Risk-Taking Increases Under Boredom

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Abstract

We examined if boredom is associated with risk-taking. While this association has frequently been postulated, it has rarely been tested, and the evidence has thus far been rather indirect and speculative. We conducted three studies to test this association more systematically. In Study 1, people high in boredom proneness reported greater risk-taking across financial, ethical, recreational, and health/safety domains. In Study 2, over a series of risky decisions, risk-taking increased in tandem with state boredom. Consistently, in Study 3, people who felt more bored were more likely to choose risky gambles. Furthermore, while dispositional self-control predicted lower risk-taking, state boredom nullified this association, suggesting that elevated risk-taking might be attributed the erosion of self-control under boredom. Our findings establish via direct empirical tests that boredom is associated with making riskier decisions.

Keywords: boredom, risk taking, decision making, self-control

Risk-Taking Increases Under Boredom

Making all the right decisions is hard: People face decisions all the time, including seemingly trivial ones—such as when, where, and with whom to get lunch—to seemingly more profound ones—such as when, where, and with whom to get married. Furthermore, people may face the challenge of having to identify the most appealing from a large number of options under time pressure, with limited cognitive capacity, with incomplete information, and, when worse comes to worst, fresh out of coffee. Perhaps unsurprisingly, people do not always choose the most reasonable option during the decision-making process (Hastie & Dawes, 2010). Decision-making is regularly influenced by variables detrimental or irrelevant to the decision at hand, like cognitive biases (Gigerenzer & Selten, 2002) and incidental affect (Loewenstein & Lerner, 2003). We examined one of such potential unwarranted influences: boredom. Specifically, we examined the impact of boredom on risk-taking in decision making. While the idea that boredom involves risk-taking is certainly not new, it is a surprising fact that this association has not been studied systematically.

Boredom

Boredom has been defined as "the aversive experience of wanting but being unable, to engage in satisfying activity" (Eastwood, Frischen, Fenske, & Smilek, 2012, p.482). It is an emotion characterized by various unpleasant physical and psychological experiences, such as low (Smith & Ellsworth, 1985; Van Tilburg & Igou, 2017a) or mixed (Merrifield & Danckert, 2014) arousal, failure to engage attention (Hunter & Eastwood, 2016), and an acute sensation of purposelessness (Chan et al., 2018). Boredom can be expressed physically with a collapsed upper body and leaning head accompanied by relative lack of movement (Walbott, 1998). Besides difficulties in maintaining attention (Eastwood et al., 2012), cognitive features of boredom include thoughts about one's assumed meaningless state (Van Tilburg & Igou, 2012, 2017a), and the perception that time is passing slowly (Watt, 1991). Bored people mind-wander (Smallwood & Schooler, 2015), retrieve self-soothing memories (Van Tilburg, Igou, & Sedikides, 2013), and act impulsively (Moynihan, Igou, & Van Tilburg, 2017; Moynihan et al., 2015). Boredom makes people reconsider their current course of action (or lack thereof) in favor of alternative activities that might be more cost-effective (Kurzban, Duckworth, Kable, & Myers, 2013) and that appear to be more purposeful (e.g., Van Tilburg & Igou, 2011, 2013, 2017b).

Researchers have examined boredom both as a momentary state and as a trait—the latter typically operationalized as proneness to boredom (e.g., Vodanovich, 2003). State boredom is especially related to an inadequately stimulating environment (Mikulas & Vodanovich, 1993); trait boredom is more strongly associated with experiencing tasks as dissatisfying (Farmer & Sundberg, 1986). Boredom has various personal and interpersonal consequences, both desirable and undesirable. State boredom has been linked to outcomes such as charitable intensions (Van Tilburg & Igou, 2017b), creativity (Mann & Cadman, 2014), nostalgic reverie, (Van Tilburg, Sedikides, & Wildschut, 2015), intergroup bias (Van Tilburg & Igou, 2011), and political polarization (Van Tilburg & Igou, 2016). Trait boredom shares some of these as correlates (e.g., political polarization) and is furthermore associated with variables such as hero admiration (Coughlan, Igou, Van Tilburg, Kinsella, & Ritchie, 2017), anger (Dahlen, Martin, Ragan, & Kuhlman, 2004), aggression (Van Tilburg, Igou, Maher, & Lennon, 2019), and various negative physical and mental health outcomes (Vodanovich, 2003). The reason for the existence of so many and such diverse correlates and consequences of boredom might be that boredom is a 'multi-motive' emotion: It causes a search for purposeful engagement alongside a desire for stimulation, and challenge (Van Tilburg & Igou, 2012; 2017a; Westgate, & Wilson, 2018), resulting in a potentially rich repertoire of consequences.

Boredom and Risk-Taking

Boredom seems to encourage individuals to make riskier decisions or engage in riskier behaviors. For example, early research by Blaszczynski, McConaghy, and Frankova (1990) found that pathological gambling was correlated to boredom proneness; pathological gamblers reporting higher boredom proneness compared to the control group—consistent with more recent work on the topic (Fortune & Goodie, 2010). Gupta, Derevensky, and Ellenbogen (2006) predicted adolescents' problem gambling behavior severity with the sensation seeking scale (Zuckerman, Kolin, Price, & Zoob, 1964), which in part measures individual differences in boredom. Specifically, adolescents' boredom susceptibility scores correlated positively with pathological gambling behavior. Mercer and Eastwood (2010) found among undergraduate students that the link between boredom and gambling is partly attributable to the arousal that gambling can offer. Furthermore, Goldstein, Vilhena-Chruchill, Steward, Hoaken, and Flett (2016) found in a 30-day long diary study that boredom was perceived as key cause to start gambling online (and, ironically, also to eventually stop it). Beyond gambling, boredom is also implicated in behaviors that risk one's health in general. Orcutt (1984) found a positive correlation between boredom and alcohol consumption, and Stromberg, Nichter, and Nichter (2007) found that participants give "killing time" as a reason for their smoking behavior. Furthermore, Matthies and colleagues (2012) found that boredom caused non-clinical participant to take more risk, similar to that of participants with ADHD.

These above findings suggest that there may be a link between boredom and risky behavior; though, so far this has usually been investigated mostly for trait boredom rather than state boredom. Furthermore, why might boredom be associated with risk taking? Several psychological processes might explain the proposed positive association between boredom and risk-taking: lack of excitement, not fully deployed attention, lack of meaning, and low self-control.

Excitement. One of the reasons why boredom and risk-taking may be linked is that the latter might offer excitement, which is lacking under boredom. For example, gambling can change people's affective and emotional moods (Binde, 2013), increasing experienced excitement and inducing activity involvement and enjoyment (Csikszentmihalyi & Bennet, 1971). This idea is consistent with, but not equivalent to, the notion of heightened arousal and sensation seeking under boredom. Specifically, while arousal and sensation need not be pleasurable (e.g., in the form of self-administered electric shocks; Wilson, Reinhard, Westgate, et al., 2014), those activities deemed exciting presumably tend to come with relatively high arousal (e.g., Russell, 1983). Indeed, bored individuals tend to report low levels of arousal (e.g., Smith & Ellsworth, 1985; Van Tilburg & Igou, 2017a). Under boredom, low arousal is experienced as adverse and triggers attempts to increase it (Zuckerman, 2014), for example through seeking stimulation (Steenkamp, Baumgartner, &

Van der Wulp, 1996), or pursuing challenge (Csikszentmihalyi, 1975; Van Tilburg & Igou, 2012). Moreover, Schmidt, Mussel, and Hewig (2013) found that people with low resting heart rate (an indicator of low 'trait' arousal) perceived risky options as less risky, resulting in a greater willingness to take risk. A cycling exercise, inducing a temporary state of high arousal, reduced risk taking relative to control. The researchers concluded that relatively low arousal, operationalized as trait or state, is thus associated with higher risk taking.

