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Research Article

When Time Flies: State and Trait Boredom, Time Perception, and Hedonic Task Appraisals

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Abstract

An abundance of empirical research has established that a robust, positive association exists between feelings of boredom and the illusion of temporal slowing. Although state and trait forms of boredom are distinct constructs, the way these variables interact with one another to impact time perception is unknown. To further explore the association between boredom and time perception, a modified replication of a study that examined the impact of discrepancies between expected and perceived time progression on hedonic appraisals was conducted. The paradigm was extended through the inclusion of validated measures of trait and recent state boredom. Seventy-two participants (N = 72, aged 18-52, M = 23.06, SD = 5.73) were led to believe that they would perform an intrinsically unengaging task for 5 (Time Drags), 10 (Real Time), or 15 minutes (Time Flies). Consistent with previous findings, participants in the Time Drags condition reported time as progressing significantly slower than participants in the other two conditions. Moreover, participants in the Time Drags condition rated the task as significantly more aversive than did participants in the Time Flies condition. This association remained significant even when controlling for levels of trait and recent state boredom. However, the Real Time and Time Flies conditions did not differ from one another in terms of task ratings or perceived time progression. Implications of these findings and directions for future research are discussed.

Keywords: Boredom; boredom proneness; time perception; timing; temporality; attributions.

Table of Contents

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The Irregularity of Time Perception

The awareness of time informs, structures, and dictates, much of daily life. For instance, we often think about the time spent commuting to a job, the hours expended once we have arrived at work, and the subjective feeling of the workweek dragging on but weekends flying by us. Clock time does not vary as a function of one's present situation, yet human beings are acutely aware of situational differences in the speed of time. This discontinuity between clock time and perceived time progression suggests that individuals use multiple mechanisms to judge the passage of time, and each can result in a different estimation of the same temporal interval (e.g., Droit-Volet & Weardon, 2016).

Consistent with this conjecture, previous work has demonstrated that the perception of time is irregular (Larson & Von Eye, 2006), and the subjective flow of time depends on several situational and contextual factors (Wittmann, 2015). Empirical findings have demonstrated that, at least in a subjective sense, time does "fly" when you are having fun (e.g., Sackett et al., 2010). A less explored, but related question pertains to the perception of time in relation to the experience of boredom. Does time really "drag" in boring situations? Are individuals who are particularly prone to boredom more likely to experience time as progressing at a slow pace? The available research (e.g., Burton, 1943; Danckert & Allman, 2005; Raffaeli et al., 2017; Watt, 1991; Zakay, 2014) suggests that this may be the case.

State Boredom and Boredom Proneness

Boredom may be described as both an affective state and as a personality characteristic (Todman, 2003). The subjective experience of boredom, or state boredom, can result from an uninteresting environment and is thought to be situation dependent. Consequently, once an individual is given the opportunity to leave or modify the environment, the feeling of boredom should be alleviated (Todman, 2003). A predominant view of boredom postulates that certain individuals are particularly vulnerable to the experience of boredom, a characteristic defined as boredom proneness, trait boredom (Farmer & Sundberg, 1986; Todman, 2007), or 'situation independent' boredom (Todman, 2003). Individuals who have a predisposition towards the experience of boredom may fail to effectively use covert coping mechanisms (such as daydreaming), which help to manage the monotony faced in everyday life (i.e., waiting in line at the grocery store; Todman, 2003).

In this way, state boredom may be conceptualized as a global, affective state, and boredom proneness as a trait, determined or explained by individual differences in personality. The experience of boredom results from an interaction between one's environment and their propensity to experience boredom (Todman, 2003). Thus, it is important to also consider the contributions of recent experiences of boredom, independent of trait boredom levels. While it can be expected that those who are boredom prone are more likely to report more frequent and intense experiences of boredom, the reverse is not necessarily true. Situational factors may make episodes of boredom unavoidable, even among those who are not particularly boredom prone. For this reason, it is important to consider both factors when examining individual differences in the experience of boredom.

Boredom and the Passage of Time

Previous studies have shown that emotional states such as fear and anger (Droit-Volet & Meck, 2007), and personality traits such as impulsiveness (Wittmann & Paulus, 2008) and trait-mindfulness (Weiner et al., 2016) impact the subjective flow of time. Notably, several variables related to the subjective perception of time are also related to boredom and boredom proneness. These include depression (Farmer & Sundberg, 1986; Goldberg et al., 2011; Thönes & Oberfield, 2015; Todman, 2013), impulsivity (Wittman & Paulus, 2008; Watt

& Vodanovich, 1992; Moynihan et al., 2017), and mindfulness (Koval & Todman, 2015; LePera, 2011).

Findings from a recent review show that both boredom proneness and state boredom are associated with the feeling that time has slowed down (Raffaeli et al., 2017), and both have been utilized in the study of slowed perceived temporal progression (e.g., Danckert & Allman, 2005; London & Monello, 1974; Raffaeli et al., 2017; Sucala et al., 2010). There is even evidence to suggest that the relationship is bidirectional, meaning that the feeling of slowed time can promote feelings of increased boredom (e.g., London & Monello, 1974). Somewhat surprisingly, however, there is no agreed-upon explanation for the existence of this association. As such, the mechanisms through which boredom is associated with time perception remain an open question.

