Research Article

ASSOCIATION FOR PSYCHOLOGICAL SCIENCE

Psychological Science
21(1) 111–117

DOI: 10.1177/0956797609354832
http://pss.sagepub.com
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You're Having Fun When Time Flies: The Hedonic Consequences of Subjective Time Progression

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Abstract

Seven studies tested the hypothesis that people use subjective time progression in hedonic evaluation. When people believe that time has passed unexpectedly quickly, they rate tasks as more engaging, noises as less irritating, and songs as more enjoyable. We propose that felt time distortion operates as a metacognitive cue that people implicitly attribute to their enjoyment of an experience (i.e., time flew, so the experience must have been fun). Consistent with this attribution account, the effects of felt time distortion on enjoyment ratings were moderated by the need for attribution, the strength of the "time flies" naive theory, and the presence of an alternative attribution. These findings suggest a previously unexplored process through which subjective time progression can influence the hedonic evaluation of experiences.

Keywords

metacognition, time, judgment, attribution, social cognition, hedonic evaluation

Received 7/25/08; Revision accepted 5/7/09

Time perception is an integral part of psychological experience. However, because the duration of most meaningful experiences outlasts the capacity of working memory, people often have difficulty estimating how long experiences lasted. For example, in one elaborate demonstration, speleologist Michel Siffre spent 2 months isolated in a cave, away from the natural and mechanical clocks outside. Upon emerging after 59 days, he underestimated his endeavor's duration by a staggering 25 days (Siffre, 1964). Subsequent empirical investigations suggest that duration estimates are influenced by many factors, including attentional engagement (Chaston & Kingstone, 2004), arousal (Campbell & Bryant, 2007; Gruber & Block, 2003; Kellaris & Mantel, 1996; Loftus, Schooler, Boone, & Kline, 1987; Stetson, Fiesta, & Eagleman, 2007), and motivation (Conti, 2001; Sarason & Stroops, 1978; Vohs & Schmeichel, 2003). Thus, subjective duration often diverges from objective duration. When this occurs, time feels distorted: When time passes surprisingly quickly, it feels like time flew by; when time passes surprisingly slowly, it feels like time dragged on.[1]

The feeling of time distortion may prompt people to seek an explanation. A ready answer may come from overgeneralization of the common naive theory that "time flies when you're having fun." Given that attentional demands shorten duration estimates (Block & Zakay, 1997; Chaston & Kingstone, 2004) and that highly enjoyable activities can monopolize attention (e.g., Csikszentmihalyi, 1975, 1990), this intuitive link between subjective time progression and hedonic experience does not seem terribly misinformed.[2] When people are faced with otherwise inexplicable time distortions, however, overgeneralization of this presumed relationship may lead to inappropriate causal inferences. Thus, we predict that the sense that time "flew" will enhance people's evaluations of experiences, whereas the sense that time "dragged" will worsen evaluations.

Numerous experiential cues have been shown to influence evaluative judgments by prompting attributions (e.g., Schwarz et al., 1991; Stepper & Strack, 1993, Whittlesea, 1993). Typically, such cues involve a cognitive experience (e.g., violation of expectations) that leads to a process of sense making relying on theories about thinking, or *metacognition*. The imperfect

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nature of duration estimation suggests that time distortion may be a common experience that prompts sense making, and people's naive theories may provide a metacognitive attribution for this experience. In the studies reported here, we tested whether naive theories connecting enjoyment and time progression lead people to infer enjoyment of experiences from surprising time distortions. We first tested whether people evaluate experiences more favorably when they think time passed more quickly (Studies 1a, 1b, and 2). We then examined whether this effect occurs because people attribute time distortions to the hedonic value of the experience. We tested this hypothesized process by manipulating the surprising nature of time progression (Study 3), by measuring (Study 4a) and manipulating (Study 4b) beliefs in the connection between time progression and enjoyment, and by providing participants with an alternative attribution for time distortions (Study 5).

