14 Subjective Duration in the Laboratory and the World Outside

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This chapter deals with the topic of *subjective duration*, defined as judgments of various sorts about how long stimuli and events last, or judgments about how fast time seems to pass. Studies of subjective duration have formed the major part of the study of time perception by psychologists (see Fraisse, 1964, for example), although duration judgments are only part of the broader psychology of time, encompassing as it does such things as judgments of temporal order, as well as the study of rhythm perception and production.

The literature on the perception of duration is far too voluminous to be reviewed here, but fairly recent discussions of some aspects of duration judgments are to be found in Wearden (2003) and Wearden and Lejeune (2008), as well as edited volumes such as Meck (2003) and Grondin (2008). Readers interested in the early history of research on duration perception might also read Lejeune and Wearden (2009).

This chapter is intended to discuss some studies of duration judgment in situations intended to mimic aspects of real-life situations, although data come from rather artificial laboratory experiments or results obtained from questionnaires posing questions about time experience in ordinary life. Its principal ideas may be briefly summarized as follows: (a) there are two fundamentally different sorts of questions that can be asked about subjective duration, and these concern *duration judgments* (questions about how long some stimulus or event appeared to last) and *passage of time judgments* (questions about the phenomenal "speed" of time during some event); (b) both duration judgments and passage of time judgments can be based on either *direct experience* of the event judged, or some kind of *inference* about the event, which may not involve the same direct experience of time, in the sense that attention was not paid to time during the event.

Lack of clarity about what people are doing when they make different sorts of duration judgments (in particular when verbal responses are obtained from participants) is a major source of confusion in the field and can lead to pseudo-problems where common explanations are sought in vain for what are probably quite different phenomena, as well as a pervasive lack of focus about what is being discussed. Particularly confusing is the question of what people mean when they say that "time flies" or "drags," and what the implications of this are for measurements of subjective time. The case of "flying" time could mean that

duration estimates are systematically changed compared with some control condition, although it is unclear what the exact prediction would be if "time flies" during some interval. Would the estimate of the interval duration be longer if "time flew," or shorter? If time "goes faster" during some event, is there "more time" in the event (so judgments are increased relative to a control condition), or is the event shortened in time, just as journey time is shortened if we go faster?

Adding to the confusion is what the implications are of time judgments being based on some clocklike mechanism that can "tick" at different rates. To strip internal clock theory down to its simplest, suppose that the estimated duration of some event is ordinally related to the number of "ticks" that occur in it: more ticks therefore give rise to longer estimates. The effect of increasing the rate of ticks ("clock speed") would be to increase duration estimates (as more ticks accumulate than before), so external stimuli would seem to last longer, presumably giving rise to the sensation of time "dragging." So, if the clock "speeds up," perceived time would appear to "slow down," and the reverse is also true of clock slowing: slower clocks make events seem shorter, so (at least presumably) give rise to time "speeding up" (see Penton-Voak et al., 1996 and Wearden, 2008a). As will be seen later, however, estimates of duration in laboratory situations can often be changed without any apparent change in the passage of time at all.

Perhaps statements that "time flies" or "drags" are best related to passage of time judgments rather than duration judgments. Here, the implications are at least clearer: presumably, by definition, the statement that "time flies" is a statement about the feeling of passage of time (feelings that can be quantified, as will be seen later). The question then arises of what the relation is, if any, between differences in passage of time judgments in different situations, and changes in duration judgment, and this question will be addressed in a later section.

Another definitional issue is that we need to address what we mean by "subjective" in subjective duration. To us, the situation is simple: *all* psychological judgments of stimuli and events are subjective, whatever the unit the judgment is expressed in (ranging from physical units like milliseconds for duration, which seem to confuse some people into thinking that these time judgments are in some way "objective," to ratings of the beauty of film stars and models). All involve some kind of translation of a physical stimulus into something internal, a *psychophysical process*, as Fechner described in his *Elements of Psychophysics,* 1860, section VII, "The Measurement of Sensation," in Langfield's (1912) translation; see Herrnstein and Boring (1965, pp. 66–75).

> It must be remembered that the stimulus does not cause sensation directly, but rather through the assistance of bodily processes with which it stands in more direct connection. The dependence, quantitatively considered of sensation on stimulus, must finally be translated into one of sensation on the bodily processes which directly underlie the sensation—in short the psycho-physical processes; and the sensation, instead of being measured by the amount of the stimulus, will be measured by the intensity of these processes.

