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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).

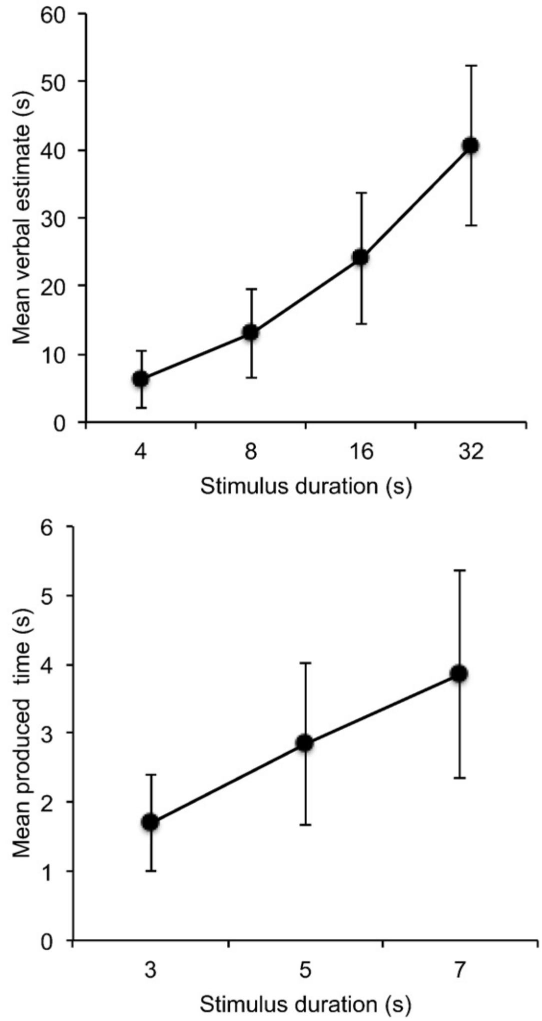

Fig. 1. Mean verbal estimates (top) and mean time produced (bottom) plotted against stimulus duration (seconds).

averaged over all durations were significantly greater than zero in the former task (M = 0.50, SD = 0.54, $t(578) = 22.22$, $p = 0.0001$) and smaller than zero in the latter one (M = −0.44, SD = 0.20, $t(578) = 53.73$, $p = 0.0001$). A significant effect of durations was nevertheless found for the verbal estimation task, $F(3, 1728) = 14.11$, $p = 0.0001$, $\eta^2_p = 0.08$. This effect did not reach significance for the production task, $F(2, 1144) = 2.75$, $p = 0.07$. The significant linear effect of durations, $F(1, 576, = 62.11$, $p = 0.000$, $\eta^2_p = 0.76$, suggested that the magnitude of the temporal overestimation in the verbal estimation task decreased with the length of the durations (4-s: M = 0.60 , SD = 0.99; 8-s: M = 0.61, SD = 0.81; 16-s: M = 0.50, SD = 0.60, 32-s; M = 28, SD = 0.44).

We next analyzed the best predictors of verbal estimates (Table 1), produced durations (Table 2) and PoTJ (Table 3) using multilevel modeling (MLM) (for a similar procedure, see Droit-Volet & Wearden, 2015, 2016). As similar patterns of results were found for the different stimulus durations, the analyses were conducted on the temporal performance that was averaged over the durations recorded after each alert (4 for the verbal estimation task and 3 for the temporal production task). This made for 15 participants, two temporal estimates (verbal estimates and temporal production) for 8 alerts per day and 5 consecutive days. The results did not reveal any significant relationship between PoTJ and DJ for either the verbal estimation or the production task (all $p > 0.05$). In contrast, the

Table 1
Potential predictor of verbal estimates for durations from 2 to 33 s (Experiment 1).