Attention. One of the hallmark features of boredom is that it involves not fully deployed attention systems (Eastwood et al., 2012; Van Tilburg & Igou, 2017a). For example, Hunter and Eastwood (2016) found that people highly prone to boredom performed worse on a sustained attention to response task (SART; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997); these participants, relative to their less boredom prone counterparts, more often committed commission errors. Consistently, neuroimaging of bored people (vs. control) revealed comparative deactivation of the default mode network—brain regions that are activated when people are not engaging with an activity or task, which may signal lack of exercising executive control (Danckert & Merrifield, 2016). Specifically, they found that boring tasks resulted in negatively correlated activity in the anterior insular, whereas an interesting task resulted in positively correlated activity instead.

How might such a lack of attention cause risk-taking? Presumably, the failure to fully deploy attention systems limits people's appreciation of the complexity of the decision at hand (e.g., probabilities, differences in outcome), resulting in more arbitrary decisions. Importantly, in decision-making tasks that feature only positive outcomes (i.e., gain frame) people normally act risk-averse: they disproportionally favor safe options over risky options if the expected values of these options are identical (Tversky & Kahneman, 1991). Given that people generally gravitate towards safe (vs. risky) choices in the domain of gains, those who make more arbitrary decisions will appear relatively risk-seeking. That is, while the proportion of risky choices is normally lower than the proportion of safe choices in the domain of gains, a more random strategy will cause these proportions to become equivalent (up to a 50/50 split for entirely random decision-making). Therefore, the failure to fully deploy attention that characterizes boredom qualifies as a potential cause of risky-decision making through the making of more arbitrary decisions.

Meaning. Boredom is closely related to a lack of perceived meaning. On the one hand, those who report a lack of meaning in life are more prone to boredom (Fahlman, Mercer, Gaskovski, Eastwood, & Eastwood, 2009; Coughlan et al., 2017), and sources of perceived meaning in life prevent boredom (e.g., religiosity; Van Tilburg, Igou, Maher, Moynihan, & Martin, 2019). Furthermore, boring situations (Chan et al., 2018) and the state of boredom are characterized by a perceived lack of purpose and meaning (Van Tilburg & Igou, 2012, 2017a). Importantly, this lack of meaning that boredom signals triggers a search for alternative behaviors that offer a sense of purpose.

On the other hand, Moynihan and colleagues (2017) propose that in the absence of more meaningful alternative behaviors, boredom causes people to distract from this acute meaningless state by seeking out distractors, typically in the form of behaviors that tend to be coincide with impulsive actions (e.g., hedonic food consumption, Moynihan et al., 2015). For example, these authors found that state boredom correlated with impulsivity-related behaviors such as self-reported aggression, alcohol consumption, and, indeed, risk-taking (Study 1a). Furthermore, this association could in part be attributed to the meaninglessness associated with state boredom. A follow-up study (Study 1b) found similarly that state boredom was associated with a reduced willingness to wait for a delayed reward, statistically mediated by meaninglessness. Experimental boredom inductions in further studies confirmed the causal link between boredom and impulsiveness.

Could it be that the lack of meaning or search for it help to understand the proposed link between boredom and risk-taking? One conceptualization of meaning relevant to boredom emphasizes that people’s perceptions of the meaningfulness (or lack thereof) of their behavior is grounded in the interaction between the instrumentality of that behavior and the value of the goal that the behavior serves (Van Tilburg & Igou, 2012). Specifically, people judge behavior to be meaningful if it is helpful (highly instrumental) in the pursuit of an important (high value) goal. When a behavior is perceived as lacking in either or both instrumentality and goal value then people evaluate it as relatively meaningless. Importantly, the search for meaning increases people's tendency to distinguish more and less useful behaviors (Van Tilburg & Igou, 2018, Study 1). In a decision-making context this might mean that boredom, featuring a lack of and desire for meaning, increases people's sensitivities to the instrumentality of a choice (i.e., probability of success) and its value (i.e., prospective gain). While we do not know if this process will cause more or less risk-taking, it does offer a speculative link between boredom and decision-making behavior. Indeed, Barbalet (1999) suggested that one of the reasons why boredom causes gambling behavior might be that this activity allows people to obtain a sense of meaning. Accordingly, we also looked at meaning in the current research, albeit rather speculatively.

Self-control. Self-control refers to people's ability to delay a gratification, control their impulses, or modulate emotions (Tangney, Boone, & Baumeister, 2018). People high in self-control are better able to resist short-term temptations (e.g., a piece of chocolate) in favor of long-term goals (e.g., reaching one's diet goal). Self-control is important: studies demonstrate that high self-control predicts positive life outcomes, such as having a healthy or happy life (e.g., Moffitt et al., 2011). In decision-making and gambling context, lacking self-control is associated with impulsive behavior (De Ridder & Lensvelt-Mulders, 2018; Nigg, 2017), such as high-risk, high-outcome choices (Pfundmair, Lermer, & Frey, 2017). Consistently, an EEG study by Schmidt, Holroyd, Debener, and Hewig (2017) showed that, among people who are impulsive and lack self-control, the difference in neurological reward signals for immediate and delayed options is exaggerated, favoring more strongly immediate but small rewards over delayed larger ones. Furthermore, Schmidt and colleagues (Schmidt, Kanis, Holroyd, Miltner, & Hewig, 2018) found that people with lower (relative to higher) anxiety made more risky choices. This effect seemed attributable to the comparatively high level of cognitive control that those high in anxiety exhibited, suggesting that self-control can indeed prevent risk-taking.

Impulsiveness is often considered, within decision-making, as the tendency to discount delayed (relative to immediate) rewards (e.g., Jimura, Chusak, & Braver, 2013). Namely, high impulsiveness manifests as tendency to yield to temptation. It is a boredom correlate both at state and trait level (Gerritsen, Toplak, Sciaraffa, & Eastwood, 2014;

Moynihan et al., 2017) and in that context has been linked to various arguably risky behaviors, including aggression (Dahlen et al., 2004), unsafe driving (Dahlen, Martin, Ragan, Kuhlman, 2005), and hedonic consumption (Moynihan et al., 2015). While high self-control tends to coexist with low impulsiveness (Baumeister, 2002), self-control spans a wider range of phenomena than resisting temptation alone (e.g., persistence, affect regulation, thought suppression). Indeed, someone who is more or less consistently high in self-control may nonetheless be found to act impulsively in a specific decision-making context. While those who possess high self-control may *generally* be disinclined to behave riskily in decision-making tasks relative to their low self-control counterparts, boring activities may limit this association between self-control and risky behavior.