In addition to the issue of what "subjective duration" means in timing studies, there are further distinctions that are useful. A particular complexity of time perception research is that judgments (both of duration and passage of time) can be based on *direct experience* or on *inferences*. In the first case, people actually appear to experience the passage of time directly, and in the other case something intrinsically nontemporal is used to make duration judgments. This interacts with the well-known distinction between *prospective* and *retrospective* timing. The terms "prospective" and "retrospective" are somewhat confusing to readers outside the time perception field, since they do not involve differences in *when* the time judgment is made: almost all time judgments are made retrospectively, when all or part of some event has elapsed. The distinction refers, rather, to the instructions given to participants before the study begins: in *prospective timing* people are told that the task involves time judgment (e.g., "hold down this button for one second," "when the tone finishes tell me how long it lasted"), whereas in *retrospective timing* people are asked to perform a task, with time not being explicitly mentioned, and then at the end of some time period they are, unexpectedly, asked how long the period has lasted.

It is tempting to map the "experience-inference" distinction directly onto the "prospective-retrospective" one and to conclude that prospective timing is based on *experienced* time, and retrospective timing based on *inferences* about nontemporal "information" processed during the event judged, but this would only be partially true. Prospective duration judgments in the sense defined above can be based on inferences: for example, a person could be asked to give a series of estimates of the time needed to travel between pairs of places (so they know in advance that time judgments are required, thus the time judgments are prospective by definition), but use distance to make the judgments. Indeed, people can estimate the time needed to go from A to B, possibly quite accurately, without having been to either place. Retrospective duration judgments, on the other hand, are certainly almost always inferences of some sort, as the instructions given for the task did not involve any requirement to "pay attention" to time.

It might also appear that passage of time judgments are based on experiences, the idea that people "feel" that time is passing slowly or quickly, so passage of time judgments are based on phenomenal experience of time passage. This is almost certainly true in many or most cases, but passage of time judgments can also be based on inferences. A person may believe that "time passes quickly when you're enjoying yourself " (more on this later), so an enjoyable period may be *assumed* to have passed quickly, yet the person in fact may not have experienced the passage of time as fast or slow during the time period in question.

We should admit at the outset that this brief discussion of types of timing does not exhaust the domain of judgments that people can make about duration, and some others are mentioned later. Neither is the "experience-inference" distinction entirely unproblematic; for example, a person will still have some phenomenal experience of time when in a retrospective timing experiment, even though time does not appear to be the focus of interest of the study from the person's point of view. A more detailed discussion of these matters

could, however, occupy this entire chapter, and may try the patience of readers. Rather, we attempt to wrestle with some of the questions about how duration judgments and passage of time judgments are made by reference to empirical data.

How are duration estimates and passage of time judgments related? In some cases, marked differences in duration judgments may not be accompanied by any feeling that passage of time differs between the conditions compared. Figure 14.1 shows an example. This shows verbal estimates (in ms) of the duration of auditory and visual stimuli (tones and squares of color on a computer screen, respectively). Durations actually ranged from 77 to 1183 ms, and people were asked to use a scale where "1000" = 1 second. The upper panel shows results obtained when people received either visual or auditory stimuli, and the lower panel the effects of receiving both, so essentially the study replicates the main results of Wearden, Todd, and Jones (2006) that auditory-visual differences can be manifested when verbal estimation is used, even when different groups receive the stimuli to be judged. For present purposes, the important result is that the very marked difference in prospective duration judgments is not accompanied by any feeling of difference in the passage of time: auditory stimuli do not seem to "rush" or "drag" compared with visual ones. Other examples of this are the effects of "filled" versus "unfilled" intervals (e.g., Wearden et al., 2007), or the effect of click trains on subjective duration. It has been known since Treisman et al. (1990) that click trains can make both auditory and visual stimuli seem longer. For example, Penton-Voak et al. (1996) found that both auditory and visual stimuli were estimated as lasting longer when preceded by a 5 second train of clicks than without clicks, a result replicated in a number of studies since (e.g., Wearden et al., 1998). Work by Jones, Allely, and Wearden (2011) has shown that the click trains can enhance performance on reaction time and memory tasks, possibly by giving people "more time" to perform the tasks required, although that is not the only possible explanation of the effects obtained. In no case, however, was the change in performance, whether a time judgment or something else, accompanied by any sensation that the passage of time had been changed by the clicks.

