer the following questions about their intended behaviour on a 5-point scale from 1 (definitely no) to 5 (definitely yes): “Do you plan to give the next data entry task your undivided attention?”, “Do you plan to check your phone at any point during the next data entry task?”, and “Do you plan to stop or take a break during the next data entry task?” By asking participants about their intended behaviour on the subsequent data entry task, I operationalized self-control failure as a discrepancy between the person’s stated intentions and their actual reported behaviour. If people generally intended to perform well on the main task—that is, they had a goal to do well—and then performed poorly this would represent a more

valid measure of self-control failure, as opposed to someone who did not intend to perform well and then didn't (Milyavskaya, Berkman, et al., 2019).

Uncertainty Manipulation. To manipulate uncertainty, I used a classic writing exercise that has frequently served as a mortality salience induction in terror management research (Greenberg et al., 1997). There has been some debate within the terror management literature over the distinctiveness of mortality salience relative to other uncertainty-related threats. However, threat-and-defense researchers generally agree that the existential uncertainty aroused by thinking about one's own death activates the same BIS-mediated processes—that are the focus of the present investigation—as other uncertainty threats (Jonas et al., 2014; Tritt et al., 2012). In the present study, participants were randomly assigned to one of two conditions: the mortality salience condition or a dental pain salience condition. In the mortality salience condition participants answered each of the following questions:

1. As specifically as you can, describe what you think will happen to you as you physically die and once you are dead.
2. Briefly describe the emotions that the thought of your own death arouses in you.

In the dental pain salience condition—a control condition that is commonly used in terror management research (Burke et al., 2010; Greenberg et al., 1997)—participants answered each of the following questions:

1. As specifically as you can, describe what you think happens to you when you experience dental pain.
2. Briefly describe the emotions that the thought of dental pain arouses in you.

Felt Uncertainty. Felt uncertainty was measured with a shortened 13-item version of McGregor et al.'s (2001) anxious uncertainty scale. Participants rated the extent to which the

experience they had just written about made them feel each of thirteen uncertainty-related emotions, such as “uncertain,” “uneasy,” and “confused” on a scale from 1 (strongly disagree) to 5 (strongly agree). A mean score was calculated with higher scores reflecting greater experienced uncertainty. Cronbach’s alpha reliability in the current study was .93.

Personal Project Boredom. Participants were instructed to imagine pursuing each of the three academic or career-related personal projects that they identified at the beginning of the study and then rate how boring each one seemed. Participants rated their agreement with six items including, “When imagining pursuing this project right now, it feels boring” and “When imagining pursuing this project right now, it is hard to find interesting” rated on a 5-point scale from 1 (strongly disagree) to 5 (strongly agree). Items were adapted from the Disengagement factor of the Multidimensional State Boredom Scale (Fahlman et al., 2013). A mean score was calculated with higher scores reflecting greater anticipated project boredom. Cronbach’s alpha reliability in the current study was .92.

Personal Project Self-Control. For each of their three projects, participants rated their agreement with six items (e.g., “I will be very disciplined in pursuing this project” and “I will exercise self-control to keep me on track to accomplish this project”) on a 5-point scale from 1 (strongly disagree) to 5 (strongly agree). A mean score was calculated with higher scores reflecting more anticipated self-control pursuing the project. Cronbach’s alpha reliability was .94.

Main Data Entry Task. Participants were told that they would be completing another simulated data entry exercise like the one they did earlier in the study. They read the same instructions as for the baseline data entry task and were again told that the screen would

automatically advance after an unspecified amount of time. This time, the screen advanced after five minutes had elapsed.

Data Entry Task Boredom. Participants responded to two questions about how boring the data entry task was: “How boring did you find the task?” and “How much did you wish you could be doing something else?” ($r = .77$) rated on a 5-point scale from 1 (not at all) to 5 (a great deal). A mean score was calculated with higher scores reflecting greater boredom during the task.

Data Entry Task Self-Reported Self-Control. Participants responded to three questions about their behaviour while completing the data entry task, which mirrored the three intention questions that they were asked earlier in the study: “Did you get distracted during the task?”, “Did you check your phone during the task?” and “Did you stop or take a break(s) during the task?”, rated on a 5-point scale from 1 (most of the time) to 5 (never, not at all). I regressed people’s ratings for each of the three behaviour questions on its associated intention question and used the residual as the measure of self-control. The residual score represents the difference between a person’s reported behaviour during the main task and their predicted behaviour as a function of their intention (i.e., the degree of discrepancy between intention and behaviour). I then calculated the mean of the three residuals to create an overall index of self-reported self-control during the task. The resulting variable was negatively skewed ($\text{skew} = -1.19$). I therefore followed up all analyses reported below by re-running them using a log transformed version of the variable. Across all analyses, results using the log transformed variable were consistent with those using the original variable. For ease of interpretation, I report results using the non-transformed variable.

Data Entry Task Behavioural Self-Control. Behavioural self-control was assessed by the total number of characters that participants entered into the text box before the screen advanced. There was one outlier more than three standard deviations above the mean. Following my pre-registered plan, I examined the outlier and found that the individual indeed followed the task instructions. Because the extreme value was not the result of failing to follow instructions, I did not exclude the case. Notably, excluding the case did not change any of the results. For all analyses with task performance as the outcome, I included the number of characters entered during the baseline assessment to control for between-person variability in typing speed that was not a result of the manipulation.

Results

Descriptive statistics and correlations for all study variables are presented in Table 2.

Table 2

Descriptive Statistics and Intercorrelations for All Study Variables

Variable	Mean	SD	1	2	3	4	5	6
1. Boredom proneness	3.19	0.85	—					
2. Felt uncertainty	2.82	0.99	.21**	—				
3. Project boredom	2.53	0.86	.43**	.24**	—			
4. Project self-control	4.18	0.63	-.24**	-.05	-.43**	—		
5. Task boredom	3.86	1.13	.28**	.14**	.31**	-.08	—	
6. Reported task self-control	0.00	0.97	-.18**	-.08	-.23**	.14**	-.34**	—
7. Characters entered	707.93	271.59	-.14**	-.09	-.21**	.13*	-.20**	.40**

* $p < .05$. ** $p < .01$.

Pre-Registered Analyses

To check whether the writing exercise successfully manipulated uncertainty, I conducted an independent-samples t test to compare felt uncertainty across the two conditions. The results

indicated that felt uncertainty significantly differed across conditions, $t(362.01) = -2.08$, $p = .039$, Hedge's $g = -0.21 [-0.41, -0.01]$. As expected, writing about the experience of dying made people feel more uncertain ($M = 2.93$, $SD = 1.10$) than writing about the experience of dental pain ($M = 2.72$, $SD = 0.86$). However, the magnitude of this difference was small.

Following my pre-registered analysis plan, I ran two-step linear regressions to test the effect of the manipulation on imagined boredom and self-control completing personal projects. I regressed personal project boredom and personal project self-control each on condition (effect coded) and boredom proneness (mean centered) in an initial step and added their interaction term in a second step (see Table 3). Neither the main effect of condition in Step 1 nor the Condition x Boredom Proneness interaction in Step 2 significantly predicted personal project boredom (Models 1a and 1b). Similarly, neither the main effect of condition in Step 1 nor the Condition x Boredom Proneness interaction in Step 2 significantly predicted personal project self-control (Models 2a and 2b).

Next, I ran the same analyses but with boredom and self-control (both self-reported and behavioural) during the data entry task as the outcomes. The main effect of condition on task boredom in Step 1 was not significant (Model 3a), but the Condition x Boredom Proneness interaction in Step 2 was significant (Model 3b). I probed the interaction by testing the simple effect of condition (dummy coded; dental pain = 0) on task boredom at high and low levels of boredom proneness. Despite the significant interaction, the simple effect of condition on task boredom was not significant at either high levels of boredom proneness (+1 SD), $b = 0.24 [0.07, -0.55]$, $SE = 0.16$, $t(379) = 1.53$, $p = .128$, nor at low levels of boredom proneness (-1 SD), $b = -0.29 [-0.60, 0.02]$, $SE = 0.16$, $t(379) = 1.85$, $p = .065$. The non-significant trend suggested that people high in boredom proneness were more bored during the data entry task after writing about

the experience of dying, whereas people low in boredom proneness were more bored during the data entry task after writing about the experience of dental pain.

Table 3

Regressions of Boredom and Self-Control Outcomes on Condition, Boredom Proneness and their Interaction

Model	Predictor	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95% CI	<i>R</i> ²
Personal project boredom							
1a	Condition	-0.02	0.04	-0.59	.555	[-0.10, 0.05]	.19
	Boredom proneness	0.44	0.05	9.31	<.001	[0.35, 0.53]	
1b	Condition x Boredom proneness	-0.02	0.05	-0.44	.660	[-0.11, 0.07]	.19
Personal project self-control							
2a	Condition	0.01	0.03	0.32	.752	[-0.05, 0.07]	.06
	Boredom proneness	-0.18	0.04	-4.89	< .001	[-0.26, -0.11]	
2b	Condition x Boredom proneness	-0.01	0.04	-0.25	.802	[-0.08, 0.06]	.06
Data entry task boredom							
3a	Condition	-0.01	0.06	-0.23	.822	[-0.12, 0.10]	.08
	Boredom proneness	0.38	0.07	5.77	<.001	[0.25, 0.51]	
3b	Condition x Boredom proneness	0.16	0.07	2.38	.018	[0.03, 0.28]	.09
Data entry task reported self-control							
4a	Condition	-0.08	0.05	-1.73	.085	[-0.18, 0.01]	.04
	Boredom proneness	-0.20	0.05	-3.46	< .001	[-0.31, -0.09]	
4b	Condition x Boredom proneness	-0.07	0.06	-1.19	.234	[-0.18, 0.04]	.04
Data entry task behavioural self-control (Task performance)							
5a	Condition	-30.37	11.77	-2.58	.010	[-53.52, -7.23]	.30
	Boredom proneness	-22.28	13.87	-1.61	.109	[-49.56, 5.00]	
5b	Condition x Boredom proneness	6.17	13.82	0.45	.656	[-20.99, 33.34]	.30

Running the same analyses with the two self-control outcomes revealed no main effect of condition and no Condition x Boredom Proneness interaction on reported self-control during the

data entry task (Models 4a and 4b). However, there was a main effect of condition on task performance with people in the mortality salience condition on average entering 61 characters less than people in the dental pain condition (Model 5a). There was no evidence of a Condition x Boredom Proneness interaction on task performance (Model 5b).

Finally, I tested the indirect effect of condition (dummy coded; dental pain = 0) on anticipated project self-control through project boredom, and the indirect effects of condition on data entry task self-control and characters entered through task boredom.¹ None of the indirect effects were significantly different from zero (see Table 4).

Table 4

Summary of Mediation Results

Indirect Effect	<i>ab</i>	<i>SE</i>	<i>z</i>	<i>p</i>	95% CI
Condition > Project boredom > Project self-control	0.00	0.03	0.10	.922	[-0.05, 0.06]
Condition > Task boredom > Task self-control	-0.00	0.03	-0.06	.949	[-0.07, 0.06]
Condition > Task boredom > Task performance	-0.25	3.91	-0.06	.949	[-7.92, 7.42]

Exploratory Analyses

The results of the pre-registered analyses largely did not support my original hypotheses. I therefore performed several exploratory analyses, detailed below. The results of these analyses ultimately led to discoveries that prompted me to further revise my method and statistical model in subsequent studies.

Felt Uncertainty Measure. The manipulation check revealed a significant difference in felt uncertainty across the two conditions in the expected direction. However, the effect size was

¹ I originally planned to combine the measures of self-reported self-control and number of characters entered during the data entry task into a single composite score. However, it ultimately seemed more informative to keep these two measures separate to allow for comparison between self-reported and behavioural assessments of self-control.

small: felt uncertainty was only 0.21 scale points higher on average after writing about the experience of dying compared to writing about the experience of dental pain. This raised questions about whether the measure was assessing negative affective reactions more broadly, with some of the items more clearly targeting uncertainty compared to others.

To investigate this, I performed an exploratory factor analysis of the felt uncertainty items to see whether the measure had a multi-dimensional structure. Before performing the analysis, I first examined whether the item-level data were suitable for factor analysis. The Keiser-Meyer-Olkin measure of sampling adequacy was 0.93, within the recommended range of 0.80 to 1 (Kaiser, 1974), and Bartlett's test of sphericity was significant $\chi^2(78) = 3576.44, p < .001$. Having met the basic criteria for factorability of the correlation matrix, I proceeded with the analysis. I used maximum likelihood factoring to estimate one, two, three, and four factor solutions, in each case applying an oblique (oblimin) rotation to allow for intercorrelations among the factors. Of these, the three factor solution, which explained 67% of the variance, was preferred because a parallel analysis suggested that the number of factors was three, and the pattern of factor loadings was easily interpretable (see Table 5). Examination of the model fit for the three-factor solution also generally indicated a good fit to the data with one of the two absolute fit indices and one of the two relative fit indices meeting the recommended cut-off criteria: Standardized Root Mean Square Residual (SRMR) = 0.03 (recommended < 0.08; Hu & Bentler, 1999); Root Mean Square Error of Approximation (RMSEA) = 0.09 (recommended < 0.08; MacCallum et al., 1996); Tucker Lewis Index (TLI) = 0.93 (recommended > 0.95; Hu & Bentler, 1999); and Comparative Fit Index (CFI) = 0.96 (recommended > 0.95; Hu & Bentler, 1999).

Table 5*Factor Loadings For Felt Uncertainty Items*

Item	Factor 1	Factor 2	Factor 3
1. It makes me feel uneasy.		.866	
2. It makes me feel torn.	.436	.416	
3. It makes me feel bothered.		.907	
4. It makes me feel pre-occupied.			
5. It makes me feel confused.	.804		
6. It makes me feel distractible.			.573
7. It makes me feel restless.			.831
8. It makes me feel jumbled.			.616
9. It makes me feel uncomfortable.		.670	
10. It makes me feel conflicted.	.657		
11. It makes me feel indecisive.	.797		
12. It makes me feel chaotic.	.432		
13. It makes me feel uncertain.	.826		

Note. Factor loadings < .40 are not displayed.

The first factor was most conceptually close to uncertainty. The following items loaded highly on the first factor: confused, conflicted, indecisive, chaotic, and uncertain. Torn also loaded on the first factor, but had a cross-loading on the second factor. Despite the cross-loading, conceptually, torn fit better with the uncertainty items so I decided to retain it as part of the first factor. Examination of the items revealed that the second and third factors assessed negative affective reactions that were less closely linked to uncertainty. I labelled the three factors uncertainty, agitation, and restlessness, respectively. I created composite scores for each of the three factors and conducted follow-up *t* tests to compare mean differences across the mortality salience and dental pain salience conditions on each of the three new variables. There was a medium size difference in uncertainty, $t(372.23) = -5.11$, $p < .001$, Hedge's $g = -0.52$ [-0.72, -0.32]; people reported more uncertainty after writing about the experience of dying ($M = 2.95$,

$SD = 0.97$) compared to writing about the experience of dental pain ($M = 2.40$, $SD = 1.15$). However, there were no significant differences in either agitation, $t(374.40) = 1.63$, $p = .104$, Hedge's $g = 0.17$ $[-0.03, 0.37]$, or restlessness, $t(380.92) = 0.21$, $p = .834$, Hedge's $g = 0.02$ $[-0.18, 0.22]$, across the conditions.

Serial Path Models. The results of the pre-registered mediation models showed no evidence of an indirect effect of condition on self-control through boredom for either the personal project outcomes or the data entry task outcomes. Although there were no significant differences in either project boredom or task boredom across the two conditions (the a path of the models), examination of the raw correlations (see Table 2) showed significant negative associations between project boredom and project self-control, as well as task boredom and task self-control (the b path of the models). There were also significant correlations between felt uncertainty and both project boredom and task boredom. Moreover, these associations were even stronger when using the new uncertainty measure from the results of the factor analysis presented above (personal project boredom $r = .28$ and task boredom $r = .18$). Based on this pattern of associations, I reasoned that a serial path model may be a better fit to the data. More specifically, that condition may exert its effect on self-control indirectly through felt uncertainty about the manipulation and then project/task boredom.

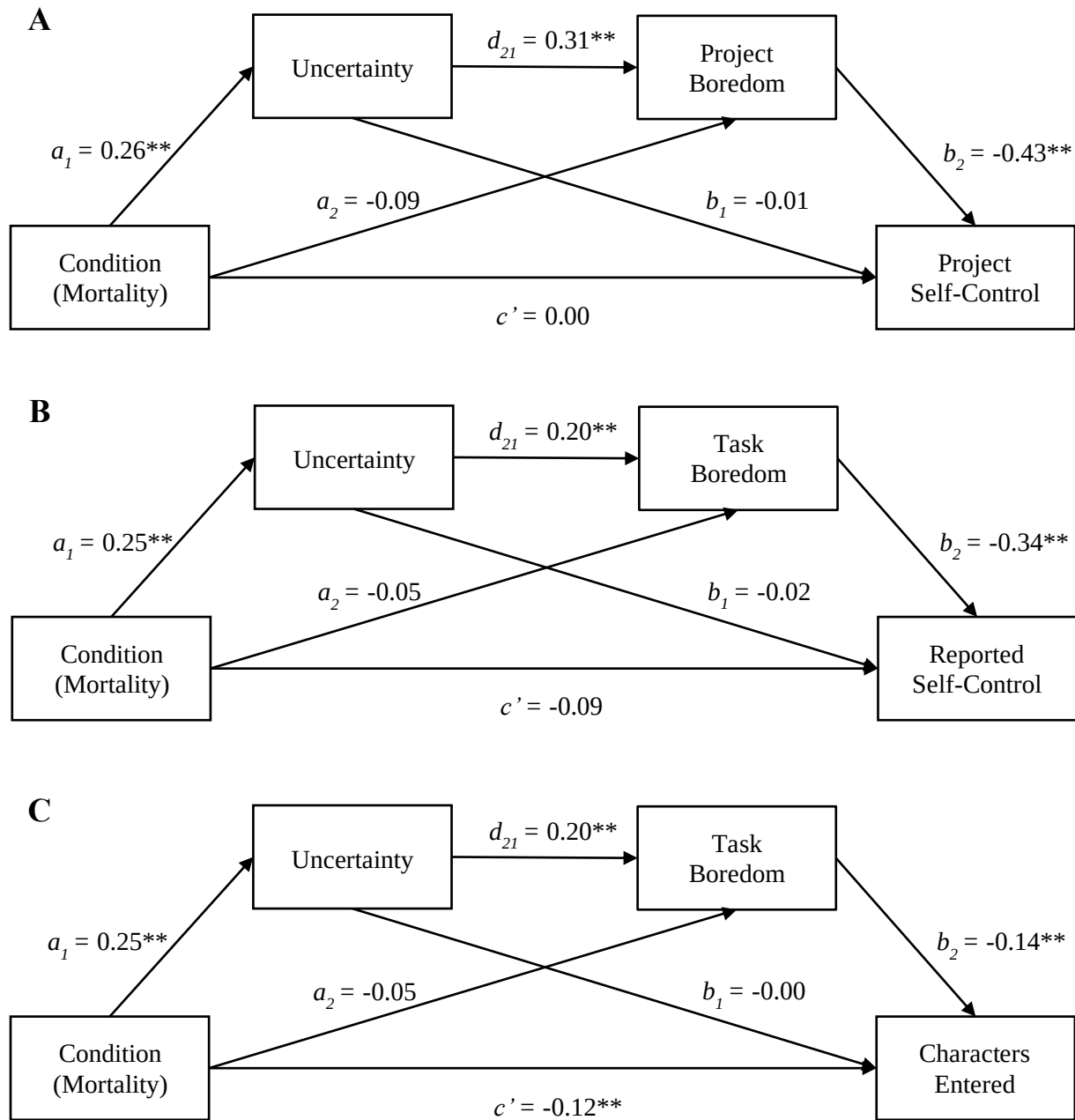
I fit three serial path models examining the indirect effects of condition on: 1) project self-control through uncertainty and project boredom, 2) self-reported data entry task self-control through uncertainty and task boredom, and 3) characters entered during the data entry task through uncertainty and task boredom controlling for baseline data entry performance (see Figure 3). Because the different outcomes had different measurement scales, here I present both standardized and unstandardized coefficients and in Figure 3 I report standardized coefficients to

allow for easier comparison of effect sizes across models. As can be seen in Figure 3, writing about the experience of dying made people feel more uncertain, $b = 0.55$ [0.34, 0.77], $SE = 0.11$, $\beta = 0.35$, $t(381) = 5.11$, $p < .001$ (Models 1-3). People who felt more uncertain, in turn, reported that their personal projects seemed more boring, $b = 0.24$ [0.16, 0.32], $SE = 0.04$, $\beta = 0.31$, $t(378) = 5.98$, $p < .001$ (Model 1), and found the data entry task more boring, $b = 0.20$ [0.10, 0.32], $SE = 0.05$, $\beta = 0.20$, $t(380) = 3.74$, $p < .001$ (Models 2 and 3). Finally, people who rated their projects as more boring anticipated having less self-control in pursuit of them, $b = -0.32$ [-0.39, -0.25], $SE = 0.04$, $\beta = -0.43$, $t(377) = -8.89$, $p < .001$ (Model 1), and people who felt more bored during the data entry task reported having less self-control while completing it, $b = -0.29$ [-0.37, -0.21], $SE = 0.04$, $\beta = -0.34$, $t(379) = -6.89$, $p < .001$ (Model 2), and entered fewer characters, $b = -33.73$ [-54.28, -13.19], $SE = 10.45$, $\beta = -0.14$, $t(378) = -3.23$, $p = .001$ (Model 3).