In terms of explanations put forth for the boredom-temporal slowing association, some theorists have posited that metacognitive or self-perception-type mechanisms play a role in explaining how and why feelings of boredom might emerge from feelings of temporal slowing (e.g., London & Monello, 1974; Sackett et al., 2010; Troutwine & O'Neal, 1981; Watt, 1991) and vice versa (Sucala et al., 2010).

One theory purports that boredom can be described as a low level of non-temporal information (Zakay, 2014). This may be conceptualized as an uninteresting environment, or a predisposition to experience environments as monotonous. The suboptimal level of non-temporal input leaves a greater number of attentional resources available for the processing of temporal information. Moreover, because boredom is conceptualized as a negative emotional state, the individual turns their attention to the passage of time in anticipation of the end of the experience. The more attentional resources are allocated to the passing of time, the slower it seems to progress (Zakay, 2014).

Boredom and Mechanisms of Time Perception

- Passage of Time Judgments (PoTJ) and Interval Length Estimation Judgments (ILEJ)

The lack of consensus, in part, likely stems from the fact that the studies that have explored the boredom-temporal slowing association have varied greatly in terms of their theoretical assumptions and methodologies. The boredom-temporal slowing association appears to be contingent in large part on the type of subjective temporal experience that is being assessed. Almost all of the studies that have been able to demonstrate the expected association have employed what Wearden (2005) and other time researchers refer to as "Passage of Time Judgments" (PoTJ), which are judgments about the pace at which time seems to progress during a specific period. PoTJ are usually assessed using a Likert-type scale that varies from "very slow" to "very fast", and are prompted by questions such as "how quickly did time seem to flow while you were engaged with the task?" (e.g., Sackett et al., 2010; Sucala et al., 2010).

PoTJ are contrasted with Interval Length Estimation Judgments (ILEJ), which require participants to estimate the length of a temporal interval using conventional units of time, such as minutes or seconds (see Droit-Volet & Wearden, 2016; Wearden, 2005). Although there have been several studies that have used ILEJ to explore the relationship between temporal perception and boredom (e.g., Watt, 1991), only one (Danckert & Allman, 2005) has demonstrated that ILEJ and boredom levels are positively correlated. This is also consistent with the conclusion of Wearden (2005) and others who contend that ILEJ and PoTJ are separable and separate temporal experiences and are affected differently by various contextual factors.

- Retrospective and Prospective Time Judgments

Another important distinction is the difference between "prospective" and "retrospective" time judgments. Prospective time judgments require participants to be informed beforehand that they will be asked to estimate the amount of time that has elapsed during a given period (Block, 1990). Retrospective judgments also require participants to estimate the amount of time that has elapsed, but they are not informed beforehand that they will be required to do so (Block, 1990). Both ILEJ and PoTJ can be made retrospectively or prospectively. However, most studies that have employed PoTJ in the exploration of the boredom-temporal slowing illusion have used a retrospective paradigm.

ILEJ, when made retrospectively, are believed to be influenced by the amount of information or contextual changes encoded in memory during the interval (Block & Reed, 1978; Ornstein, 1969; Zakay, 2014). This conjecture is supported by the finding that more difficult or complex tasks (i.e., tasks that incur more information processing demands) are more likely to lead to longer interval estimates. Prospective ILEJ, on the other hand, are believed to be the product of a different process in which higher information processing demands (as in the case with a difficult task) limit the number of attentional resources that can be allocated to processing temporal information, thereby causing an underestimation of interval length (Block & Zakay, 1997). Zakay (1992, 2014) has also suggested that the relevance or salience of time in a particular context (e.g., being put on hold during a call to a helpline) can also influence prospective temporal judgments by privileging the processing of temporal information.

Empirical Research on Boredom and Time Perception

- Boredom's Associations with Perceived Time Progression

Some researchers have attempted to explore the association between boredom and time perception by comparing high and low boredom-prone individuals on task performance, without manipulating perceived time progression (e.g., Danckert & Allman, 2005; Watt, 1991). Watt (1991) was one of the first researchers to confirm in the same study that the boredom-temporal slowing association obtains when temporal progression is assessed using PoTJ but not when it is assessed using ILEJ. This study compared high trait boredom with low trait boredom participants on the same intrinsically uninteresting task (circling numbers). Compared to low boredom prone participants, high boredom prone individuals rated time as moving more slowly on a PoTJ measure. The two groups did not differ from one another when asked to make estimates of the elapsed duration (i.e., ILEJ). However, the study also left open the question of whether the trait boredom differences can promote the feelings of temporal slowing independently of the state boredom induced by the properties of the task and the study constraints.