In contrast, there are situations, some to be described later, where passage of time changes between conditions, but duration estimates are unaffected. Wearden (2008b) reported one such effect, in which instructions to process a film clip differently changed passage of time judgments but had no effect on duration judgments, and everyday life furnishes other examples. A person may be in a queue in a supermarket with a clock visible. There is no ambiguity as to the actual time elapsed, so duration estimates would be 100% accurate if required, yet the passage of time experience may be different from the same known time period spent in some more enjoyable activity. The relation between the "content" of time intervals, how the duration is estimated, and passage of time experienced is discussed in more detail later.

14.1 Retrospective Timing and Passage of Time Judgments

In the world outside the laboratory, people have many potential cues that they can use to judge duration, such as the events occurring during time periods, distances traversed, and

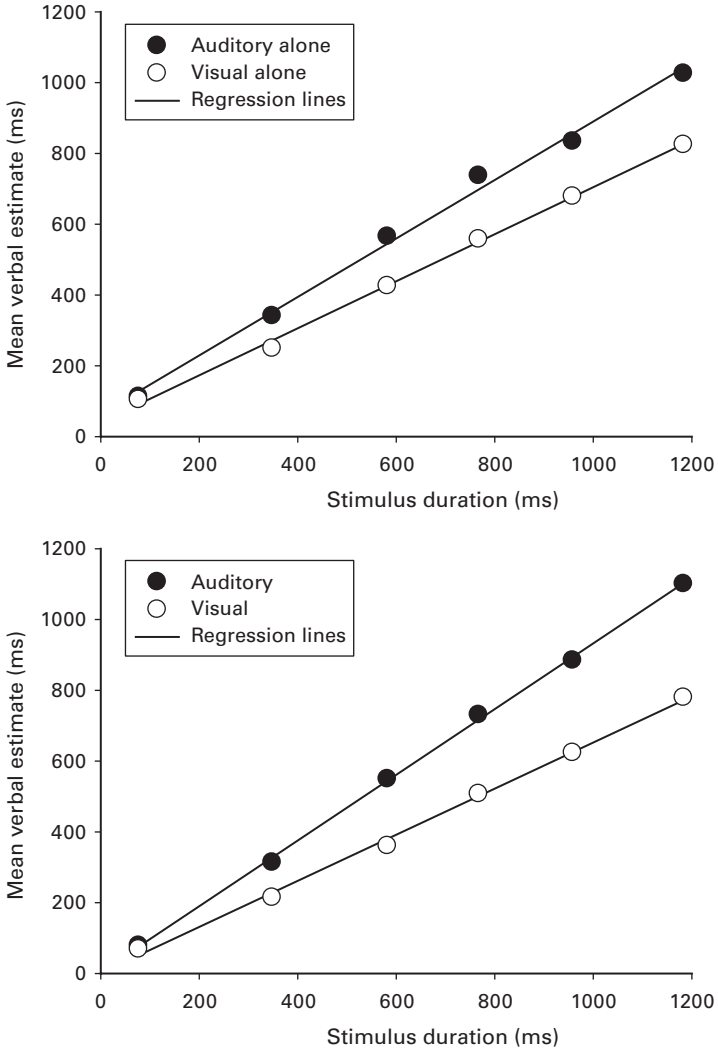

Figure 14.1
Upper panel: Mean verbal estimate (in ms) plotted against stimulus duration for judgments of the duration of auditory and visual stimuli in conditions where participants received either auditory or visual stimuli. Lower panel: the same measure from participants who received intermixed trials with auditory and visual stimuli.

so on. The common use of such cues suggests that many real-world duration judgments might be largely retrospective in nature, which is not to deny that the "deliberate" timing of events is something that people do in some circumstances in their everyday lives. In addition, many statements about time experiences in real life, such as those related to time passing quickly or slowly, at parties or in queues, seem more closely related to passage of time judgments than duration judgments of any sort, either retrospective or prospective. These considerations lead us to the conclusion that attempts to investigate phenomena related to outside-world timing in the laboratory might be more usefully focused on retrospective timing rather than prospective timing (although studies of prospective timing are overwhelmingly common in the timing literature), and that passage of time judgments might also form a fruitful area of research. Unfortunately, both retrospective timing and passage of time judgments have received relatively little previous research compared with prospective timing, so we will try to fill the gap with some studies of our own, which, alas, are not sufficiently extensive to investigate all the issues of interest. We start with some discussion of the differences between prospective and retrospective timing, and then move on to some of the factors said to influence both sorts of judgments.

