Running Head: When Time Flies

You're Having Fun When Time Flies:

The Hedonic Consequences of Subjective Time Progression

Aaron M. Sackett

University of Chicago

Tom Meyvis

New York University

Leif D. Nelson

University of California San Diego

Benjamin A. Converse

University of Chicago

Anna L. Sackett

University at Albany, SUNY

Please address correspondence to:

Aaron M. Sackett
Center for Decision Research
University of Chicago GSB
5807 S. Woodlawn Ave.
Chicago, IL 60637

Phone: (773) 702-8396
E-mail: aaron.sackett@uchicago.edu

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Abstract

Five studies test the hypothesis that people use subjective time progression in hedonic evaluation. We demonstrate that inducing people to believe that time passed more quickly than expected makes mundane tasks more engaging, noises less irritating, and favorite songs more enjoyable (Studies 1-3). We propose that perceived time distortion operates as a metacognitive cue and that people implicitly attribute it to their enjoyment of an experience (i.e., time flew, so it must have been fun). Consistent with this attribution account, perceived time distortion did not influence enjoyment when the progression of time was made to be unsurprising (Study 3) or when an alternative explanation was provided (Study 4). These findings suggest an important and previously unexplored process through which time perception can influence the subjective enjoyment of experiences.

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Time perception is an integral part of psychological experience. However, the duration of most psychologically meaningful experiences typically outlasts the capacity of working memory. Thus, as James (1890/1950) observed, "the durations we have practically most to deal with—minutes, hours, and days—have to be symbolically conceived, and constructed by mental addition… and the exact sum of the bits never makes a very clear impression on our mind" (p. 611). In other words, people's duration estimates are imperfect. For example, in one elaborate demonstration, Michel Siffre isolated himself in a cave for two months, away from any contact with the natural and mechanical clocks of the outside world. When he emerged some 59 days later, he discovered that his subjective estimate of the duration was off by a staggering 25 days (Siffre, 1964). Subsequent empirical investigations have confirmed and elaborated upon this peculiar phenomenon, demonstrating that duration estimates change with attentional engagement (Chaston & Kingstone, 2004), arousal (Campbell & Bryant, 2007; Gruber & Block, 2003; Kellaris & Mantel, 1996; Loftus, Schooler, Boone, & Kline, 1987), and motivation (Conti, 2001; Sarason & Stroops, 1978; Vohs & Schmeichel, 2003). Inevitably, then, people often discover that their perception of time's passage does not match reality. When this occurs, the resulting metacognitive experience is that time has been distorted: When time passes surprisingly quickly, it feels like time flew by; when time passes surprisingly slowly, it feels like time dragged on.

The feeling that time has been distorted may lead people to question why. We propose that, to make sense of such a distortion, people infer that subjective time perception carries information about the hedonic value of the experience at hand. Specifically, people may rely upon a naïve theory that enjoyment accelerates the passage of time—while suffering decelerates

it. Thus, we hypothesize that if people think time has passed unusually quickly (slowly), they will evaluate the experience or activity that filled that time more positively (negatively).

Evaluative judgments are influenced by a variety of metacognitive experiences, including the ease with which information comes to mind (e.g., Schwarz et al, 1991; Stepper & Strack, 1993) and the fluency with which information is processed (e.g., Whittlesea, 1993). However, no research to date has examined whether perceived time distortion may have a similar metacognitive impact on people's hedonic judgments (but see London & Monello, 1974, for an early demonstration consistent with this hypothesis). While past research suggests that people often underweight duration when evaluating experiences (e.g., Fredrickson & Kahneman, 1993; Redelmeier & Kahneman, 1996; cf. Ariely & Loewenstein, 2000), we propose that *discrepancies* between expected and actual duration can have important hedonic consequences. In this paper, we will first test the basic hypothesis that people evaluate experiences more positively when they think time passed more quickly (Studies 1a, 1b, and 2). Next, we examine whether this effect occurs because people implicitly attribute the surprising time distortion to their enjoyment of the experience. We test this proposed metacognitive process by manipulating the surprising nature of time progression (Study 3), and by providing participants with an alternative attribution for the apparent time distortion (Study 4).