Danckert and Allman (2005) also compared high and low boredom prone individuals and found no difference in the temporal allocation of attention on an attentional blink task. However, low boredom prone individuals were more likely to underestimate brief time intervals (2 to 60-second intervals) than high boredom prone individuals in a prospective, ILEJ task. Danckert and Allman (2005) speculate that the tendency of high boredom prone individuals to overestimate the passage of time increases the likelihood that they would also overestimate the amount of time spent on a task, thus causing them to discontinue a task sooner than low boredom prone individuals. However, this explanation still leaves open the question of whether a high level of trait boredom is independently predictive of perceived temporal slowing.

Although Danckert and Allman's (2005) findings appear to be at odds with Watt's (1991) results, it is worth noting that the experimental tasks employed in the two studies are quite different, making it difficult to compare the findings. In addition, Dankcert and Allman (2005) employed a prospective time judgment paradigm, whereas Watt (1991) appeared to utilize a retrospective paradigm. As these are types of timing judgments are thought to be affected by different processing mechanisms, the discrepant findings are not surprising.

- Boredom and the Experimental Manipulation of Time Progression

Other researchers have attempted to explain the association between temporal progression and hedonic appraisals of an experience by experimentally manipulating time progression (e.g., London & Monello, 1974; Sackett et al., 2010; Sucala et al., 2010). Notably, however, despite the evidence that boredom proneness does affect time progression to some degree, its role in the boredom-temporal slowing relationship has not been addressed in any of these studies.

London and Monello (1974) used a rigged clock to covertly manipulate the temporal constraints of a task to provide one of the first and most compelling demonstrations of bi-directionality in the boredom-temporal slowing illusion. Specifically, a task objectively lasting 20 minutes was made to appear to last either 10 or 30 minutes. The researchers found that participants in the 10-minute condition (i.e., where time seemed to move more slowly) reported that they felt more bored than participants in the other condition. London and Monello (1974) attempted to explain this finding by suggesting that participants in the 10-minute condition, due to the felt discrepancy between the observed and perceived rates of passage of time, were induced into interpreting their experience through the lens of a naïve, experientially informed schema of the boredom-temporal slowing illusion.

Sucala et al. (2010, Experiment 1) elected to tackle the role of expectancies in relation to time perception directly. They utilized what could reasonably be described as an intrinsically interesting virtual reality task and did not attempt to manipulate the interestingness/boringness of the task in any way other than through expectancies. The findings confirmed that when participants were induced into expecting that their experience would be boring, they found the experience less enjoyable and rated time as moving more slowly. They also found the opposite pattern when participants were expecting the task to be enjoyable. Based on their findings, the authors concluded that the boredom-temporal slowing association was most likely to be the product of a metacognitive:

> heuristic for judging time as running faster while enjoying an event, and enjoying an event more while experiencing an accelerated time progression (Sucala et al., 2010, p. 239).

The authors suggested that this metacognitive heuristic was the result of prior experience with boring tasks and stimuli, coupled with naïve theories of time.

Sackett et al. (2010), like Sucala et al. (2010), demonstrated that it is possible to induce a discrepancy between the anticipated and perceived passage of time without the use of a timekeeping device. Participants were simply informed that they would be performing the task for a specific period and then the actual time spent on the task was manipulated. Using this approach, Sackett et al. (Studies 1A & B; 2010) found that feelings of enjoyment on a task increased when time progression was made to seem as if it had been accelerated. However, the researchers found that the illusion held only if (a) the temporal distortion was unexpected, (b) the participant was convinced that their enjoyment was attributable to the accelerated time, and (c) there were no other plausible interpretations available. In other words, if the expectancies were believed to represent legitimate constraints of the task, the participants were then inclined to “make sense” (p. 114) of the discrepant experience by adjusting both their hedonic response and their ratings of time perception.

However, Sackett et al. (2010) did not address the effects of time progression on boredom directly. Instead, they focused on the impact of induced time acceleration on the hedonic appraisals in response to a range of tasks and stimuli. In a separate experiment, Sucala et al. (2010; Study 2) replicated Sackett et al.’s (2010) study but included a single item measuring task-related boredom. Employing the same relatively interesting virtual reality task, participants were told that they would spend ten minutes engaging in the task. In one condition, participants were stopped after five minutes (Time Flies), and in the other, they were stopped after 20 minutes (Time Drags). Participants in the Time Drags condition not only rated time as moving significantly slower, but rated the task as less enjoyable and more boring.

The Present Study

In sum, in addition to differences in theoretical explanations and methodological approaches, these clock-manipulation studies did not take into account individual differences in the experience of boredom (e.g., London & Monello, 1974; Sackett et al., 2010; Sucala et al., 2010). However, as discussed above, previous research has demonstrated that high levels of boredom proneness can, in fact, interfere with time perception (e.g., Danckert & Allman, 2005). Moreover, it is reasonable to predict that individuals who experience boredom more easily and more frequently would find a monotonous task to be more aversive and boring.

It is possible that manipulating the clock to move slower or faster than expected can affect hedonic appraisals of a task and levels of current boredom, regardless of individual differences accounted for by boredom proneness, and relatedly, recent experiences of boredom. Conversely, these individual differences may override the effects of the manipulation on the experience of boredom and task appraisals. The present study is an attempt to address these limitations of previous clock-manipulation studies and provide a preliminary response to this question.