Studies 1a and 1b: When Time Flies, Tasks Are More Fun

In our first test, we manipulated external time cues while participants completed a mundane task. By manipulating actual or alleged task duration, we created the illusion of fast or slow time progression. For example, if someone engages in a task for 5 (or 20) min but is told that 10 min have passed, that person should be surprised by time's progression—that is, he or she should feel that time flew (or dragged) by. There are two ways to execute this temporal discrepancy: (a) manipulating actual duration while holding alleged duration constant and (b) holding actual duration constant while manipulating alleged duration. Study 1a used the former strategy, whereas Study 1b used the latter. In both studies, we expected that participants would evaluate the task more positively when time seemed to pass surprisingly quickly than when time seemed to pass surprisingly slowly.

Method

In Study 1a, university students ($N = 37$; 23 males, 14 females) were paid for participating in a study ostensibly examining cognitive processing. Each participant completed the study individually. In each session, the participant was asked to set aside all possible distractions, including watches and mobile phones, thus leaving no external time cues. The experimenter then provided selections of text and instructed the participant to quickly and accurately underline all words containing double-letter combinations (e.g., the word *epigrammatic* has double *m*s). The participant was told that the task would last exactly 10 min. Upon instructing the participant to begin, the experimenter conspicuously started a stopwatch and exited the room.

Outside the room, the experimenter exchanged her stopwatch for an identical one preset to approximately 10 min. In the time-flies condition, she reentered the room after only 5 min had passed. In the time-drags condition, she reentered after 20 min had passed. Upon reentering the room, however, the experimenter announced that 10 min had passed and casually set the stopwatch reading 10 min next to the participant while proceeding with instructions. The participant then used 7-point scales to rate the task in terms of enjoyment, challenge, engagement, fun, skill required, and how excited he or she would be to participate in a similar task in the future. As a manipulation check, the participant also indicated how time seemed to progress, using a 7-point scale (1 = *time dragged*, 4 = *pretty normal*, 7 = *time flew*).

Table 1. Effects of the Time Manipulation on Felt Time Progression (Manipulation Check) and Enjoyment Ratings in Studies 1a and 1b

Rating	Time condition	
	Time flies	Time drags
Felt time progression		
Study 1a	6.16 (1.21)	1.83 (0.71)
Study 1b	5.72 (1.12)	2.88 (1.20)
Enjoyment		
Study 1a	3.75 (1.29)	2.72 (1.38)
Study 1b	3.30 (1.20)	2.61 (0.87)

Note: Standard deviations are given in parentheses. Within each row, the means are significantly different from each other, $ts > 2.35$, $ps < .025$.

The procedure of Study 1b was identical to that of Study 1a, except that all participants ($N = 79$; 34 males, 45 females) spent the same amount of time (10 min) on the task. In the time-flies condition, the alleged task duration was 20 min; in the time-drags condition, it was 5 min.

Results

The results of Studies 1a and 1b are summarized in Table 1. The manipulation was successful: Participants in the time-flies conditions reported faster time progression than did participants in the time-drags conditions, $t(35) = 13.14$ in Study 1a and $t(77) = 10.86$ in Study 1b, ps < .001, p_{rep}s > .99. Ratings of enjoyment, challenge, engagement, fun, skill required, and excitement to reengage were highly related ($\alpha_{1a} = .89$, $\alpha_{1b} = .83$) and were thus combined to create a composite measure of enjoyment. As hypothesized, participants in the time-flies conditions rated the task as more enjoyable than did participants in the time-drags conditions—Study 1a: $t(35) = 2.36$, $p = .024$, $p_{rep} = .92$, $d = 0.80$; Study 1b: $t(77) = 2.95$, $p = .006$, $p_{rep} = .97$, $d = 0.67$. Thus, the experience of time distortion affected evaluations of the task regardless of whether that experience was induced by manipulating the actual (Study 1a) or alleged (Study 1b) passage of time.

