



Time flows: Manipulations of subjective time progression affect recalled flow and performance in a subsequent task



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ABSTRACT

Subjective time progression has been shown to serve as a heuristic cue for evaluating stimuli, tasks and events. The subjective feeling that “time flies” is a characteristic feature of flow experience. In four experiments, we investigated whether and how subjective time progression, as operationalized by announcing either shorter or longer time intervals than the actual time during task completion, affects recalled flow and subsequent performance. In Study 1, we were able to show that subjectively accelerated time progression increases recalled flow. Studies 2, 3, and 4 tested our central hypothesis, according to which the experience that time flies while working on a task should lead to better performance in a subsequent similar task. This effect was found in all studies. Studies 3 and 4 further revealed that, as expected, the effect was mediated by recalled flow, while controlling for potential alternative mediators. The findings from Study 4 further indicate a spillover effect such that participants who recalled higher levels of flow as a result of our manipulation also experienced higher levels of flow in a subsequent task. The present research contributes to an integration of naïve theories on subjective time progression, flow experience, and objective performance. The research provides preliminary evidence that recalled flow experience can be affected post hoc using time manipulation. These findings bear practical implications for applied pedagogical and organizational psychology.

Among all perceivable environmental factors, time appears to be one of the few that humankind has not yet been able to alter. We can neither turn it back nor stop it, neither speed it up nor slow it down. Still, *subjective* time progression is amazingly variable, as an hour can fly by or last forever, very much depending on how we spend it. A popular English idiom says “*time flies when you're having fun*” (Block & Zakay, 1997; Gable & Poole, 2012; Sackett, Meyvis, Nelson, Converse, & Sackett, 2010), and conversely, boredom is associated with slower time progression. Similarly, the rewarding experience of absorption during an activity—called flow—is characterized by a distorted sense of time (Csikszentmihalyi, 1975). Thus, people appear to hold a rather universal naïve theory of time progression, linking the experienced duration of events with hedonic tone (see Droit-Volet & Gil, 2009, for a review).

Decades of social cognition research have shown that people frequently use heuristic cues, such as subjective time progression, when making all types of evaluative judgments (see Fiske & Taylor, 2013, for a review). In a comprehensive series of experiments, Sackett et al. (2010) asked their participants to pursue a simple concentration task for five vs. 20 min, while the actual duration was held constant to

10 min (Exp. 1b). As expected, enjoyment of this mundane task was enhanced if participants had been led to believe that time flew, i.e., in the 20 min condition. Similar effects emerged when presumable duration was held constant but actual duration was manipulated (Exp. 1a) and when the stimuli to be evaluated were not tasks but irritating noises (Exp. 2) or popular songs (Exp. 3). Moreover, in Exp. 2 and 3, time progression was not manipulated by violating expectancies but by presenting participants with a manipulated timer that either accelerated or slowed-down during task completion. Follow-up studies investigated the role of approach vs. avoidance motivation as elicited by properties of the stimuli presented (Gable & Poole, 2012) and showed that differences between time flies vs. time drags conditions can be generalized to the evaluation of social stimuli, e.g., photographs of faces (Vliek & Rotteveel, 2012).

The present research aimed to test whether manipulations of subjective time progression have the potential to elicit evaluative consequences not only on general hedonic tone but also on (1) evaluations of internal states (such as the recalled experience of flow). Furthermore, our research goes beyond previous evidence by investigating (2) whether these evaluative consequences have effects on future behavior

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(such as better performance in a subsequent task). Thereby, it could provide an interesting contribution to both the social cognition literature and the literature on flow experience, as will be elaborated upon in the following sections. In addition, the present research bears practical importance for applied contexts such as pedagogical and organizational psychology, as suggested in the general discussion.