Predictor	Estimate	Standard error	t-Value	*p*-Value
Production	−2.10 [−3.16, −1.04]	0.38	−5.55	0.006
PoTj	−24.26 [−434, 385]	208.63	−0.12	0.91
Happiness	77.49 [−346.64, 501.62]	215.93	0.3	0.72
Sadness	−35.94 [−556.80, 484.91]	265.19	−0.13	0.89
Arousal	−81.66 [−466.32, 302.99]	181.77	−0.45	0.66
Relaxation	310.94 [−285.55, 907.43]	270.89	1.15	0.28
Activity difficulty	160.09 [−143.77, 463.96]	139.46	1.15	0.27
Attention capture	271.91 [37.30, 506.52]	119.45	2.28	0.02

judgments of durations for the two DJ tasks were negatively related ($r(577) = 0.27$, $p = 0.0001$). Short temporal productions were indeed associated with longer verbal estimates (Fig. 2).

In addition, the factors related to inter-individual differences in DJ were different from those related to PoTJ. Indeed, PoTJ was positively related to the affective states experienced at the moment of the alert ($p < 0.05$). The passage of time was thus judged to be faster when the participants felt happier and more aroused. Conversely, it was judged to be slower when the state of sadness increased. In our study, no significant link was observed between the PoTJ and the activity performed at the moment of the alert in terms of activity difficulty or attention capture.

Unlike the PoTJ, the judgment of durations in the verbal and production task was not related to the affective states reported by the participants (happiness, arousal, sadness) (all $p > 0.05$). We nevertheless observed that the participants tended to produce shorter durations when they felt happier (Table 2, $p < 0.05$). The degree of attention focused on the current activity was also a reliable predictor of DJ in the verbal estimation task (Table 1): The more the activity captured the participants' attention at the moment of the alert, the longer they judged the stimulus durations to be.

In sum, a first ESM study was conducted by Droit-Volet and Wearden (2016) to examine the relations between the PoTJ and the DJ using short durations (<1.5 s). The results of this study did not reveal any link between these two forms of temporal judgment. In our study, we used the same procedure with longer durations, between 3 and 33 s. The results again revealed no relation between the PoTJ and the DJ. However, before concluding that there is no link between PoTJ and DJ, we decided to conduct a second experiment with longer durations of several minutes. However, to be able to assess the PoTJ and the DJ for durations of this length, we decided to use only the verbal estimation task, and the participants had to estimate the temporal interval between two auditory signals. Furthermore, as in Experiment 1, the participants went about their normal daily activity while performing the temporal tasks on the smartphone after each alert, but for a period of one day only. Consequently, as there were less repeated measures per participants, more participants were recruited.

Table 2
Potential predictor of produced durations from 3 to 7 s (Experiment 1).

Predictor	Estimate	Standard error	t-Value	*p*-Value
Estimates	−0.04 [−0.05, −0.02]	0.007	−5.59	0.0001
PoTj	−33.64 [−91.45, 24.18]	29.43	−1.14	0.25
Happiness	−161.29 [−295.75, −26.83]	58.31	−2.77	0.02
Sadness	3.68 [−130.64, 137.99]	50.44	0.07	0.95
Arousal	−5.55 [−62.51, 51.41]	26.80	−0.21	0.84
Relaxation	4.82 [−62.38, 72.01]	30.64	0.16	0.88
Activity difficulty	−49.77 [−120.72, 21.19]	33.33	−1.49	0.16
Attention capture	−42.73 [−96.80, 11.33]	22.88	−1.87	0.10

Table 3
Potential predictor of passage of time judgment (Experiment 1).