To achieve these aims, a modified replication of Sackett et al.'s (2010) clock manipulation study was conducted using a task designed to induce boredom. We expected that recent state boredom, boredom proneness, and current boredom levels would be associated with slower time perceived time progression and with negative ratings of the boredom-induction task. Consistent with previous clock manipulation studies, it was predicted that participants who were given an underestimate of the task's duration (i.e., Time Drags condition) would rate time as moving slower, find the boring task significantly more adverse, and report higher levels of current boredom than participants who were given either an overestimate (i.e., Time Flies), or accurate information about the duration of the task (i.e., Real Time).

As noted, the role of individual differences in the experience of boredom has not yet been explored using this type of paradigm. Thus, an additional aim was to determine whether this expected pattern remained when controlling for boredom proneness and recent boredom experiences. To examine the influence of individual differences in the experience of boredom, measures of recent state boredom and boredom proneness were included as covariates.

Method

Participants

Participants were recruited from the undergraduate and graduate student population at a large, Northeastern university in the United States. All students at the university were eligible to participate in the study, except for those who had experienced a concussion in the past twelve months. This was considered an exclusionary criterion because previous research has shown that concussions can alter time perception (Mioni et al., 2014). All participants received a research credit for completing the study. The final sample consisted of 72 participants aged 18-53 (*M* = 23 years-old, *SD* = 5.73). Sixty participants identified as female, and twelve identified as male. More detailed demographic information can be found below in Table 1.

Table 1.

Demographic Information for the Sample.

Variable	*N* (%)	*M(SD)*
Age		23.06(5.73)
Gender		
Female	60(83.3)	
Male	12(16.7)	
Race		
Asian	14(19.4)	
Black/African American	1(1.4)	
Bi-racial	7(9.7)	
White	36(50)	
Latinx/Hispanic	8(11.1)	
Middle Eastern	2(2.8)	
Native Hawaiian/Pacific Islander	1(1.4)	
Turkish	1(1.4)	
Missing data	2(2.8)	
Education		
Current undergraduate student	39(54.20)	
Current graduate student	28(38.90)	
Missing data	5(6.9)	

Measures and Materials

Individual Differences in Boredom Experiences

- Boredom Proneness

Participants' proclivity to experience boredom was measured using the 28-item Boredom Proneness Scale (BPS; Farmer & Sundberg, 1986). The BPS is the most extensively used measure of trait boredom (Struk et al., 2017), and items are rated on a Likert scale from 1 (*Highly disagree*) to 7 (*Strongly agree*). A composite score is typically created by summing all items. However, the mean scores were used to account for a few missing data points. The scale showed good internal consistency in the present study, Cronbach's alpha = .86 for the 28 items.

- Recent/Frequent Boredom Experiences

The 8-item State Boredom Measures (SBM; Todman, 2013) is used to assess experiences of recent boredom in terms of attributions, frequency, tolerance, and intensity over the past two weeks. In this study, participants were asked to recall boredom experiences over the past week. Items are rated on a 7-point Likert-type scale and the SBM shows good convergent validity with other boredom measures (Todman, 2013). The SBM showed acceptable internal consistency in the present study, Cronbach's alpha = .72 for the 8 items. A composite score was created by summing all eight items. A high value on this composite indicates that an individual reports a recollection of more frequent, and more unpleasant, boredom experiences in the recent past.

Dependent Variables

- Passage of Time Judgments (PoTJ)

Participants were asked to make judgments about the passage of time using the following question: *"During the task you just participated in, how quickly did time seem to progress?"* Participants then selected their response from a 7-point Likert-type scale ranging from 1 (*time dragged*) to 7 (*time flew*; Sackett et al., 2010).

- Task Ratings

Participants rated the boredom-inducing task on a Likert-type scale of 1 to 5 in terms of five hedonic appraisals: task-related amusement, enjoyment, anxiety, boringness, and tediousness. The ratings of enjoyment and amusement were reverse-coded, and the five items were summed to create a composite score of overall task aversiveness. Thus, higher scores indicated more overall task aversiveness. The summed items showed acceptable internal consistency, Cronbach's alpha = .66 for the 5 items.

- Post-induction Boredom Levels

Participants completed the Multidimensional State Boredom Scale (MSBS; Fahlman et al., 2013). The MSBS is a 29-item scale that measures the respondent's current level of boredom across five dimensions: time perception, low arousal, high arousal, inattention, and disengagement (Fahlman et al., 2013). A total score is calculated by summing all of the items, and separate summary scores are calculated for each dimension. In the current study, the MSBS showed excellent internal consistency, Cronbach's alpha = .92 for all 29 items. Particularly relevant to the present study is the time perception dimension, which is a 5-item subscale assessing the perceived passage of time (e.g., "*Right now it seems like time is passing slowly*"). This subscale showed excellent internal consistency, Cronbach's Alpha = .89 for the 5 items. Unfortunately, however, only forty-four participants (n = 44, 61%) completed this measure. Thus, it was not possible to conduct a reliable examination of the differences between conditions.