The Present Research

Boredom's association with risk-taking has frequently been postulated but rarely been tested; evidence for an association is rather indirect, such as inferred from boredom's association with impulsiveness (Moynihan et al., 2017) and aggressive tendencies (Dahlen et al., 2004), or in relation to highly contextualized behaviors such as pathological gambling (Blaszczynski et al., 1990), and drug abuse (Kaestner, Rosen, & Appel, 1977). We therefore studied the association between boredom and risk-taking more closely. Specifically, we investigated this link across risk-taking domains (Study 1), examined state experiences of boredom and actual decision-making behavior (Study 2&3), and explored potential mechanisms that associate boredom to risk-taking (Study 3).

Study 1: Individual Differences in Boredom and General Risk-Taking

We first examined the hypothesized association between boredom and risk-taking. In keeping with much prior research on boredom, we tested this link at the level of individual differences in boredom and risk-taking. We predicted that higher levels of boredom proneness come with higher risk-taking.

Method

Participants and design. The study adopted a correlational design. We recruited a sample size of N=180, which granted a power of $(1–\beta)$=.90, for detecting effects sizes of $|r|$=.28 (α =.05, two-tailed; G*power; Faul, Erdfelder, Lang, & Buchner, 2007). Participants were USA residents (96 women, 84 men; M_{age} =34.91, SD_{age}=11.98), recruited through MTurk (www.mturk.com). No participants were excluded. The study received approval by the relevant research ethics committee (REC) of King's College London.

Materials and procedure. Participants gave informed consent and then completed the revised domain-specific risk-taking scale (DOSPERT; Blais & Weber, 2006). This 30-item self-report scale measures risk-taking tendencies using seven-point scale (1=*extremely unlikely*, 7=*extremely likely*) across five domains: financial risk (α=.77), ethical risk (α=.86), health/safety risk (α=.73), recreational risk (α=.84) and social risk (α=.76). The scale also provides an overall score across all items (α=.90). Afterwards, participants worked on the short boredom proneness scale (Struk, Carriere, Chenye, & Danckert, 2017; 1=*strongly agree*, 7=*strongly disagree*; α=.90). This scale was recently developed to replace the original and popular boredom proneness scale (Farmer & Sundberg, 1986), which suffered from issues regarding validity and factor structure (Struk et al., 2017; Vodanovich, 2003). The short boredom proneness scale has a clear uni-factorial solution, behaves well in item-response analysis, and tends to have high internal consistency (α=.88). The scale possesses good construct validity; it correlates appropriately with measures such as the aggression questionnaire and DASS subscales. This new measure is regularly used in boredom research since its conception (e.g., Lee & Zelman, 2019). We measured individual differences in boredom after the risk-taking scale to reduce demand effects. Afterwards, participants reported demographics, were debriefed, and were rewarded.

Results and Discussion

Boredom proneness correlated positively with risk-taking across domains, r=.318, p<.001. For the individual domains, boredom correlated with financial risk-taking, r=.280, p<.001, ethical risk-taking, r=.499, p<.001, health/safety risk-taking, r=.331, p<.001, and recreational risk-taking, r=.153, p<.040; boredom proneness did not correlate significantly with social risk-taking, r=-.067, p=.369. Overall, findings suggest that boredom is reliably associated with self-reported risky behavioral tendencies. Specifically, people who are prone to boredom report a greater willingness to engage in risky activities. It was only on one of four subscales of the risk measure, namely social risk-taking, where this pattern did not emerge. Perhaps social risk-taking is influenced by additional variables in the social context, thus diluting the impact of boredom proneness. Moving on from boredom proneness as a predictor of risk taking, in Study 2 we examined state boredom as the predictor of risky decision-making behavior. Specifically, we examined the link between state boredom and gambling.

Study 2: State Boredom and Risk-Taking in Gambling

After finding evidence in Study 1 that boredom proneness correlates with risk-taking, we tested in Study 2 if state boredom related to risk-taking. We examined this in context of a series of monetary gambles where we offered participants the choice between a comparatively safe and risky option. The design of the study built on the notion that a repetitive task increases boredom (e.g., Hunter & Eastwood, 2016; Van Tilburg & Igou, 2011). Accordingly, we predicted that risk-taking could be attributed to state boredom that was associated with a repetitive task.

Method

Participants and design. The study followed a within-subjects design (decision round: 1 through 24). We aimed for a sample size of at least N=100. Our repeated-measurement design would likely result in correlations between observations within subjects, with a theoretical range from $|r|=0$ to $|r|=1$. Specifically, while each participant would contribute 24 measurements of risk-taking, it was likely that these responses were not entirely independent (e.g., a result of personal risk preferences). At one (unlikely) extreme, participants' choices for safe or risky options could be consistent across all 24 choices (i.e., all safe or all risky), giving us effectively only a single independent observation. At the other (unlikely) extreme, participants' choice of one safe or risky option could be entirely independent of their other choices (i.e., the 24 choices that the participant makes are unrelated to each other), resulting in 24 independent observations. Using these extreme values as benchmarks, our sample size would grant a power of, $(1–\beta)=.90$, for detecting effects sizes in the range of $|r|=.07$ to $|r|=.32$ ($\alpha=.05$, two-tailed; G*power; Faul et al., 2007). A total of 108 USA residents participated online (55 women, 51 men, 2 undeclared; $M_{age}=35.96$, $SD_{age}=12.04$), recruited through MTurk (www.mturk.com). No participants were excluded, but small deviations from this sample size resulted from individual participants who skipped a question. The study received approval by the relevant REC of King's College London.

Materials and procedure. Participants gave informed consent and reported demographics. Then, they worked on the repetitive gambling task, which included 24 rounds. Participants made the choice between a risky and safe option for hypothetical money. The safe options featured integer outcomes from $1 through $12 that would be awarded with certainty (100%); the accompanying risky option would always offer double the outcome value (i.e., $2 through $24) at half the chance (50%). Thus, the expected values of the safe and risky options were equivalent. This resulted in 12 decision pairs, resulting in 24 pairs by varying on which side of the screen the options were presented (left: safe & right: risky vs left: risk & right: safe). The order of these 24 tasks was randomized. Each of the 24 decision-tasks was accompanied by a short measure of boredom ("How bored do you feel right now?"; 1=*not at all*, 7=*very much*). Afterwards, participants were debriefed and rewarded.

Results and Discussion

We tested the association between boredom and risk-taking with a binary logistic random-intercept multilevel analysis on participants' choices (risky, safe). Random intercepts were assigned to participants, and boredom at time of the decision was included as fixed-effect predictor. Boredom was significantly related to risk-taking, B=0.086, SE=0.030, t(2562)=2.840, p=.005, 95% CI [0.026, 0.145]; the more participants felt bored, the more likely they were to choose a risky (vs. safe) option, with the odds for a risky choice increasing by factor, exp(B)=1.09, for each increase of one in boredom. This finding is consistent with our hypothesis and extends the findings from Study 1 by showing that the association between boredom and risk-taking indeed occurs at the level of state boredom and in-the-moment decision behavior.