Predictor	Estimate	Standard error	t-Value	p-Value
Estimates	−0.000002 [−0.00002, 0.000015]	0.000008	−0.20	0.84
Production	−0.00006 [−0.0002, 0.00005]	0.00006	−1.05	0.29
Happiness	0.13 [0.02, 0.25]	0.05	2.43	0.03
Sadness	−0.17 [−0.30, −0.04]	0.06	−2.85	0.01
Arousal	0.19 [0.02, 0.36]	0.08	2.39	0.03
Relaxation	−0.11 [−0.23, 0.01]	0.06	−1.96	0.07
Activity difficulty	0.06 [−0.018, 0.14]	0.04	1.68	0.12
Attention capture	0.07 [−0.19, 0.16]	0.04	1.65	0.12

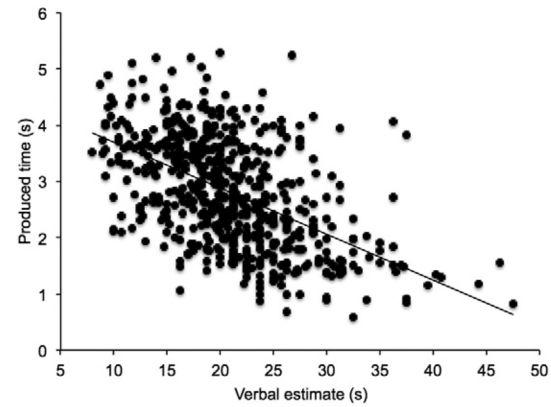

Fig. 2. Correlation between mean verbal estimate (averaged over the 4 verbal estimates of each alert) and mean temporal production (averaged over the 3 temporal production of each alert) obtained by each participant, and this for the 8 alerts of the 5 testing days.

3. Experiment 2

3.1. Method

3.1.1. Participants

The sample consisted of 30 participants (17 women and 13 men, Mean age = 29.18, SD = 5.69). The participants signed a consent form before taking part in this experiment, which was approved by the Sud-Est VI Statutory Ethics Committee.

3.1.2. Material and procedure

The material was the same as that used in Experiment 1. However, the experimental procedure differed. On the first day, the participants received an explanation of the experimental procedure and the functioning of the smartphone. For the verbal estimation task, they were told that they would have to judge the temporal interval between two sounds of between 1 and 16 min. They were also instructed not to look at a clock during this temporal interval. If they judged, for example, that the between-sounds duration was 3 min and 30 s, they had to type 3.30 on the smartphone. One demonstration was given. On the second day, the participants switched on the smartphone after waking up, having previously been told to wake up before 8 a.m. They then received 21 alerts during the day, one for each trial, with a between-alerts interval randomly chosen between 10 and 17 min. On the third day, they returned the smartphone.

After each alert, the word "ready/prêt" appeared, and the participants touched the smartphone screen to initiate a trial. Two sounds were then delivered, separated by the target temporal interval. The length of first sound was 2 s, and the second sound ended when the participants touched the smartphone screen in order to respond. They thus gave their estimation of the interval on a scale ranging from 1 to 16 min. There were 4 target interval durations, each presented 3 times (12 trials) (2, 4, 6, 8 min) with 9 other interval durations randomly chosen between 2 and 8 min (i.e. 21 trial/alerts in total). The order of presentation of the trials was random.

After each time judgment, the participants responded to the same series of questions as in Experiment 1: the PoTJ, followed by the 4 affective questions (Happiness, Sadness, Arousal, Relaxation) and the 2 activity questions (Activity difficulty, Attention capture).

3.2. Results and discussion

Fig. 3 shows the verbal estimates as a function of interval duration. As Fig. 3 suggests, there was a significant linear relationship between the verbal estimates and the length of the durations, $F(1, 29) = 259.89$, $p = 0.0001$, $\eta^2_p = 0.90$. The participants thus discriminated different durations of several minutes, despite generally overestimating these durations. The relative time estimates[2] [(duration estimates − target duration) / target duration)] averaged over all interval durations were indeed greater than zero, indicating a general overestimation of time (M = 0.35, SD = 0.27, $t(29) = 7.14$, $p = 0.0001$). However, the effect of durations on this temporal index also reached significance, $F(3, 87) = 2.59$; $p = 0.05$, $\eta^2_p = 0.08$, and this effect appeared to be linear, $F(1, 29) = 259.89$, $p = 0.0001$, $\eta^2_p = 0.90$. In other words, the overestimation of time decreased with the duration length. We also calculated the variability of temporal estimates (SD) and found a significant linear relationship between the temporal variability and the duration values, $F(1, 29) = 54.34$, $p = 0.0001$, $\eta^2_p = 0.65$. This indicated that the judgment of durations of several minutes was more variable on longer durations, a finding consistent with the scalar property of variance obtained for durations in the seconds range (Wearden & Lejeune, 2008).