Many studies have indicated fundamental differences between prospective and retrospective timing. For example, Hicks, Miller, and Kinsbourne (1976) used a card-sorting task in which cards contained varied amounts of information. Judgments of the duration of the entire task were made under either prospective or retrospective conditions. Hicks et al. (1976) found that, under prospective conditions, the more information processing was involved in sorting the cards, the shorter the duration estimate, but no effect of information-processing load was found for retrospective judgments.

A common idea (e.g., Ivry & Hazeltine, 1992) is that prospective time judgments involve "timing with a timer"; that is, they are based on the operation of some timing-specific mechanism, such as an internal clock. In contrast, retrospective timing involves "timing without a timer," where the time judgment is not based on the activation of timing-specific mechanisms, but instead derived from something else. So what are retrospective duration estimates based on?

Ornstein (1969) with his "storage-size hypothesis" suggested that the amount of information stored in memory since a given start point can be used to produce a retrospective time estimate. So, for example, the more information processed during a time period, the longer the retrospective duration judgment of that period. However, Block and colleague (Block, 1982; Zakay & Block, 2004) have proposed that varying the level of information processing in a time period affected only prospective judgments, and that retrospective timing judgments were based on the amount of cognitive "contextual changes" (e.g., changes of environment, mood, task type, and shifts of cognition) that occur. This contextual-change hypothesis has gained support from a number of studies. For example, Zakay and Block (2004) showed that a task involving resolving syntactic ambiguity shortened prospective estimates, whereas retrospective estimates were lengthened, a result Zakay and Block (2004)

suggest is due to contextual changes arising while solving the ambiguity. Likewise, when carrying out a task-switching procedure, prospective estimates remained unaffected, while retrospective durations were lengthened.

The claim that the amount of "information processing," "memory storage," or "contextual change" is used to make duration judgments in retrospective conditions sometimes receives striking confirmation in experimental data. The upper panel of figure 14.2 shows an example from research conducted at Keele University. People made verbal estimates of a 181-second interval either in two retrospective (conducted first) or two prospective conditions. The conditions differed only in the amount of "information processing" required. The task was always the same: the participant received a display containing the numbers "0" to "9" arranged in a 3×3 matrix, and had to identify which number was missing. In the low information-processing condition, the numbers were arranged in numerical order, while in the high information-processing condition the numbers were in random order, which made finding the missing number subjectively much more difficult and took longer. The upper panel shows mean verbal estimates: here, the prospective estimates were significantly longer overall, but there was a just-significant interaction between information-processing load and timing condition. A higher information-processing load made the retrospective estimates longer, but the prospective ones shorter. In contrast, passage of time judgments (on a scale from 0 to 100, where higher numbers mean faster) were not affected by the timing condition (prospective or retrospective), but were significantly faster in the high information-processing condition.

The data on duration judgments replicates work by Block (1992) that information-processing load had different effects on retrospective and prospective timing, lengthening estimates in the former case and shortening them in the latter. The effect of information-processing load on passage of time judgments was significant, but did not depend on timing condition, illustrating a dissociation between duration judgments and passage of time judgments similar to that noted elsewhere (e.g., Wearden, 2008b, who reported manipulations that changed passage of time judgments but did not affect retrospective duration estimates at all).

The finding that "more information processing" increases retrospective duration estimates is in line with most previous work (see Block, Hancock, & Zakay, 2010 for a review) but, alas, other data from our own studies suggest a more complicated picture. A well-known manipulation in memory studies is "levels of processing" (Craik & Lockhart, 1972). The basic idea here is that the same verbal material can be processed to different levels of "depth." For example, a judgment might be "shallow," such as deciding whether a word presented is in upper or lower-case letters, or might be "deep," such as deciding whether the word is the name of an animal. The first of these is supposed to engage only superficial visual processing, the latter a deeper, semantic processing. The normal finding from such manipulations is that the words are remembered better after "deep" (e.g., semantic) processing, a finding so robust as to be a standard manipulation in psychology laboratory classes.