In each case, the negative serial indirect effect of condition on self-control through uncertainty and boredom was significantly different from zero (Model 1 $a_1d_{21}b_2 = -0.04$ [-0.07, -0.02], $SE = 0.01$, $a_1d_{21}b_2 \text{ std.} = -0.03$, $z = -3.63$, $p < .001$; Model 2 $a_1d_{21}b_2 = -0.03$ [-0.06, -0.01], $SE = 0.01$, $a_1d_{21}b_2 \text{ std.} = -0.02$, $z = -2.78$, $p = .006$; Model 3 $a_1d_{21}b_2 = -3.77$ [-7.09, -0.44], $SE = 1.70$, $a_1d_{21}b_2 \text{ std.} = -0.01$, $z = -2.22$, $p = .026$). There was no evidence of a direct effect of condition on personal project self-control, $b = 0.004$ [-0.12, 0.12], $SE = 0.06$, $\beta = 0.003$, $t(377) = 0.06$, $p = .954$, nor self-reported self-control during the data entry task, $b = -0.17$ [-0.36, 0.02], $SE = 0.10$, $\beta = -0.09$, $t(379) = -1.79$, $p = .074$, after accounting for felt uncertainty and boredom. However, there was a significant direct effect of condition on task performance even after accounting for felt uncertainty and boredom, $b = -62.72$ [-110.01, -15.44], $SE = 24.05$, $\beta = -0.12$, $t(378) = -2.61$, $p = .009$. Notably, as can be seen in Figure 3, in all three serial models the direct

Figure 3

Personal Projects and Data Entry Task Serial Path Models



Note. Panel A: Personal project self-control outcome (Model 1). Panel B: Data entry task self-reported self-control outcome (Model 2). Panel C: Data entry task behavioural self-control outcome (Model 3).

* $p < .05$. ** $p < .01$.

effect of condition on boredom was negative (though nonsignificant) after accounting for uncertainty (path a_2).

Discussion

The results of the exploratory serial path analyses were consistent with the UM-B-SCF. The significant serial indirect pathway suggests that felt uncertainty, specifically caused by awareness of death, was associated with higher levels of boredom and less self-control in two unrelated contexts: academic and career-related personal projects and a data entry task. While these exploratory results support my proposed conceptual model, I did not originally predict that the mortality salience manipulation would exert its effect on boredom through felt uncertainty. In all three of the serial models, there were counteracting direct and indirect effects of the mortality salience manipulation on boredom, which is indicative of statistical suppression (MacKinnon et al., 2000). The positive indirect effect through uncertainty and the negative direct effect, when combined, effectively cancel each other out so that the total effect of condition on boredom is close to zero and non-significant. As I elaborate in the general discussion, it is possible that for some people, thinking about their own death could instill a sense of peace (e.g., for people who are highly spiritual and/or religious) or a sense of curiosity (e.g., for people who are fascinated by meta-physical concepts such as the afterlife). If this were the case, these mediators could simultaneously work to reduce boredom counteracting any effect of uncertainty.

Additionally, previous research has shown that mortality salience manipulations exert stronger effects and sometimes only produce effects among participants for whom the source of uncertainty is personally salient (Van den Bos, 2009; Van den Bos et al., 2005). This is important in the context of the UM-B-SCF, as the model only predicts downstream effects on boredom and self-control to the extent that the experimental manipulation actually produces ambient

uncertainty (and hence lingering BIS activation). Nevertheless, given the exploratory nature of these analyses and the fact that I did not specify an a priori serial mediation hypothesis, it was necessary to replicate and validate these results in a separate study.

Study 3

Study 3 provided a pre-registered direct replication of the findings from Study 2. Based on those findings, I hypothesized three serial indirect effects: that writing about the experience of dying (mortality salience condition) would make people feel more uncertain, which would in turn lead them to perceive their personal projects as more boring and then anticipate having less self-control while pursuing them (H1), that writing about the experience of dying would make people feel more uncertain, which would in turn lead them to find the data entry task more boring and then both report less self-control while completing it (H2), and enter fewer characters (H3). I pre-registered my hypotheses and analysis plan on OSF while data collection was underway, but before looking at any of the data or performing any statistical analyses (pre-registration available at: <https://osf.io/du7pn>, Part 2).

Method

Participants and Power

I conducted an a-priori power analysis using an application in R designed specifically for power and sample size calculations for mediation models based on Monte Carlo simulation (described in Schoemann et al., 2017). I used the estimates from Study 2 for the serial mediation model with the smallest effect size (i.e. Model 3 in which characters entered was the outcome), since this model would require the largest sample size to achieve sufficient power to detect the serial indirect effect (see Appendix B, Figure B1 for input parameters and calculations). The app uses correlations between the variables in the model to compute a covariance matrix that is then used to generate the simulation data. To more accurately represent the pattern of associations, I used semi-partial correlation coefficients for associations between the predictors and characters entered, controlling for characters entered at baseline. The results of the analysis indicated that a

sample of 450 people would provide 90% power to detect the serial indirect effect. I planned to continue data collection until the end of the academic semester, with the aim of recruiting a sample of at least 450 people.

Because the study involved deception, I began by removing data from participants who either did not complete the post-study consent form ($n = 38$) or who declined their consent after being debriefed ($n = 8$). Next, I removed two duplicates (i.e. responses from the same person), in each case retaining the response that was completed first. Following my pre-registered exclusion criteria, I also removed data from people who scored less than three on a 4-item compliance measure that was included at the end of the study (see Study 2 for a description of the items; $n = 13$). The final sample after exclusions consisted of 436 undergraduate students from the University of Waterloo (124 males, 309 females, 3 other; $M_{\text{age}} = 20.06$, $SD_{\text{age}} = 3.75$, range = 17 to 49; 55.35% non-white), who participated in exchange for course credit.

Procedure and Materials

The procedure and materials were the same as those used in Study 2 with two exceptions. First, the measure of boredom proneness was not included in this study. Second, based on the results of the exploratory factor analysis in Study 2, the uncertainty measure in this study consisted of only the 6 items that loaded highly on the uncertainty factor: torn, confused, conflicted, indecisive, chaotic, and uncertain.

Baseline Assessment of Data Entry Performance. There was one outlier more than three standard deviations above the mean. Following my pre-registered plan, I examined the response and found that the individual failed to follow the instructions and therefore excluded the case.

Data Entry Task Self-Reported Self-Control. Self-reported self-control during the data entry task was again negatively skewed (skew = -1.36). I therefore followed up all analyses reported below by re-running them using a log transformed version of the variable. Results using the log transformed variable were consistent with those using the original variable. For ease of interpretation, I report results using the non-transformed variable.

Data Entry Task Behavioural Self-Control. There were three outliers more than three standard deviations above the mean. Following my pre-registered plan, I examined the outliers and found that the responses were indicative of a failure to follow the task instructions. I therefore excluded the three extreme cases.

Results and Discussion

Descriptive statistics and correlations for all variables are presented in Table 6.

Table 6

Descriptive Statistics and Intercorrelations for All Study Variables

Variable	Mean	SD	1	2	3	4	5
1. Felt uncertainty	2.81	1.07	—				
2. Project boredom	2.49	0.88	.19**	—			
3. Project self-control	4.19	0.64	-.04	-.44**	—		
4. Task boredom	3.78	1.12	.11*	.23**	-.06	—	
5. Reported task self-control	0.00	0.99	-.08	-.09	.10*	-.38**	—
6. Characters entered	680.67	285.44	-.14**	-.14**	.08	-.21**	.40**

* $p < .05$. ** $p < .01$.

Before testing my pre-registered hypotheses, I first conducted independent-samples t tests to compare felt uncertainty, boredom and self-control outcomes across the two conditions (see Table 7). Consistent with Study 2, there was a significant small-to-medium size difference in felt

uncertainty using the shortened 6-item measure; writing about the experience of dying made people feel more uncertain than writing about the experience of dental pain. Also consistent with Study 2, there were no total effects of condition on project boredom, project self-control, data entry task boredom or data entry task self-control. However, there was a total effect of condition on data entry task performance with people in the mortality salience condition entering significantly fewer characters than their counterparts in the dental pain condition.

Table 7

Total Effect of Condition on Outcomes

Outcome	MS <i>M</i> (<i>SD</i>)	DP <i>M</i> (<i>SD</i>)	<i>t</i>	<i>p</i>	Hedge's <i>g</i>	95% CI
Felt uncertainty	3.00 (1.14)	2.61 (0.96)	-3.82	< . .001	-0.36	[-0.55, -0.18]
Project boredom	2.47 (0.89)	2.50 (0.87)	0.36	.716	0.03	[-0.15, 0.22]
Project self-control	4.22 (0.61)	4.15 (0.67)	-1.14	.256	-0.11	[-0.30, 0.08]
Task boredom	3.69 (1.16)	3.88 (1.08)	1.74	.082	0.17	[-0.02, 0.35]
Task reported self-control	0.05 (0.94)	-0.05 (1.04)	-1.07	.287	-0.10	[-0.29, 0.09]
Task characters entered ^a	659.28 (286.93)	702.77 (282.87)	-2.15	.032	—	—

Note. MS = Mortality salience condition; DP = Dental pain condition.

^a*t* statistic and *p* value were computed using regression so that characters entered during the baseline task could be included as a covariate.

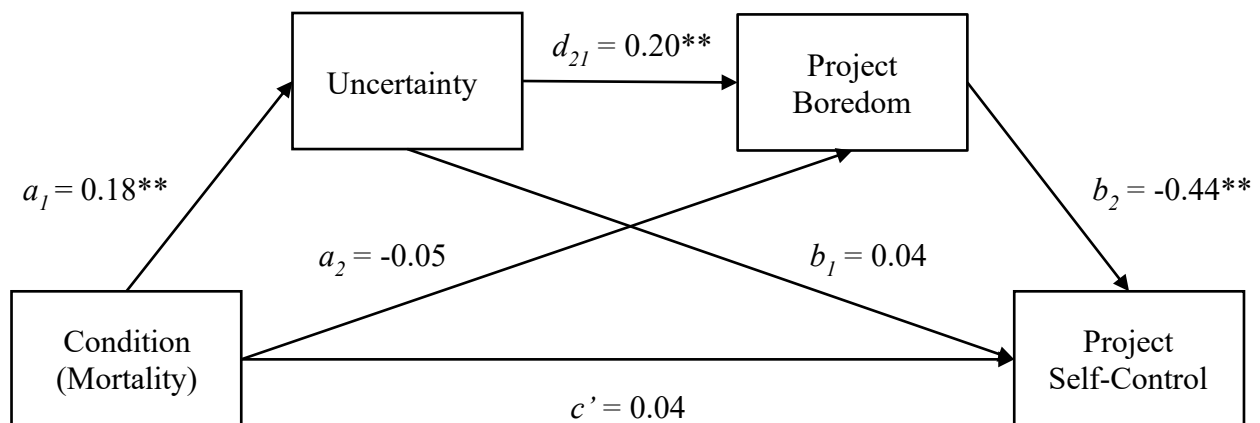
Personal Project Serial Path Model

To test my first hypothesis, I modelled the serial indirect effect of condition on personal project self-control through uncertainty and project boredom (see Figure 4). Like in Study 2, here I present both standardized and unstandardized coefficients and in Figure 4 I report standardized coefficients given the different measurement scales of the outcomes. Writing about the

experience of dying made people feel more uncertain than writing about the experience of dental pain, $b = 0.39$ [0.19, 0.58], $SE = 0.10$, $\beta = 0.18$, $t(434) = 3.81$, $p < .001$. People who felt more uncertain, in turn, reported that their academic and career-related personal projects seemed more boring, $b = 0.16$ [0.09, 0.24], $SE = 0.04$, $\beta = 0.20$, $t(432) = 4.12$, $p < .001$. Finally, people who reported that their personal projects seemed more boring also anticipated having less self-control while completing them, $b = -0.32$ [-0.38, -0.26], $SE = 0.03$, $\beta = -0.44$, $t(431) = -10.08$, $p < .001$. Consistent with my hypothesis, the negative serial indirect effect was significantly different from zero, $a_1d_2b_2 = -0.02$ [-0.03, -0.01], $SE = 0.01$, $a_1d_2b_2 \text{ std.} = -0.02$, $z = -2.67$, $p = .008$. There was no direct effect of condition on personal project self-control after accounting for felt uncertainty and boredom, $b = 0.05$ [-0.06, 0.16], $SE = 0.06$, $\beta = 0.04$, $t(431) = 0.91$, $p = .365$.

Figure 4

Personal Projects Serial Path Model



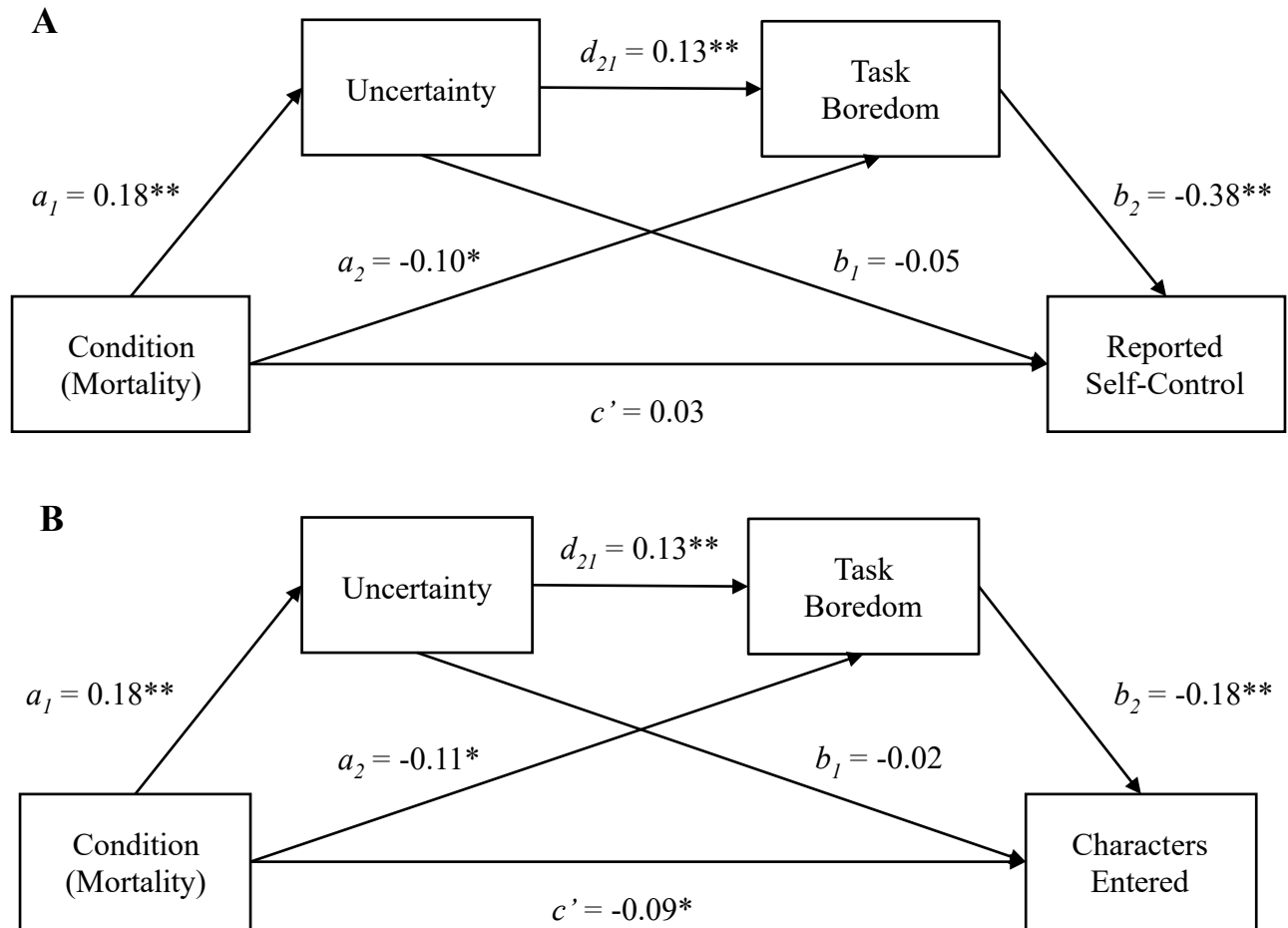
****** $p < .01$.