1. Flow experience and subjective time progression

Flow is the gratifying experience of deep involvement in an optimally challenging activity or task (Csikszentmihalyi, 1975; EFRN, 2016). During flow, individuals experience a high degree of concentration and attention to the task at hand, while the attention is reported to be effortless (Bruya, 2010). The process of the activity is perceived as fluent, with the individual knowing every next step. The experience itself is rewarding, leading to positive affect immediately after that task and a motivation to perform such a task again (for an overview on consequences of flow experience see Landhäußer & Keller, 2012). Interestingly, flow leads to an alteration of the experience of time, typically to the perception that “time flies”. Previous observations of an association between flow experience and time perception have been causally interpreted (Csikszentmihalyi, 1975; Sanders & Cairns, 2010), with flow leading to an altered sense of time. However, flow and subjective time progression are typically both assessed with self-report measures retrospectively. Thus, the converse could also hold true and complement previous interpretations, but this topic has not yet been systematically investigated. We find arguments for our research idea in literature on the psychology of information processing, memory and cognition, particularly in the concept of processing fluency. There appear to be essential similarities between the abovementioned definition of flow experiences and the concept of subjective processing fluency, as both are strongly associated with mental ease and effortless attention as well as with feelings of accelerated time progression (e.g., Bruya, 2010; Winkielman, Schwarz, Fazendeiro, & Reber, 2003). Winkielman et al. (2003) consider both objective and subjective processing fluency as characterized by features of overall high efficiency, such as processing ease, low effort and high speed. Fluency experiences are, by definition, closely associated with accelerated time progression. Therefore, the impression that “time flies”, as induced via Sackett et al.'s (2010) manipulation, appears to be a plausible source of feelings of ease and processing fluency. There is ample and profound empirical evidence showing that subjective processing fluency accompanies positive evaluations (for a review, see Winkielman et al., 2003), suggesting that the fluency signal itself is hedonically marked and triggers positive affect (e.g., Winkielman & Cacioppo, 2001). Historically grounded in research on the mere-exposure effect on liking (a comprehensive review is found in Bornstein, 1989; Zajonc, 1968, 1998), it is now well established that effects on liking emerge from repeated exposure and familiarity and when processing fluency is enhanced via priming or figure-ground contrast (Reber, Schwarz, & Winkielman, 2004; Reber, Winkielman, & Schwarz, 1998). More-recent evidence demonstrates that feelings of fluency affect a wide range of related dependent measures, such as truth judgments (Topolinski & Reber, 2010; Unkelbach, 2007), fame judgments (Topolinski & Strack, 2010), or the feeling of knowing (Koriat & Levy-Sadot, 2001). Wänke and Hansen (2015) as well as Hansen and Wänke (2013) argue that, throughout all these lines of research, it is the experience of *relative* rather than *absolute* fluency that underlies the effects: Being sensitive toward deviations from an expected level of fluency (or a baseline state) is essential to adapting to changing environmental challenges. In this line of reasoning, the researchers could show, for instance, that participants report varying levels of ease for one and the same task, depending on the level of ease they were led to expect (Hansen & Wänke, 2008, Exp. 3). Against this background, we suggest that Sackett et al.'s effects of subjective time progression on liking may hark back to an increase in experienced fluency. It should thus be possible to induce experienced fluency by the

impression that time flies, as it can be evoked by violating expectations regarding task duration (Sackett et al., 2010, Exp. 1a, 1b, 4a, 4b and 5). Based on the postulated similarity between the concepts of subjective processing fluency and flow experience, we hypothesize that a manipulation of subjective time progression will affect recalled flow (Hypothesis 1).

2. Time progression and performance

The second aim of the present work is to explore the consequences of subjective time progression on actual task performance and the role of recalled flow in this relationship. Evidence for a relationship between time progression and performance can be drawn from research on memory and text comprehension suggesting a negative relationship between time and meta-cognitive judgment of learning as well as actual memory performance (Dunlosky, Baker, Rawson, & Hertzog, 2006; Hertzog, Dunlosky, Robinson, & Kidder, 2003; Koriat, 2008; Koriat, Ackerman, Lockl, & Schneider, 2009; Koriat & Ma'ayan, 2005; Rawson & Dunlosky, 2002). For instance, Rawson and Dunlosky (2002, Exp. 1 and 3) found that subjective ease of processing is negatively related to the time spent on encoding and that subjective ease, in turn, is positively related to performance: The longer it took participants to work through a text by encoding, the worse they predicted themselves to perform and the worse they did indeed perform in a subsequent test task. Similarly, Koriat and Ma'ayan (2005, Exp. 1) found that judgments of learning as well as actual learning success increased with decreasing self-paced study time. Thus, obviously, time is related to subjective heuristics about performance, as well as to actual performance. Assuming that this relationship is not necessarily restricted to the area of encoding and retrieval from memory, we hypothesize that subjective time progression affects performance in subsequent tasks (Hypothesis 2).

3. Recalled flow as a mediator between time progression and performance

A positive relationship between flow and performance is well established in the literature. In a series of three studies, Engeser and Rheinberg (2008) investigated performance outcomes of flow experience as assessed with the Flow Short Scale. Flow values during class or during preparation time predicted students' success in a statistics course (Study 1) and a language course (Study 3), as measured by the grade achieved on the final exams. Engeser and Rheinberg also found an association between flow and performance in playing a computer game (Study 2). Further studies confirmed these associations of flow with performance in other contexts, such as in sports (e.g., Schüler & Brunner, 2009) or the workplace (e.g., Demerouti, 2006). The relationship between flow and performance can be explained, among other factors, by higher concentration during the activity at hand and by effects on future similar tasks through an enhanced motivation to perform such tasks again. This relationship results in long-term positive effects on task-related skills (Engeser & Rheinberg, 2008; Landhäußer & Keller, 2012). Considering the positive effects of flow on performance in future similar tasks, we expect that recalled flow mediates the effect of subjective time progression on performance in subsequent similar tasks (Hypothesis 3).

4. Overview of studies

Drawing from findings on subjective time progression, processing fluency, flow experience, and performance, we hypothesize that experimentally accelerated subjective time progression during a task should enhance recalled flow (Hypothesis 1) and performance in a subsequent task (Hypothesis 2). We further postulate that the link between subjective time progression and performance is mediated by recalled flow (Hypothesis 3).

In Study 1, we aimed to test the effectiveness of our time manipulation paradigm and the postulated causal effect of subjective time

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