Study 3: Further Examinations and Generalizability

Study 1 and 2 indicate that boredom is associated with risk-taking. In Study 3, we sought to replicate and extend these finding. Firstly, we explored which psychological variables might explain or qualify the association between boredom and risk-taking. Perhaps, as Barbalet (1999) proposed for the context of gambling behavior, risky behavior exhibited by bored people may result from the lack of perceived meaning that is characteristic of boredom (Van Tilburg & Igou, 2012, 2017a). Another possibility is that the lack of excitement associated with boredom (Blaszczynski et al., 1990) causes people to seek thrills in risky choices. In addition, failure to fully deploy attention systems (Eastwood et al., 2012) may result in a failure to examine decision options. Importantly, people normally prefer a safe over risky option when considering options of equivalent positive expected value (Kahneman & Tversky, 1979). Failure to attend should therefore result in more equal selection of safe and risky options, effectively causing an increase in risk-taking relative to the default preference for safe options. To examine the roles of lack of meaning, excitement, and attention as boredom-constituents that potentially explain boredom's association with risk-taking, we measured these properties alongside state boredom and examined if they could account for the association that boredom was predicted to have with risk-taking. Besides these three boredom constituents, we furthermore tested if and how the (presumably negative) association between state boredom and risk-taking varied across levels of dispositional self-control. We tested this possible role of self-control with boredom by examining the statistical interaction between these variables. For example, the association between boredom and risk-taking might be different for those low versus high in dispositional self-control.

In addition, we tested if the association between boredom and risk taking held after controlling for individual differences in variables theoretically related to state boredom and/or risk-taking behavior, including anxiety, stress, depression, and regulatory focus (Higgins, 1998). If so, then this would speak to the relevance of boredom in risky behavior above and beyond individual differences in these variables.

As another test of the generality of our findings, we examined if boredom's association with risk-taking was more or less prominent in exciting versus comparatively dull environments. This extension has important practical relevance. For example, problem gambling, a correlate of trait boredom (Blaszczynski et al., 1990; Mercer & Eastwood, 2010), involves interacting with rich environmental stimuli (e.g., colorful displays, spinning wheels and animation). To understand if experiences of boredom can cause such behavior it is important to test if the association between boredom and risk-taking in the relatively dull decision-making context of Study 2 generalizes to richer contexts.

Method

Participants and design. The study adopted a mixed-design. Participants completed 64 decision-tasks that required a choice between a comparatively safe and risky option. The corresponding expected values were matched for each pair of choices. All participants worked on two 'blocks' of 32 decision-tasks each. Between subjects, the 'block' comprising of the first 32 of these decision-tasks was randomly set in a dull or comparatively exciting environment. Also, the block comprising of the second group of 32 decision-tasks was randomly set in a dull or comparatively exciting environment (determined independently of the first block), which would result in 'dull-dull', 'dull-rich', 'rich-rich', or 'rich-dull' environment combinations.

We aimed for a minimum sample size of N=200. As in Study 2, our design would likely result in correlations between the measurements nested within participants, with a theoretical range from $|r|$=0 to $|r|$=1. Using these extreme values as benchmarks, our sample size would grant a power of, (1–β)=.90, for detecting effects sizes in the range of $|r|$=.03 to $|r|$=.23 (α=.05, two-tailed; G*power; Faul et al., 2007). Participants were 248 USA residents, recruited through MTurk (www.mturk.com). We oversampled by 48 participants as a precaution for participant drop-out. We excluded 19 participants who quit the online study before the decision-making task, resulting in a final sample of 229 participants (122 women, 104 men, 2 non-binary, 1 undeclared; M_{age}=38.07, SD_{age}=14.01). Participants had a chance to win their decision-task earnings based on a random draw. The study received approval by the relevant REC of King's College London.

Materials and Procedure

Participants gave informed consent and reported demographics, followed by a number of self-report measures: (a) (trait) self-control (Tangney, Baumeister, & Boone, 2004; 10 items; 1=*not at all like me*, 5=*very much like me*; α=.84); (b) promotion and prevention focus (Higgins et al., 2001; 11 items; 1=*never or seldom*, 5=*very often*; $\alpha_{promotion}$=.68,

$\alpha_{prevention}$=.57); (c) anxiety, stress, and (subclinical) depression (Crawford & Henry, 2003; 0=*did not apply to me at all*, 3=*applied to me very much or most of the time*; α_{stress}=.93, $\alpha_{anxiety}$=.90, $\alpha_{depression}$=.95); and (d) boredom proneness (Struk et al., 2017; α=.92).

Participants were then given instructions to make decisions between two options which were represented by two spinning wheels accompanied by corresponding payoffs and their likelihoods of winning. Underneath these instructions we presented two spinning wheels drawn from the dull environment version of the task (Figure 1). We told participants that they would win the amount indicated above the rotating wheel if the wheel stopped with the arrow pointing to a black segment; a white segment would yield no earnings. We then informed participants that they might also encounter colored versions of the task with green segments representing a win and red segments representing a loss, accompanied by two spinning wheels drawn from the exciting environment task (Figure 2). We further informed them that we would hold a random draw with one participant receiving their earnings in full.