Data Entry Task Serial Path Models

To test my second hypothesis, I modelled the serial indirect effects of condition on reported data entry task self-control and characters entered during the task through uncertainty and task boredom (see Figure 5). Writing about the experience of dying made people feel more

Figure 5

Data Entry Task Serial Path Models



Note. Panel A: Data entry task self-reported self-control outcome. Panel B: Data entry task behavioural self-control outcome (performance).

* $p < .05$. ** $p < .01$.

uncertain and people who felt more uncertain, in turn, reported that the data entry task was more boring, $b = 0.13$ [0.03, 0.23], $SE = 0.05$, $\beta = 0.12$, $t(433) = 2.57$, $p = .010$. Finally, people who found the data entry task more boring reported having less self-control during it, $b = -0.33$ [-0.41, -0.25], $SE = 0.04$, $\beta = -0.38$, $t(431) = -8.37$, $p < .001$, and also entered fewer characters, $b = -44.11$ [-62.62, -25.60], $SE = 9.42$, $\beta = -0.17$, $t(427) = -4.69$, $p < .001$. Again consistent with my

hypothesis, the negative serial indirect effects on both self-reported self-control during the task, $a_1d_{21}b_2 = -0.02 [-0.03, -0.001]$, $SE = 0.01$, $a_1d_{21}b_2 \text{ std.} = -0.01$, $z = -2.09$, $p = .036$, and characters entered, $a_1d_{21}b_2 = -2.25 [-4.50, -0.01]$, $SE = 1.15$, $a_1d_{21}b_2 \text{ std.} = -0.004$, $z = -1.97$, $p = .049$, were significantly different from zero. Similar to Study 2, there was no direct effect of condition on self-reported self-control during the data entry task after accounting for felt uncertainty and boredom, $b = 0.06 [-0.12, 0.23]$, $SE = 0.09$, $\beta = 0.03$, $t(431) = 0.63$, $p = .527$, but there was a significant direct effect of condition on characters entered, $b = -52.90 [-94.83, -10.97]$, $SE = 21.33$, $\beta = -0.09$, $t(427) = -2.48$, $p = .014$.

The results of Study 3 supported my pre-registered hypotheses, replicating the exploratory findings from Study 2. The findings, once again showed that after writing about the experience of dying, people who felt more uncertain about death experienced greater boredom and less self-control in subsequent, unrelated tasks and goals.

Study 4

Study 4 extended the findings of Studies 2 and 3 by assessing a different source of uncertainty, as well as examining boredom and self-control in two different unrelated contexts. Specifically, I assessed uncertainty arising from the ongoing COVID-19 pandemic declared by the World Health Organization (WHO) in March 2020. Following this declaration, the WHO urged countries to take immediate and aggressive action to curb the spread of the virus (WHO, 2020), and in response, governments began implementing various containment measures. By April 2020, many countries had restricted travel, closed schools and non-essential businesses—or required that they implement a work-from-home policy—and adopted social distancing rules that encouraged people to stay home and limit physical contact with others (Roser et al., 2020). While these measures were necessary to mitigate impacts to public health, they also caused significant disruption of people's daily lives. Given the long-term focus of many important personal goals (Van den Bos et al., 2015), events that generate widespread uncertainty about the future can be an especially potent activator of the BIS (Hirsh et al., 2012). In the context of the COVID-19 pandemic, the imposed containment measures and precariousness of the evolving situation had negative consequences for many personal goals (e.g., Bickis, 2020; Killam, 2020); to various extents, social, relationship, financial, career, academic, and health goals were all impeded. The uncertainty of the situation was further compounded by reports of the severe symptoms of contracting the virus and steadily rising death tolls, which are a form of mortality salience insofar as they remind people of their own mortality.

I examined how uncertainty elicited by the pandemic affected boredom and self-control in two unrelated activities: working on day-to-day tasks and while completing the online study. I hypothesized that people who felt more uncertain due to the pandemic would report that their

daily tasks were more boring and, in turn, that they had less self-control while working on them. Likewise I hypothesized that people who felt more uncertain would find the study more boring and, in turn, would report exercising less self-control while completing it. In addition to these confirmatory analyses, I explored the relative strength of uncertainty as a predictor of boredom and low self-control, compared to more general negative affect. This allowed me to further examine whether there is something unique about feelings of uncertainty—as was suggested by the results of the exploratory factor analysis in Study 2. Finally, I also explored whether felt uncertainty assessed during the initial study session predicted more boredom and less progress made on personal projects one month later. I pre-registered my hypotheses and analysis plan on OSF before collecting any data (pre-registration available at: <https://osf.io/j5efa>). Additional exploratory analyses were included in the pre-registration that are not presented in this dissertation.

Method

Participants and Power

I conducted an a-priori power analysis using the same method and application described in Study 3 for conducting power analyses for mediation models (Schoemann et al., 2017). The main confirmatory analyses of interest were tests of the indirect effects of uncertainty on task self-control through task boredom, and uncertainty on survey self-control through survey boredom. I used an average of the estimates from Studies 2 and 3 for the personal project outcomes (see Appendix B, Table B1 and Figure B1 for input parameters and calculations), since completion of both everyday tasks and completion of the survey seemed more conceptually related to pursuing personal projects than data entry performance. The results of the analysis indicated that a sample of 200 people would provide 90% power to detect the indirect effect.

However, because I anticipated having to exclude participants who provided low-quality data (see Chmielewski & Kucker, 2020 for a discussion of data-quality issues on MTurk) and I anticipated that there would be attrition between the initial assessment and one-month follow-up, I aimed to collect a sample of 400 people.

Participants were Amazon Mechanical Turk (MTurk) workers from either the United States or Canada with an approval rate of 85% or higher and completion of at least 100 HITS. Participants were compensated 1.75 USD in exchange for their time. Initially, 433 people started the study; 32 (7.39%) did not complete it. To remove low-quality data, I pre-registered exclusion criteria intended to filter out automated, invalid and/or unconscientious responses. I excluded 148 people who either somewhat or strongly agreed (a score > 3 out of 5) with the statement, “I sometimes just clicked random responses in order to get through this survey as quickly as possible.” I excluded an additional 52 people who provided unusual or non-sense responses to an open-ended question that asked participants to describe their experience during the pandemic. Unusual and/or non-sense responses included single words that were unrelated to the question (e.g., “nice”, “good”), random strings of words or incomprehensible phrases, and information copied and pasted directly from the internet (e.g., about the symptoms of COVID-19). The final sample after exclusions consisted of two hundred MTurk workers (106 male, 93 female; $M_{\text{age}} = 39.71$, $SD_{\text{age}} = 12.19$, range = 20 to 73). Seventy-one percent (71.50%) self-identified as White, 8.50% Black, 4.50% Asian, 6.50% Hispanic or Latino, 1.50% mixed ethnicity, 1.50% other, and 6.00% unknown.

Procedure

All data from the initial session were collected on May 4, 2020, approximately two months after COVID-19 was officially declared a pandemic by the World Health Organization.

At the beginning of the initial session, participants responded to a series of questions about their current situation and, more specifically, the extent to which their lives had been affected by the pandemic. Then they were asked to provide an open-ended description of their experience thus far during the pandemic. They responded to the following prompt: “Please describe your feelings and experiences over the last few weeks during the pandemic. Think about the challenges you are facing and the ways your living situation, relationships, feelings, goals, or desires may have been affected.” I included this open-ended description to make goal conflict and uncertainty salient as participants completed the measures that followed. Following the description, participants completed measures of their felt uncertainty, general negative affect, and approach-related affect over the last few weeks since the pandemic began.

Next, participants were asked to briefly describe the three main day-to-day tasks that they had been trying to get done over the past week. Participants were asked to, as much as possible, try to select tasks that were similar to the kinds of things they were working on before the pandemic to reduce the possibility that increases in task boredom and self-control were due to differences in the kinds of tasks that people were engaged in rather than differences in their motivational state. Participants were also told that they would be asked questions about their experience working on these tasks so they should make sure to select things that they had recently completed or were currently in the process of doing and not things that they imagined doing in the future. For each task, they rated how bored they had felt while working on it and their capacity to exercise self-control while working on it. Next, they were asked to describe two goals or projects that they were not currently working on, but planned to make progress on over the next month. For each goal, they rated how boring they expected it to be and how much self-control they expected to have while working on it over the following month. Finally, participants

were instructed to reflect on their experience completing the survey and rate how boring they found it and their level of self-control while completing it.

Participants were invited to participate in a second session approximately one month later; all follow-up data were collected between June 2 – 15, 2020. Participants were reminded of the two goals that they had nominated in the first session. For each one, they were asked to rate how bored they had felt while working on it and how much progress they had made on it over the past month.

Measures

All measures were rated on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Additional measures not reported in the present study were included and are listed in Appendix A.

Current Living Situation. To understand how peoples' lives had been affected by the pandemic, participants rated their agreement with seven statements about their current living situation. Four of the statements were about peoples' work (e.g., "My employment status has changed as a result of the pandemic"), one was about childcare ("I am currently doing much more childcare than usual as a result of the pandemic"), one was about daily routines ("My daily routine has been significantly disrupted as a result of the pandemic"), and the final statement was about living arrangements ("The space, layout, and social dynamics where I live gives me more options for activities than most people have during the pandemic"; reverse scored). Participants could also select "not applicable" for any statements that were not relevant to them. I combined the items into three variables: employment disruption which was a composite of the four work-related items, childcare duties which was the single childcare item, and lifestyle constraints which was a composite of the daily routine and living arrangement items.

Felt Uncertainty. Participants were instructed to think about their experience since the pandemic began. Then they rated the extent to which, compared to usual, over the last few weeks they had felt more: uncertain, confused, conflicted, and chaotic. A mean score was calculated with higher scores reflecting greater felt uncertainty. Cronbach's alpha reliability was .88.

Negative Affect. Participants rated the extent to which, compared to usual, over the last few weeks they had felt more: distressed, nervous, scared, and upset. A mean score was calculated with higher scores reflecting greater general negative affect. Cronbach's alpha reliability was .92.

Approach-Related Affect. Participants rated the extent to which, compared to usual, over the last few weeks they had felt more: enthusiastic, determined, strong, and proud. A mean score was calculated with higher scores reflecting greater approach-related affect. Cronbach's alpha reliability was .88.

Daily Task Boredom and Self-Control. For each of the three daily tasks that people described—which were piped back to them one at a time in their own words—they were asked to first think about how they had felt while working on the task and rate the extent to which they had felt: bored, uninspired, interested (reverse scored) and engaged (reverse scored). Then, they were asked to think about their behaviour while working on the task and rate the extent to which they had been: lazy (e.g., procrastinated or put off getting started or didn't put in much effort; reverse scored), disciplined (e.g., avoided distraction by phone, email, food, or anything else), effective at getting it done (e.g., worked efficiently, was able to concentrate fully), and self-controlled (e.g., resisted temptation, stayed diligent). Two mean scores were calculated for each task reflecting greater task boredom and task self-control, respectively. The average Cronbach's alpha reliability was .84 for the task boredom measure and .86 for the task self-control measure.

Survey Boredom and Self-Control. This was assessed with the same eight items (four boredom and four self-control) as the daily tasks, except this time referring to participants experience completing the survey (e.g., It was boring, I was lazy). Participants were asked to be as honest and accurate as possible and were assured that their responses would not affect their payment. Two mean scores were calculated reflecting greater boredom and self-control while completing the survey, respectively. Cronbach's alpha reliability was .90 for the survey boredom measure and .83 for the survey self-control measure.

Goal Boredom and Progress at Follow-Up. For each of the two goals that participants nominated in the initial session—which were piped back to them one at a time in their own words—they rated the same four boredom items as the daily tasks and survey experience, but instead referring to working on that goal. Then, they rated their agreement with four items assessing the progress they had made on that goal over the past month: “My progress met or exceeded my expectations,” “I am satisfied with the amount of progress I made over the past month,” “I am disappointed with the amount of progress I made over the past month” (reverse scored), and “Working on this goal was more difficult than I anticipated” (reverse scored). The average Cronbach's alpha reliability for the goal boredom measure was .89, and for the goal progress measure was .88.

Data Analysis

Since each person rated multiple daily tasks, ratings from the same person were expected to be more similar than ratings from someone else. Thus, the data had a multilevel structure with tasks (Level 1) nested within people (Level 2). Like the daily tasks, each person rated more than one month-long goal, with goals (Level 1) also nested within people (Level 2). To account for this interdependence, I analyzed the daily task and the month-long goal data using multilevel

modeling. For all multilevel models I included a random intercept and fixed slope, which assumes that participants differ on average (i.e., different intercepts) but have the same slopes. Following my pre-registered plan, I included employment disruption, childcare duties, and lifestyle constraint as covariates in all models predicting daily task boredom and self-control to control for situational changes as a result of the pandemic that may have affected the types of tasks that people were doing and the environment in which they were working on them.

Results

Descriptive statistics and correlations for all study variables are presented in Table 8.

Table 8

Descriptive Statistics and Intercorrelations for All Study Variables

Variable	<i>M (SD)</i>	1	2	3	4	5	6	7	8
1. Felt Uncertainty	2.48 (1.16)	—							
2. Negative Affect	2.59 (1.27)	.86**	—						
3. Approach Affect	2.90 (1.14)	-.10	-.14*	—					
4. Task Boredom	2.45 (0.87)	.47**	.44**	-.33**	—				
5. Task Self-Control	3.74 (0.83)	-.39**	-.35**	.29**	-.68**	—			
6. Survey Boredom	2.38 (1.06)	.19**	.15*	-.38**	.45**	-.33**	—		
7. Survey Self-Control	4.33 (0.78)	-.23**	-.19**	.03	-.30**	.33**	-.35**	—	
8. Project Boredom	2.59 (1.09)	.25**	.19*	-.41**	.49**	-.44**	.42**	-.24**	—
9. Project Progress	3.07 (1.06)	-.19*	-.17*	.43**	-.31**	.32**	-.33**	.17*	-.71**

* $p < .05$. ** $p < .01$.

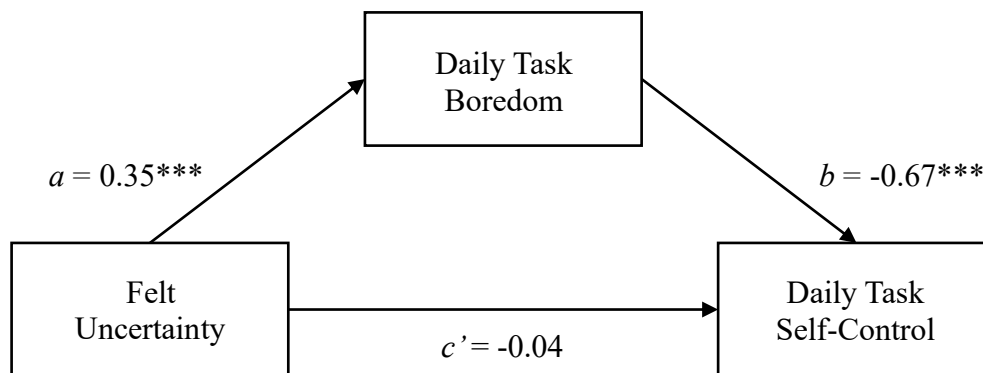
Daily Tasks

To test my first hypothesis, that increased felt uncertainty would predict more boredom and less self-control on daily tasks, I fit two multilevel models regressing both task boredom and task self-control, respectively, on felt uncertainty. People who reported feeling more uncertain

since the pandemic began also reported that they had been more bored while working on their daily tasks, $b = 0.29$ [0.18, 0.41], $SE = 0.06$, $t(125) = 5.15$, $p < .001$, and that they had less self-control while working on them, $b = -0.25$ [-0.36, -0.13], $SE = 0.06$, $t(125) = 4.36$, $p < .001$. Next, I fit a multilevel path model to test both the direct pathway from uncertainty to task self-control and the indirect pathway through boredom (see Figure 6). As predicted, there was a significant indirect pathway from felt uncertainty to task self-control through task boredom, $ab = -0.23$ [-0.32, -0.15], $SE = 0.04$, $z = -5.54$, $p < .001$. There was no evidence of a direct pathway from felt uncertainty to task self-control after accounting for the association between task boredom and self-control, $b = -0.04$ [-0.14, 0.05], $SE = 0.05$, $z = -0.95$, $p < .001$.

Figure 6

Daily Tasks Path Model



*** $p < .001$.

In additional exploratory analyses, I examined the relationships between felt uncertainty, general negative affect and approach-related affect with task boredom and task self-control. All three variables were independently associated with both task boredom and task self-control, in each case exhibiting moderate-to-large correlations (see Table 8). The correlations were similar in magnitude, though felt uncertainty had the strongest absolute correlation with both variables. Additionally, when entered into a simultaneous regression, only felt uncertainty and approach-

related affect remained significant predictors of the outcomes, while negative affect became non-significant (see Table 9, Models 1 and 2). Notably, felt uncertainty and negative affect were highly correlated with each other. When multicollinearity is an issue (i.e., predictors in the same linear model are highly correlated with each other), coefficient estimates and significance tests become increasingly unreliable and difficult to interpret (Allen, 1997).

To further explore these relationships, I therefore estimated semi-partial coefficients of determination using the *partR*² package in R (Stoffel et al., 2021) to partition the variance explained by the fixed effects into variation unique to and shared among the predictors. Together, the three predictors accounted for 20% of the variance in task boredom. Examining the unique variance accounted for by each predictor revealed that uncertainty accounted for 3% of the variance, negative affect accounted for 0% of the variance and approach-related affect accounted for 5% of the variance. Together the three predictors accounted for 15% of the variance in task self-control, with uncertainty uniquely accounting for 2%, negative affect uniquely accounting for 0%, and approach-related affect uniquely accounting for 4%. These results suggest that, although much of the explained variance in task boredom and self-control was shared among the predictors, felt uncertainty was able to predict unique variance in the outcomes that was not accounted for by either general negative affect or approach-related affect.