As in Experiment 1, we analyzed the best predictors of verbal estimates (Table 4) and PoTJ (Table 5) using multi-level modeling. Previous analyses had found similar patterns of results for the different interval durations. Unlike the short durations in the seconds range, there was a significant relationship between the DJ and the PoTJ for the durations lasting several minutes ($p = 0.0001$): when the passage of time was experienced as faster, the interval durations were also judged shorter.

However, the factors allowing us to predict variability in time judgments also changed as a function of the type of judgment. Indeed, the PoTJ was significantly related to the affective states reported at the moment of the alert (Table 5, $p < 0.05$). The passage of time was indeed judged to be faster when the participants reported being more aroused,

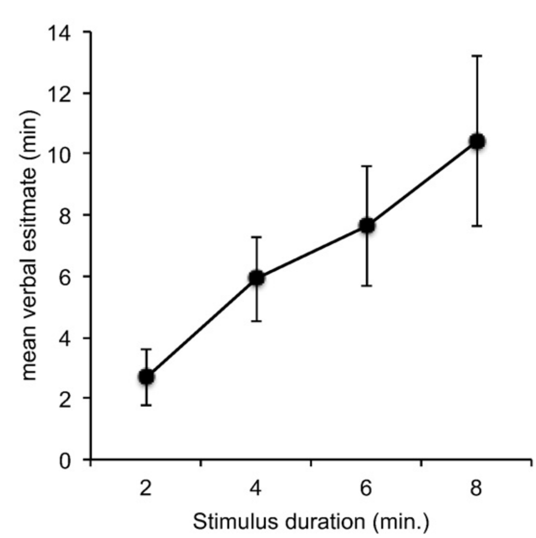

Fig. 3. Mean verbal estimates plotted against stimulus duration (minutes).

[2] An ANOVA was performed on the relative time estimates with the time-of-day factor. This factor was not significant, $F(20, 338) = 0.08$, $p = 0.64$. Furthermore, no difference was observed between the first and the last alert of the day ($p > 0.05$).

Table 4
Potential predictor of verbal estimates for durations from 2 to 8 min (Experiment 2).

Predictor	Estimate	Standard error	t-Value	*p*-Value
PoTj	−54,453 [−71,880, −37,026]	8857	−6.15	0.0001
Happiness	−1534 [−24,919, 21,851]	11,813	−0.13	0.90
Sadness	−11,794 [−35,271, 11,682]	11,487	−1.03	0.31
Arousal	−21,343 [−41,144, −1543]	10,049	−2.12	0.04
Relaxation	−5834 [−25,347, 13,678]	9851	−0.59	0.55
Activity difficulty	−1717 [−14,661, 11,227]	6557	−0.26	0.79
Attention capture	−2951 [−16,462, 10,558]	6854	−0.43	0.667

and slower when they felt sadder and more relaxed. In the present experiment, the difficulty of the activity and attention capture were also significant predictors of the PoTJ: The more difficult the activity was and the more attention it captured, the greater the acceleration of the passage of time reported by the participants was.

Unlike the PoTJ, the verbal estimates in the DJ task were not related to any of the affective and attentional states reported by the participants. We observed only a negative link between the reported level of arousal and the estimation of interval durations (Table 4, $p < 0.05$): The more nervous the participants felt, the shorter the interval durations were judged to be.