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

We first tested our basic hypothesis by manipulating external time cues while participants worked on a relatively mundane task. By manipulating the actual or alleged task duration, we created the illusion of fast or slow passage of time. For example, if someone engages in a task for five minutes, but is (mis)informed that ten minutes have passed, that person should be surprised at how quickly time has passed (i.e., time flew by). Similarly, if someone engages in a task for twenty minutes, but is (mis)informed that ten minutes have passed, that person should be

surprised at how slowly time has passed (i.e., time dragged on). There are two alternate 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 while Study 1b used the latter. In both studies, we expected that participants would evaluate the task more positively when time seemed to have passed surprisingly quickly than when time seemed to have passed surprisingly slowly.

Method

In Study 1a, university students (n = 37; 23 males) earned $4 for participating in a study requiring up to 25 minutes. They were told that the study examined cognitive processing when people are "completely focused and attentive to tasks." The experimenter asked participants to set aside all possible distractions, including watches and mobile phones. This step ensured that participants completed the study in a room with no external time cues. The experimenter told participants to work quickly and accurately at underlining all words containing double-letter combinations (e.g., the word *letters* has double "t"s) in a selection of text. They were told that the task would last exactly 10 minutes. When participants were ready to begin, the experimenter conspicuously started a stopwatch and left the room.

Outside the room, the experimenter exchanged her stopwatch for an identical one preset to approximately 10 minutes. In the time-flies condition, she re-entered the room after half as much time (5 minutes) had passed as was alleged. In the time-drags condition, she re-entered after twice as much time (20 minutes) had passed as was alleged. Upon re-entering the room, the experimenter announced that 10 minutes had passed and casually set the stopwatch reading 10 minutes on the desk next to the participant while proceeding with the next set of instructions. Participants were asked to rate the task on 7-point scales in terms of enjoyment, challenge, engagingness, fun, skill, and how excited they would be to participate in a similar task in the

future. As a manipulation check, participants also indicated how time seemed to progress, using a 7-point scale with endpoints labeled "time dragged" and "time flew" and a midpoint labeled "pretty normal".

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

Results and Discussion

The results of Studies 1a and 1b are summarized in Table 1. The manipulation check indicated that the time manipulation was successful. Participants in the time-flies conditions indicated that time seemed to progress more quickly than did participants in the time-drags conditions (Study 1a: $t(35) = 13.14$, $p < .001$, $p_{rep} > .99$; Study 1b: $t(77) = 10.86$, $p < .001$, $p_{rep} > .99$). Ratings of enjoyment, challenge, engagingness, fun, skill, and excitement to re-engage were highly related ($\alpha_{1a} = .89$; $\alpha_{1b} = .83$) and were thus combined to create a composite measure of task enjoyment. As hypothesized, participants in the time-flies conditions rated the task as more enjoyable than did those in the time-drags conditions (Study 1a: $t(35) = 2.36$, $p = .024$, $p_{rep} = .92$, $d = 0.80$; Study 1b: $t(77) = 2.95$, $p = .006$, $p_{rep} = .97$, $d = 0.67$). These results suggest that people evaluate tasks more favorably when time seems to have passed surprisingly quickly rather than surprisingly slowly. This occurred regardless of whether the experience of time distortion was induced by manipulating the actual (Study 1a) or alleged (Study 1b) passage of time.