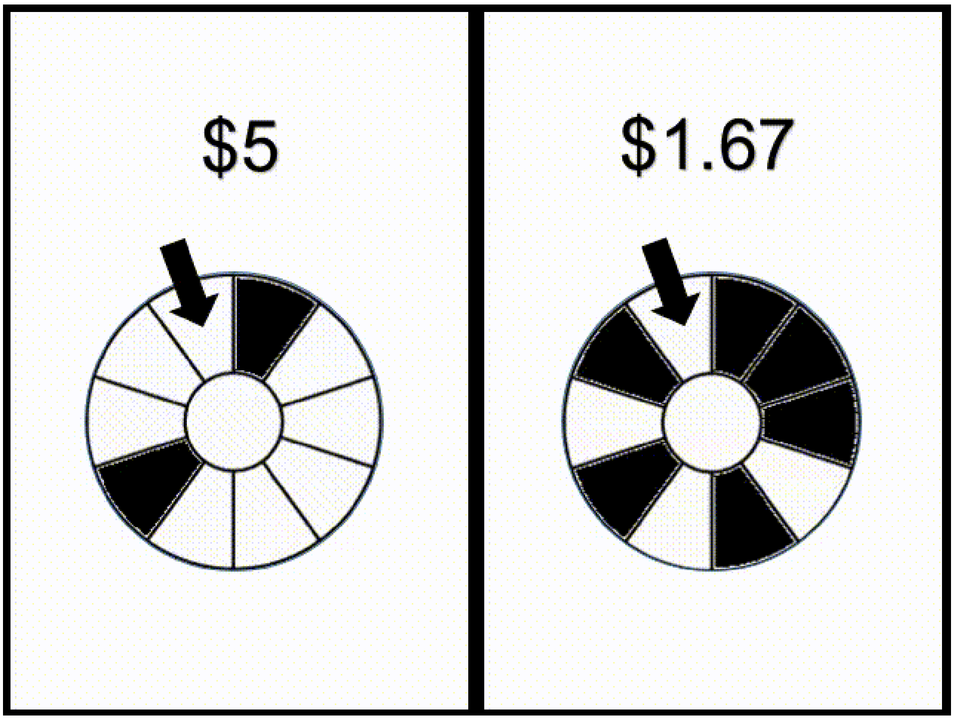

Figure 1. Example of decision task from dull environment

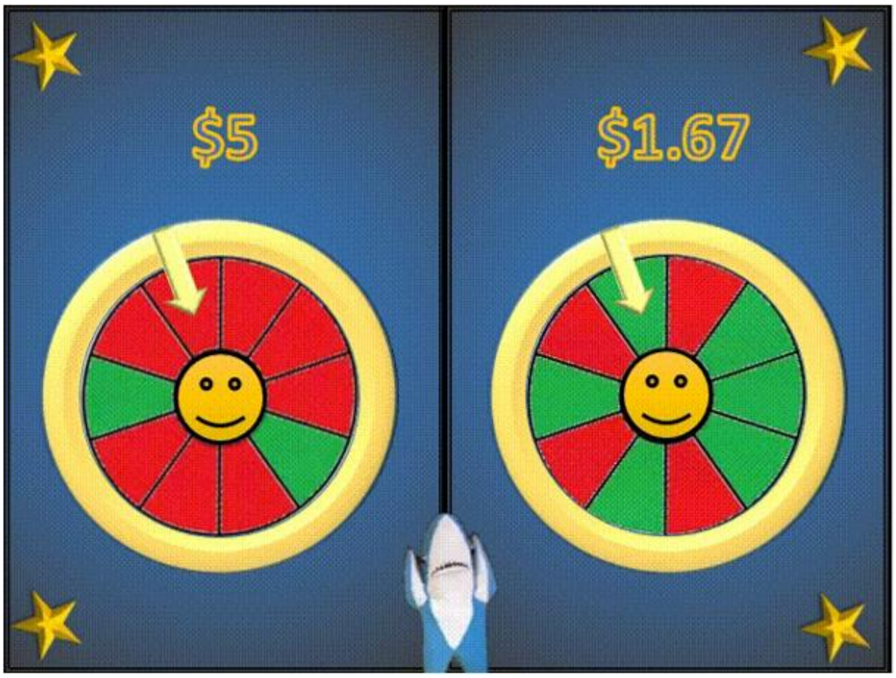

Figure 2. Example decision task from exciting environment

Participants then completed 64 decision tasks, separated in two blocks of 32 tasks. We created these as follows: Each decision-task featured two spinning wheels. Each spinning wheel had 10 segments, of which 2, 4, 6, or 8 segments resulted in a win. Furthermore, we assigned outcomes to each wheel such that the probability and outcome value produced one of four expected values: $0.50, $1, $2, or $4; this resulted in a total combination of 16 different wheels, 4 for each expected value. For example, the four wheels corresponding to an expected value of $4 where: (a) 2/10 winning segments worth $20; (b) 4/10 winning segments worth $10; (c) 6/10 winning segments worth $6.67; and (d) 8/10 winning segments worth $5. Pairs were created of these 16 wheels that had matching expected values. For example, the ‘2/10 winning segments worth $20’ was paired with ‘4/10 winning segments worth $10’, ‘6/10 winning segments worth $6.67’ and with ‘8/10 winning segments worth $5’, and itself (‘2/10 winning segments worth $20’). Thus, each wheel was paired with four others, resulting in 64 pairs. Of the resultant decision tasks, 24 featured a riskier wheel on the left (vs. right) side, and 24 featured a riskier wheel on the right (vs. left) side; the remaining

16 decision tasks featured wheels that were equally risky (e.g., both 4/10 winning segments worth $10).[1]

We distributed the 64 decision tasks among two sets (Table 1 & 2). At random for each participant, one of these sets featured as first block of 32 decisions and the other set featured in the second block of 32 decisions. Also, the order of the specific decision-tasks within each block was randomized.

At random, the first block was either presented using the dull format illustrated in Figure 1 or the comparatively exciting format in Figure 2. After participants selected a wheel (left vs. right) we showed them either “You won!” or “You lost…”, determined according to the chance level associated with the selected wheel. These outcome messages appeared in a simple black and white box (dull environment) or as pulsating text in a colorful box with bright, falling stars in the background (exciting environment). After completing the 32 decision tasks of the first block, participants proceeded with the remaining 32 decision tasks of the second block. At random, this second block was either presented in dull environment or exciting environment. A total of 52 participants completed only decisions embedded in a dull environment, and 53 participants completed only decisions embedded in exciting environments; 55 and 56 participants faced a dull and then exciting versus exciting and then dull environment, respectively.

Importantly, participants indicated how bored, excited, meaningful, and attentive they felt (“To what extent do you feel bored [excited, meaningful, attentive]?”; 1=*not at all*, 7=*very much*) before the first block, and before the second block. Different from Study 2, we thus measured boredom twice rather than for every decision-task. Afterwards, participants were debriefed, thanked, and rewarded.

Results and Discussion

Boredom and risk-taking. We tested the association between state boredom and risk-taking with a binary logistic random-intercept multilevel analysis on participants’

[1] These 16 decision tasks allowed us to identify participants who selected exclusively the left or right-sided option in these tasks, which we thought might happen because of boredom. Excluding participants who selected exclusively the left or right option in these tasks did not substantially alter the results and we therefore retained these individuals.

choices (risky, safe). Random intercepts were assigned to participants and boredom was included as fixed-effect predictor. In this model, boredom was represented by participants' most recent reported level of boredom for a given decision task (boredom scores reported prior to the first block or prior to the second block).[2] Results indicated the predicted significant association between boredom and risk-taking, B=0.071, SE=0.022, t(10113)=3.221, p=.001, 95% CI [0.028, 0.114]; participants who felt more bored made riskier decisions with the odds for a risky choice increasing by factor exp(B)=1.07, for each increase of one in boredom.

We tested the generality of this effect next. First, we examined if the positive association between state boredom and risk-taking persisted after controlling for in regulatory focus (promotion & prevention focus), anxiety, stress, (non-clinical) depression, and boredom proneness. After adding these six variables as predictors the association between state boredom and risk-taking was still significantly positive, B=0.071, SE=0.022, t(10107)=3.1871, p=.001, 95% CI [0.027, 0.114], exp(B)=1.07. Also, individual differences in anxiety had a positive association with risk-taking, B=1.057, SE=0.401, t(10107)=2.637, p=.008, 95% CI [0.271, 1.843], exp(B)=2.88, and depression marginally predicted a reduction in risk-taking, B=-0.734, SE=0.392, t(10107)=1.869, p=.062, 95% CI [-1.503, 0.036], exp(B)=1.48; the other predictors were not significant (ps≥.120).

Second, we tested if the association between boredom and risk-taking differed across the exciting and comparatively dull environments. We again conducted a binary logistic random-intercept multilevel analysis on participants' choices with random intercepts for participants. Boredom, the decision environment, and the boredom × decision environment interaction were included as fixed-effect predictors. In this model, environment was effect-coded (*dull*=-1, *exciting*=1). Results again produced a significant positive association between boredom and risk-taking, B=0.095, SE=0.022, t(10111)=4.241, p<.001, 95% CI [0.051; 0.139], exp(B)=1.10. We also found a significant effect of environment, B=0.321,

[2] We excluded from this analysis, and all analyses to follow, decisions the data from the 16 tasks that featured two identical choices (e.g., both 4/10 winning segments worth $10) and hence did not distinguish risky and safe choices.