4. General discussion

To try to better understand the humans' awareness of passage of time in everyday life, the present studies examine the relations between the PoTJ and DJ with long durations between 3 and 33 s in Experiment 1 and in the range of minutes in Experiment 2, instead of 350 to 1650 milliseconds as the durations used by Droit-Volet and Wearden (2016).

The results of Experiment 1 with durations between 3 and 33 s replicated those of Droit-Volet and Wearden (2016) even though longer durations were used. Indeed, in line with their results, the results of our Experiment 1 did not find any significant relation between the PoTJ and the DJ in either the verbal estimation or the production task, whereas the temporal judgments in these two tasks were correlated. In addition, and in line with Droit-Volet and Wearden's (2016) results, we found that the experience of the passage of time varied with the emotional states reported by the participants at the moment of the alert. The participants did indeed experience a speeding up of the passage of time when they felt happier and more aroused. Conversely, they experienced a slowing down of time when they felt sadder. These self-reported emotional states did not affect the judgment of durations (DJ) in our Experiment. We only observed a significant relationship between the level of happiness and temporal production, with the participants producing shorter durations when they felt happier. The effect of emotion on DJ has been clearly established in numerous studies, at least with regard to highly arousing emotions (for a review, see Droit-Volet, Fayolle, Lamotte, & Gil, 2013; Lake, 2016). Numerous studies have indeed obtained time distortions in the form of time dilatations in different tasks involving a wide variety of emotional stimuli (i.e., emotional facial expressions, emotional sounds, emotional pictures). However, we must differentiate emotion from mood (Frijda, 2007; Izard, 1991; Sander & Scherer, 2009). Emotion consists in an intense and immediate emotional reaction triggered by an emotional stimulus, a person or a specific event. For example, detecting a snake sets off the emotion of fear, and a child's foolishness that of anger. However, mood is a more diffuse and less intense feeling that endures beyond the context that caused the emotional reaction (Ekkekakis, 2012; Frijda, 2009; Russell & Barrett, 1999). We can thus assume that the affective states assessed in our self-reported questions correspond to mood rather than emotion. This being the case, our results suggest that mood affects the subjective experience of the passage of time but is not sufficiently intense, as emotion is, to induce significant distortions in the judgment of stimulus durations. This is consistent with the fact that depressed people overcome by the mood of sadness experience a slowing down of the passage of time even though they are able to accurately judge short durations (Blewett, 1992; Thönes & Oberfeld, 2015).

In Experiment 2, we tested longer durations in the range of minutes instead of seconds, and more specifically long interval durations between two sounds. Our results replicated those of Experiment 1 by showing that the self-reported level of affective states was significantly related to the PoTJ, with an acceleration of the passage of time being experienced when the participants felt aroused and a slowing down when they felt sadder and more relaxed. We can therefore conclude that the link between self-reported affective states and PoTJ is a robust phenomenon, as it has been demonstrated in our two experiments as well in three other studies conducted in our laboratory and involving young and elderly people (Droit-Volet, 2016b; Droit-Volet & Wearden, 2015, 2016). However, in Experiment 2, we also found a significant correlation between the PoTJ and the activity performed at the moment of the alert, that is to say its level of difficulty and the attention that it required. This correlation was not obtained in Experiment 1. Larson and Von Eye (2006) and Conti (2001) also found a significant correlation between the PoTJ and the degree of engagement in activities and intrinsic work motivation, respectively. However, other studies have not found this link between activity and PoTJ (Droit-Volet, 2016b; Droit-Volet & Wearden, 2016). As suggested above, the inconsistency of the data relating to the activity is certainly due to the great variability of activities performed by individuals during everyday life and assessed by the experience sampling method. Whatever the case may be, in our second experiment, the factors associated with PoTJ once again did not, with the exception of the level of arousal, appear to be significant predictors of DJ even with long durations of several minutes. As explained above, this can be explained by the nature of affective states (mood vs. emotion) and their differential effects on time judgment as a function of the judgment type (PoTJ vs. DJ).

