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Passage of time judgments in everyday life are not related to duration judgments except for long durations of several minutes

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ABSTRACT

This study investigated relations between judgments of passage of time and judgments of long durations in everyday life with an experience sampling method. Several times per day, the participants received an alert via mobile phone. On each alert, at the same time as reporting their experience of the passage of time, the participants also estimated durations, between 3 and 33 s in Experiment 1, and between 2 and 8 min in Experiment 2. The participants' affective states and the difficulty and attentional demands of their current activity were also assessed. The results replicated others showing that affective states and the focus of attention on current activity are significant predictors of individual differences in passage-of-time judgments. In addition, the passage-of-time judgments were significantly related to the duration judgments but only for long durations of several minutes.

1. Introduction

> "*When nothing significant happens to absorb our attention, awareness of the passage of time increases*"
> *Heidegger (1927)*

Being is grounded in time (temporality) because humans are aware of their own being in the world, with death as the ultimate horizon (Heidegger, 1927). Phenomenologists invoke an internal consciousness of time (Husserl, 1964). This awareness of internal time produces the feeling that the pace at which time passes changes sometimes, going faster or slower than usual. For phenomenologists, this feeling comes from the comparison between a "time of self" - the "time of our being" - and an external time - the "time of world" - (Merleau-Ponty, 1945; Minkowski, 1968). Sometimes, the "time of self" goes faster than the world-time, thus leading to the feeling that time is passing more quickly. Sometimes, it lags behind the world-time, provoking the feeling that time is slowing down. Eugène Minkowski (1968) reports the case of a depressive patient aged 26 years who had the feeling of walking negatively with respect to time: "I feel time moving onwards but I do not have the feeling of following its movement" (for a review, see Droit-Volet, 2016a). In this way, this patient expressed his awareness of a sort of desynchronization between his time and that of others. However, some fundamental questions still have to be asked: What determines this awareness of internal time and its variations? Is it linked to other forms of explicit time judgments, such as the estimation of event durations?

The awareness of the passage of time, also called the passage-of-time judgment (PoTJ) (Wittmann & Lehnhoff, 2005; Friedman & Janssen, 2010), was recently investigated using the Experience Sampling Method (ESM) in order to assess the experience of the passage of time in everyday life (Droit-Volet, 2016b; Droit-Volet & Wearden, 2015, 2016). Using this technique, participants are given a mobile phone for a period of several days. They then receive alerts via the mobile phone several times per day, between 8 a.m. and 8 p.m. In studies of time, the participants give their spontaneous and immediate impression of the current passage of time. They also describe their emotional state in terms of affective state (happiness, sadness) and arousal level (excited/stimulated, relaxed/calm). In addition, they evaluate their current activity, indicating whether they find it difficult (activity difficulty) and whether it captures their attention (attention capture). An analysis of the detailed descriptions of the activities conducted at the moment of the alert was impossible since the reported daily activities have been too numerous and varied (Droit-Volet & Wearden, 2015). The results have shown that emotion and attention are relevant factors affecting PoTJ, with participants experiencing an acceleration of the passage of time when they feel happy and their level of arousal increases. Conversely, they experience a slowing down of time when they are sadder and calmer. Passage-of-time judgments have also been found to change as a function of the level of attention devoted to the current activity,

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accelerating when participants are engaged in an interesting activity. However, these activity-related results seem to differ within the various studies, probably due to the wide diversity of daily activities.

Furthermore, Droit-Volet and Wearden (2016) used ESM to examine the relationship between PoTJ and the judgment of stimulus durations (DJ). On each alert, at the same time as the participants reported their experience of the passage of time, they had to judge a number of stimulus durations. In particular, they had to evaluate three durations in the millisecond range from 350 ms to 1650 ms (verbal estimation task), and also had to produce the duration corresponding to 3 different values: 500, 1000 and 1500 ms (production task). The results did not reveal any significant link between PoTJ and DJ, either for the verbal estimation or for the production task. Changes in PoTJ were thus not associated with variations in the judgment of stimulus durations. In other words, it is not because the participants experienced a speeding-up of the passage of time that they overestimated or underestimated stimulus durations.

These results led Droit-Volet and Wearden (2016) to conclude that there is a dissociation between PoTJs and DJs and stated in the title of their article that PoTJs are not DJs. However, such a conclusion might be too hasty. Further investigation is required before we can conclude definitively. Indeed, in their study, these authors tested only very short durations, i.e. <1.6 s. Some studies have suggested that the mechanisms involved in the processing of sub-second durations are different from those involved in the processing of durations in the seconds range (Lewis & Miall, 2003; Coull, Cheng, & Meck, 2011). The difference lies in part in the cerebral areas involved in the circuits responsible for the processing of short and long durations, namely the cerebellum for short durations and the frontal cortex for long durations (Callu, Massioui, Dutrieux, & Brown, 2009). Indeed, the processing of long durations requires sustained attention and memory processes. As early as 1967, Paul Fraisse referred to "temporal estimation" (and no temporal perception) for durations longer than 2–3 s, because, as he said, these durations are revealed to our consciousness due to the feeling of persistence in time. If the awareness of the passage of time does not emerge with short durations, then it is logical that PoTJs are not related to judgments of sub-second durations. In the present study, we therefore decided to test the relations between PoTJ and DJ in everyday life using the same ESM procedure as that used by Droit-Volet and Wearden (2016), but with longer durations lasting several seconds. The affective states and current activity (difficulty, attention) were also assessed when the participants made their temporal judgments.