Study 2: When Time Flies, Noises Are Less Irritating

Studies 1a and 1b suggest that experiences seem more enjoyable when time is felt to have progressed surprisingly quickly and less enjoyable when time is felt to have progressed surprisingly slowly. In Study 2, we sought to test the robustness of these findings in three ways. First, whereas the word task used in Studies 1a and 1b was of relatively neutral valence, we wanted to examine whether time distortions also influence evaluations of tasks that have strong (in this case, negative) hedonic value.[3] Second, the active participation required by the word task may have induced *flow* (i.e., complete immersion in an active task—Csikszentmihalyi, 1975, 1990), which is associated with both increased enjoyment and reduced awareness of time. Study 2 tested whether evaluations of a passively experienced task, which is unlikely to induce flow, can be similarly influenced by time distortions. Third, in Study 2, we manipulated subjective time progression in the presence of external time cues; the presence of such features better simulates those naturalistic settings in which clocks and timers are ubiquitous, but these features also might mitigate the influence of subjective time distortions.

Method

Ninety-nine undergraduates (44 males, 55 females) participated in fulfillment of a course requirement. Participants sat at a computer, donned headphones, and listened to a 30-s clip of synchronized dot-matrix printers, taken from a track titled "} . } @ } . @ . } @ } . @ . } @ } . @ . } @ } . @ . } @ } . @ . }" ([The User], 2002). The track was described as "printing sounds" and was generally considered to be irritating. While participants listened to the clip, a timer counting each second of elapsed time was presented on the screen. To manipulate subjective time progression, we either accelerated (*time flies*) or decelerated (*time drags*) the timer by 20%. Participants then rated their experience on a 9-point scale with endpoints labeled *not unpleasant at all* and *very unpleasant*, and rated their irritation with the sounds on an 11-point scale with endpoints labeled *OK noise* and *terrible noise*. Additionally, participants listened to a 5-s sound clip of an electric drill and then indicated their preference for listening to the printing sounds again versus listening to the drill instead; ratings were made on a 201-point slider scale ranging from –100 (*definitely would prefer the printing noise*) to +100 (*definitely would prefer the drill sound*).

Results

Because unpleasantness and irritation ratings were highly related ($\alpha = .92$), these two measures were standardized and combined into a single composite variable (with larger values indicating more negative ratings). Results were consistent with those of Studies 1a and 1b; participants in the time-flies condition ($M = -0.39$) rated their listening experience less negatively than did participants in the time-drags condition ($M = 0.53$), $F(1, 97) = 5.67$, $p = .019$, $p_{rep} = .95$, $\eta_p^2 = .06$. Furthermore, participants were less willing to switch from printing sounds to a different irritating noise (electric-drill sounds) if they were in the time-flies condition ($M = -25.6$) than if they were in the time-drags condition ($M = 11.9$), $F(1, 97) = 6.17$, $p = .015$, $p_{rep} = .96$, $\eta_p^2 = .06$. These results again indicate that people evaluate an experience more positively if time seems to pass surprisingly quickly rather than surprisingly slowly—even when the experience is clearly unpleasant, there is no active participation, and there is continuous temporal feedback.

Study 3: When Time Flies, Good Songs Get Better

We have argued that the accelerated passage of time leads to feelings of time distortion, which are then attributed to greater subjective enjoyment. However, Studies 1a, 1b, and 2 left open the possibility that subjective time progression influences enjoyment directly (e.g., fast subjective time progression might be inherently pleasant). The remaining studies tested our proposed attribution explanation by manipulating the need for attribution (Study 3), by measuring and manipulating the strength of participants' naive theory connecting time progression and enjoyment (Studies 4a and 4b), and by manipulating the presence of an alternative attribution (Study 5).

People typically seek explanations for subjective experiences only when the experiences diverge surprisingly from expectations (Whittlesea & Williams, 2000). Study 3 used a procedure similar to that of Study 2 but manipulated the surprising nature of the time progression by varying whether the timer counted up (elapsed time) or down (remaining time). If subjective time progression influences enjoyment of an experience directly, then any felt acceleration or deceleration of time should influence participants' ratings of the experience. In contrast, if a sense-making process is involved, then effects on enjoyment ratings should be observed only when time's progress is surprising. When the timer counted up, the alleged duration was unknown at the beginning and became apparent only as the experience concluded, resulting in surprise at the discrepancy between alleged and expected elapsed time. When the timer counted down, however, participants learned the (alleged) duration before the experience began. By the time the endpoint (0:00) arrived, it was unsurprising and therefore required no sense making.