Although these findings indicate that experiences seem more (less) enjoyable when time is perceived as having progressed more quickly (slowly), it is not clear to what extent we can generalize this conclusion. Notably, we used a neutrally valenced, performance-oriented task. It

is possible that time distortion is only used as a cue to infer enjoyment of experiences with weak valence and, more importantly, when the experience involves active participation. Active participation allows for the experience of *flow* (i.e., the participant is immersed in the activity, Csikszentmihalyi, 1975, 1990), which is associated with both increased enjoyment and a reduced awareness of the surrounding context (including the passage of time). Additionally, the first studies were characterized by an absence of time cues during the experience itself, which is analogous to contexts in which people may not be attentive to external time cues until after the experience is over (e.g., in a dark theater). In many other contexts, however, time cues are continuously present, and people find themselves repeatedly surprised at the unusually fast or slow passage of time. It is plausible that when time cues are continuously available, evaluations of enjoyment are less malleable by perceived time distortions because the individual is still directly experiencing that enjoyment (or lack thereof). In the second study, we will alter these procedural and contextual features to examine the robustness of the effect.

Study 2: When Time Flies, Noises Are Less Irritating

Study 2 tested whether time distortion influences a negative hedonic experience that does not require active participation, and during which time cues are continuously available.[1] To this end, we asked participants in Study 2 to listen to irritating printing sounds while a clock displayed elapsed time.

Method

Ninety-nine undergraduates (44 males) participated in partial fulfillment of a course requirement. Participants were seated at a computer and wore a pair of headphones for the study's duration. After preliminary instructions, participants listened to a 30-second clip of synchronized dot matrix printers taken from a track entitled "@.}@.}@.}@.}@.}@.}@.}" by

the Québécois experimental music duo [The User] (2002). The track was described merely as "printing sounds" and was generally considered to be irritating. While participants listened to the clip, a timer counting up each second of elapsed time was presented on the screen. To manipulate perceived time distortion, this timer was either accelerated ("time flies") or decelerated ("time drags") by 20%. After listening to the clip, participants were asked to rate their experience on a 9-point scale with endpoints labeled "not unpleasant at all" and "very unpleasant," and to indicate their irritation with the sounds on an 11-point scale with endpoints labeled "OK noise" and "terrible noise." Additionally, we presented participants with a 5-second sound clip of an electric drill and asked them to indicate their relative preference between listening to the printing sounds again or listening to the drill instead, on a 201-point slider scale ranging from –100 ("definitely would prefer the printing noise") to +100 ("definitely would prefer the drill sound").

Results and Discussion

Because unpleasantness and irritation ratings were highly related (α= .92), these two measures were standardized and combined into a single composite variable (scores were also reversed so that larger values indicated less negative ratings). Consistent with 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, η_p^2 = .06. These results again indicate that people perceive experiences as more enjoyable if time seems to pass surprisingly quickly rather than surprisingly slowly—even when the experience is clearly unpleasant, there is no active participation, and people receive continuous temporal feedback. 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, η_p^2

= .06. This difference in relative preferences suggests that the experience of accelerated time does not make all stimuli more appealing, but only those stimuli that are associated with the accelerated time distortion.

Study 3: When Time Flies, Good Songs Get Better

The results so far indicate that people value experiences more when they perceive that time passed more quickly. We have argued that the accelerated passage of time leads to an unexpected feeling of time distortion, which is then attributed to greater subjective enjoyment. However, it is also possible that the perceived passage of time influences experience evaluations directly (e.g., the feeling that time is flying or has flown might be inherently pleasant). In the final two studies, we test our proposed attribution explanation against this alternative account by manipulating the need for attribution (Study 3) and the presence of an attribution alternative (Study 4).

People tend to only look for attributions of subjective experiences when the experience surprisingly diverges from expectations (Whittlesea & Williams, 2000). Therefore, Study 3 uses a procedure similar to that of Study 2 but manipulates the surprising nature of the time progression by varying whether the timer counts up (showing elapsed time) or down (showing remaining time). If the perceived passage of time influences experience evaluations directly, then any acceleration or deceleration of perceived time progression—regardless of whether the timer counts up or down—should influence participants' ratings of the experience. In contrast, if these effects involve a sense-making process prompted by the feeling of perceived temporal distortion, then these effects should only be observed when the temporal distortion is surprising. When the timer counts up, the alleged duration of the experience is unknown at the beginning and only becomes apparent as it comes to a close, resulting in surprise at the discrepancy between alleged and expected elapsed time. When the timer counts *down*, however, participants learn the

(alleged) duration before it even begins. The endpoint is unsurprising and therefore requires no sense-making.