SE=0.064, *t*(10111)=4.996, *p*<.001, 95% CI [0.195; 0.447], exp(*B*)=1.38, indicating that the exciting environment caused more risk-taking. The boredom × environment interaction was not significant, *B*=-0.012, *SE*=0.020, *t*(10111)=0.569, *p*=.569, 95% CI [-0.052; 0.028], exp(*B*)=0.99, (Figure 3). Thus, the positive association between boredom and risk-taking seemed generalizable across the dull and exciting environment.

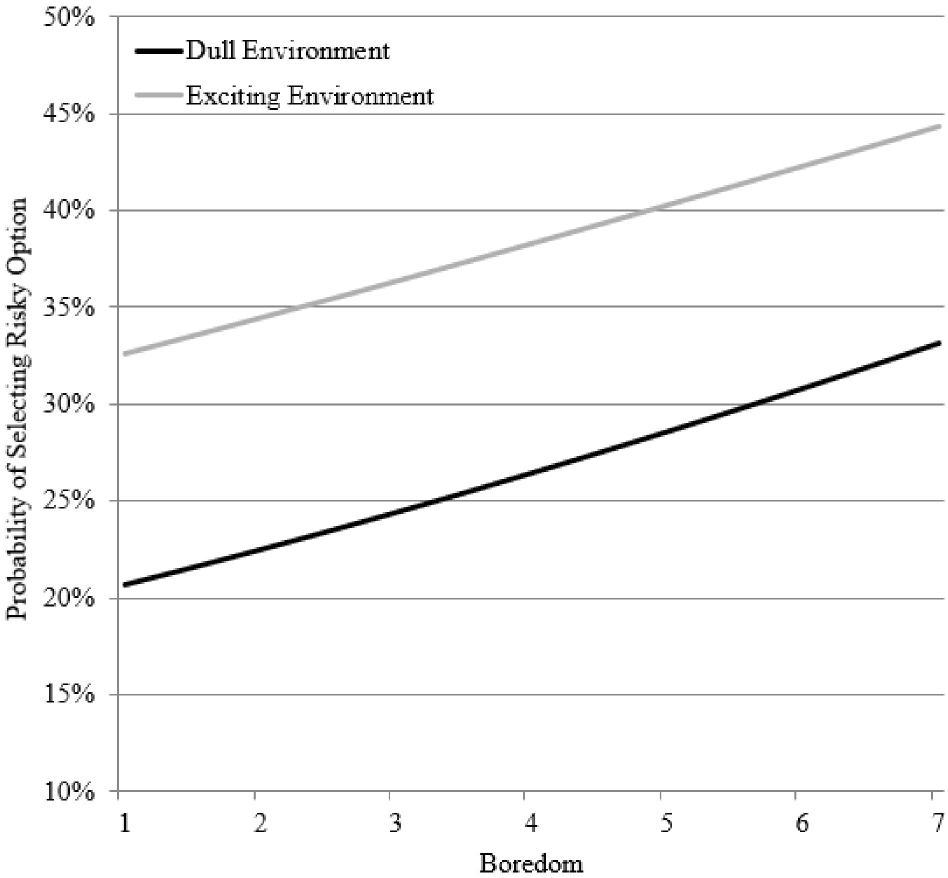

Figure 3. Predicted probability of selecting risky option by boredom and environment

We next examined what psychological variable might explain or qualify the relationship between boredom to risk-taking. In particular, we suggested that one or more of boredom's constituents (lack of excitement, lack of attention, lack or meaning) might be responsible for its association with risk-taking. Besides these three, research suggests that boredom may erode self-control, resulting in risky behavior. We tested these possibilities with two binary logistic random-intercept multilevel analyses on participants' choices with random intercepts for participants.

First, we included—in addition to boredom—reported excitement, meaning, and attention as predictors of risk-taking. As we did for boredom, we represented these variables by participants' most recent reported levels. The results reproduced the significant positive association between boredom and risk-taking from previous analysis, *B*=0.057, *SE*=0.027, *t*(10086)=2.14, *p*=.032, 95% CI [0.005; 0.110], exp(*B*)=1.06; excitement, meaning, and attention were not significantly associated with risk-taking (*p*s≥.225).

Second, we examined the role of self-control. Boredom, individual differences in self-control, and their interaction were included as predictors of risk-taking. The association between boredom and risk-taking was rendered non-significant, *B*=-0.142, *SE*=0.085, *t*(10111)=1.678, *p*=.093, 95% CI [-0.308; 0.024], exp(*B*)=0.87. Higher self-control significantly predicted lower risk-taking, *B*=-0.450, *SE*=0.212, *t*(10111)=2.124, *p*=.034, 95% CI [-0.865; -0.035], exp(*B*)=0.64. Most interestingly, the boredom × self-control interaction was significant, *B*=0.090, *SE*=0.034, *t*(10111)=2.630, *p*=.009, 95% CI [0.023; 0.157], exp(*B*)=1.09, (Figure 4). While high self-control was associated with less risk-taking under low levels of boredom, high boredom mitigated this negative association, involving higher levels of risk-taking even among those with high self-control.

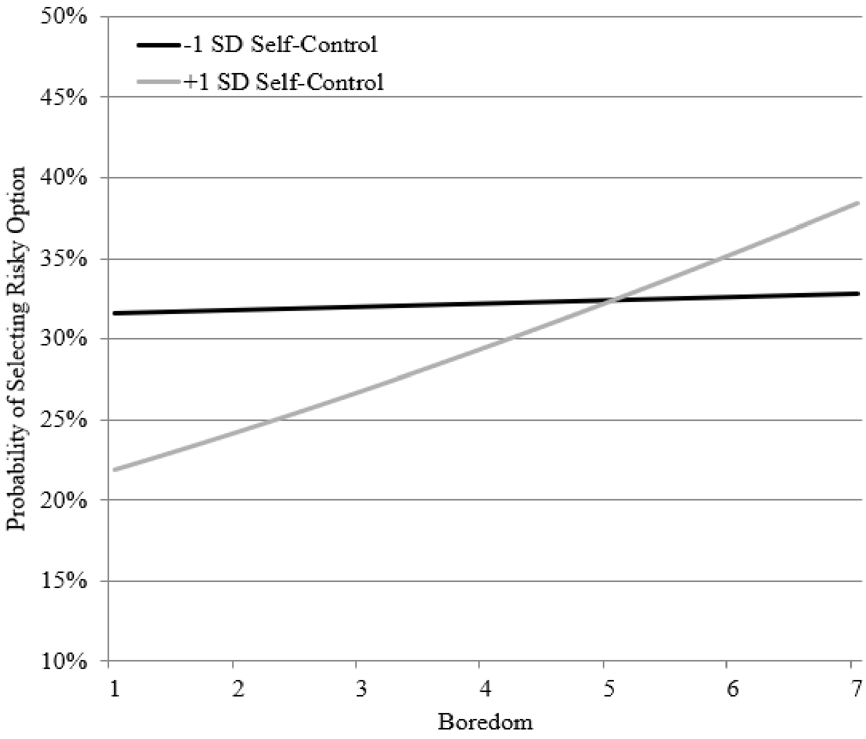

Figure 4. Predicted probability of selecting risky option by boredom and self-control

We tested the robustness of this interaction by adding regulatory focus (promotion & prevention focus), anxiety, stress, (non-clinical) depression, and boredom proneness as covariates. Doing so did not substantially alter the results: The association between boredom and risk-taking remained non-significant, B=-0.135, SE=0.085, t(10105)=1.601, p=.093, 95% CI [-0.301; 0.030], exp(B)=0.87, higher self-control still significantly predicted lower risk-taking, B=-0.648, SE=0.267, t(10105)=2.433, p=.015, 95% CI [-1.171; -0.126], exp(B)=0.52, and the boredom × self-control interaction remained significant, B=0.087, SE=0.034, t(10105)=2.545, p=.011, 95% CI [0.020; 0.154], exp(B)=1.09. Of the additional predictors, anxiety had a positive association with risk-taking, B=1.094, SE=0.403, t(10105)=2.718, p=.007, 95%CI = [0.305, 1.883], exp(B)=1.50, and depression marginally predicted lower risk-taking, B=-0.710, SE=0.392, t(10105)=1.810, p=.070, 95% CI [-1.478, 0.059], exp(B)=0.49; the other predictors were not significant (ps≥.109).