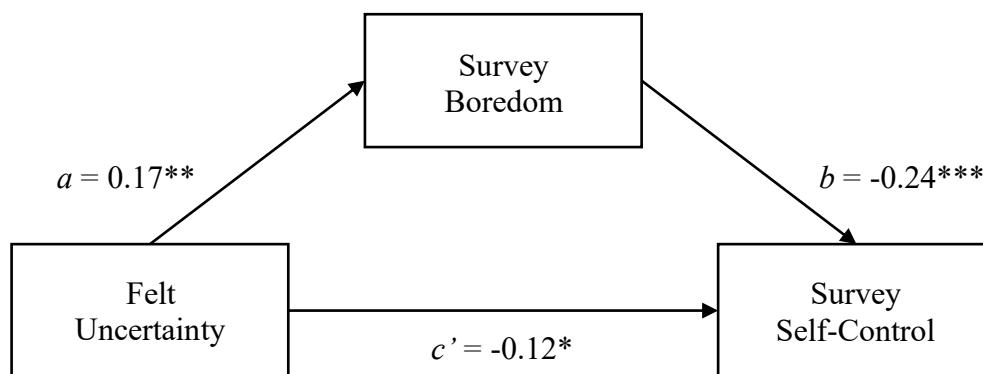
Survey Experience

To test my hypothesis that felt uncertainty would predict more boredom and less self-control while completing the survey, I regressed survey boredom and then survey self-control, respectively, on felt uncertainty. Like the daily tasks, people who reported feeling more uncertain since the pandemic began also reported that they found completing the survey more boring, $b = 0.17$ [0.04, 0.29], $SE = 0.06$, $t(198) = 2.66$, $p = .008$, and that they had less self-control while

completing it, $b = -0.15 [-0.25, -0.06]$, $SE = 0.05$, $t(198) = -3.32$, $p = .001$. Next, I fit a simple mediation model to examine the direct pathway from uncertainty to survey self-control and the indirect pathway through survey boredom (see Figure 7). As predicted, there was a significant indirect pathway from felt uncertainty to survey self-control through survey boredom, $ab = -0.04 [-0.07, -0.01]$, $SE = 0.02$, $z = -2.34$, $p = .019$. After accounting for the association between boredom and self-control, felt uncertainty still significantly predicted less self-control while completing the survey, $b = -0.12 [-0.20, -0.03]$, $SE = 0.05$, $z = -2.57$, $p = .010$.

Figure 7

Survey Experience Path Model



$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

I performed the same set of exploratory analyses to examine the relationships between felt uncertainty, general negative affect and approach-related affect with survey boredom and survey self-control. All three affect variables were independently associated with survey boredom; however, only felt uncertainty and negative affect were independently associated with survey self-control (see Table 8). Approach-related affect had the strongest absolute correlation with survey boredom and felt uncertainty had the strongest absolute correlation with survey self-control. When entered into a simultaneous regression, only felt uncertainty and approach-related affect remained significant predictors of survey boredom. None of the three affect variables

significantly predicted survey self-control, although there was a non-significant trend ($p < .06$) suggesting that felt uncertainty predicted less self-control (see Table 9, Models 3 and 4).

Table 9

Summary of Simultaneous Regression Models Predicting Boredom and Self-Control Outcomes

Predictor	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95% CI	Part R^2
Model 1: Daily Task Boredom						
Felt Uncertainty	0.28	0.09	3.22	.002	[0.11, 0.46]	.03
Negative Affect	0.05	0.08	0.59	.558	[-0.11, 0.21]	.00
Approach-Related Affect	-0.22	0.05	4.67	< .001	[-0.31, -0.13]	.05
Model 2: Daily Task Self-Control						
Felt Uncertainty	-0.25	0.09	2.83	.005	[-0.43, -0.08]	.02
Negative Affect	-0.01	0.08	0.11	.914	[-0.17, 0.15]	.00
Approach-Related Affect	0.19	0.05	3.99	< .001	[0.09, 0.28]	.04
Model 3: Survey Boredom						
Felt Uncertainty	0.23	0.12	1.98	.049	[0.001, 0.46]	.02
Negative Affect	-0.10	0.11	0.94	.350	[-0.31, 0.11]	.00
Approach-Related Affect	-0.35	0.06	5.68	< .001	[-0.47, -0.23]	.14
Model 4: Survey Self-Control						
Felt Uncertainty	-0.18	0.09	1.91	.058	[-0.36, 0.01]	.02
Negative Affect	0.02	0.08	0.28	.784	[-0.14, 0.19]	.00
Approach-Related Affect	0.01	0.05	0.18	.862	[-0.09, 0.10]	.00
Model 5: Project Boredom						
Felt Uncertainty	0.32	0.14	2.35	.020	[0.05, 0.59]	.06
Negative Affect	-0.12	0.12	1.02	.308	[-0.36, 0.12]	.02
Approach-Related Affect	-0.37	0.07	5.18	<.001	[-0.52, -0.23]	.16
Model 6: Project Progress						
Felt Uncertainty	-0.20	0.13	1.53	.130	[-0.46, 0.06]	.03
Negative Affect	0.06	0.12	0.54	.592	[-0.17, 0.30]	.00
Approach-Related Affect	0.39	0.07	5.49	< .001	[0.25, 0.53]	.18

Because of the multicollinearity issue, I again estimated the semi-partial R^2 to examine the proportion of explained variance that was unique to and shared among the predictors. Together the three predictors explained 17% of the variance in survey boredom; felt uncertainty uniquely accounted for 2%, negative affect uniquely accounted for 0%, and approach-related affect uniquely accounted for 14%. Together the three predictors explained 5% of the variance in survey self-control; felt uncertainty uniquely accounted for 2%, negative affect uniquely accounted for 0%, and approach-related affect uniquely accounted for 0%. Consistent with the findings for the daily tasks, these results suggest that felt uncertainty was able to predict unique variance in both survey boredom and survey self-control that was not accounted for by either general negative affect or approach-related affect.

Month-Long Goals

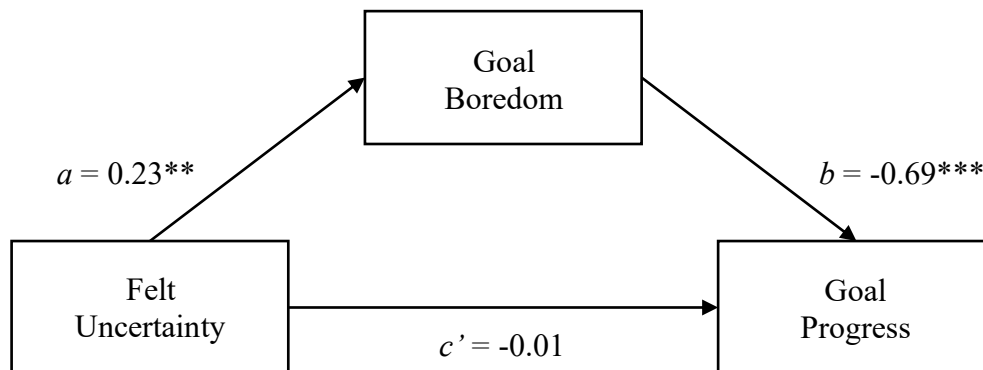
Of the 200 people who completed the initial session 140 also completed the one-month follow-up. First, I regressed ratings of how bored people were while working toward their goals on felt uncertainty at the initial session. Feeling more uncertain at the initial session significantly predicted being more bored while working on goals over the following month, $b = 0.23$ [0.08, 0.39], $SE = 0.08$, $t(138) = 3.02$, $p = .003$. This relationship persisted even after controlling for how boring people expected their goals to be (assessed during the initial session), $b = 0.21$ [0.07, 0.35], $SE = 0.07$, $t(137.47) = 2.95$, $p = .004$, and controlling for employment disruptions, childcare duties and lifestyle constraints, $b = 0.30$ [0.11, 0.50], $SE = 0.10$, $t(87) = 3.07$, $p = .003$.

Next, I regressed goal progress over the past month on felt uncertainty at the initial session. Feeling more uncertain at the initial session also predicted making less progress on goals over the following month, $b = -0.17$ [-0.33, -0.02], $SE = 0.08$, $t(138) = 2.30$, $p = .023$. This relationship persisted after controlling for how much self-control people expected to have

working on their projects (assessed at the initial session), $b = -0.16 [-0.31, -0.02]$, $SE = 0.07$, $t(136.93) = 2.20$, $p = .030$, and controlling for employment disruptions, childcare duties and lifestyle constraints, $b = -0.27 [-0.47, -0.07]$, $SE = 0.10$, $t(87) = 2.68$, $p = .009$. Finally, I fit a multilevel path model to examine the direct pathway from felt uncertainty to goal progress and the indirect pathway through goal boredom (see Figure 8). Consistent with the daily task and survey experience findings, there was a significant indirect pathway from felt uncertainty at the initial session to goal progress through goal boredom, $ab = -0.16 [-0.27, -0.05]$, $SE = 0.06$, $z = 2.85$, $p = .004$. There was no evidence of a direct pathway from felt uncertainty on goal progress after accounting for the association between boredom and progress, $c' = -0.01 [-0.13, 0.10]$, $SE = 0.06$, $z = 0.23$, $p = .819$.

Figure 8

Month-Long Goals Path Model



** $p < .01$. *** $p < .001$.

I again performed the same set of exploratory analyses and found that while all three affect variables were independently associated with both goal boredom and goal progress, approach-related affect showed the strongest absolute correlations with both outcomes (see Table 8). Simultaneous regressions revealed that both felt uncertainty and approach-related affect significantly predicted goal boredom, but approach-related affect remained the only significant

predictor of goal progress (see Table 9, Models 5 and 6). Examining the semi-partial R^2 similarly revealed that approach-related affect uniquely accounted for a large proportion of the explained variance in both goal boredom and progress (24% and 25%, respectively), however, felt uncertainty did uniquely account for a proportion of the variance, albeit a smaller one.

Discussion

Extending the findings from Studies 2 and 3, the results of the present study supported the UM-B-SCF with a different source of uncertainty (the COVID-19 pandemic) and assessing boredom and self-control in the context of two different unrelated activities (daily tasks and the online study). Exploratory analyses also showed that feeling more uncertain about the pandemic at the initial session predicted more boredom and less progress on personal goals when reflecting on them one month later, providing further evidence that ambient uncertainty lingering BIS activation can have far-reaching impacts on goal pursuit. Additional exploratory analyses revealed that felt uncertainty generally predicted unique variance in boredom and self-control outcomes that could not be accounted for by either general negative affect or approach-related affect. These results suggest that changes in boredom and self-control during the pandemic cannot be explained solely by increased negative affect or decreased approach-related affect providing some evidence for discriminant validity. It is worth noting, however, that a large proportion of the explained variance in survey boredom, goal boredom and goal progress was unique to approach-related affect.

One limitation of the present study is the fact that the analyses are correlational and therefore preclude causal conclusions. However, the path models are consistent with the proposed UM-B-SCF process beginning with felt uncertainty about an eliciting event (i.e., the pandemic) to boredom and low self-control working on subsequent unrelated tasks and goals.

Furthermore, when selecting daily tasks I asked participants to as much as possible choose tasks that were similar to the kinds of things they were doing before the pandemic and controlled for employment disruptions, childcare duties and lifestyle constraints. This provides further support that changes in boredom and self-control were the result of pandemic-related uncertainty and not simply due to working on different types of tasks or a different dynamic at home.

It is notable that in the present study there was a large quantity of poor quality data that had to be excluded. Based on my pre-registered criteria I excluded 195 participants, ultimately losing close to half (48.62%) of the initial sample. In a study by Chmielewski and Kucker (2020) the authors reported that for MTurk data collected in Spring 2019, 38% of their sample failed at least one validity indicator. In comparison, the present study suggests a considerable increase in poor quality data. This is consistent, however, with reports that new MTurk workers during the COVID-19 pandemic were 10-20% more likely to be inconsistent, fail attention checks, and give unusual or unexpected responses (Arechar & Rand, 2020). It is possible that during the height of the pandemic financial hardship led to more MTurk workers racing through studies to earn quick money while investing minimal effort. This highlights the importance of participant and data screening in general and in particular for data collected during the pandemic.

Study 5

Study 5 built on Study 4 by experimentally manipulating uncertainty as a result of the pandemic. Specifically, I sought to make COVID-19-related uncertainty salient by having people describe the ways the pandemic had disrupted their life and examining effects on anticipated boredom and self-control when imagining pursuing current personal projects. I hypothesized that: (1) people in the uncertainty (COVID-19-salience) condition would report greater felt uncertainty relative to people in the control (general) condition, (2) felt uncertainty would predict more personal project boredom, (3) felt uncertainty would predict less personal project self-control (i.e. more difficult to exercise self-control in pursuit of projects), and (4) people in the uncertainty condition (relative to the control condition) would report less personal project self-control indirectly through increased felt uncertainty and personal project boredom (i.e., a serial indirect pathway). Given the large volume of unusable data in Study 4, in the present study, I also applied more stringent inclusion criteria at the outset to try and reduce the amount of low-quality data that would need to be excluded. I pre-registered my hypotheses and analysis plan on OSF before collecting any data (pre-registration available at: <https://osf.io/35gyr>).

Method

Participants and Power

I conducted an a-priori power analysis using the same method and application described in Studies 3 and 4 for conducting power analyses for mediation models. The main confirmatory analysis was the test of the serial indirect effect of condition (COVID-19-salience vs. control) on personal project self-control through felt uncertainty and project boredom. I used an average of the path estimates for the serial indirect effect of the mortality salience manipulation on project self-control through felt uncertainty and project boredom from Studies 2 and 3 (see Appendix B,

Table B2 and Figure B3 for input parameters and calculations). The results of the analysis indicated that a sample of 245 people would provide 90% power and a sample of 215 people would provide 85% power to detect the serial indirect pathway. Because I anticipated having to exclude some participants who provided low-quality data—though less than in Study 4 due to more stringent screening criteria (described below)—I aimed to collect a sample of 250 people.

Participants were MTurk workers from either the United States or Canada with an approval rate of 95% or higher and completion of at least 100 HITS. Participants were compensated 3 USD in exchange for their time. I included two screening questions at the outset to filter out automated or unconscientious responders. Individuals were required to answer both questions correctly in order to qualify for the study. The first question asked people to select from a list of five animals the one that would come fourth if they were arranged in alphabetical order, and the second question asked them to type the words “monkeys like bananas” in reverse order. Fifty-four people answered one of the two questions incorrectly and were disqualified from participating. Initially, 307 people started the study; 56 (18%) did not complete it. In addition to the screening questions, I pre-registered the same exclusion criteria as in Study 4 to remove low-quality data. I excluded 3 people who either somewhat or strongly agreed (a score > 3 out of 5) with the statement, “I sometimes just clicked random responses in order to get through this survey as quickly as possible.” After applying these exclusion criteria, I did not identify any additional cases of unusual or non-sense open-ended responses. The final sample consisted of 248 people (97 male, 149 female, 2 other; $M_{\text{age}} = 42.42$, $SD_{\text{age}} = 13.30$, range = 20 to 83). Seventy-seven percent (77%) self-identified as White, 8.06% Black, 3.23% Hispanic or Latino, 6.05% East Asian, 2.42% South Asian, 2.42% other, and 0.81% prefer not to answer.

Procedure and Materials

All data were collected on February 2, 2021, close to one year after the start of the COVID-19 pandemic. Participants were randomly assigned to one of two conditions: an uncertainty condition that made the negative impact of the pandemic on people's lives salient ($n = 131$) or a general control condition ($n = 117$). Following the uncertainty manipulation, participants were asked to think about the general circumstances of their life and complete a measure of their felt uncertainty. Participants were then asked to list any projects that they had started over the past month or were currently engaged in, and from that list, select the four projects that gave the best overview of their goals at present. Next, they rated how boring each project was and reported their capacity to exercise self-control in pursuit of it. Additional measures were included in the present study that are not presented here (see Appendix A).

Uncertainty Manipulation. Participants who were randomly assigned to the control condition were presented with the following prompt that asked them to describe their life:

General Description

In a few sentences, please describe how the general circumstances of your life have been over the past month (e.g., your living situation, relationships, feelings, goals, desires).

Participants who were randomly assigned to the uncertainty condition were given similar instructions, but were also prompted to think about the ways that the pandemic had disrupted important aspects of their life:

COVID-19 Salient Description

In a few sentences, please describe how the general circumstances of your life have been over the past month. Describe the challenges you are facing as a result of the ongoing

COVID-19 pandemic and the ways your living situation, relationships, feelings, goals, or desires may have been affected.

Felt Uncertainty. Participants rated the extent to which they felt: uncertain, confused, conflicted, and chaotic, about the general circumstances of their life over the past month and at present. I calculated a mean score with higher values reflecting greater felt uncertainty. Cronbach's alpha reliability was .88.

Personal Projects: Boredom and Self-Control. Based on the approach used in past personal projects research (e.g., McGregor & Little, 1998; Palys & Little, 1983), participants were first introduced to the concept of a personal project—described as the kinds of activities and concerns that people have in their lives—and were shown a list of examples (see Appendix C for full materials). They were then given three minutes to list as many current personal projects as they could think of. Specifically, I instructed participants to list projects that they had started over the past month and were currently engaged in—that is, projects they had started but not yet finished. They then selected the four projects that together gave the best overview of what they were up to in their life at present. For each of the four projects, which were piped back to them in their own words, they rated their agreement with four statements: “This project is boring,” “This project is hard to find interesting,” “This project is difficult to get started on or put much effort into” and “This project is difficult to remain focused on—it is susceptible to distractions and temptations that could derail my progress.” I calculated the mean of the first two items (average $r = .70$) to create the measure of project boredom and I calculated the mean of the second two items (average $r = .57$) to create the measure of project self-control.

Results and Discussion

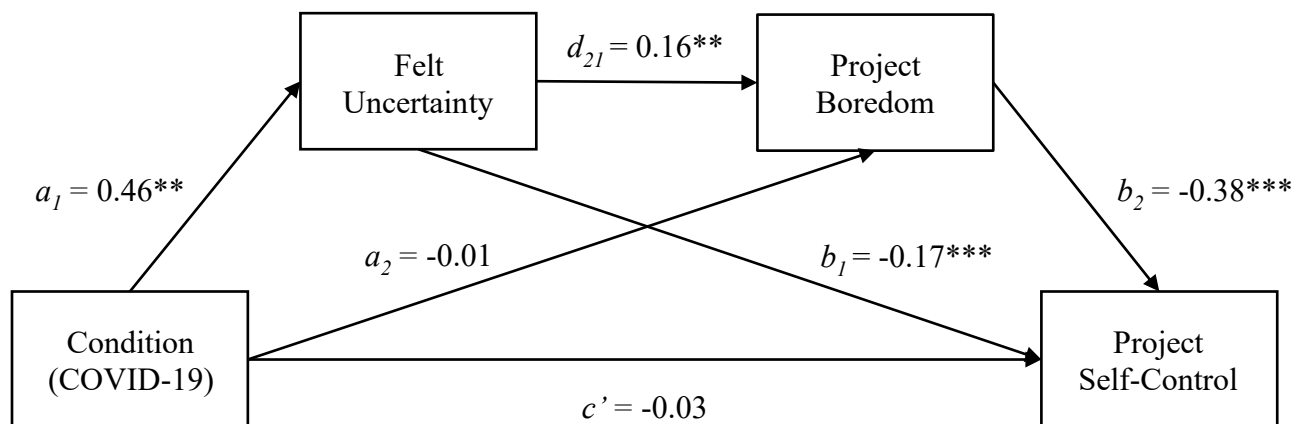
Similar to Study 4, in the present study, each person rated multiple projects and therefore projects (Level 2) were nested within people (Level 1). I therefore used multilevel models to account for the interdependence, again specifying random intercepts and fixed slopes. To test my first hypothesis, I conducted an independent samples *t*-test to compare the mean level of felt uncertainty across the uncertainty and control conditions. Felt uncertainty significantly differed across the conditions, $t(243.53) = -3.03, p = .003$, Hedge's $g = -0.38 [-0.63, -0.13]$. As predicted, people reported feeling more uncertain about the general circumstances of their life after writing about the COVID-19-related challenges they were facing ($M = 2.83, SD = 1.20$) compared to writing about their life experiences more generally ($M = 2.37, SD = 1.18$). The manipulation explained approximately 4% of the variance in felt uncertainty ($R^2 = .036$).