Additionally, Study 3 involved a clearly pleasant hedonic experience. This allowed us to test whether fast time progression can not only make less-than-pleasant experiences seem more tolerable, but can also make pleasant experiences seem more enjoyable. It is possible that pleasant experiences are less enjoyable (and more stressful) when time flies, because people would prefer positive experiences to be extended rather than abbreviated. However, if people use subjective time progression to infer enjoyment, then the experience of time flying should enhance both unpleasant and pleasant experiences, and the experience of time dragging should worsen both unpleasant and pleasant experiences.

Method

University students ($N = 106$; 72 males, 34 females) were paid to participate in a study in which they chose their favorite song from 12 popular selections (e.g., "Crazy" by Gnarls Barkley) and evaluated that song using a 201-point slider scale (–100 = *I really hate it*, +100 = *I really love it*). After completing an unrelated filler study, participants listened to their chosen song. The song timer was displayed on the computer screen; it was either accelerated or decelerated by 20% and displayed either elapsed time or remaining time. Participants then reported their enjoyment on a 9-point scale with endpoints *did not enjoy it at all* and *enjoyed it tremendously* and rated the song on an 11-point scale with endpoints *terrible song* and *fantastic song*.

Results

To control for prior song liking, we used initial song rating as a covariate in all analyses. Postlistening enjoyment ratings and song evaluations were highly related ($\alpha = .94$) and were standardized and combined into a single composite. There were no main effects of timer speed or direction on this composite measure, Fs < 1, ps > .30. However, as expected, timer speed and direction showed a reliable interaction, $F(1, 173) = 4.50$, $p = .035$, $p_{rep} = .93$, $\eta_p^2 = .03$. When the timer displayed elapsed time, participants reported enjoying the song more in the time-flies condition ($M = 0.54$) than in the time-drags condition ($M = –0.44$), $F(1, 173) = 4.21$, $p = .042$, $p_{rep} = .92$, $\eta_p^2 = .05$. This effect was eliminated when the timer displayed the remaining time (Ms = –0.22 and 0.13), $F < 1$, $p > .30$. Thus, when the timer displayed elapsed time, even a pleasant experience seemed more enjoyable when time passed surprisingly quickly (vs. surprisingly slowly). However, consistent with an attributional account, this effect disappeared when the timer displayed remaining time—and thus removed the experience of surprise.

Studies 4a and 4b: Measuring and Manipulating Naive Theories

We have proposed that to make sense of surprising time distortion, people implicitly rely on a belief that time passes more quickly during more enjoyable experiences. If this is true, then the effects of time distortion should depend on the strength of this belief. In the next two studies, we measured (Study 4a) and manipulated (Study 4b) participants' belief in the naive theory that "time flies when you're having fun." The more strongly people endorse this naive theory, the more likely they should be to attribute surprising time progression to enjoyment.

Study 4a

Method. Students from two universities ($N = 109$) were paid for participating in either a paper-based ($n = 43$) or a computer-based ($n = 66$) study. All participants were told that they would be evaluating anagram puzzles for future research. Participants first indicated their general liking of anagrams on an 11-point scale (–5 = *dislike very much*, +5 = *like very much*). Next, they were presented with a list of 45 five-letter anagrams and asked to solve as many as possible in 10 min (*time flies*) or in 5 min (*time drags*). They then worked on the anagram task for exactly 7.5 min, after which they were told that 10 or 5 min had passed, either by the program (in the computer-based version) or by the experimenter showing them a preset stopwatch (in the paper-based version). Next, participants indicated their enjoyment of the anagram task on a 7-point scale (1 = *did not enjoy it at all*, 7 = *enjoyed it a great deal*). After answering some filler questions, participants indicated their belief that "time flies when you're having fun" by using a 7-point scale to rate the extent to which the saying holds in real life (1 = *it never holds*, 7 = *it always holds*). The study concluded with a funnel debriefing procedure that probed for suspicion regarding the time manipulation.