We expanded the above analysis by including also the main and interaction effects for the environment (effects coded). Specifically, risk-taking regressed on (a) boredom, (b) self-control, (c) environment, (d) the boredom × self-control interaction, (e) the boredom × environment interaction, (f) the self-control × environment interaction, and (g) the boredom × self-control × environment interaction. Participants were assigned a random intercept. This analysis produced similar results to the one without environment and its interactions: the association between boredom and risk-taking remained non-significant, B=-0.071, SE=0.086, t(10107)=0.818, p=.413, 95% CI [-0.240; 0.099], exp(B)=0.93, higher self-control significantly predicted lower risk-taking, B=-0.431, SE=0.209, t(10107)=2.024, p=.039, 95% CI [-0.840; -0.022], exp(B)=0.65, and also the boredom × self-control interaction was significant, B=0.070, SE=0.035, t(10107)=2.024, p=.043, 95% CI [0.002; 0.138], exp(B)=1.07. The effect of environment or its interactions were not significant (ps≥.104). Thus, boredom plausibly increases risk-taking by undoing the otherwise negative association between self-control and risk-taking, and this seemed generalizable across dull and exciting environment and persisted after controlling for a range of individual differences.

General Discussion

We directly investigated the relationship between boredom and risky decision-making. In Study 1, we investigated the correlational link between boredom proneness and self-reported risky behavioral tendencies across different areas. Results indicated that boredom prone individuals were more likely to report participating in risky activities in financial, ethical, health, and recreational domains, which is congruent with the previous literature suggestive of such links (e.g., Blaszczynski et al., 1990; Dahlen et al., 2005; Gupta et al., 2006). We tested in Study 2 if this association generalizes to state boredom experiences. Specifically, we tested and found that boredom—elicited in a repetitive decision-making task—corresponded to an increasing preference for risky over safe options. Subsequently, in Study 3 we investigated the possible underlying mechanisms that might link boredom and risk-taking. In a paradigm using a series of choices between risky and comparatively safe gambles, we replicated the positive association between state boredom and risky decision-making. Furthermore, we found this association with and without controlling for a range of individual differences (regulatory focus, anxiety, stress, non-clinical depression) and across two contextual variations (a dull and comparatively lively decision-making environment). Exploratory analyses did not suggest that a lack of excitement, attention, or meaning explained this association between boredom and risk-taking, even though previous research demonstrated that low arousal may be linked to risk taking behavior (e.g., Schmidt et al., 2013). However, we found that the typical negative association between self-control and risk-taking interacted with state boredom: as boredom increased, self-control's negative association with risk-taking was reduced, suggesting that boredom might involve risk-taking by virtue of undoing people's ability to exercise self-control.

The finding that self-control might interact with state boredom in its relationship with risk-taking is interesting and potentially impactful. Tangney and colleagues (2004) stated that "people are happiest and healthiest when there is an optimal fit between self and environment, and this fit can be substantially improved by altering the self to fit the world" (p. 272). Nonetheless, when this harmony between self and environment is broken, individuals may try to alter environment (primary control) or themselves (secondary control) to re-gain the lost control (Rothbaum, Weisz, & Snyder, 1982). Thus, from this point of view, the experienced boredom may damage this harmony between the self and the environment, and it may cause the loss of self-control, resulting in more risky decision-making.

While boredom research is relatively new, research in cognitive and experimental psychology has previously found that popular, but repetitive, tasks such as the sustained attention to response task (SART) and starry night task, can inadvertently cause boredom (Malkovsky, Merrifield, Goldberg, & Danckert, 2012; Danckert & Merrifield, 2016). Possibly, the cause for this is the combination of high repetition combined with what perhaps is, from the participant's perspective, a series of seemingly meaningless tasks, thus setting the stage for boredom (Van Tilburg & Igou, 2012). Several measures and tasks in decision-making and economic psychology employ highly repetitive tasks, such as temporal discounting measures (e.g., Green, Myerson, & McFadden, 1997), the Wason card selection task (e.g., Kirby, 1994), or the balloon analogue risk task (BART; Lejuez, Aklin, Zvolensky, & Pedulla, 2003). Quite possibly, increasing levels of boredom over the course of such tasks may cause increments in risk-taking. This impact may be relatively harmless if the task is similar across conditions, thus experimentally controlling for differences in task-elicited boredom. However, researchers should be cautious when examining behavior where accidental boredom may interact with other predictors, such as self-control. An example where task-related boredom may indeed alter experimental finding or decision-making paradigms is in the study of temporal discounting. For example, Smits, Stein, Johnson, Odum, and Madden (2013) found that an experiential measure of temporal discounting, using actual rather than the more traditional hypothetical rewards, was sensitive to individual differences in boredom proneness. Specifically, those higher (vs. lower) in boredom proneness were more likely to choose a small immediate over larger delayed reward when these delays were actually experienced rather than merely hypothetical. This influence of boredom is possibly desirable if researchers wish to use a temporal discounting measure sensitive to contextual influences (e.g., to understand the relation between temporal discounting and addiction), but possibly undesirably when such influences are to be avoided.

More broadly, our findings may underscore Loewenstein's (1999) concern that excessive repetition may in some cases hamper rather than promote study validity.

We found in Study 3 that both experienced boredom and the relatively exiting decision-making environment were associated with greater risk-taking. How might these seemingly contradictory findings be consolidated? Perhaps finding for the exciting environment represent the impact of win-concurrent sensory cues (e.g., celebratory starts and flashed on a 'win') that Cherkasova and colleagues recently documented (2018). Specifically, these researchers found in several experiments that introducing audio-visual cues to accompany reward in classic decision-making tasks, such as the Iowa gambling task, increased risk-taking by directly engaging attention and increasing reward anticipation. While this may appear contradictory to the idea that boredom increases risk-taking, we suspect that these processes may well go hand-in-hand. Boredom is generally associated with a desire for stimulation or arousal, and these stimuli may therefore appeal to those who are bored. We hasten to say that the associations between boredom and risk-taking on the one hand, and the environment and risk-taking on the other hand were independent; they did not interact. Our data thus suggests that the associations that risk-taking holds with boredom and the environment may therefore be complementary, producing the highest level of risk-taking when people feel bored and the gambling environment is relatively exiting. This interpretation seems consistent with the findings Mercer and Eastwood (2010) that the link between boredom and gambling cannot be entirely attributed to reward sensitivity.