To test my second and third hypotheses, I fit two multi-level models regressing personal project boredom and personal project self-control, respectively, on felt uncertainty. Consistent with my predictions, both the relationship between felt uncertainty and project boredom, and between felt uncertainty and project self-control were significant. People who reported feeling more uncertain about the general circumstances of their life also reported that their personal projects were more boring, $b = 0.16 [0.07, 0.26], SE = 0.05, t(246.09) = 3.39, p < .001$, and that it was more difficult to exercise self-control in pursuit of them, $b = -0.23 [-0.32, -0.14], SE = 0.05, t(246.18) = -4.94, p < .001$. Although I did not predict a total effect of condition on either project boredom or project self-control, it is notable that consistent with the findings from Studies 2 and 3, neither project boredom, $b = 0.07 [-0.17, 0.30], SE = 0.12, t(246.03) = 0.58, p = .563$, nor project self-control significantly differed across the two conditions, $b = -0.13 [-0.36, 0.10], SE = 0.12, t(246.11) = -1.11, p = .270$; (dummy coded; control = 0).

To test my fourth and final hypothesis, I fit a multi-level serial path model to examine the indirect pathway from condition (Level 2) through felt uncertainty (Level 2) to project boredom (Level 1) and then project self-control (Level 1) (see Figure 9). Again, consistent with my hypothesis, there was a significant serial indirect pathway from condition (uncertainty vs. control) to personal project self-control through felt uncertainty and personal project boredom, $ab = -0.03 [-0.06, -0.001]$, $SE = 0.01$, $z = -2.04$, $p = .042$. There was no evidence of a direct effect of the experimental manipulation on project self-control after accounting for its association with felt uncertainty and project boredom, $c' = -0.03 [-0.23, 0.17]$, $SE = 0.10$, $z = -0.28$, $p = .784$. The results of the present study again supported the UM-B-SCF showing that people who felt more uncertain due to the COVID-19 pandemic, in turn, perceived their unrelated personal projects as more boring and more difficult to complete (hence harder to exercise self-control in pursuit of).

Figure 9

Personal Projects Serial Path Model



$^{**}p < .01$. $^{***}p < .001$.

Study 6

Studies 2-5 provided evidence that heightened uncertainty elicited in one context (e.g., by awareness of one's mortality or the impact of the COVID-19 pandemic) can lead people to feel more bored and have less self-control working on unrelated tasks and goals. Study 6 was designed to build on these prior studies by examining how both within-person variability in uncertainty (i.e., fluctuating levels of uncertainty over time within the same person) and between-person variability (i.e., stable individual differences in experienced uncertainty) predict changes in boredom and self-control working on specific academic goals. That is, does working on the same goal feel more boring and effortful when the circumstances of one's life seem more uncertain? And do people who are chronically more uncertain about their life find their goals more boring and effortful? I tested three pre-registered hypotheses: (1) on weeks when students report greater general life uncertainty, they will also report that working on their academic goals felt more boring; (2) greater goal boredom will predict less self-control while working towards those goals and less progress made on them; and (3) general life uncertainty will predict less self-control working towards goals and less goal progress indirectly through increased goal boredom.

In addition, Study 6 built on previous studies by also assessing a more consequential outcome as a proxy for self-control: students' course grades. In exploratory analyses I examined whether, on average, students who reported greater general life uncertainty found their academic goals more boring during the semester, and whether this, in turn, predicted lower course grades at the end of the semester. I pre-registered my hypotheses and analysis plan on OSF before collecting any data (pre-registration available at: <https://osf.io/5dqrp>). Additional hypotheses and analyses not relevant the present study were included in the pre-registration but are not presented here.

Method

Participants

The data were collected in two sections of a third-year undergraduate personality psychology course at the University of Waterloo. Because I was collecting the data from students in a specific course, the sample size was determined firstly by the enrollment, and secondly by the number of students who consented to their course data being used for research purposes. Based on data from past offerings of the course, I anticipated a final sample in the range of 100-140 students.

One-hundred and forty students completed at least one of the weekly assessments and 124 completed all five assessments. Consent to use the data for research purposes was obtained during the fifth and final weekly assessment. As a result, students who did not complete this final assessment (e.g., they dropped the course at some point during the first month) did not have the opportunity to provide consent and were therefore excluded. Two additional people did not consent to their data being used for research purposes and were also excluded. No additional exclusion criteria were applied. Relative to the samples used in Studies 2 and 3 which were drawn from the undergraduate participant pool and Studies 4 and 5 which were from MTurk, I expected the sample in the present study to be more motivated to provide honest and accurate responses because the data were collected as part of a course assignment. Furthermore, the students received participation credits for completing each assessment that counted towards their final course grades. The final sample consisted of 122 people (27 male, 93 female, 1 other, 1 prefer not to answer; $M_{\text{age}} = 21.25$, $SD_{\text{age}} = 1.76$, range = 19 to 33). Thirty-eight percent (38.52%) self-identified as White, 1.64% Black, 1.64% Hispanic or Latino, 25.41% East Asian, 1.64% Middle Eastern, 22.95% South Asian, 4.10% multi-ethnic, and 4.10% other.

Procedure and Materials

Data were collected at the beginning of the Fall 2021 semester over the course of five weeks. In the first week of the course, students identified two academic goals that they planned to work towards over the next month. I asked them to pick specific goals for which they could easily evaluate their experience and progress and provided them with examples. Specific goal examples were: study for 15 hours a week or finish all assigned readings before class, while vague goal examples were: be a good student or study hard. The following week, and each week thereafter (for a total of four weeks), they completed an online survey, which was described as an experiential learning assignment. The links to the surveys were emailed to students on Tuesday evening and the assignments were due the same week by Saturday afternoon. Students were told that, ideally, they would schedule a block of time on the same day each week to complete the assessment so that the five parts were completed approximately one week apart. However, they still received the participation credit as long as they submitted it at some point before the deadline. Students had to first complete the initial survey in which they nominated their academic goals to get access to the surveys in the following weeks. The surveys consisted of a weekly assessment, which is the focus of the present study, as well as other materials relevant to the course content. The weekly assessments were presented at the beginning of the survey and asked students to rate their general life uncertainty, how bored they had been working towards their academic goals, how much self-control they had while working towards them and how much progress they had made on them. In the final two weeks of the course, I also asked for permission to access students' grades from the registrar's office.

General Life Uncertainty. Participants were asked to reflect on their general life experiences over the past couple days/week since they completed the last survey. Then they rated

on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*) the extent to which their life had felt: uncertain, confusing, conflicted, and chaotic. I calculated a mean score from the four items with higher values reflecting greater general life uncertainty. Average Cronbach's alpha reliability was .80.

Goal Boredom and Self-Control. Participants were asked to reflect on their experience over the past couple days/week since they completed the last survey, working towards the academic goals they had nominated at the beginning of the course. For each of the two goals, which were piped back to them in their own words, they indicated on a scale from 1 (*strongly disagree*) to (*strongly agree*) their agreement with eight statements. The first four statements assessed goal boredom: "I was bored," "I was uninspired," "I was interested" (reverse scored), and "I was engaged (reverse scored)." The next four statements assessed goal self-control: "I was lazy (reverse scored)," "I was disciplined," "I was effective," and "I was self-controlled." I calculated a mean score for each with higher values reflecting greater boredom and self-control respectively. Average Cronbach's alpha reliability was .85 for goal boredom and .90 for goal self-control.

Goal Progress. Participants were asked to think about the progress they had made working towards each of their goals over the past couple days/week since the last survey. Then they indicated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*) their agreement with five statements: "I made progress on my goal," "My progress met or exceeded my expectations," "I am satisfied with my progress," "I am disappointed with my progress (reverse scored)," and "Working towards this goal was more difficult than I anticipated (reverse scored)." I calculated a mean score with higher values reflecting greater goal progress. Average Cronbach's alpha reliability was .87.

Academic Performance. Final course grades were used to assess academic performance, expressed as a percentage out of 100. We used students' average from the previous three active/academic terms (i.e., full course load, non-co-op) to control for prior academic performance.

Data Analysis

I first calculated the intraclass correlation coefficients (ICC) for each of the variables to examine the proportion of variability that could be attributed to differences between (vs. within) people. ICCs approaching 1 indicate that there are reliable differences between people, but that conversely each person's scores on that repeatedly sampled variable show little variance (i.e., there is a strong correlation between the measurements). I analyzed the data using multilevel modeling to account for the hierarchical structure. I grand-mean centered general life uncertainty at the between-person level, which represented participants' personal mean, or dispositional, uncertainty across all the weeks. I person-mean centered uncertainty at the within-person level, which represented participants' weekly deviation from their personal mean uncertainty. I also controlled for the week, as I expected that boredom would increase over the weeks as people spent more time working on the same goals, independent of any changes in general life uncertainty.

Results

As can be seen in Table 10, the ICCs ranged from .49 to .56 indicating that about a half to just over half of the variance in weekly ratings could be attributed to between-person (rather than within-person) differences.²

² The ICC for general life uncertainty represents the correlation between the four weekly ratings within the same person. The ICC for goal boredom, self-control and progress represent the correlations between the four weekly ratings for the same goal within the same person. That is, they account for the fact that for

Table 10*Descriptive Statistics and Intraclass Correlation Coefficients*

Variable	<i>M</i>	<i>SD</i>	ICC
General life uncertainty	3.13	0.92	.56
Goal boredom	2.92	0.94	.55
Goal self-control	3.03	1.03	.50
Goal progress	2.98	0.95	.49

To test my first hypothesis, I regressed goal boredom on uncertainty, including both the between and within-person fixed effects, with random intercepts for the goal and the person and controlling for the week. There was a non-significant trend suggesting that on weeks when participants' life felt more uncertain, they found their academic goals more boring, $b = 0.07$ [-0.003, 0.15], $SE = 0.04$, $t(727.99) = 1.88$, $p = .061$. The results also revealed a significant association between uncertainty and goal boredom at the between-person level, $b = 0.27$ [0.11, 0.44], $SE = 0.08$, $t(119.99) = 3.36$, $p = .001$. People who reported greater general life uncertainty, on average across the four weeks, reported that working towards their academic goals was more boring.

To test my second hypothesis, I regressed goal self-control on goal boredom, including both the between and within-person fixed effects, with random intercepts for the goal and the person. Again, I grand-mean centered the between-person fixed effect of boredom (i.e., mean boredom across the four weeks) and person-mean centered the within-person fixed effect (i.e., participants' weekly deviation from their personal mean boredom), and controlled for the week. There was a significant association between boredom and self-control at the within-person level,

a given person, ratings of their first goal will tend to resemble each other more than ratings of their second goal.

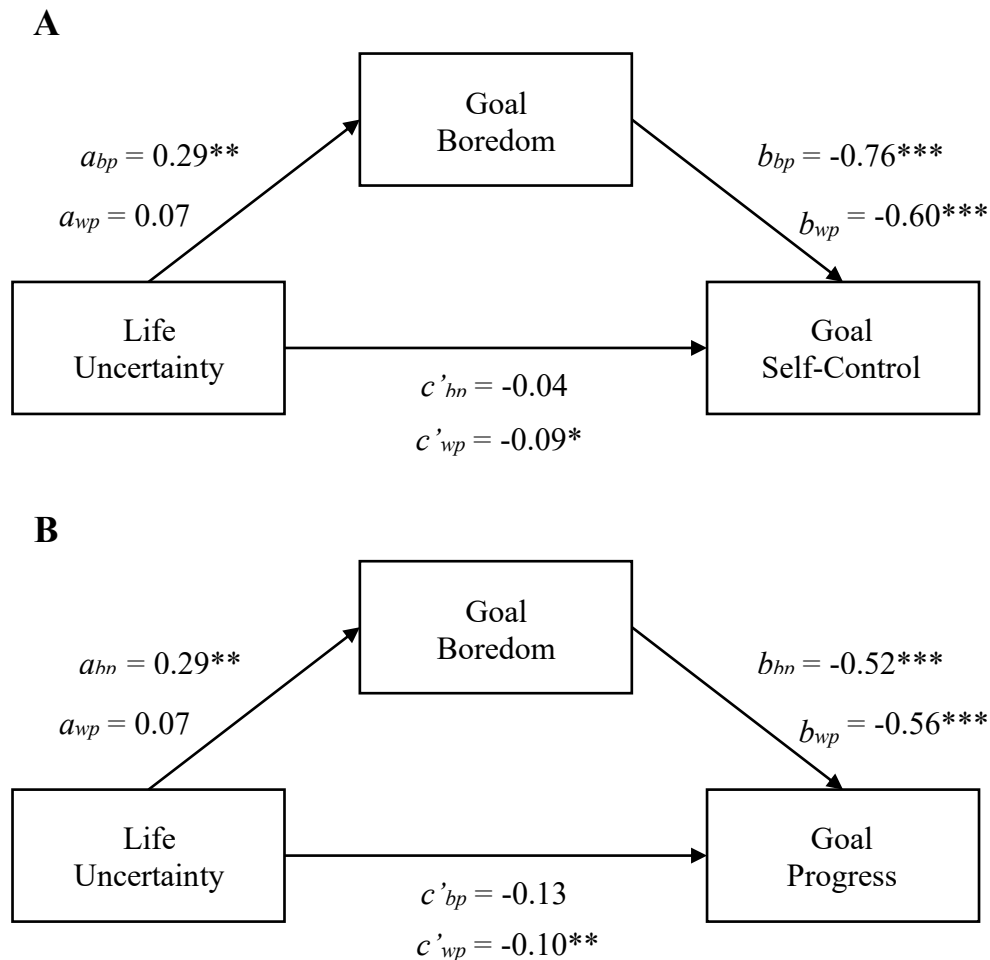
$b = -0.61 [-0.67, -0.54]$, $SE = 0.03$, $t(848.33) = -18.32$, $p < .001$, as well as a significant association between boredom and self-control at the between-person level, $b = -0.76 [-0.89, -0.63]$, $SE = 0.07$, $t(120) = -11.45$, $p < .001$. The pattern of results was the same when I ran the same analysis with goal progress as the outcome; there was a significant within-person association, $b = -0.55 [-0.61, -0.49]$, $SE = 0.03$, $t(846.96) = -17.07$, $p < .001$, and a significant between-person association between boredom and progress, $b = -0.56 [-0.69, -0.43]$, $SE = 0.07$, $t(119.93) = -8.45$, $p < .001$. On weeks when people reported that their goals were more boring, they reported having less self-control while working towards them and making less progress on them. Additionally, people who reported experiencing greater boredom on average across the four weeks reported that they had less self-control working towards their goals and made less progress on them.

Finally, to test my third hypothesis, I fit a multi-level path model to examine the indirect pathway from uncertainty (Level 1) to goal self-control (Level 1) through goal boredom (Level 1) (see Figure 10; Panel A). Because the lavaan package in R can only model data with a two-level and not a three-level nested structure, I specified a random intercept for the person only (as opposed to person and goal) and controlled for the Week at Level 1. The between-person indirect pathway was significant, $ab_{bp} = -0.22 [-0.36, -0.08]$, $SE = 0.07$, $z = -3.14$, $p = .002$. However, the within-person indirect pathway was not significant, $ab_{wp} = -0.04 [-0.09, 0.01]$, $SE = 0.03$, $z = -1.77$, $p = .077$, though the trend was in the expected direction. There was no evidence of a direct effect of uncertainty on goal self-control at the between-person level, $c'_{bp} = -0.04 [-0.18, 0.09]$, $SE = 0.07$, $z = -0.62$, $p = .538$, however, at the within-person level uncertainty was a significant predictor of self-control after accounting for its association with boredom, $c'_{wp} = -0.09 [-0.17, -0.01]$, $SE = 0.04$, $z = -2.32$, $p = .021$. Repeating the same analysis with goal progress as the

outcome variable produced a very similar pattern of results (see Figure 10; Panel B). The between-person indirect pathway was significant, $ab_{bp} = -0.15 [-0.25, -0.05]$, $SE = 0.05$, $z = -2.98$, $p = .003$, but the within-person indirect pathway was not, $ab_{wp} = -0.04 [-0.09, 0.01]$, $SE = 0.02$, $z = -1.75$, $p = .08$. At the between-person level, the direct pathway from uncertainty to goal self-control was not significant, $c'_{bp} = -0.13 [-0.27, 0.01]$, $SE = 0.07$, $z = -1.86$, $p = .063$, however, the direct pathway was significant at the within-person level, $c'_{wp} = -0.10 [-0.18, -0.03]$, $SE = 0.04$, $z = -2.66$, $p = .008$.

Figure 10

Academic Goals Path Models



* $p < .05$. ** $p < .01$. *** $p < .001$.

Exploratory Analyses

To further explore the relationship between uncertainty and goal boredom, I fit the same model that I used to test my first hypothesis but this time included a random slope for the within-person effect of uncertainty. That is, I allowed the slope of uncertainty to vary across participants. Comparing the original random-intercept-only model to the random-slope model indicated that the random-slope model fit the data significantly better, $\chi^2(2) = 7.38, p = .025$. Despite being a better fit to the data, inclusion of the random slope did not meaningfully change the model estimates. It did suggest, however, that there was meaningful variability in the relationship between uncertainty and boredom across people. I therefore plotted the individual slopes of uncertainty for each person to examine the variability (see Figure 11). Visual inspection of the graph revealed a single slope that appeared divergent from the others, suggesting that it may be an influential case.

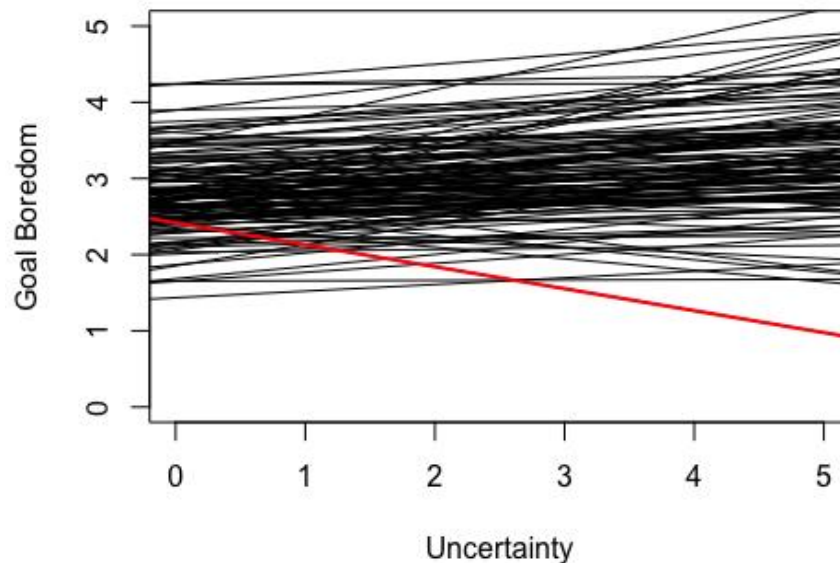
I used the R-package *influence.ME* (Nieuwenhuis et al., 2012), which provides tools for detecting influential data in multi-level regression models, to further investigate the case. I calculated both the Cook's Distance and the standardized difference of the beta (DFBETAS) to assess the individual cases' influence on the within-person association between uncertainty and boredom. Cook's Distance is a measure of the extent to which model parameters are affected by influential data and the DFBETAS is a measure of the difference in parameter estimates between a model based on a full set of data and a model from which the potentially influential case is removed (Nieuwenhuis et al., 2012). Cases are regarded as too influential if the Cook's distance exceeds the cut-off value $4/n$ and if the DFBETAS exceeds the cut-off value $2/\sqrt{n}$ (Belsley et al., 2005; Van der Meer et al., 2010), where n refers to the number of groups in the grouping factor—in the present study, people in the sample. The Cook's Distance was 0.52 and the

DFBETAS was 0.72, which both exceeded the recommended cut-off values of 0.03 and 0.18, respectively.