Boredom Induction Task

Participants completed a ten-minute vowel-counting task designed to induce boredom (see Koval & Todman, 2015). Each participant was given a packet with a printed short story. They were instructed to count all of the vowels in the story, periodically summing them and then entering the totals into empty boxes placed throughout the text. Participants were told to be as accurate as possible, as their error rate would be assessed. Because the vowel counting task is attentionally demanding, low in its intrinsic meaningfulness, and accompanied by an explicit injunction from the experimenter to minimize error for a finite period, we hypothesized that the focal task would induce a high level of subjective constraint and induce feelings of boredom.

Procedure

As noted above, a modified replication of Sackett et al.'s (2010) study was conducted. Participants were recruited to participate in a study ostensibly about cognitive processes related to a reading task and assigned to one of three conditions. In the Time Flies condition

(n = 24), participants were told that they would spend fifteen minutes working on the reading task (i.e., the boredom induction task). In the Real Time (n = 25) and Time Drags (n = 23) conditions, participants were told that they would, respectively, spend ten minutes or five minutes working on the task. In all conditions, the researcher set a timer for ten minutes and placed it out of sight. After ten minutes had elapsed, the timer rang, and the researcher informed the participant that time was up.

All study procedures took place in-person, individually, and in a lab room with no clocks. After providing written consent, participants were instructed to place cellphones out of sight, and remove all jewelry from their hands and wrists, ostensibly to minimize distractions during the task. This was done to prevent participants from checking the time on their phone or a watch during the task. Participants completed the task while listening to white noise through headphones, to minimize interference from sounds outside of the lab room.

Participants first completed a demographic information form, followed by the BPS, and then were given the boredom induction task. Immediately after the task, participants rated perceived time progression (PoTJ ratings) and then provided hedonic ratings of the task. Finally, participants completed the SBM and the MSBS and then were debriefed and credited for their participation.

Results

Associations Between Boredom, PoTJ, and Task Ratings

Data were analyzed using *SPSS Statistics*, Version 26 (IBM, Armonk, NY).[1] Pearson's bivariate correlations were conducted to examine associations between recent state boredom (SBM), boredom proneness (BPS), current boredom (MSBS), PoTJ, and boredom induction task ratings. These relationships are displayed in Table 2.

As expected, reports of current boredom, as measured by the MSBS, were positively correlated with both recent state boredom (SBM; r (41) = .51, p = .001) and boredom proneness (BPS; r (40) = .60, p < .001). Additionally, the MSBS Time Perception subscale was positively correlated with recent state boredom (SBM; r (41) = .38, p = .013) and boredom proneness (r (40) = .45, p = .003), suggesting that individuals who reported higher

[1]One participant had a missing BPS summary score, and one participant had a missing MSBS summary score. These participants were retained for other analyses but were excluded from analyses including the BPS and the MSBS, respectively.

levels of boredom proneness and recent state boredom reported slower time perception as measured by the MSBS. However, contrary to expectations, the correlations between boredom proneness, recent state boredom, MSBS summary scores, and PoTJ were not significant. PoTJ were significantly correlated with the MSBS Time Perception subscale in the expected direction.

As predicted, Pearson's bivariate correlations revealed that high levels of boredom proneness were positively correlated with negative ratings of the boredom-induction task, r (69) = .35, p = .002. Similarly, high levels of recent state boredom (SBM scores) were positively associated with negative task ratings (r (70) = .32, p = .004) as were levels of current boredom as measured by the MSBS summary score, r (41) = .36, p = .019.

Table 2.

Correlations between State Boredom, Boredom Proneness, and Time Progression.

	1	2	3	4	5	6	7	8	9	10
1. BPS	-									
2. SBM	.59**	-								
3. MSBS	.60**	.51**	-							
4. MSBS Time Perception	.45**	.38*	.80**	-						
5. MSBS Inattention	.45**	.44**	.80**	.60**	-					
6. MSBS Disengagement	.62**	.45**	.83**	.59**	.51**	-				
7. MSBS Low Arousal	.43**	.35*	.71**	.43**	.55**	.44**	-			
8. MSBS High Arousal	.24	.30	.68**	.45**	.59**	.42**	.35*	-		
9. Task Aversiveness	.35**	.32**	.36*	.40**	.25	.34*	.22	.09	-	
10. Time Progression (PoTJ)	-.04	-.19	-.17	-.42**	-.11	-.08	-.10	-.07	-.35**	-

Note. ** = p < .01; * = p < .05. BPS = Boredom Proneness Scale; SBM = State Boredom Measure; MSBS = Multidimensional State Boredom Measure

Consistent with expectations, negative task ratings were associated with slowed subjective time perception as measured by PoTJ (r (70) = -.35, p = .003) and the MSBS Time Perception subscale (r (41) = .40, p = .009). Negative task ratings were also associated with higher scores on the MSBS Disengagement Subscale, r (41) = .35, p = .025. However, task ratings were not associated with any other MSBS subscales (see Table 2).