Additionally, the previous studies used only neutral or negative experiences, raising the possibility that our effects may be restricted to making some experiences more *tolerable*, and that they may not necessarily extend to making positive experiences more *enjoyable*. It is possible, for example, that the feeling of time flying would actually be distressing when one is engaged in a positive experience, since one would presumably like to extend pleasant experiences as much as possible. In contrast, if people use perceived time distortion to infer enjoyment, then the effects of time distortion should be unidirectional. People should rate experiences more positively if time flew, and more negatively if time dragged, regardless of the valence of the experience. Thus, Study 3 also tested this prediction by presenting participants with a clearly enjoyable experience.

Method

University students (n = 106; 72 males) participated in exchange for $8. Participants were seated at a computer and wore headphones for the duration of the study. They were asked to select their preferred song from a set of 12 popular songs (see Appendix) and then to evaluate their chosen song on a 201-point slider scale ranging from –100 (“I really hate it”) to +100 (“I really love it”). After completing an unrelated filler study, participants then listened to the song they had chosen. As in Study 2, a timer counted off seconds during the song. This timer was either accelerated or decelerated by 20% and either counted up (showing elapsed time) or down (showing remaining time). After listening to the entire song, participants indicated how much they enjoyed it (on a 9-point scale with endpoints labeled “did not enjoy it all” and “enjoyed it tremendously”) and what they thought of the song (on an 11-point scale with endpoints labeled “terrible song” and “fantastic song”).

Results and Discussion

To control for individual differences in prior song liking, we used initial song rating as a covariate in all analyses. As in Study 2, post-listening enjoyment ratings and song evaluations were highly related (α= .94) and were standardized and combined into a single composite. There were no main effects of timer direction or timer speed on this composite measure, *F*s < 1, *ns*. However, as expected, timer speed and direction showed a reliable interaction, $F(1, 173) = 4.50$, $p = .035$, $p_{rep} = .93$, $\eta_p^2 = .03$. Consistent with the previous studies, participants in the elapsed-timer condition enjoyed the song more in the time-flies condition ($M = 0.54$) than in the time-drags condition ($M = -0.44$), $F(1, 173) = 4.21$, $p = .042$, $p_{rep} = .92$, $\eta_p^2 = .05$. In contrast, when the timer displayed the remaining time, there was no difference in enjoyment between the time-flies ($M = -0.22$) and time-drags ($M = 0.13$) conditions, $F(1, 173) < 1$, *ns*.

Thus, when the timer displayed the elapsed time, we replicated the effect observed in the previous studies, showing that even a pleasant experience becomes more enjoyable when time passes surprisingly quickly (rather than surprisingly slowly). However, consistent with a sense-making account, this effect was eliminated when the timer displayed the remaining time and thus removed the experience of surprise. These findings support the hypothesis that perceived time distortion influences the evaluation of an experience through an attribution process triggered by feelings of surprise with revealed duration.

Study 4: Providing Alternative Attributions for Time Distortion

If apparent time distortions are indeed serving as a metacognitive cue for enjoyment, then their effects should be reduced or eliminated when they can be attributed to an unrelated source (Schwarz, 2004). Study 4 tests this hypothesis by providing a subset of participants with an alternative attribution for their experienced time distortion. Orthogonal to our time distortion

manipulation, we manipulated the presence or absence of a plausible alternative explanation. If an external attribution eliminates the effects, it would suggest that an inferential process underlies the effects of time distortion on enjoyment.