The evidence clearly indicated that this case was having a disproportionate influence on the slope estimate. I therefore excluded the single case and re-ran the same analyses as described above. With this case removed, the within-person effect of uncertainty on boredom was significant, $b = 0.10$ [0.02, 0.18], $SE = 0.04$, $t(722) = 2.56$, $p = .011$. The within-person indirect pathway from uncertainty to self-control through boredom was also significant, $ab_{wp} = -0.06$ [-0.11, -0.01], $SE = 0.03$, $z = -2.40$, $p = .016$, and so was the indirect pathway from uncertainty to goal progress through boredom, $ab_{wp} = -0.06$ [-0.10, -0.01], $SE = 0.02$, $z = -2.38$, $p = .017$. Additionally, with this case removed, inclusion of a random slope did not significantly improve the model fit, $\chi^2(2) = 1.96$, $p = .376$.

Figure 11

Plot of Individual Slopes



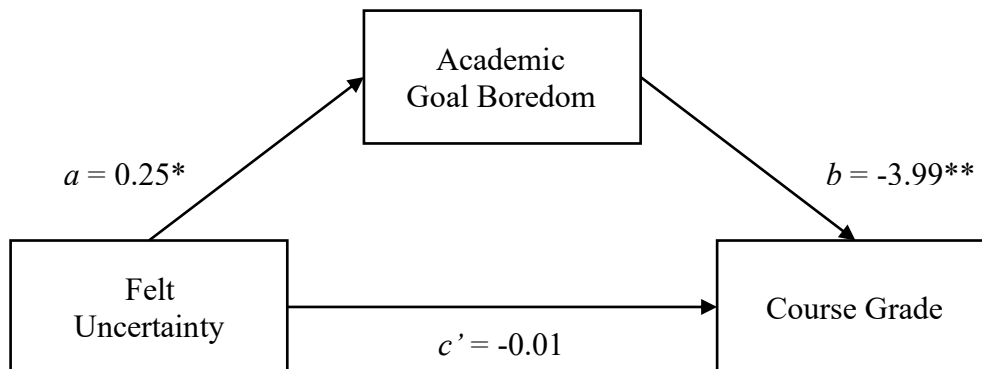
Note. Within-person relationship between uncertainty and boredom (i.e., random intercept and slope estimates plotted for each person). The red line indicates the influential case.

Academic Performance

Of the sample of 122 students, 60 provided consent for their grades to be released from the registrar's office. I started by regressing final course grades on academic goal boredom (averaged across the four weeks) controlling for prior academic performance. There was a significant negative association, indicating that boredom working on academic goals predicted lower course grades at the end of the term, $b = -3.44 [-6.49, -0.396]$, $SE = 1.52$, $t(57) = -2.26$, $p = .027$. Next, I modelled the indirect pathway from general life uncertainty to final course grades through academic goal boredom. The indirect effect was in the expected direction, however, it was not statistically significant, $ab = -0.98 [-2.11, 0.15]$, $SE = 0.58$, $z = -1.70$, $p = .088$. Notably, when modelling the indirect pathway using the *lavaan* package only observations with complete data are used to estimate the path coefficients, meaning that estimates of both the a ($X \rightarrow M$) and b ($M \rightarrow Y$) pathways are calculated based on the 60 students' who provided their grades. Using all available data to model the a path (from uncertainty to goal boredom) produced a somewhat larger indirect effect with a bias corrected 95% bootstrap confidence interval (based on 1000 replicates) that did not include zero, $ab = -1.10 [-2.91, -0.23]$.

Figure 12

Academic Performance Path Model



* $p < .05$. ** $p < .01$.

Discussion

The results of Study 6 show that there is both meaningful within- and between-person variability in how uncertain people feel about the general circumstances of their life, and this variability is associated with differences in the experience of goal pursuit. More specifically, at the between-person level, people who felt chronically more uncertain about their life over the course of the four weeks reported that their academic goals were more boring and that they in turn had less self-control and made less progress working on them. At the within-person-level, there was also evidence that on weeks when people felt that the circumstances of their life were more uncertain than usual, they found their academic goals more boring and had less self-control working on them and made less progress. Supporting the UM-B-SCF, in both cases, uncertainty about the circumstances of one's life was associated with less self-control and progress on academic goals indirectly through increased boredom. In the present study, I also found that working on academic goals during the first month of the semester was associated with lower course grades at the end of the term. Furthermore, there was preliminary evidence to suggest that general life uncertainty during the semester, predicted lower course grades at the end of the term indirectly through increased boredom working on academic goals.

Study 7

Studies 1-6 found consistent evidence that various sources of uncertainty predict boredom and self-control failure in the context of unrelated goal pursuit. However, a limitation of the work thus far is the lack of a total experimental effect of uncertainty on boredom and self-control. Both the mortality salience manipulation used in Studies 2 and 3 and the COVID-19-salience manipulation used in Study 5 did not have a total effect (i.e., the direct effect plus the indirect effect) on boredom or self-reported self-control (though there was evidence of a total effect on behavioural self-control in Studies 2 and 3). Rather, in all three of these experimental studies the manipulations caused people to feel uncertain about the topic of the manipulation, which in turn predicted boredom and self-control failure during unrelated tasks and activities—that is, the manipulations predicted boredom and self-control indirectly through felt uncertainty. The main goal of this final study was therefore to provide some evidence for a causal relationship showing that heightened uncertainty causes subsequent boredom and self-control failure. Accordingly, in Study 7, I used a different uncertainty manipulation than in the previous studies by having people think about an uncertain personal relationship. People tend to highly value their interpersonal relationships (Cavallo et al., 2013; Klinger, 1977) so I expected that manipulating uncertainty with a relationship conflict would produce stronger and longer lasting effects. Additionally, in this study I used more extreme comparison conditions—an approach condition and a personal value condition in which participants wrote about something they wanted to approach and their highest personal value respectively—that I expected would actually reduce uncertainty to create a more powerful contrast.

I hypothesized that writing about an uncertain relationship would cause participants to anticipate being more bored and expect to have less self-control for the remainder of the

assessment compared to the approach and value conditions. Replicating the findings from Studies 2-6, I also hypothesized that the effect of the manipulation would cause greater boredom indirectly through increased felt uncertainty, and increased boredom would in turn predict less self-control. Furthermore, I expected that the effect of the manipulation on boredom through felt uncertainty would persist even after controlling for state approach motivation, which the comparison conditions would presumably increase. I pre-registered my hypotheses and analysis plan on OSF while data collection was underway but before looking at the data or performing any statistical analyses (pre-registration available at: <https://osf.io/phfbx>). Additional hypotheses and analyses were included in the pre-registration but are not presented here (see Appendix C).

Method

Participants and Procedure

Participants were students in a third-year undergraduate personality psychology course at the University of Waterloo. As in Study 6, the sample size was determined firstly by course enrollment, and secondly by the number of students who consented to their data being used for research purposes. The data were collected as part of a larger course assignment and students received participation credits for completing each assessment. Each assessment included a battery of other measures related to the course content that were not part of the present study. Students were invited to share their anonymized course data at the end of the term after the final grades had been submitted. No other exclusion criteria were applied. Of the 72 students enrolled in the course, 52 consented to their data being used for research purposes (14 male, 35 female, 2 other; $M_{\text{age}} = 21.65$, $SD_{\text{age}} = 1.59$, range = 19 to 27). Forty-two percent (42.31%) self-identified as white, 5.77% black, 5.77% Hispanic or Latino, 19.23% East Asian, 3.85% Middle Eastern, 11.54% South Asian, 1.92% Native Canadian/Indigenous, 3.85% multi-ethnic, and 5.77% other.

The study used a within-subjects experimental design with three conditions: an uncertainty condition, an approach condition, and a personal value condition. An additional daily routine condition was included in the present study, however, this condition had certain limitations and did not perform as expected. Thus, I do not present it in the main dissertation, but see Appendix C for further discussion and analyses with this condition. Although the sample size was relatively small, a sensitivity analysis conducted in G*Power 3 (Faul et al., 2007) nevertheless indicated that a sample of 52 people with three repeated measures would provide 90% power to detect a small-to-medium sized main effect of condition (Cohen's $f = 0.19$; $\eta^2 = 0.03$). All participants responded to the three writing prompts, which were each embedded within one of the course assessments and had to be completed a minimum of 8 hours apart. In the first assessment, participants described a relationship that they were uncertain about (uncertainty condition). In the next assessment, they described something in their life that they wanted to eagerly approach (approach condition). In the final assessment, participants described their highest value in life (personal value condition). After responding to each of the prompts, they were asked to rate how uncertain and approach motivated they felt regarding what they had just written about. Participants were then told that for the remainder of the course assessment they would be filling out personality questionnaires and it would take about 5-10 mins to complete depending on their speed. Immediately following, participants were asked to rate how boring they thought the rest of the assessment would be and how much self-control they would have completing it.

Materials

Manipulation Conditions. In the uncertainty, approach and personal value conditions, respectively, participants responded to the following writing prompts:

Uncertain Relationship

Please describe a relationship with a friend, family member, or partner, that is not going very well and that you are uncertain about. Describe the kinds of problems you are having in this relationship, and why you are uncertain about how the relationship could end up. What are the difficulties that might be causing your relationship to continue to go poorly or get worse?

Eager Approach

Please describe what you most eagerly want to approach, in other words, you enthusiastically want to move towards getting or having more of in your life. It could be a specific thing (e.g., a fluffy kitten) or a more abstract state (e.g., love, justice, success). Choose your most powerful current desire, regardless of what others might think.

Highest Value

Please describe your highest value in life, in other words, the ideal of goodness that most inspires you. It could relate to the high value you place on family, friends, relationships, beauty, knowledge, success, religion, spirituality, or having fun and gaining new experiences. Choose whatever most inspires you—there is no right or wrong answer.

Measures

All measures were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Felt Uncertainty. Participants were instructed to rate how torn, confused, indecisive, uncertain, chaotic, and conflicted they felt regarding what they had just written about. I calculated a mean score with higher values reflecting greater felt uncertainty. Cronbach's alpha

reliability was .88 for the uncertainty condition, .93 for the approach condition and .93 for the personal value condition.

Approach Motivation. Participants rated their agreement with six statements adapted from the behavioural activation system (BAS) reward and drive subscales of the trait BIS/BAS Scale (Carver & White, 1994) regarding what they had just written about. Example items include: “I would feel excited and energized if I got something I wanted related to it,” and “I would be fiercely determined in going after what I wanted related to it.” I calculated a mean score with higher values reflecting greater approach motivation. Cronbach’s alpha reliability was .95 for the uncertainty condition, .93 for the approach condition and .92 for the personal value condition.

Boredom. Participants rated their agreement with the following statements as they thought about completing the rest of the assessment: “It seems boring,” “It seems hard to find interesting,” “It seems fascinating (reverse scored),” and “It seems absorbing (reverse scored).” I calculated a mean score with higher values reflecting more anticipated boredom. Cronbach’s alpha reliability was .68 for the uncertainty condition, .82 for the approach condition and .84 for the personal value condition.

Self-Control. Participants rated their agreement with the following statements as they thought about completing the rest of the assessment: “I feel lazy” (reverse scored), “I feel like working toward my goals,” “I feel like procrastinating” (reverse scored), “I feel like concentrating,” and “I feel like getting things done.” I calculated a mean score with higher values reflecting more anticipated self-control. Cronbach’s alpha reliability was .84 for the uncertainty condition, .75 for the approach condition, and .78 for the personal value condition.

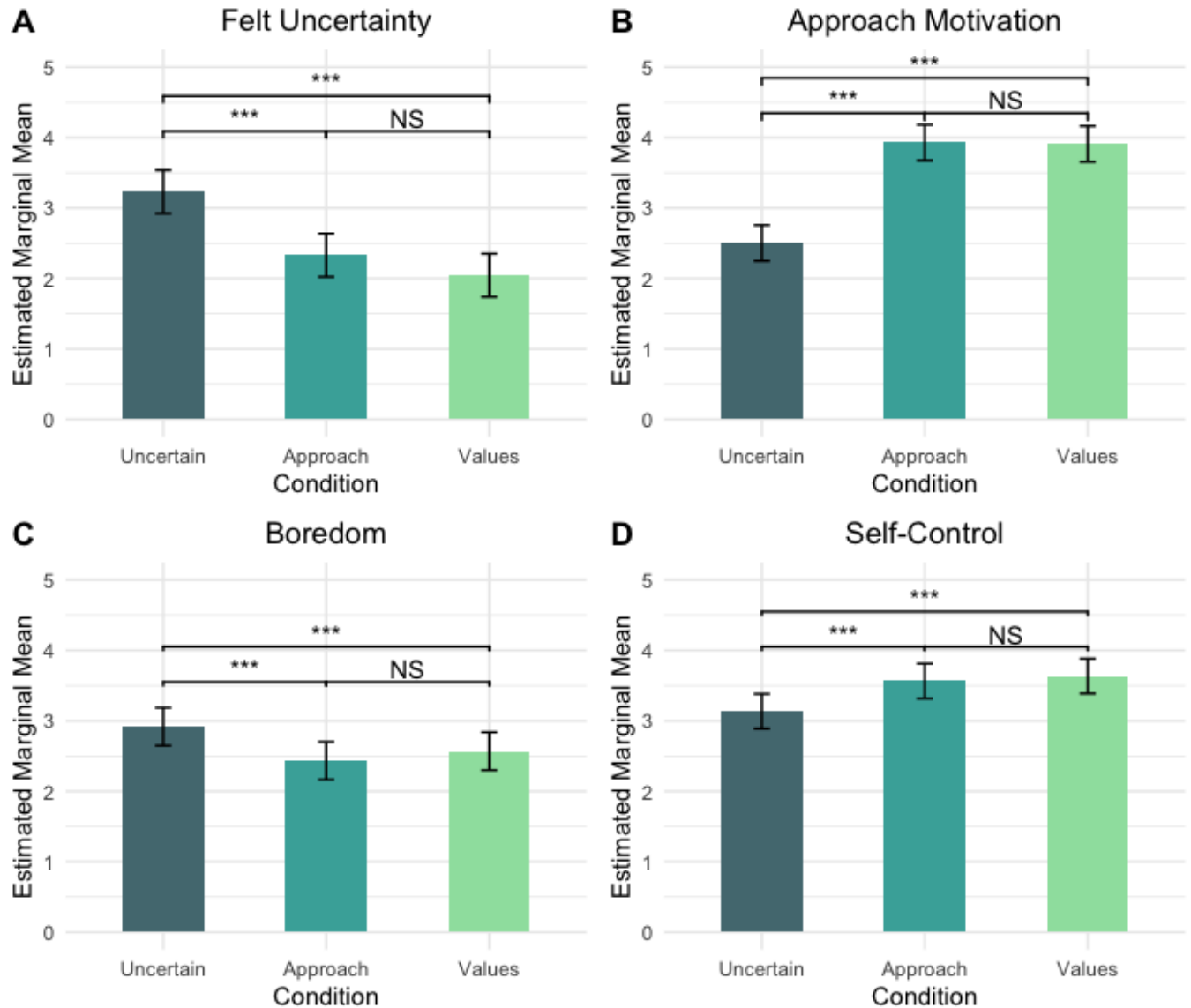
Results

I started by conducting repeated measures ANOVAs to examine felt uncertainty and approach motivation related to the manipulation content across the three conditions. There was a significant effect of condition on both felt uncertainty, $F(2, 102) = 42.09, p < .001, \eta p^2 = 0.45$, and approach motivation, $F(2, 102) = 75.52, p < .001, \eta p^2 = 0.45$. As expected, Tukey pairwise comparisons showed that people felt significantly more uncertain after writing about an uncertain relationship compared to writing about something they wanted to approach, $M_{diff} = 0.90, SE = 0.14, t(102) = 6.68, p < .001$, and writing about a personal value, $M_{diff} = 1.19, SE = 0.14, t(102) = 8.79, p < .001$, but there was no difference between the approach and value conditions, $M_{diff} = 0.29, SE = 0.14, t(102) = 0.14, p = .092$ (see Figure 13, Panel A). In contrast, people felt significantly less approach motivated after writing about an uncertain relationship compared to writing about something they wanted to approach, $M_{diff} = -1.43, SE = 0.13, t(102) = -10.72, p < .001$ and writing about a personal value, $M_{diff} = -1.42, SE = 0.13, t(102) = -10.57, p < .001$; again, there was no difference between the approach and value conditions, $M_{diff} = 0.02, SE = 0.13, t(102) = 0.14, p = .989$ (see Figure 13; Panel B).

Next, to test my first hypothesis, I conducted repeated measures ANOVAs to examine differences in expected boredom and self-control completing the remainder of the assessment across the conditions. There was a significant effect of condition on both anticipated boredom, $F(2, 102) = 14.03, p < .001, \eta p^2 = 0.22$, and anticipated self-control completing the assessment, $F(2, 102) = 16.06, p < .001, \eta p^2 = 0.24$. Consistent with my hypothesis, pairwise comparisons showed that people expected the remainder of the assessment would be more boring after writing about an uncertain relationship compared to something they wanted to approach, $M_{diff} = 0.49, SE = 0.09, t(102) = 5.14, p < .001$, or a personal value, $M_{diff} = 0.35, SE = 0.09, t(102) = 3.69, p =$

Figure 13

Mean Differences in Outcomes Across the Uncertainty, Approach and Value Conditions



*** $p < .001$. NS = nonsignificant.

.001. There was no difference in expected boredom between the approach and value conditions, $M_{diff} = -0.14$, $SE = 0.09$, $t(102) = 1.44$, $p = .324$ (see Figure 13, Panel C). Also consistent with my hypothesis, people expected to have less self-control completing the remainder of the assessment after writing about an uncertain relationship compared to writing about something

they wanted to approach, $M_{diff} = -0.43$, $SE = 0.10$, $t(102) = -4.51$, $p < .001$, or a personal value, $M_{diff} = -0.50$, $SE = 0.09$, $t(102) = -5.23$, $p < .001$. There was no difference in expected self-control between the approach and value conditions, $M_{diff} = -0.07$, $SE = 0.09$, $t(102) = -0.72$, $p = .750$.