Effects of Time Manipulation on PoTJ and Task Ratings

As hypothesized, a one-way analysis of variance (ANOVA) revealed a significant effect of condition on perceived time progression (PoTJ), F (2, 69) = 6.38, p = .003, η_p^2 = .16. As expected, pairwise comparisons revealed that participants in the Time Drags condition (M = 3.83, SE = .33, 95% CI [3.17, 4.48]) rated time as progressing significantly slower than participants in the Time Flies (*M* = 5.17, *SE* = .32, 95% CI [4.52, 5.81], M_{diff} = 1.34, SE = .46, *p* = .015, 95% CI [.21, 2.47]) and the Real Time (*M* = 5.32, *SE* = .32, 95% CI [4.69, 5.95], M_{diff} = 1.49, *SE* = .46, *p* = .005, 95% CI [.37, 2.61]) conditions. However, contrary to expectations, the Real Time and Time Flies conditions did not differ significantly from one another, M_{diff} = .15, *SE* = .45, *p* = 1.0, 95% CI [-.96, 1.26]. These results are displayed in Figure 1.

To examine whether these patterns changed when accounting for the variance explained by boredom proneness (BPS) and recent state boredom (SBM), we conducted a one-way analysis of covariance (ANCOVA) including SBM and BPS scores as covariates. The ANCOVA yielded similar results. The effect of condition on PoTJ remained significant, F (2, 66) = 5.34, p =.007, η_p^2 = .14.[2]

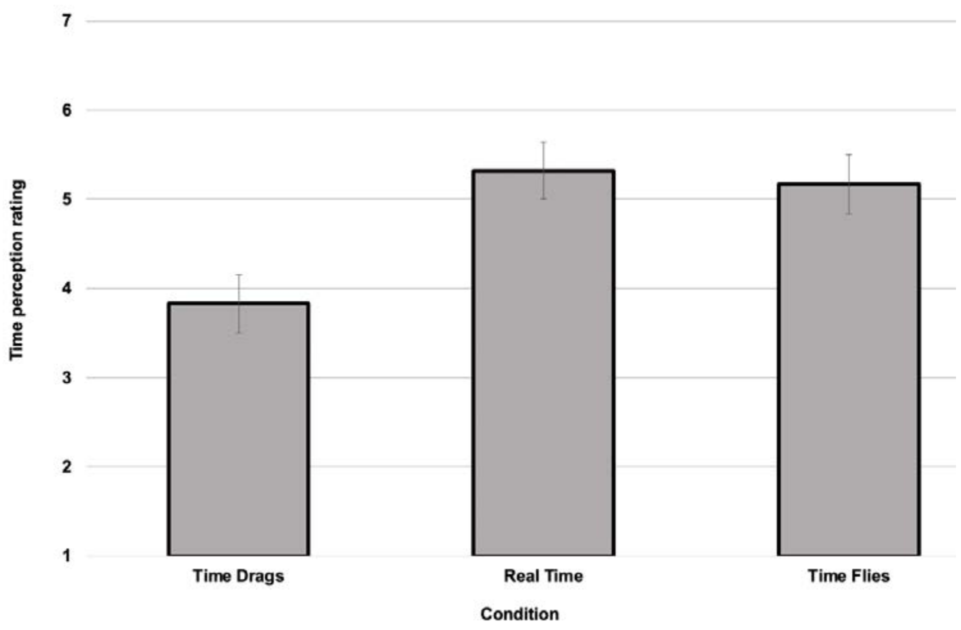

Figure 1. *Ratings of perceived time progression as a function of condition. As expected, participants in the Time Drags condition rated time as moving significantly slower than participants in the other two conditions. Error bars represent SE.*

Moreover, as predicted, a one-way ANOVA demonstrated a significant effect of condition on boring task ratings, F (2, 69) = 3.72, p = .029, η_p^2 = .10. Pairwise comparisons revealed that participants in the Time Drags condition (*M* = 17.70, *SE* = .74, 95% CI [16.23, 19.17]) rated the task as significantly more aversive than participants in the Time Flies condition (*M* =

[2] Levels of boredom proneness (BPS) did not differ between conditions (F (2, 68) = .34, p = .713, η_p^2 = .01), nor did levels of recent state boredom (SBM; F (2, 69) = .77, p = .468, η_p^2 = .02), suggesting that participants had been successfully randomized to the different conditions.

14.96, *SE* = .72, 95% CI [13.52, 16.40], M_{diff} = 2.74, *SE* = 1.03, *p* = .029, 95% CI [.29, 5.27]). Although participants in the Real Time condition (*M* = 15.76, *SE* = .71, 95% CI [14.35, 17.17]) tended to rate the task as less aversive than participants in the Time Drags condition, this difference was not significant, M_{diff} = -.1.94, *SE* = 1.02, *p* = .186, 95% CI [-.57, 4.44]. Finally, the Real Time and Time Flies conditions did not differ from one another with regard to task aversiveness ratings, M_{diff} = .80, *SE* = 1.01, *p* = 1.0, 95% CI [-1.67, 3.28].