Method

As in Study 1a, university students (n = 60; 23 males) spent either 5 or 20 minutes on a task identified as taking exactly 10 minutes. The design of Study 4 differed from Study 1a in two ways. First, all participants in Study 4 wore foam earplugs as part of the cover story about reducing external distractions. Second, after participants completed the task, but prior to evaluating their experience, half of the participants read a survey item suggesting that wearing earplugs may make time seem to fly (or drag, depending on condition). The remaining participants, in the no-explanation conditions, did not receive this survey question and instead proceeded directly to the evaluation questionnaire. At the end of the questionnaire, all participants were also given an opportunity to check a box indicating that they would like to participate in a future study involving a 60-minute version of the same word judgment task.[2]

Results and Discussion

The time manipulation check confirmed that time seemed to progress faster for participants in the time-flies condition (M = 6.25) than for participants in the time-drags condition (M = 2.47), $F(1, 56) = 119.35$, $p < .001$, $p_{rep} > .99$. The explanation manipulation did not influence perceptions of whether time flew or dragged, all Fs < 0.31, *ns*.

As can be seen in Figure 1, there was no main effect of the explanation manipulation on the enjoyment composite ($\alpha = .81$), $F(1, 56) = 1.20$, *ns*. However, the time manipulation did affect enjoyment, $F(1, 56) = 12.11$, $p < .001$, $p_{rep} = .99$, $\eta_p^2 = .18$, and as expected, this effect was significantly moderated by the explanation manipulation, $F(1, 56) = 4.10$, $p = .048$, $p_{rep} = .88$, $\eta_p^2 = .07$. Replicating the previous studies, when no explanation was provided, participants reported

greater task enjoyment in the time-flies condition (M = 4.71) than in the time-drags condition (M = 2.81), $t(30) = 3.94$, $p < .001$, $p_{rep} > .99$, $d = 1.44$. However, and consistent with an inferential process hypothesis, when participants were provided with the alternative "earplugs" explanation for the apparent time distortions, participants in the two time conditions reported enjoying the task equally ($M_{flies} = 3.57$, $M_{drags} = 3.36$), $t(26) = 1.02$, $p = .32$, $p_{rep} = .76$. 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%), $\chi^2(1, n = 32) = 4.23$, $p = .040$, $p_{rep} = .93$, while volunteer rates among participants in the earplugs-explanation condition were unaffected by the time manipulation (Ms = 79% and 71%, respectively), $\chi^2(1, n = 28) = 0.19$, *ns*.

General Discussion

This research reveals new directions for understanding the psychological relationship between time perception and hedonic experience. When time seems to have flown, people think they had more fun. Five studies demonstrated that the feeling of time distortion can cue inferences of enjoyment, but only when the time distortion is surprising (Study 3), and only when no other attributions are salient (Study 4). These findings indicate that hedonic experience is partially grounded in subjective time perception. We suggest that perceived 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 (e.g., Reber, Winkielman, & Schwarz, 1998) and accessibility (e.g., Schwarz et al., 1991; for a review, see Schwarz & Clore, 2007). The present findings also offer an important extension of previous research on duration neglect (Fredrickson & Kahneman, 1993; Redelmeier & Kahneman, 1996), building in part on speculation that duration neglect will be overcome when attention is drawn to time (Fredrickson

& Kahneman, 1993; see also Ariely & Loewenstein, 2000). Our data suggest that, although true duration alone might often be neglected in hedonic judgments, discrepancies between expected and actual durations can fundamentally change hedonic experience.

We further suggest that experiences can be improved by artificially accelerating perceived time progression. However, because all of our studies compared accelerated time with decelerated time, it is hard to isolate the unique influence of accelerated time progression. Therefore, to confirm the positive effects of accelerated time progression, we conducted an additional investigation (n = 59) employing the elapsed time condition from Study 3 to compare a regular timer to an accelerated timer. 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), $F(1, 56) = 7.67$, $p = .008$, $p_{rep} > .99$, $\eta_p^2 = .14$. Familiar enjoyable experiences can be improved simply by artificially influencing perceived time progression.