Results. All analyses used participants' prior self-reported liking of anagrams as a covariate. The computer-based and paper-based groups did not differ in their reported enjoyment of the task, nor did this factor interact with the time effect (Fs < 1, ps > .30). We therefore present analyses of the pooled data. Once again, participants in the time-flies condition ($M = 4.62$) reported enjoying the experience more than did participants in the time-drags condition ($M = 4.10$), $F(1, 106) = 8.58$, $p = .004$, $p_{rep} = .97$, $\eta_p^2 = .07$. Moreover, the effect of the time manipulation was significantly more pronounced among participants with a stronger belief that "time flies when you're having fun," $\beta = 0.33$, $t(103) = 2.57$, $p = .012$, $p_{rep} = .95$, $\eta_p^2 = .06$.

We also examined debriefing responses to assess whether participants were indeed unaware of the inaccuracy of the timing instructions. Of the 109 participants, 5 suspected a timing inaccuracy after this possibility was suggested to them. Removing these participants from the analyses did not change any of the conclusions.

Study 4b

Method. Sixty-four university students (31 males, 33 females) were recruited for a paid study in which they would be asked to recall details from news articles. To manipulate participants' belief in the "time flies" naive theory, we presented them with a fabricated article reporting scientific evidence that either supported this belief or refuted it. All participants also read an additional (real) article (Ansari, 2008) unrelated to our hypothesis. They then completed the word task described in Study 1a, which was ostensibly a filler task before the recall portion of the study. The time manipulation and task rating procedures were identical to those of Study 1a. After rating the task, participants were asked to rate how convincing each article was, using a 7-point scale (1 = *not at all convincing*, 7 = *extremely convincing*). The study concluded with a funnel debriefing interview.

Results. There was no main effect of article condition on task enjoyment ratings (composite $\alpha = .83$), $F < 1$, $p > .30$, and

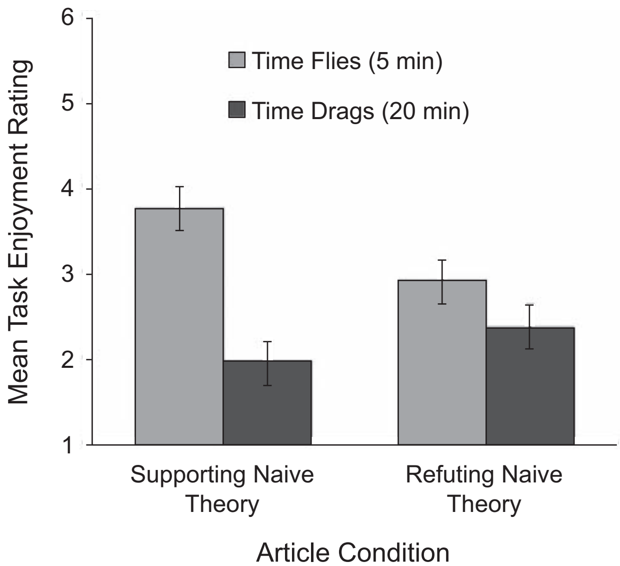

Fig. 1. Mean task enjoyment in Study 4b as a function of the manipulations of subjective time progression (time flies vs. time drags) and belief in the naive theory that "time flies when you're having fun." Error bars indicate ±1 *SEM*.

participants rated the two articles about the experience of time as similarly convincing, $F(1, 59) = 2.28$, $p = .14$. Participants reported enjoying the task more in the time-flies condition than in the time-drags condition, $F(1, 60) = 21.51$, $p < .001$, $p_{rep} > .99$, but more important, this effect was moderated by the manipulation of belief in the naive theory, $F(1, 60) = 5.94$, $p = .018$, $p_{rep} = .95$, $\eta_p^2 = .09$ (see Fig. 1). Participants who read the article confirming their naive theory reported enjoying the word task more in the time-flies condition ($M = 3.73$) than in the time-drags condition ($M = 1.95$), $t(33) = 5.16$, $p < .001$, $p_{rep} > .99$, $d = 1.75$. No such effect was observed among participants who read the refuting article ($M_{flies} = 2.89$, $M_{drags} = 2.34$), $t(27) = 1.52$, $p = .14$, $d = 0.57$.

In the funnel debriefing, 10 participants voiced some suspicion of timing inaccuracies after this possibility was suggested to them. Removing these participants from the analyses did not change any of the conclusions.