To examine whether these relationships changed when accounting for the variance explained by boredom proneness and recent boredom, an ANCOVA was conducted using BPS and SBM as covariates. The ANCOVA yielded a significant effect of condition on task ratings, *F* (2, 66) = 3.37, *p* = .040, η_p^2 = .09. When adjusting for recent boredom and boredom proneness, participants in the Time Drags condition still rated the task as significantly more aversive than participants in the Time Flies condition, M_{diff} = 2.52, *SE* = .99, *p* = .040, 95% CI [.09. 4.57]. Similarly, although participants in the Time Drags condition tended to rate the task more negatively than participants in the Real Time condition, this difference was not significant, M_{diff} = 1.74, *SE* = .98, *p* = .243, 95% CI [-.67, 4.16]. As before, participants in the Real Time and Time Flies conditions did not differ significantly from one another, M_{diff} = .78, *SE* = .96, *p* = 1.0, 95% CI [-1.57, 3.13]. These results are displayed in Figure 2.

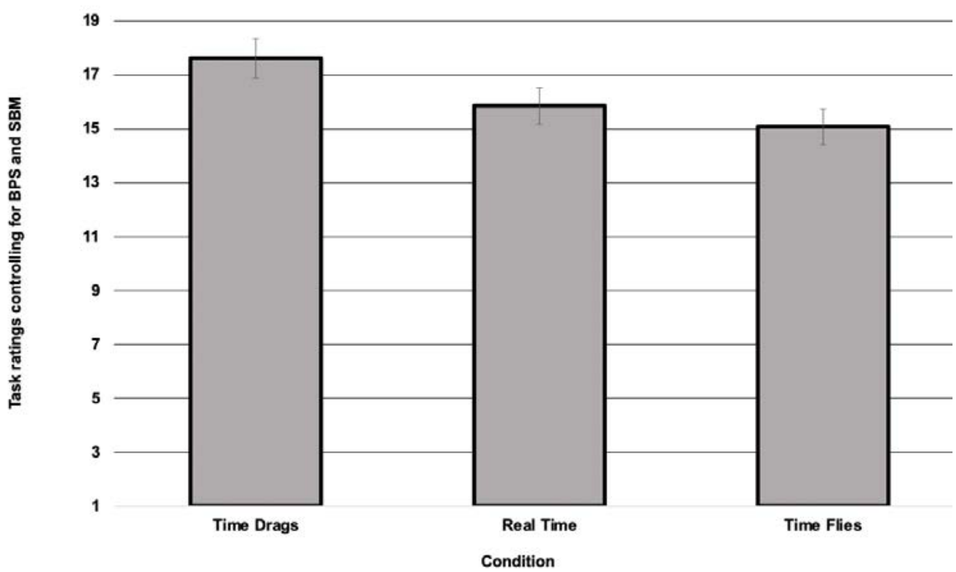

Figure 2. *Negative Task Ratings as a function of Condition. As expected, participants in the Time Drags conditions provided more negative task appraisals than participants in the Time Flies condition, even when controlling for SBM and BPS. Error bars represent SE.*

Discussion

This study replicates previous findings that the manipulation of perceived time progression affects hedonic appraisals of a task (Sackett et al., 2010). Participants in the Time Drags condition reported significantly slower perceived time progression as compared to those in the Real Time and Time Flies conditions. Participants in the Time Drags condition also rated the task as significantly more aversive than those in the Time Flies condition. However, participants in the Time Flies and Real Time conditions did not differ from one another in terms of perceived time progression or task ratings.

Although this latter finding is inconsistent with our expectations, it is worth noting that most previous time manipulation studies (London & Monello, 1974; Sackett et al., 2010 Study 1A & 1B; Sucala et al., 2010) have included only Time Flies and Time Drags conditions, with ostensive time discrepancies of 10-15 minutes between the two conditions. This is similar to the 10-minute discrepancy between the Time Flies and Time Drags conditions in the present study. Thus, it is possible that the felt discrepancy of five minutes (i.e., 5 vs. 10 minutes; 10 vs. 15 minutes) was too subtle to affect task appraisals, and to an extent, perceived time progression.

We also aimed to extend previous research by taking into consideration individual differences in participants' propensity to experience boredom, as well as recent experiences of state boredom. Consistent with expectations, both boredom-proneness and recent state boredom were positively correlated with negative ratings of the boredom induction task. However, even when controlling for these variables, task ratings still significantly differed as a function of perceived time progression. The results of this study suggest that, above and beyond individual differences in the experience of boredom, the perceived progression of time can indeed make a boring task seem either more or less adverse.

The expectation that slowed time progression would be associated with higher reports of current boredom (MSBS) yielded inconclusive results. Due to an error, MSBS scores were unavailable for approximately half of the study participants. Thus, it was not feasible to provide a meaningful or reliable analysis of current boredom between the three conditions. In the correlational analysis, MSBS summary scores were not significantly correlated with PoTJ, although with a larger sample size this correlation may have reached statistical significance. Moreover, the MSBS time perception subscale was significantly correlated with

PoTJ. As this was the first clock-manipulation study to utilize a validated measure of current boredom levels, these findings point to the need for additional research in this area.