2. Experiment 1

2.1. Method

2.1.1. Participants

The final sample consisted of 15 participants (13 women and 2 men, Mean Age = 32.2, SD = 7.28). All participants signed a consent form before taking part in this experiment and received 40 euros for their participation. The experiment was approved by the Sud-Est VI Statutory Ethics Committee of France.

2.1.2. Material

Motorola G Androit Jelly Bean smartphones were used for this experiment and a program was specifically written by the CATech department (http://lapsco.univ-bpclermont.fr/catech) of the Laboratory of Social and Cognitive Psychology at Clermont Auvergne University. This program delivered and recorded all the experimental events (alerts, temporal tasks, questions, responses). The participants responded by pressing on the touch screen of their smartphone. The stimulus used in the verbal estimation and the temporal production task was a sound (LA, 440 Hz).

2.1.3. Procedure

The procedure was similar to that used by Droit-Volet and Wearden (2016), except for the durations tested in the DJ tasks. The participants were given a smartphone that they kept for 5 consecutive weekdays (from Monday to Friday). Alerts were issued 8 times per day, between 8.00 a.m. and 8.00 p.m., with an alert being randomly issued during each 90-min period and at least 15 min elapsing between two consecutive alerts. Each participant thus received a total of 40 alerts.

After each alert, the participants performed the verbal estimation task and the production task followed by their PoTJ. In the verbal estimation task, they had to judge 4 different durations (auditory stimulus) using a scale ranging between 1 s and 60 s. They were explicitly instructed not to count time in order to prevent biases in the results (for a test of the different methods of preventing counting, see Rattat & Droit-Volet, 2012). The durations to be estimated were randomly chosen between (1) 2.8 and 5.2 s, (2) 6.8 and 9.2 s, (3) 14.8 and 17.2 s, and (4) 30.8 and 33.2 s. The presentation order of these durations was random. In the production task, the participants had to produce 3 durations: 3, 5 and 7 s. More specifically, they were initially presented with a duration value. A blue circle then appeared and they pressed on this circle to trigger a sound. Their task was to stop pressing (thus stopping the sound) when they judged that the sound duration was equal to the temporal value indicated. The target durations were also presented randomly. For all DJ tasks, each trial started when the participant touched the screen after the word "ready/prêt", and the trial events followed 500 ms afterwards.

After the DJ tasks, the PoTJ question was presented on the smartphone screen: "At the moment, the moment of the alert, how is time passing for you compared to the time of the clock". The participant then responded on a 7-point scale: "(1) much slower - (2) moderately slower - (3) a little slower - (4) at the same speed as the clock - (5) a little faster - (6) moderately faster - (7) much faster". Following the PoTJ question, they responded to affective and activity questions. There were 4 affective questions: "At the moment of the alert, do you feel (1) happy" (Happiness), (2) "sad" (Sadness), (3) "excited/stimulated" (Arousal) and (4) "relaxed/calm" (Relaxation). The activity questions concerned the difficulty of the activity performed at the moment of the alert (Activity difficulty) and whether it captured the participants' attention (Attention capture). For these different questions, the participants responded on 7-point scale from "not at all" to "very much".

2.2. Results and discussion

Fig. 1 presents the mean verbal estimates (top Figure) and produced durations (bottom Figure) for the different tested durations. For each type of time judgment, there was a significant linear relationship between temporal performance and stimulus durations (verbal estimation, $F(1, 576) = 5054$, $p = 0.0001$, $\eta^2_p = 0.90$; production, $F(1, 572) = 1841$, $p = 0.0001$, $\eta^2_p = 0.76$), indicating that the participants discriminated the different durations in an everyday context, just as they can in a laboratory context. However, durations were systematically overestimated in the verbal estimation task whereas they were underestimated in the production task. Indeed, the relative time estimates[1] [(duration estimates − target duration) / target duration)]

[1] Analyses were first conducted on the relative time estimates and the mean time estimates to examine the effect of the day of the alert and the time of alert during the day in the time production and verbal estimation tasks. For the relative time estimates no main effect of day and alert time and no interaction involving these factors were found for either temporal task. As far as the mean produced duration is concerned, only a trend effect of day was found, $F(4, 530) = 2.42$, $p = 0.05$, $\eta^2_p = 0.02$, suggesting that the produced duration tended to be longer on the fifth than on the first day of assessment (2.96 vs. 2.56, Bonferroni, $p = 0.03$); no other day-related difference was found. For the mean verbal estimates, the effect of alert time was not significant but the effect of day, $F(4, 534) = 12.28$ $p = 0.0001$, $\eta^2_p = 0.08$, and the duration x day interaction reached significance, $F(12, 1602) = 3.64$, $p = 0.0001$, $\eta^2_p = 0.03$. This interaction indicated that the mean estimates were longer for the first day of assessment than for the other days, no difference being observed between the other days (Day 1 = 23.93, Day 2 = 21.67, Day 3 = 20.52, Day 4 = 20.35, Day 5 = 18.44).