Study 5: Providing Alternative Attributions for Time Distortion

We have argued that people attribute surprising time distortions to their enjoyment of the experience, using their naive theory about the relationship between time progression and enjoyment. If this is the case, then the effect of time distortion on hedonic evaluations should occur only in the absence of a reasonable alternative explanation for the distortion (see Schwarz, 2004). Study 5 tested this hypothesis by providing some participants with an alternative attribution for their experienced time distortion.

Method

As in Study 1a, university students ($N = 60$; 23 males, 37 females) spent either 5 or 20 min on a task identified as taking exactly 10 min. The design of Study 5 differed from that of Study 1a in three ways. First, all participants wore foam earplugs as part of a cover story about reducing external distractions. Second, at the beginning of the task evaluation questionnaire, half of the participants were presented with a mock survey question designed to suggest that wearing earplugs may make time seem to fly (or drag, depending on time condition). The remaining half of the participants did not see this questionnaire item. Third, at the end of the task evaluation questionnaire, all participants were asked to indicate whether they would like to participate in a future study involving a 60-min version of the same word judgment task.

Results

Participants reported that time progressed faster in the time-flies condition ($M = 6.25$) than in the time-drags condition ($M = 2.47$), $F(1, 56) = 119.35$, $p < .001$, $p_{rep} > .99$. The explanation manipulation did not influence this measure, Fs < 1, ps > .30.

Participants reported greater enjoyment (composite $\alpha = .81$) if time flew than if time dragged, $F(1, 56) = 12.11$, $p < .001$, $p_{rep} = .99$, $\eta_p^2 = .18$, but this effect was moderated by the presence of an alternative attribution, $F(1, 56) = 4.10$, $p = .048$, $p_{rep} = .88$, $\eta_p^2 = .07$ (see Fig. 2). In the absence of an alternative

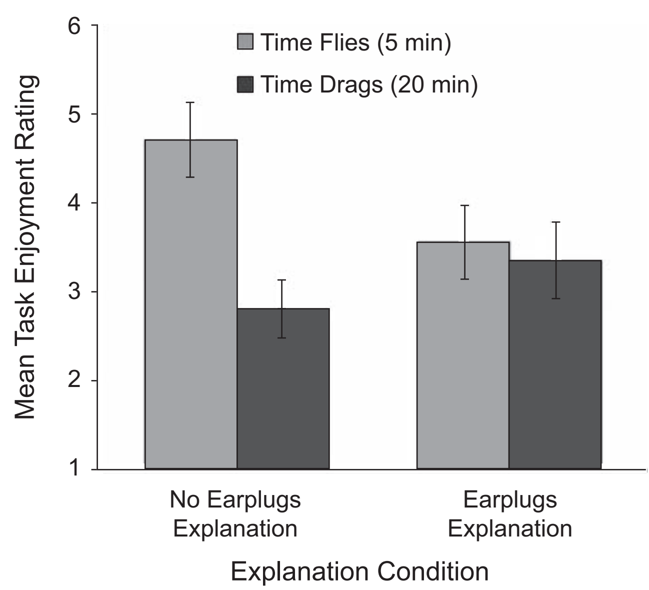

Fig. 2. Mean task enjoyment in Study 5 as a function of the manipulations of subjective time progression (time flies vs. time drags) and the availability of an alternative explanation for the experienced time distortion. Error bars indicate ±1 *SEM*.

attribution, participants reported greater task enjoyment in the time-flies condition ($M = 4.71$) than in the time-drags condition ($M = 2.81$), $t(30) = 3.94$, $p < .001$, $p_{rep} > .99$, $d = 1.44$, but when participants were provided with the alternative, earplugs explanation, this effect was eliminated ($M_{flies} = 3.57$, $M_{drags} = 3.36$), $t(26) = 1.02$, $p = .32$. Furthermore, participants in the no-explanation condition were more likely to volunteer for a future study involving the task if they were in the time-flies condition (93%) than if they were in the time-drags condition (61%), $\chi^2(1, N = 32) = 4.23$, $p = .040$, $p_{rep} = .93$, whereas volunteer rates in the earplugs-explanation condition were not significantly influenced by the time manipulation (*M*s = 79% and 71%), $\chi^2(1, N = 28) = 0.19$, $p = .66$.