Finally, contrary to expectations and previous findings (Danckert & Allman, 2005; Watt, 1991), boredom proneness (BPS) and recent state boredom (SBM) were not associated with ratings of perceived time progression. One explanation for this nonsignificant finding may be that perceived time progression was manipulated to vary between conditions, while boredom proneness and recent state boredom were not. Prior studies that have found associations between boredom proneness and time perception have not manipulated how quickly or slowly time appeared to progress.

Implications

The aim of this study was to provide a more in-depth exploration of the relationship between time perception and boredom. Understanding the relationship between state boredom, boredom proneness, and temporal estimation has important implications, as it may help to develop effective strategies for coping with boredom (Zakay, 2014). This is a meaningful area of research, as boredom is associated with a host of negative consequences. For instance, decades of previous research have established that both state boredom and boredom proneness are associated with depression (Fahlman et al., 2013; Goldberg et al., 2007; Sommers & Vadonovich, 2000; Spaeth et al., 2015; Todman, 2013). Boredom is also related to negative affect and fatigue (Raffaelli et al., 2017), higher levels of anger and anxiety (Fahlman et al., 2013), lower levels of life-satisfaction, (Todman, 2013) greater symptom severity in psychiatric patients (Todman, 2003, 2007), unhealthy eating habits (Abramson & Stinson, 1977; Havermans et al., 2015), and substance abuse (e.g., LePera et al., 2011; Sharp et al., 2011).

Boredom's associations with substance use (Lepera, 2011; Sharp et al., 2011) and impulsivity (Moynihan et al., 2017; Watt, 1991) may be especially important to consider in the context of time perception and task appraisals. In a meta-analysis by Cheng and Gonzalez (2014), individuals with substance use disorders were found to engage in more discounting behavior, defined as "*a preference for immediate, smaller rewards over delayed, larger ones*" (Cheng & Gonzalez, 2014, p. 1), in time-related decisions (intertemporal choice) compared to individuals without substance use disorders. The difference was due to an interaction of task-related differences and individual valuation differences, and *not* due to differences in actual time perception. Further research may seek to explore the role of boredom in the relationship between impulsivity and intertemporal choice. This may have implications for a better understanding of decision-making in individuals with substance use disorders.

Furthermore, the connections between the experience of boredom, whether a task is perceived as engaging, and the subjective experience of time may have implications for task-related motivation. When one feels as if time is moving slower than it is, they may feel as if they have been putting effort into a task for an extended period of time. This may result in frustration or impatience, or in a higher chance of failing to see the task through to completion (Danckert & Allman, 2005).

Consistent with this, meta-analytic findings indicate that boredom is correlated with decreased motivation in academic settings (Tze et al., 2016), and boredom proneness has been associated with amotivation (Farmer & Sundberg, 1986). Boredom is also related to lowered levels of effort (Asseburg & Frey, 2013; Farmer & Sundberg, 1986) and strain in relation to task completion (Thackray et al., 1977). Recent work has demonstrated that boredom proneness is associated with difficulties with locomotion (i.e., the ability to 'get going' and engage in tasks; Mugon et al., 2018). This is consistent with our finding that participants who reported high levels of boredom proneness also endorsed stronger feelings of disengagement and tended to rate the boredom induction task more negatively.

Limitations

Despite the potential significance of our findings, this study has several limitations that should be taken into consideration when interpreting the results. First, the sample was recruited from a university setting, and despite the relative diversity in terms of age (due to the inclusion of both undergraduate and graduate students), it is unknown whether these results would generalize to a broader population. Relatedly, due to the study's design, participants had to sign-up for an appointment and meet with the researcher in-person to participate. This may have resulted in logistical constraints that limited the number of students who were able to take part in the study during the data collection period. The resulting sample size may have led to insufficient statistical power to detect some existing associations. Additionally, the relatively small sample size emphasizes the preliminary nature of these findings.

Moreover, the sample was restricted in terms of gender and ethnicity, with most participants identifying as white (50%) and female (83%). The disproportionate number of female participants included in the study may have influenced the findings. Previous research has shown gender differences exist in proneness to boredom, with males tending to report higher rates of boredom proneness than females (e.g., Watt & Vodanovich, 1999). However, as only 12 male students participated in the study, it was not feasible to conduct between-group analyses based on gender.

Finally, although participants in each condition performed an identical boredom induction task, they were given different instructions about the task's duration. The difference in instructions may have influenced the amount of effort participants expended on the task, which subsequently may have affected task appraisals, time perception ratings, and boredom levels. Future research should consider the inclusion of a measure of effort to assess this possibility.

Conclusions and Directions for Future Research

Overall, the results of this study demonstrate that individual differences in the experience of boredom do affect hedonic task appraisals. However, when these differences are held constant, altering perceived time progression still leads to a shift in hedonic appraisals, even when the task at hand is objectively boring. As discussed above, the relationship between time perception and boredom could have critical implications for motivation and task completion, especially in academic and work settings. However, an exploration of the ways in which these findings might be applied in such settings is beyond the scope of the present study. Future research should aim to examine these questions in a more ecologically valid setting in an attempt to use perceived time progression as a mechanism to counteract boredom and increase motivation.

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Competing Interests

The authors have declared that no competing interests exist.

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