More interestingly, however, in Experiment 2, when the participants had to evaluate long durations of several minutes in the everyday life, our results indicated a significant relation between PoTJ and DJ in the verbal estimation task. Indeed, when the participants experienced a speeding up of the passage of time, their estimates of the interval durations tended to be shorter. A significant link was therefore found between PoTJ and DJ for durations of several minutes but not for shorter durations in the seconds range. However, it will be important to verify our results by using the same conditions for the different duration ranges, as the procedure used in Experiment 1 and Experiment 2 was not exactly the same with more alerts per day in Experiment 2, even though the time of the alerts during the day had no significant effect on time judgment. Nevertheless, the significant link between PoTJ and DJ for durations of several minutes but not for shorter durations in the seconds range raises questions about the judgment of the passage of time. The PoTJ corresponds to an everyday awareness of time that is expressed in a qualitative form as the verbal ascertainment that time is shorter or longer than usual. In laboratory situations, when participants are instructed to explicitly judge short durations of a few seconds,

Table 5
Potential predictor of passage of time judgment (Experiment 2).

Predictor	Estimate	Standard error	t-Value	*p*-Value
Verbal estimates	−0.000002 [−0.0000003, −000001]	0.0000001	−4.63	0.0001
Happiness	0.11 [−0.04, 0.26]	0.08	1.50	0.14
Sadness	−0.21 [−0.35, −0.06]	0.07	−2.77	0.006
Arousal	0.27 [0.16, 0.39]	0.06	4.67	0.0001
Relaxation	−0.15 [−0.28, −0.01]	0.07	−2.20	0.03
Activity difficulty	0.12 [0.03, 0.20]	0.04	2.58	0.01
Attention capture	0.15 [0.07, 0.22]	0.04	3.58	0.0001

they deliberately allocate attention to stimulus durations in order to measure them, to give a duration judgment. In the laboratory situations, stimulus durations are thus always consciously processed. However, in ecological everyday situations, even if durations are continuously processed to predict and anticipate events in order to permit behavioral adaptation to the environment, they certainly do not constitute the focus of consciousness, even in the case of durations of several seconds. As suggested by Fraisse (1967), the sensation of duration only emerges in consciousness when time becomes burdensome in the activity. Based on Janet's idea, he added that the case in which we are most clearly aware of time is when we are waiting. Waiting is indeed an active regulation of action between two phases: preparation for an action and its outcome (Janet, 1928). We can therefore assume that the PoTJ in everyday life is related to the judgment of durations of several minutes and not to that of shorter durations, because the short durations (<30 s) are not in the focus of consciousness in the everyday life, and the PoTJ is spontaneously based on a time scale of several minutes, which corresponds to the daily activities and events of life. However, the question of the exact reference (temporal span) used by participants to make their PoTJ still has to be considered. Furthermore, a link between PoTJ and DJ in the minutes range was empirically established in our study. However, new experiments are required to go further, even if it is difficult to do due to the current lack of scientific studies of the judgment of long durations of several minutes, in particular in everyday life. We possess only a few studies testing specific tasks lasting several minutes (playing video games, reading a text) (Bisson, Tobin, & Grondin, 2012; Tobin & Grondin, 2009; Tobin, Bisson, & Grondin, 2010). Other, more numerous, studies have examined long tasks but in a retrospective time judgment paradigm and involving only a single trial since the participants had to be unaware of the fact that they were going to have to estimate time (Zakay & Block, 2004). Nevertheless, all these studies on long durations of several minutes highlight the close link between time and memory. The mechanisms underpinning the processing of durations of several minutes (temporal memory) thus differ from those that underpin the processing of short durations (internal clock). This would explain the dissociation between the PoTJ and DJ observed for the short and not the long durations. Consequently, the PoTJ would be largely based on the memory judgment of the current activity. In sum, it is necessary to experimentally examine the memory processes involved in the estimation of long durations of several minutes if we are to gain a better understanding of the mechanisms common to both the PoTJ and the DJ.

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