General Discussion

Subjective time progression influences hedonic evaluation. Feelings of time distortion can cue inferences of enjoyment, but only when subjective time progression is surprising (Study 3), when one holds the belief that enjoyment accelerates time progression (Studies 4a and 4b), and when no alternative attributions are available (Study 5). We suggest that subjective time progression serves as input into a metacognitive judgment mechanism and thus plays a role similar to that of other metacognitive experiences, such as fluency and accessibility (for reviews, see Sanna & Schwarz, 2007; Schwarz & Clore, 2007; Schwarz, Sanna, Skurnik, & Yoon, 2007). Furthermore, the present findings extend previous research suggesting that people often neglect the duration of events when judging hedonic value (e.g., Redelmeier & Kahneman, 1996; but see Ariely & Loewenstein, 2000). Consistent with speculation that people might overcome duration neglect when they become attentive to time (Fredrickson & Kahneman, 1993), our data suggest that although people might neglect true duration when making hedonic judgments, surprising discrepancies between expected and actual durations significantly influence hedonic evaluations.

Notably, however, because our studies compared accelerated time with decelerated time, it is impossible to distinguish positive effects of accelerated time progression from negative effects of decelerated time progression. We therefore conducted an additional investigation ($N = 59$) comparing song ratings obtained under an accelerated timer with those obtained under a regular timer, using the elapsed-time condition from Study 3. As predicted, participants in the time-flies condition reported enjoying the song more ($M = 0.46$) than did those in the regular-time condition ($M = –0.31$), $F(1, 56) = 7.67$, $p = .008$, $p_{rep} > .99$, $\eta_p^2 = .14$. This result suggests that experiences can be improved simply by accelerating subjective time progression.

Taken together, these findings have important implications for understanding and changing hedonic experience. As recent work suggests, there is value in increasing subjective enjoyment without changing core features of the task at hand (see Hsee, Hastie, & Chen, 2008). Extraneous variables that systematically shorten duration estimates, such as physiological arousal (e.g., Gruber & Block, 2003) or inattention to temporal cues (e.g., Curton & Lordahl, 1974), might influence people's hedonic judgments in ways previously not understood. The current research thus provides insight into new ways to improve people's subjective enjoyment of a wide range of experiences, particularly negative experiences (e.g., waiting) that are virtually inevitable in day-to-day life.

Acknowledgments

Aaron M. Sackett is now at the Opus College of Business, University of St. Thomas.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interests with respect to their authorship and/or the publication of this article.

Funding

This work was supported in part by Grant 12344 from the John Templeton Foundation.

Notes

1. Duration estimates may be inaccurate for numerous reasons (see, e.g., Jones & Boltz, 1989; Zakay & Block, 1997). However, the studies we report in this article focused on the hedonic consequences of experiencing time distortion, independent of what caused the time distortion itself.
2. We define "subjective time progression" as the relative pace at which time seems to have passed from the perceiver's standpoint.
3. We later used a positive hedonic experience (Study 3).

References

Ansari, A. (2008, November 19). Scientists map DNA of prehistoric animal. *CNN.com.* Retrieved from http://www.cnn.com/2008/TECH/science/11/19/mammoth.dna/index.html

Ariely, D., & Loewenstein, G. (2000). When does duration matter in judgment and decision making? *Journal of Experimental Psychology: General*, *129*, 508–523.

Block, R.A., & Zakay, D. (1997). Prospective and retrospective duration judgments: A meta-analytic review. *Psychonomic Bulletin & Review*, *4*, 184–197.

Campbell, L.A., & Bryant, R.A. (2007). How time flies: A study of novice skydivers. *Behaviour Research and Therapy*, *45*, 1389–1392.

Chaston, A., & Kingstone, A. (2004). Time estimation: The effect of cortically mediated attention. *Brain and Cognition*, *55*, 286–289.

Conti, R. (2001). Time flies: Investigating the connection between intrinsic motivation and the experience of time. *Journal of Personality*, *69*, 1–26.

Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety: The experience of flow in work and games*. San Francisco: Jossey-Bass.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper Collins.

Curton, E.D., & Lordahl, D.S. (1974). Effects of attentional focus and arousal on time estimation. *Journal of Experimental Psychology*, *103*, 861–867.

Fredrickson, B.L., & Kahneman, D. (1993). Duration neglect in retrospective evaluations of affective episodes. *Journal of Personality and Social Psychology*, *65*, 45–55.

Gruber, R., & Block, R. (2003). Effect of caffeine on prospective and retrospective duration judgments. *Human Psychopharmacology*, *20*, 275–286.

Hsee, C.K., Hastie, R., & Chen, J. (2008). Hedonomics: Bridging decision research with happiness research. *Perspectives on Psychological Science*, *3*, 224–243.

Jones, M.R., & Boltz, M. (1989). Dynamic attending and responses to time. *Psychological Review*, *96*, 459–491.

Kellaris, J.J., & Mantel, S.P. (1996). Shaping time perceptions with background music: The effect of congruity and arousal on estimates of ad durations. *Psychology and Marketing*, *13*, 501–515.

Loftus, E.F., Schooler, J.W., Boone, S.M., & Kline, D. (1987). Time went by so slowly: Overestimation of event duration by males and females. *Applied Cognitive Psychology*, *1*, 3–13.

Redelmeier, D.A., & Kahneman, D. (1996). Patients' memories of painful medical treatments: Real-time and retrospective evaluations of two minimally invasive procedures. *Pain*, *66*, 3–8.

Sanna, L.J., & Schwarz, N. (2007). Metacognitive experiences and hindsight bias: It's not just the thought (content) that counts! *Social Cognition*, *25*, 185–202.

Sarason, I.G., & Stroops, R. (1978). Test anxiety and the passage of time. *Journal of Consulting and Clinical Psychology*, *46*, 102–109.

Schwarz, N. (2004). Metacognitive experiences in consumer judgment and decision making. *Journal of Consumer Psychology*, *14*, 332–348.

Schwarz, N., Bless, H., Strack, F., Klumpp, G., Rittenauer-Schatka, H., & Simons, A. (1991). Ease of retrieval as information: Another look at the availability heuristic. *Journal of Personality and Social Psychology*, *61*, 195–202.

Schwarz, N., & Clore, G.L. (2007). Feelings and phenomenal experiences. In A. Kruglanski & E.T. Higgins (Eds.), *Social psychology: Handbook of basic principles* (2nd ed., pp. 385–407). New York: Guilford.

Schwarz, N., Sanna, L.J., Skurnik, I., & Yoon, C. (2007). Metacognitive experiences and the intricacies of setting people straight: Implications for debiasing and public information campaigns. *Advances in Experimental Social Psychology*, *39*, 127–161.

Siffre, M. (1964). *Beyond time*. New York: McGraw-Hill.

Stepper, S., & Strack, F. (1993). Proprioceptive determinants of emotional and nonemotional feelings. *Journal of Personality and Social Psychology*, *64*, 211–220.

Stetson, C., Fiesta, M.P., & Eagleman, D.M. (2007). Does time really slow down during a frightening event? *PloS ONE*, *2*, e1295. Retrieved April 30, 2009, from http://www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0001295

[The User]. (2002). } . } @ }. @ . } @ } . @ . } @ } . @ . } @ } . @ . } @ } . @ . }. On *Symphony #2 for Dot Matrix Printers* [CD]. Montreal, Quebec, Canada: Asphodel/The Orchard.

Vohs, K.D., & Schmeichel, B.J. (2003). Self-regulation and the extended now: Controlling the self alters the subjective experience of time. *Journal of Personality and Social Psychology*, *85*, 217–230.

Whittlesea, B.W.A. (1993). Illusions of familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *19*, 1235–1253.

Whittlesea, B.W.A., & Williams, L.D. (2000). The source of feelings of familiarity: The discrepancy-attribution hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*, 547–565.

Zakay, D., & Block, R.A. (1997). Temporal cognition. *Current Directions in Psychological Science*, *6*, 12–16.