Finally, it should be noted that applying the "time flies" naïve theory may represent the overgeneralization of a reasonable heuristic and is not necessarily a formal mistake. Given that positive experiences can make time pass quickly and negative experiences can make time pass slowly (e.g., Campbell & Bryant, 2007; Conti, 2001; Vohs & Schmeichel, 2003), inferring valence from time's passage may certainly seem reasonable. Given the general imprecision of duration estimates, however, there are surely many instances in which time distortions occur for reasons unrelated to enjoyment. Whereas much research has taken up the task of explaining these time distortions, the present data underscore the importance of also examining their psychological and behavioral consequences.

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Appendix

Popular songs used in Study 3 (with actual duration):

"Son of a Preacher Man" (2:28) by Buffalo Springfield

"Vertigo" (3:14) by U2

"London Calling" (3:23) by The Clash

"Darts of Pleasure" (2:59) by Franz Ferdinand

"Milk Shake" (3:07) by Kelis

"California Uber Alles" (3:00) by Dead Kennedys

"Two Timin' Woman" (2:04) by Johnny Cash

"Don't Let Me Be Misunderstood" (2:47) by Nina Simone

"12:51" (2:33) by The Strokes

"Crazy" (3:01) by Gnarls Barkley

"The Distance" (3:00) by Cake

"American Idiot" (2:53) by Green Day

Footnotes

[1] We will later use a pleasant hedonic experience in Study 3.

[2] All participants were left to assume that they would also be paid for their 60 minutes of participation in this future study, although they were not explicitly told that this was the case.

Table 1

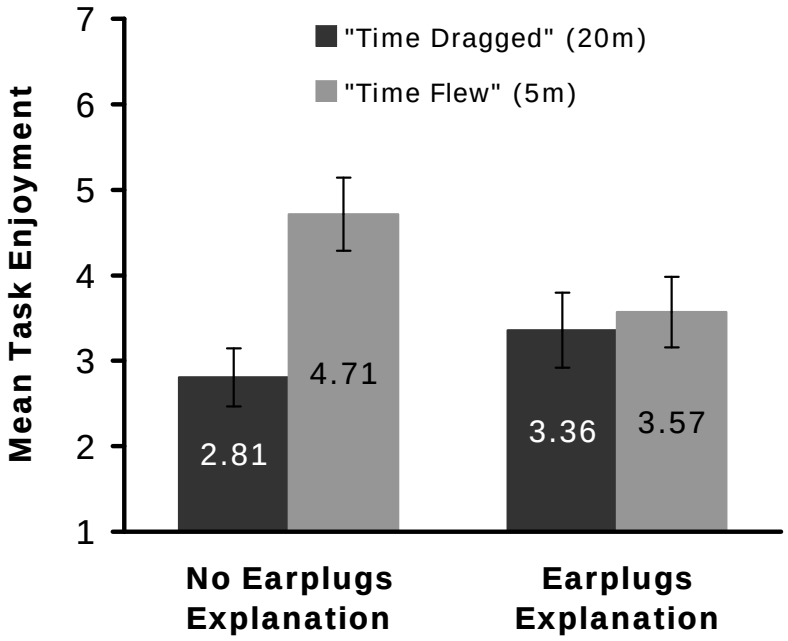
Effects of the time manipulation on perceived time progression (manipulation check) and enjoyment (Studies 1a and 1b).

	Time condition	
	"Time Flies"	"Time Drags"
Manipulation Check		
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 in parentheses.

Figure 1. Mean enjoyment ratings of the word judgment task as a function of time condition and explanation condition (Study 4). Error bars indicate +/- 1 standard error from the mean.

Figure 1


Mean Task Enjoyment
7
6
5
4
3
2
1
"Time Dragged" (20m)
"Time Flew" (5m)
2.81
4.71
3.36
3.57
No Earplugs Explanation
Earplugs Explanation