Within-Subjects Path Model

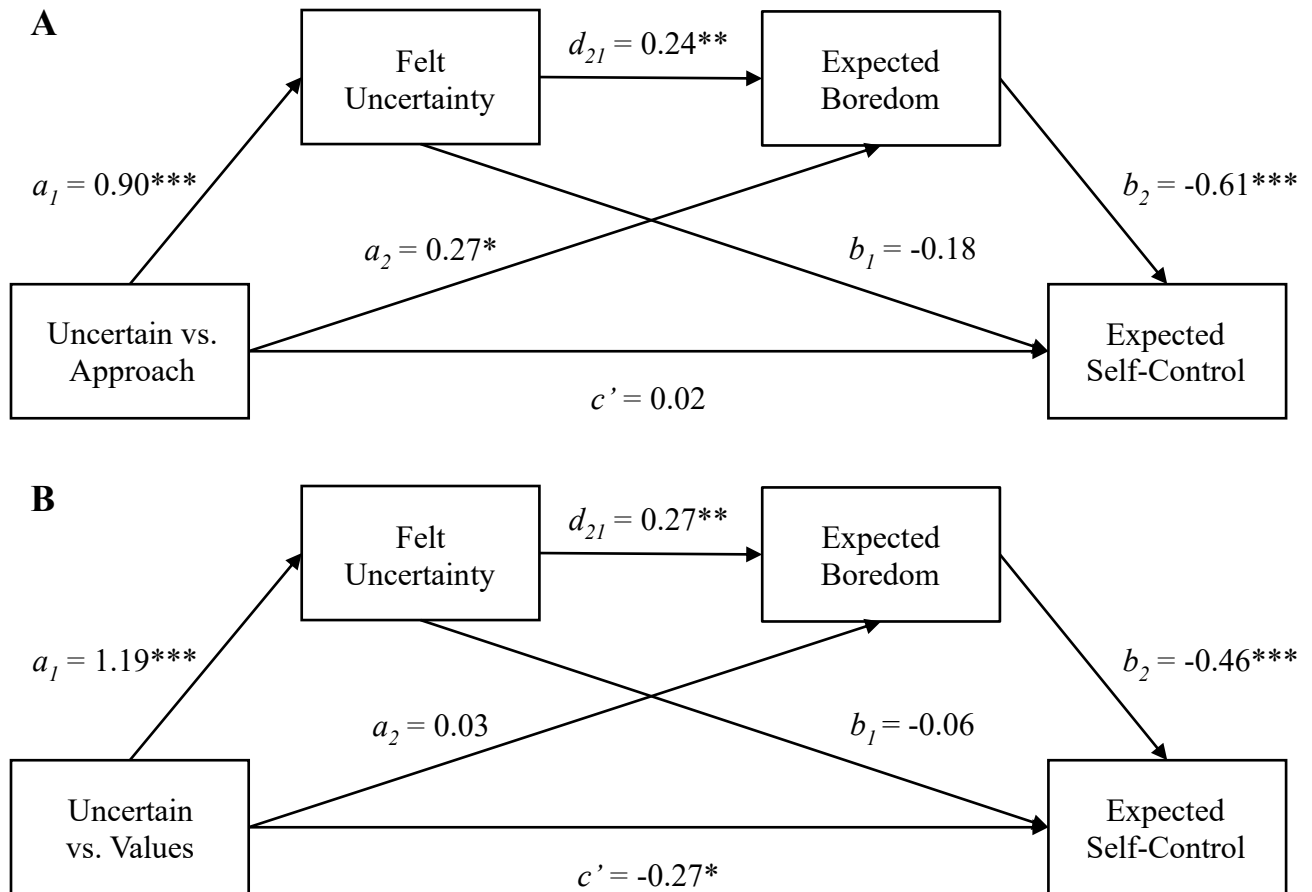
To test my second hypothesis, I estimated a within-subjects (multi-level) serial path model, first comparing across the relationship uncertainty and eager approach condition. The results showed that writing about an uncertain relationship made people feel more uncertain, $b = 0.90$ [0.63, 1.17], $SE = 0.14$, $z = 6.52$, $p < .001$, which in turn predicted anticipating more boredom completing the assessment, $b = 0.24$ [0.07, 0.41], $SE = 0.09$, $z = 2.82$, $p = .005$, which in turn predicted less anticipated self-control, $b = -0.61$ [-0.88, -0.34], $SE = 0.14$, $z = -4.37$, $p < .001$. The within-person serial indirect pathway was significant, $abd = -0.13$ [-0.24, -0.02], $z = -2.23$, $p = .026$ (see Figure 14; Panel A). The results did not change even after controlling for approach motivation; uncertainty remained a significant predictor of boredom, $b = 0.23$ [0.06, 0.40], $SE = 0.09$, $z = 2.68$, $p = .007$, while approach motivation did not significantly predict boredom, $b = -0.05$ [-0.22, 0.11], $SE = 0.09$, $z = -0.62$, $p = .533$.

Next, I ran the same analysis but instead comparing across the relationship uncertainty and personal value condition. Again, writing about an uncertain relationship made people feel more uncertain, $b = 1.19$ [0.90, 1.47], $SE = 0.15$, $z = 8.11$, $p < .001$, which in turn predicted anticipating more boredom completing the assessment, $b = 0.27$ [0.09, 0.46], $SE = 0.10$, $z = 2.86$, $p = .004$, which in turn predicted less anticipated self-control, $b = -0.46$ [-0.69, -0.22], $SE = 0.12$, $z = -3.82$, $p < .001$. The within-person serial indirect pathway was significant, $abd = -0.15$ [-0.28, -0.02], $z = -2.20$, $p = .028$ (see Figure 14; Panel B). Once again the results did not

change when controlling for approach motivation; uncertainty remained a significant predictor of boredom, $b = 0.26$ [0.08, 0.45], $SE = 0.09$, $z = 2.78$, $p = .005$, while approach motivation did not significantly predict boredom, $b = -0.08$ [-0.26, 0.10], $SE = 0.09$, $z = -0.90$, $p = .369$. The results show that after writing about an uncertain relationship people felt more uncertain, which predicted thinking the rest of the assessment would be more boring, which in turn predicted less anticipated self-control completing the assessment.

Figure 14

Within-Subjects Path Models



Note. Panel A: Uncertain relationship condition vs. eager approach condition. Panel B: Uncertain relationship condition vs. personal values condition.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

Study 7 provided further evidence to support the UM-B-SCF. It also extends the previous studies by providing initial evidence of a causal effect of uncertainty on boredom and self-control. More specifically, in the present study I found that there was both a total effect of the manipulation condition on anticipated boredom and self-control, as well as an indirect effect through felt uncertainty. Two key features of Study 7 likely contributed to the presence of a total effect in this study but not in the other experimental studies (i.e., Studies 2, 3, and 5). First, the uncertainty manipulation used in this study, which asked participants to describe an uncertain personal relationship, may have been more powerful than the ones used in the other studies and therefore more capable of producing a persistent motivational conflict. Social relationships are an integral part of peoples' lives (Cavallo et al., 2013; Fitzsimons et al., 2015) and research even suggests that the desire for successful interpersonal relationships is a fundamental human motivation (Baumeister & Leary, 1995). Consequently, relationship uncertainties can be a powerful activator of the BIS given their personal significance and potential for profound life disruption.

Second, relative to the dental pain (vs. mortality salience; Studies 2 and 3) and general life description (vs. Covid-salient description; Study 5) control conditions, the approach and values comparison conditions used in the present study likely created a more extreme contrast making it easier to detect a condition effect. A tradeoff of comparing the uncertainty condition with these non-neutral approach motivation conditions is the possibility that the observed effects were due to an increase in approach motivation rather than an increase in uncertainty. However, the fact that felt uncertainty predicted boredom and self-control but state approach motivation did not, suggests that this was not the case. Nevertheless, it will be important for future research

to replicate and extend these findings in a larger sample and including a truly neutral control condition (see Appendix C for further discussion of considerations for selecting an appropriate control condition).

General Discussion

The purpose of the present research was to propose and empirically test the Uncertainty Model of Boredom and Self-Control Failure. The UM-B-SCF integrates diverse literatures on motivation, boredom and self-control by proposing that motivational states elicited in one context can have system-wide impacts on goal pursuit, leading people to experience seemingly unrelated goals as more boring and difficult to complete. The model explains this phenomenon by highlighting how the outputs of the BIS affect goal pursuit. More specifically, under conditions of motivational conflict and uncertainty the BIS is activated causing generalized shifts in perception and behaviour (i.e., increased arousal, diffuse attention, negative biasing, and inhibition) that persist until the conflict is resolved. Furthermore, these blunt outputs produce a state of ambient uncertainty that is conducive to feelings of boredom and self-control failure. Accordingly, I hypothesized that when in a state of ambient uncertainty people would experience various tasks and projects that were seemingly unrelated to the eliciting conflict, as more boring and effortful (i.e., more difficult to exercise self-control).

Across seven studies, the results of the present research provide considerable support for some of the basic tenets of the UM-B-SCF. Heightened uncertainty (measured in Studies 1, 4, and 6; manipulated in Studies 2, 3, 5, and 7) elicited by awareness of death (Studies 2 and 3), the COVID-19 pandemic (Studies 4 and 5), an uncertain relationship (Study 7) and the general circumstances of one's life (Studies 1 and 6) was associated with more boredom and less self-control in the context of unrelated tasks and projects. Greater felt uncertainty predicted experiencing (Studies 1, 2, 3, 4, and 6) and anticipating (Studies 2, 3, 5, and 7) more boredom and less self-control in general (Study 1), during a data entry task (Studies 2 and 3; using both self-reported and behavioural measures of self-control), working on daily tasks (Study 4),

completing an online survey (Study 4), imagining pursuing general (Study 5) and academic or career-related personal projects (Studies 2 and 3), imagining completing an online personality assessment (Study 7), and working toward general (Study 4) and specific academic goals (Study 6) over the course of a month. The results of Study 6 also showed that both between- and within-person variability in uncertainty—i.e., stable individual differences in experienced uncertainty and shifts in experienced uncertainty over time—were associated with perceived boredom and difficulties exercising self-control. Furthermore, there was preliminary evidence indicating downstream consequences of ambient uncertainty on consequential academic outcomes; in this case, lower grades at the end of the academic semester. The results of Study 7 also provided initial evidence for a causal relationship between uncertainty and both boredom and low self-control. Finally, across all seven studies, the results were consistent with an indirect pathway whereby uncertainty predicted greater boredom, which in turn predicted less self-control.

Ambient Uncertainty and Boredom

An extensive literature suggests that uncertainty and BIS activation are experienced subjectively as anxiety (FeldmanHall & Shenhav, 2019; Frijda et al., 1989; Gray & McNaughton, 2000; Grupe & Nitschke, 2013; Heine et al., 2006; Hirsh et al., 2012; Inzlicht et al., 2015; McGregor et al., 2009; Morriss et al., 2022). The UM-B-SCF extends this work by arguing that, while people experience uncertainty as anxiety in the context of the eliciting conflict, it can also manifest as boredom in the context of subsequent, unrelated goal pursuit. This occurs because in a state of ambient uncertainty lingering BIS activation impedes engagement with other goals to facilitate resolution of the focal conflict. Consistent with this theorizing, the present research provides strong correlational evidence for the relationship between uncertainty on the one hand, and boredom in unrelated goal pursuit on the other. Across

all of the studies presented in this dissertation, I found that felt uncertainty about a focal motivational conflict predicted finding unrelated tasks and projects more boring.

The experimental findings, however, were more nuanced. Neither the mortality salience manipulation (Studies 2 and 3) nor the COVID-19 salience manipulation (Study 5) had a significant total effect on boredom. More specifically, in Studies 2 and 3, there was no difference in anticipated boredom working on academic personal projects or experienced boredom during the data entry task after writing about the experience of dying (compared to writing about the experience of dental pain). Likewise, in Study 5, there was no difference in anticipated boredom working on personal projects after describing how COVID-19 had disrupted one's life circumstances (compared to describing one's life circumstances in general). Only the uncertain relationship manipulation in Study 7 had a significant total effect on boredom when compared to both an eager approach and a personal values condition, as well as a significant indirect effect through felt uncertainty. In Studies 2, 3, and 5, however, there was evidence of an indirect effect of the experimental condition on boredom through felt uncertainty about the manipulation.

One possible explanation for the lack of a total effect in Studies 2, 3, and 5 is that there are other mediating and/or moderating variables at play that I did not specify in the models. In the context of mediation, statistical suppression occurs when the direct and indirect effect(s) of an independent variable on a dependent variable are inconsistent—that is, the effects have opposing signs (MacKinnon et al., 2000; Tzelgov & Henik, 1991). One or more potentially unidentified mediators could have exerted a negative (reducing) effect on boredom, as opposed to the found positive (increasing) effect of felt uncertainty, effectively cancelling each other out. For instance, it is possible that the uncertainty manipulations heightened a sense of curiosity, which in turn reduced boredom. This idea is consistent with a series of studies conducted by Bar-

Anan and colleagues (2009). In that work, the authors manipulated uncertainty by having participants repeat phrases conveying either certainty or uncertainty and measured affective reactions to film clips. Participants in the uncertainty condition were more curious about the films, which the authors argued led to greater psychological engagement, and this in turn influenced affective reactions. In the present studies, if the uncertainty manipulations made people both more uncertain and more curious, the opposing effects exerted by these mediators may have cancelled each other out. This possibility is further supported by the significant negative direct effect of condition on boredom in Study 3, suggesting that after controlling for changes in felt uncertainty the manipulation actually reduced boredom.

Alternatively, the effects of the uncertainty manipulations on boredom could vary as a function of some unidentified moderator. If the experimental manipulation exerted opposing effects in different subgroups of individuals this could produce a total effect near zero (Hayes, 2018). For instance, it is possible that how people responded to the felt uncertainty caused by the manipulation varied based on some chronic individual difference like trait approach motivation. People high in trait approach motivation may be better able to engage with subsequent goal pursuit as a way of suppressing or distracting oneself from conflict. If this were the case, the manipulations may have only caused boredom for people who were low in approach motivation. However, exploratory analyses examining potential moderators did not support this. These analyses did not reveal any significant interaction effects with trait BAS or any other trait measures that were included in the present studies (see Appendix A for all variables).

Another possible explanation is the uncertainty manipulations were simply not powerful enough to cause a lingering motivational conflict. A critical aspect of the UM-B-SCF is the fact that heightened uncertainty and associated BIS activation must persist unresolved to have an

effect on subsequent goal pursuit. The salience of a particular source of conflict is proportional to the implications that it has for our future states and actions (FeldmanHall & Shenhav, 2019); uncertainty about things that have more impact on our lives will thus be more likely to elicit persistent BIS activation. Although I used manipulations that were intended to elicit conflict with important life goals, the brief mortality salience and COVID-19-salience writing exercises may not have been significant or personally relevant enough to cause a state of ambient uncertainty. Indeed, previous research has shown that mortality salience manipulations sometimes only produce effects among people for whom uncertainty is a salient issue (Van den Bos, 2009; Van den Bos et al., 2005). It is possible that while participants acknowledged that the content of the manipulation made them feel uncertain in the moment, the motivational conflict was fleeting and BIS activation quickly dissipated once presented with a new task or activity. If this were the case, then the relationship between felt uncertainty and boredom may be more reflective of trait-level variability in experienced uncertainty as opposed to any effects of the experimental manipulation. However, the findings of Study 6 suggest that at least some variability likely does occur at the within-person level even if the mortality salience and COVID-19-salience manipulations were not powerful enough to produce a lasting effect.

Despite not finding a total effect of the manipulations on boredom in Studies 2, 3, and 5, there was evidence of a total effect of the experimental manipulation in Study 7. In that study, participants expected the remainder of the assessment to be more boring and expected to have less self-control completing it after writing about an uncertain relationship (compared to something they wanted to approach or a personal value). Furthermore, across all four experimental studies I found evidence of an indirect effect of the manipulations on boredom through heightened felt uncertainty. These findings are consistent with the UM-B-SCF insofar as

the uncertainty manipulations caused people to feel more uncertain about the content of the manipulation and these feelings in turn predicted more boredom during subsequent tasks and projects. Together with the robust association found in Studies 1, 4, and 6, the findings of the present research support the UM-B-SCF by showing that heightened uncertainty about a focal motivational conflict predicts perceiving unrelated goal pursuit as more boring. Further support that ambient uncertainty influences subsequent goal pursuit comes from the results of Study 4 which showed that self-reported uncertainty about the COVID-19 pandemic (measured at the initial session) predicted more boredom working on goals over the following month (measured at the one-month follow-up). However, because the total effect of the experimental manipulations on boredom was nonsignificant and the mediator (felt uncertainty) was measured and not manipulated in Studies 2, 3, and 5, only the results of Study 7 can provide evidence of a causal relationship between uncertainty and boredom. This highlights the need to further examine the conditions that produce lasting ambient uncertainty, as well as the conditions under which uncertainty causes boredom.

Ambient Uncertainty, Boredom and Self-Control Failure

Previous research has consistently demonstrated that boredom is associated with poor self-control (Bieleke et al., 2020; Isacescu et al., 2017; Isacescu & Danckert, 2018; Struk et al., 2016; Wolff et al., 2020). The UM-B-SCF suggests that one reason for this link is that the outputs of the BIS are conducive to both boredom and self-control failure, with the latter an emotional signal and the former a behavioural outcome of this motivational state, during subsequent goal pursuit. Across all seven studies in the present research, there was a strong correlation between boredom and self-control failure for various tasks and projects unrelated to an initial source of uncertainty. This relationship emerged in the context of both imagined and

experienced goal pursuit, using both self-reported and behavioural measures of self-control and at both the within- and between-person level. Furthermore, in all of the studies the pattern of associations was consistent with a process model whereby uncertainty exerted its influence on self-control indirectly through boredom. Although these results support the proposed UM-B-SCF, because boredom and self-control were assessed concurrently and the analyses were correlational I cannot make inferences about the causal direction. In Study 6, there was evidence that boredom working on academic goals during the semester predicted lower course grades at the end of the semester. This finding suggests that the experience of boredom precedes decrements in self-control performance. However, lower course grades do not directly reflect an instance of self-control failure; rather, they are an indicator of self-regulatory ability in general. As a result, it is not possible to establish from these findings whether boredom temporally precedes self-control failure in a specific instance of goal pursuit.