Limitations and Future Directions

The research literature on boredom is relatively novel. Our contribution to the literature on boredom and risk-taking is important with regard to the relationship of state and trait boredom with risk-taking. However, the associated underlying processes that can explain this association and the causal effects of boredom on risk taking requires further examination. Our results suggest an important role for self-control in the link between boredom and risk-taking. Nonetheless, future research should verify this effect further and examine what role related constructs, such as impulsiveness and sensation seeking, play in the link between boredom and risk-taking. For example, Mercer-Lynn, Hunter, & Eastwood (2013) found that the positive association between trait boredom and self-reported gambling and alcohol problems disappeared after controlling for trait impulsiveness, suggesting that this construct plays a key role. Furthermore, these researchers found that trait measures of boredom give different correlations internalizing and externalizing problem behaviors depending on the specific type of trait boredom measure (boredom proneness vs boredom susceptibility). Furthermore, arousal, perceived meaningfulness, and attention processes did not explain the association between boredom and risky decision-making. It is possible that the relationship between boredom and risky decision is relatively independent from the usual process variables associated with boredom. Of course, the lack of an association between risk-taking and these variables does not dismiss the possibility that these variables are nonetheless involved. Perhaps alternative measurement that does not rely on self-report (e.g., eye-tracking; physiological arousal) might show associations beyond participants' own awareness of these factors.

In Study 3 we rewarded one randomly selected participant with their earnings. Schmidt and colleagues (Schmidt & Hewig, 2015; Schmidt et al., 2019) found that this can result in a reduction of 10% to 12% in risk-taking. As a result, the overall level of risk-taking in that particular study may be lower compared to a situation in which all participants were given their earnings. While this was a constant factor across participants, and may therefore not affect the associations that boredom and self-control had with risk-taking, some caution is warranted in generalizing these results to other reward configurations.

We argue that risk-taking increases due to boredom. Could it be, however, that it is the adversity of doing nothing that causes risk-taking rather than the subjective feeling of boredom in particular? While we did not explicitly distinguish between the two, it seems unlikely that the adversity of doing nothing is primarily responsible for the higher level of risk-taking. In all studies, tendencies to experience boredom (Study 1) and subjective experiences of boredom (Study 2 & 3) correlated with risk-taking. Moreover, Study 2 and 3 employed paradigms where boredom was induced while participants were required to continuously and actively make decisions.

The notion of ‘active’ versus ‘passive’ engagement is related to another potential distinction in boredom: whether boredom results from a lack of activity or from an activity that itself is boring. Our present research did not differentiate between ‘active’ boredom—feeling bored while actively performing a task—versus ‘inactive’ boredom—feeling bored in the absence of a task, such as when doing nothing. Most research on boredom has focused on the ‘active’ type, where boredom is induced with a range of tasks requiring active participation (e.g., transcribing references, repetitive cognitive tests, turning pegs; Van Tilburg et al., 2013; Danckert et al., 2016). Fewer studies examined ‘passive’ boredom, but the few that did seem to find similar generally responses. For example, Moynihan and colleagues (2015) found that the relatively passive boring task of watching an educational aquaculture video led to snacking behavior, as did an ‘active’ boredom task in which participants solved abstract puzzles. Danckert and colleagues (2016) found that both the ‘passive’ boredom task of watching two men hang laundry and a more ‘active’ but also boring sustained attention task resulted heightened activation of the default mode network relative to a control condition that increased interest. A striking examples and consequences of ‘passive’ boredom is present in the work by Wilson and colleagues (2014), who found that participants who sat down doing nothing were willing to self-administer electric shocks as means of stimulation. Clearly, research needs to further address if such relatively ‘active’ and ‘passive’ boring contexts result in qualitatively different responses, or that boredom’s impact across these contexts is similar, though perhaps not equivalent in intensity.

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Table 1: *Overview Decision Tasks (Set 1)*

Left Wheel		Right Wheel		
Winning Segments	Winning Amount	Winning Segments	Winning Amount	Expected Value
2	$2.50	2	$2.50	$0.50
6	$0.83	2	$2.50	$0.50
2	$2.50	4	$1.25	$0.50
6	$0.83	4	$1.25	$0.50
2	$2.50	6	$0.83	$0.50
6	$0.83	6	$0.83	$0.50
2	$2.50	8	$1.63	$0.50
6	$0.83	8	$1.63	$0.50
4	$2.50	2	$5.00	$1.00
8	$1.25	2	$5.00	$1.00
4	$2.50	4	$2.50	$1.00
8	$1.25	4	$2.50	$1.00
4	$2.50	6	$1.67	$1.00
8	$1.25	6	$1.67	$1.00
4	$2.50	8	$1.25	$1.00
8	$1.25	8	$1.25	$1.00
2	$10.00	2	$10.00	$2.00
6	$3.33	2	$10.00	$2.00
2	$10.00	4	$5.00	$2.00
6	$3.33	4	$5.00	$2.00
2	$10.00	6	$3.33	$2.00
6	$3.33	6	$3.33	$2.00
2	$10.00	8	$2.50	$2.00
6	$3.33	8	$2.50	$2.00

4	$10.00	2	$20.00	$4.00
8	$5.00	2	$20.00	$4.00
4	$10.00	4	$10.00	$4.00
8	$5.00	4	$10.00	$4.00
4	$10.00	6	$6.67	$4.00
8	$5.00	6	$6.67	$4.00
4	$10.00	8	$5.00	$4.00
8	$5.00	8	$5.00	$4.00

Table 2: *Overview Decision Tasks (Set 2)*

Left Wheel		Right Wheel		
Winning Segments	Winning Amount	Winning Segments	Winning Amount	Expected Value
4	$1.25	2	$2.50	$0.50
8	$0.63	2	$2.50	$0.50
4	$1.25	4	$1.25	$0.50
8	$0.63	4	$1.25	$0.50
4	$1.25	6	$0.83	$0.50
8	$0.63	6	$0.83	$0.50
2	$1.25	8	$1.63	$0.50
4	$0.63	8	$1.63	$0.50
2	$5.00	2	$5.00	$1.00
6	$1.67	2	$5.00	$1.00
2	$5.00	4	$2.50	$1.00
6	$1.67	4	$2.50	$1.00
2	$5.00	6	$1.67	$1.00
6	$1.67	6	$1.67	$1.00
2	$5.00	8	$1.25	$1.00
6	$1.67	8	$1.25	$1.00
4	$5.00	2	$10.00	$2.00
8	$2.50	2	$10.00	$2.00
4	$5.00	4	$5.00	$2.00
8	$2.50	4	$5.00	$2.00
4	$5.00	6	$3.33	$2.00
8	$2.50	6	$3.33	$2.00
4	$5.00	8	$2.50	$2.00
8	$2.50	8	$2.50	$2.00

2	$20.00	2	$20.00	$4.00
6	$6.67	2	$20.00	$4.00
2	$20.00	4	$10.00	$4.00
6	$6.67	4	$10.00	$4.00
2	$20.00	6	$6.67	$4.00
6	$6.67	6	$6.67	$4.00
2	$20.00	8	$5.00	$4.00
6	$6.67	8	$5.00	$4.00