Theory and research on the emotional foundations of self-regulation suggests that emotions are integral to the enactment of self-control, and in particular that negative affect undermines successful self-control (Inzlicht et al., 2015; Schmeichel & Inzlicht, 2013). Furthermore, this work suggests that emotions can be seen as mediating mechanisms of self-control that act as an “affect alarm” to alert people when effortful control is needed (Schmeichel & Inzlicht, 2013). This work has focused on negative affect more broadly and anxiety in particular, however, it converges with functional accounts of boredom as an emotional signal to regulate behaviour (Bench & Lench, 2013; Elpidorou, 2014). This understanding implies that the experience of boredom influences subsequent self-controlled behaviour. The UM-B-SCF therefore conceptualizes boredom as preceding self-control failure in the process model. Self-control failure in this context reflects a failure to engage in behaviour that moves an individual

toward a current goal. Accordingly, in the present research, I assessed self-control failure as behavioural disengagement and a lack of persistence working on effortful tasks and projects. Although the proposed UM-B-SCF positions self-control failure as a consequence of boredom, the temporal distinction of which precedes the other may be less important than the distinction between boredom as an emotional signal and self-control failure as a behavioural outcome of ambient uncertainty and lingering BIS activation. Furthermore, without establishing a causal relationship between boredom and self-control, I cannot rule out the possibility of alternative processes by which uncertainty influences goal pursuit.

Alternative Conceptualizations of the Process Model

One alternative conceptualization of how the process unfolds is that changes in self-control precede changes in boredom. That is, ambient uncertainty reduces self-control, which in turn increases boredom. This process model aligns with work that suggests boredom is dependent on performance failures and attribution of this difficulty to the present activity, which would imply that self-control failure precedes the emotional experience of boredom (Eastwood et al., 2012). Another alternative is that neither changes in boredom nor changes in self-control precede one another, but rather occur simultaneously. This process model aligns with how researchers have conceptualized the different affective, cognitive, and behavioural outputs of the BIS as simultaneous outcomes (Gray & McNaughton, 2000). The significant total and direct effects of the mortality salience manipulation on data entry task performance in Studies 2 and 3 provide some support for this conceptualization. The fact that the experimental manipulation caused decrements in behavioural self-control independent of changes in boredom suggests that perceptions of boredom do not necessarily precede the associated behavioural consequences. Consistent with this idea, researchers have argued that boredom is likely a confound in studies of

self-control and have further highlighted the challenges of designing experimental paradigms that disentangle the two (Bieleke et al., 2020; Francis et al., 2018; Milyavskaya, Inzlicht, et al., 2019; Wolff & Martarelli, 2020). Indeed, Wolff and Martarelli (2020) suggest that “boredom and self-control costs closely and dynamically interact in guiding goal-directed behavior” (p. 1279). Thus, under conditions of ambient uncertainty boredom and self-control may actually have a bi-directional relationship, influencing one another over time in a positive feedback loop.

Implications for Responding to Boredom and Disengagement

The UM-B-SCF proposes that one source of boredom and self-control failure is ambient uncertainty and lingering BIS activation from an unresolved motivational conflict. Thus, it follows that in these instances the solution to alleviating boredom and improving self-control lies in resolving the eliciting conflict and down-regulating the BIS. This can occur in one of two ways: either the conflict is resolved in favor of approach/avoidance or a more viable and less conflicted alternative is identified, in either case allowing focused goal pursuit to resume (Gray & McNaughton, 2000; Hirsh et al., 2012; Jonas et al., 2014). However, it may not be intuitive for people to recognize the influence of ambient uncertainty when boredom and disengagement occur during goal pursuit that is far removed from the eliciting conflict. As a result, people are likely to instead attribute their current experience to a more salient and immediate source (most likely the task itself), which could make it difficult to remedy the situation and lead to prolonged periods of boredom and disengagement (Fenichel, 1951; Fisher, 1993). For example, consider the case study described in the introduction about the man whose work output suddenly began to suffer (Gray, 1952). When prompted about this change the man simply reported that his work was boring and difficult to complete. However, it wasn’t until his company recognized the link between this change and an ongoing issue in his personal life (i.e., his mother being sick) that

they were able to resolve the issue and the man again became engaged and proficient in his work. Presumably, if this link had not been identified and the issue went unresolved, the man may have experienced an extended period of boredom and disengagement. Another example of this comes from the pandemic, when many people reported experiencing languishing—a sense of stagnation and emptiness that dulls motivation and disrupts the capacity to focus—but could not necessarily pinpoint why they were feeling and behaving this way (Grant, 2021). This highlights the importance of looking beyond an immediate task or project to consider how the broader circumstances of a person’s life, and the motivational states that they induce, might influence their current experience.

Approaching Alternatives

When an individual cannot clearly identify and/or remedy the source of uncertainty, approaching available alternatives may be a more efficient and appealing solution that can provide at least temporary relief from boredom and disengagement. This may be especially true when goals are central to both people’s daily lives and personal identities, and as a result, are particularly susceptible to persistent conflict because people are unwilling or unable to simply disengage from them (McGregor et al., 2009; Wrosch et al., 2003). Similar to functional theories of boredom (Barbalet, 1999; Danckert & Eastwood, 2020; Elpidorou, 2014; Pekrun, 2006; Van Tilburg & Igou, 2012; Westgate & Wilson, 2018), reactive approach motivation (RAM) theory suggests that the experience of uncertainty is aversive and people are therefore motivated to relieve it (McGregor et al., 2010, 2012; Nash et al., 2011). The theory further proposes that people can accomplish this by pursuing any available alternative that can mobilize approach motivation (Jonas et al., 2014; McGregor et al., 2010). This may explain why boredom triggers the same diverse range of reactions as motivational conflict and uncertainty (Jonas et al., 2014;

Leota et al., 2023; McGregor et al., 2010, 2013). For example, boredom is associated with various impulsive and risky behaviours like gambling (Barbalet, 1999; Blaszczynski et al., 1990), anger and aggression (Dahlen et al., 2004; van Tilburg et al., 2019), ingroup favoritism and worldview defense (Barbalet, 1999; Van Tilburg & Igou, 2011), as well as more adaptive responses like increased prosocial intentions (Van Tilburg & Igou, 2017) and religiosity (Van Tilburg et al., 2019). Presumably, all these reactions would incite approach motivation and downregulate the BIS, which would in turn relieve the aversive experiences of both uncertainty and boredom (Jonas et al., 2014; McGregor et al., 2010). The results of Study 7 provide initial support for this idea insofar as the eager approach and personal values conditions, which reduced uncertainty and increased state approach motivation, were both effective in reducing boredom and self-control failure in a subsequent unrelated task.

However, turning to impulsive and risky behaviours that provide only short-lived pleasure and reward is likely only a temporary fix. Without resolving the eliciting source of uncertainty or re-orienting to a more viable long-term goal, boredom is likely to return. Several studies have found that approaching personal values and ideals—conceptualized as abstract goals—can be a particularly effective source of approach-motivated relief from uncertainty (McGregor et al., 2010, 2012, 2013, 2022). Furthermore, these types of RAM are more sustainable than transient pleasures, such as risk-taking or indulging in concrete rewards like binging on chocolate or Netflix, which can only enhance approach motivation up until consummation (McGregor et al., 2012). Thus, adaptive ways to up-regulate approach motivation such as focusing on important values and ideals may also be an effective antidote to boredom and disengagement.

Strengths, Limitations and Future Directions

A strength of the present research is that the analyses were well-powered with large sample sizes (with the exception of Study 7) based on a priori power analyses, including the integrative analysis in Study 1 that had a pooled sample of over 1,700 participants. Additionally, findings were consistent across both university student and general adult (MTurk) samples enhancing the generalizability of the findings. Another strength is the pre-registered hypotheses and analysis plans and the pre-registered direct replication of findings in Study 3. A final strength of this research is the fact that findings were consistent assessing different sources of uncertainty, assessing boredom and self-control within various different tasks and projects, and using both self-reported and behavioural measures of self-control.

Despite these strengths, the findings should be considered in light of certain limitations. One limitation of the present research is the fact that three out of four experimental studies did not produce total effects on boredom. Thus, the analyses in those studies are ultimately correlational since only measured and not manipulated uncertainty was associated with boredom, and boredom and self-control were measured concurrently. Furthermore, although I collected repeated assessments over several weeks in Study 6, uncertainty, boredom and self-control were still measured concurrently at each time point. Consequently, those results cannot speak to the directionality of effects (Fiedler et al., 2018). Only the results of Study 7, which showed a total effect of the experimental condition on boredom and self-control, provide clear evidence for a causal relationship between uncertainty and boredom. However, more evidence is needed since this significant effect only emerged when contrasting the uncertainty manipulation with other manipulations designed to increase approach motivation. I am currently running a pre-registered replication with a neutral control condition to follow-up these findings to increase confidence in

the robustness of this effect. Future experimental and longitudinal research could also help clarify the causal links between uncertainty and boredom and between boredom and self-control failure using assessments with high temporal resolution to better understand how these processes unfold.

A related limitation is the particular experimental manipulations of uncertainty that I used in Studies 2, 3, and 5. Mortality salience manipulations have been used frequently in terror management research over the past three decades (Greenberg et al., 1993; Greenberg & Arndt, 2011; Pyszczynski et al., 1999). However, recent efforts to replicate basic terror management theory findings have been mixed, with some large-scale studies failing to replicate effects (Klein et al., 2022; Treger et al., 2023). Among other things, this may suggest that mortality salience is not a very powerful manipulation. Additionally, while some researchers have argued that mortality salience is essentially an indirect uncertainty manipulation (Van den Bos, 2009; Van den Bos et al., 2005), TMT theorists have used it specifically as a manipulation of existential anxiety. Thus, mortality salience may not be the most ideal manipulation of ambient uncertainty. With respect to the COVID-salience manipulation, although I did not explicitly ask people to describe how the pandemic had affected their lives in the general control condition they may have described these negative impacts anyways since this was highly salient for most people at that time. Consequently, the manipulation may have been too subtle producing only weak effects if people were describing similar uncertain circumstances in both conditions. Future research should explore alternative manipulations of uncertainty that may be more powerful.

Another limitation of the present research is the relatively weak evidence of discriminant validity with respect to felt uncertainty. The results of Study 2 established some preliminary evidence for discriminant validity by distinguishing uncertainty from two other negative affect

factors, which I labelled restlessness and agitation. The results demonstrated that not only did the experimental manipulation have the strongest effect on uncertainty, but uncertainty was most strongly related to boredom and self-control. Study 4 provided some additional evidence for discriminant validity by showing that felt uncertainty was a stronger predictor of boredom and self-control than general negative affect. However, uncertainty and negative affect were highly correlated in that study and while uncertainty uniquely accounted for variance in both boredom and self-control beyond negative affect, the majority of the explained variance was shared between them as well as approach-related affect. Additional exploratory analyses not presented in Study 1 also found that uncertainty sensitivity was a stronger predictor of boredom proneness and trait self-control than other trait-level negative affect variables (e.g., aggression, depression). Nevertheless, further research demonstrating the unique relationship between ambient uncertainty, as opposed to negative affect in general, and boredom and self-control is needed.

A final limitation is the fact that there was only one behavioural measure of self-control, namely performance on the data entry task in Studies 2 and 3. Given the fact that the UM-B-SCF conceptualizes self-control failure as a behavioural outcome, measuring actual behaviour would provide more compelling results compared to relying on participants own self-reports of their behaviour. Furthermore, studies that assessed anticipated self-control (rather than experienced) self-control may not reflect actual behaviour. Indeed, research has shown that there is often a gap between what people anticipate or intend to do and what they actually do (Hagger et al., 2022). Future research should assess self-control performance in different tasks and projects, particularly those that are relevant to peoples' everyday lives.

Conclusion

Why do people frequently fail to engage and follow through on their goals? The present research suggests that ambient uncertainty is an important and under-appreciated barrier to effective goal pursuit. More specifically, this research demonstrates that ambient uncertainty can lead people to feel bored and exercise poor self-control during unrelated tasks and projects. A key aspect of this work that is important to emphasize is that motivational conflict and uncertainty impeded effective goal pursuit even though it was caused by circumstances far removed from the present task or project. Together the present work suggests that when struggling with a boring and effortful project on one's desk, the solution to engagement may lie in addressing unresolved issues in the broader context of one's life.

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Appendix A

Additional Materials and Measures included in Studies

Study 2 Additional Measures:

- BIS/BAS (Drive and Reward) (Carver & White, 1994)
- Promotion/Prevention Focus (Lockwood, Jordan & Kunda, 2002)
- Self-Esteem (Rosenberg, 1965)
- Hope (Snyder et al., 1991)
- Emotional Uncertainty (Greco & Roger, 2001)
- Meaning in Life (Steger, Frazier, Oishi & Kaler, 2006)
- Hedonic and Eudaimonic Motives for Activities (Huta & Ryan, 2010)
- Self-Control (Tangney, Baumeister, & Boone, 2004)
- Approach Motivation Sensitivity and Anxious Uncertainty Sensitivity (Prentice, 2016)
- Worldview Defense (McGregor et al., 2022)
- Personal Project Efficacy

Study 4 Additional Measures:

- Approach Motivation Sensitivity and Anxious Uncertainty Sensitivity (Prentice, 2016)
- Boredom Proneness (Gerritsen, Toplak, Sciaraffa & Eastwood, 2014)
- Self-Control (Tangney, Baumeister, & Boone, 2004)
- Meaning in Life (Steger, Frazier, Oishi & Kaler, 2006)
- Sources of Meaning in Life
- COVID-19 Impulsive Behaviours
- COVID-19 Prosocial Behaviours
- COVID-19 Health and Safety Behaviours

- Current Tasks Have to vs. Want to Motivation
- COVID-19 Status

Study 5 Additional Measures:

- Personal Projects Fun
- Personal Projects Expedience
- Personal Projects Integrity
- Personal Projects Self-Transcendence
- Personal Projects Self-Enhancement
- Personal Projects BIS/BAS
- Happiness
- Meaning in Life
- Autonomy and Growth (Ryff et al., 2007)
- Generativity (McAdams & de St. Aubin, 1992)
- Effort for Meaning
- Sources of Meaning in Life
- COVID-19 Disruption
- COVID-19 Impulsivity
- Desire for Life (Hayes, Ward, & McGregor, 2016)
- Wise Reasoning (Huynh, Oakes, Shay, & McGregor, 2017)

Appendix B

Power Calculations for Mediation Models

Study 3

Figure B1

Input Parameters and Results of Power Analysis for Study 3

Model Two Serial Mediators

Objective Set Power, Vary N

Target Power 0.85

Minimum N 350

Maximum N 450

Sample Size Steps 25

of Replications 1000

Monte Carlo Draws per Rep 20000

Random Seed 1234

Confidence Level (%) 95

Input Method Correlations

	X	M1	M2	Y
X	1.00			
M1	0.25	1.00		
M2	0.00	0.18	1.00	
Y	-0.13	-0.06	-0.16	1.00
Std. Deviation	0.50	1.09	1.13	271.59

Parameter	N	LL	Power	UL
a1db2	400.00	0.81	0.85	0.89
a1db2	425.00	0.85	0.88	0.90
a1db2	450.00	0.88	0.90	0.92
a1db2	475.00	0.89	0.92	0.94
a1db2	500.00	0.90	0.93	0.95

Study 4

Table B1

Estimates from Study 2, Study 3 and Average Across Both Studies

Parameter	Study 2	Study 3	Average
$r(\text{uncertainty, project boredom})$	.28	.19	0.235
$r(\text{uncertainty, project control})$	-.13	-.04	-0.085
$r(\text{project boredom, project control})$	-.43	-.44	-0.435
Uncertainty SD	1.09	1.07	1.08
Project boredom SD	0.86	0.88	0.87
Project control SD	0.63	0.64	0.635

Figure B2

Input Parameters and Results of Power Analysis for Study 4

Model One Mediator
Objective Set Power, Vary N
Target Power
Minimum N
Maximum N
Sample Size Steps
of Replications
Monte Carlo Draws per Rep
Random Seed
Confidence Level (%)

Input Method Correlations

	X	M	Y
X	1.00		
M	0.235	1.00	
Y	-0.085	-0.435	1.00
Std. Deviation	1.08	0.87	0.635

Parameter	N	LL	Power	UL
ab	150.00	0.77	0.82	0.86
ab	175.00	0.84	0.87	0.89
ab	200.00	0.89	0.91	0.93
ab	225.00	0.91	0.94	0.95
ab	250.00	0.93	0.95	0.97

Study 5

Table B2

Estimates from Study 2, Study 3 and Average Across Both Studies

Parameter	Study 2	Study 3	Average
$r(\text{condition, uncertainty})$	.25	.18	.215
$r(\text{condition, project boredom})$	-.01	-.02	-.015
$r(\text{condition, project control})$	.00	.05	.025
$r(\text{uncertainty, project boredom})$	.28	.19	.235
$r(\text{uncertainty, project control})$	-.13	-.04	-.085
$r(\text{project boredom, project control})$	-.43	-.44	-.435
Condition SD	0.50	0.50	0.50
Uncertainty SD	1.09	1.07	1.08
Project boredom SD	0.86	0.88	0.87
Project control SD	0.63	0.64	0.635

Figure B3

Input Parameters and Results of Power Analysis for Study 5

Model Two Serial Mediators

Objective Set Power, Vary N

Target Power

Minimum N

Maximum N

Sample Size Steps

of Replications

Monte Carlo Draws per Rep

Random Seed

Confidence Level (%)

Input Method Correlations

	X	M1	M2	Y
X	1.00			
M1	0.215	1.00		
M2	-0.015	0.235	1.00	
Y	0.025	-0.085	-0.435	1.00
Std. Deviation	0.50	1.08	0.87	0.635

Parameter	N	LL	Power	UL
a1db2	205.00	0.79	0.82	0.85
a1db2	215.00	0.82	0.85	0.87
a1db2	225.00	0.85	0.87	0.89
a1db2	235.00	0.87	0.89	0.91
a1db2	245.00	0.88	0.91	0.93

Appendix C

Study 7: Additional Analyses with Daily Routine Control Condition

In addition to the relationship uncertainty, approach, and personal value conditions, Study 7 also included a daily routine condition, which I originally intended to use as a neutral control. In this condition, participants were asked to “Please describe the typical daily routine that you tend to go through on a regular day. What is the sequence of events that characterize your typical weekday, starting from when you wake up in the morning until you go to bed?” I hypothesized that after writing about an uncertain relationship participants would expect the remainder of the assessment to be more boring and expect to have less self-control completing it relative to the daily routine control condition.

As expected, the results indicated that felt uncertainty was significantly lower in the daily routine condition compared to the uncertain relationship condition, $Mdiff = 1.13$, $SE = 0.13$, $t(153) = 8.79$, $p < .001$. In contrast to my predictions, there was no difference in boredom across the two conditions, $Mdiff = -0.13$, $SE = 0.11$, $t(153) = -1.15$, $p < .660$, however, self-control was significantly lower in the uncertain relationship condition compared to the daily routine condition, $Mdiff = -0.38$, $SE = 0.09$, $t(153) = -4.01$, $p < .001$. Upon reflection, the daily routine condition was likely not a very good control condition given the fact that routine and monotony have been linked to increased boredom (Gray, 1952; Shackleton, 1981). This introduces a potential confound since this additional factor, that is known to have an association with boredom, would not be held constant across the two conditions. Thus, in order to be a truly effective control condition it must not only be neutral in terms of uncertainty but also in terms of other factors that have been linked to boredom, as well as poor self-control.