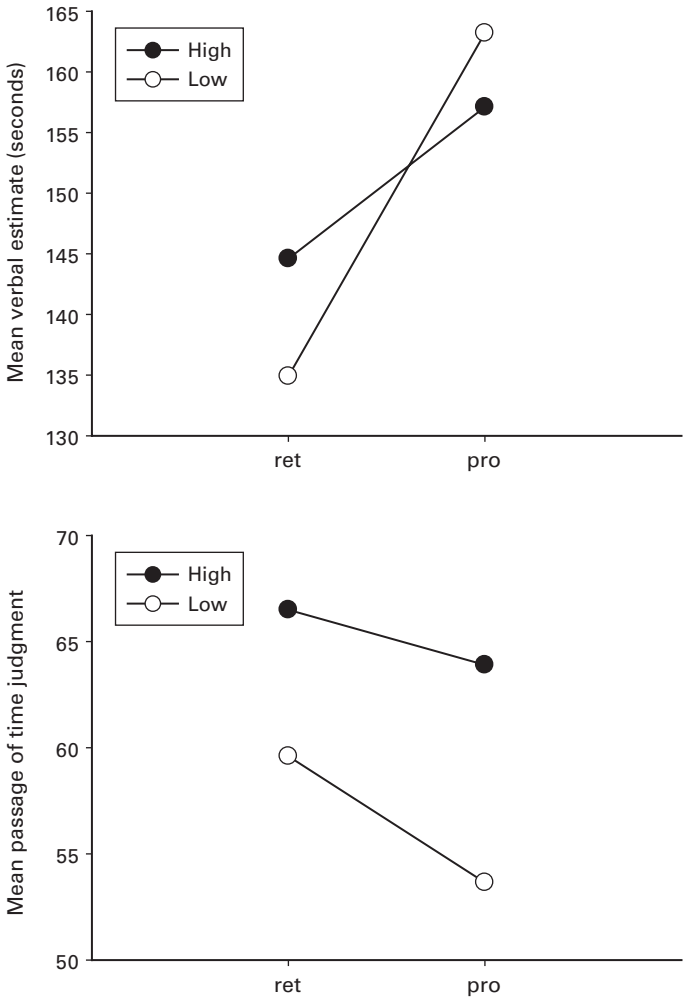

Figure 14.2
Upper panel: Durations estimates (in s) from retrospective (ret) and prospective (pro) duration judgments, under conditions of high and low information-processing load. Lower panel: Passage of time judgments from the same condition. The scale runs from 0 (slowest possible) to 100 (fastest possible), with 50 as "normal."

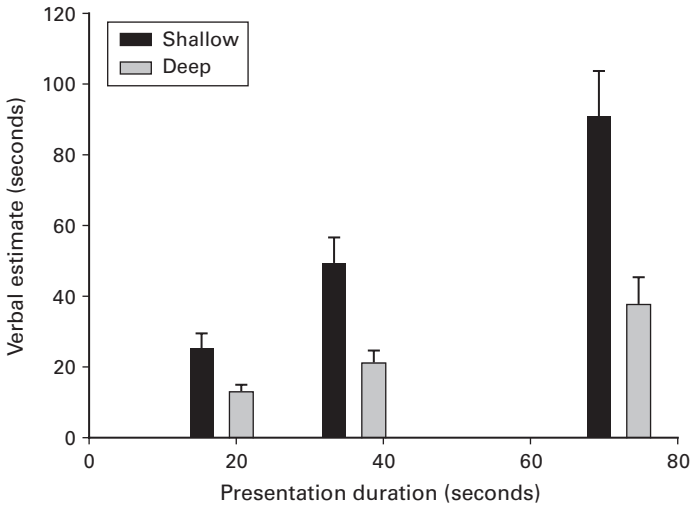

Figure 14.3
Mean retrospective time estimates (in s) of word sequences lasting 18, 36, and 72 s. Different groups received shallow (graphemic) or deep (semantic) processing of the letters. Vertical bars show standard error of the group mean.

Given that, almost by definition, semantic processing is "deeper" than processing the superficial appearance of words, this manipulation was used in a retrospective timing task. Participants received three series of words lasting 18, 36, or 72 seconds. Then, after all three had been presented, the participant had unexpectedly to judge how long each series had lasted. Different groups received either "shallow" processing of the words (upper- or lower-case), or a "deep" processing condition involving identifying whether each word was the name of an animal. Results from the duration estimates are shown in figure 14.3. Obviously, estimates were much shorter in the deep processing group than the shallow one: there were significant effects of event duration (18–72 seconds), group (shallow and deep), and an interaction between the two, suggesting that the between-group difference increased as the word series got longer. Here, we appear to have a result contrary to expectations: the form of processing that is defined as deeper (and presumably thus involves more information processing) produces retrospective estimates that are much shorter than the shallow processing.

A replication of this study produced similar results, and additionally included passage of time judgments. As in other studies (Wearden, 2008b), longer events were associated with slower passage of time, but there were also effects of processing type. For the 18 second sequence, passage of time was judged slower with deeper processing, whereas for the 72 second sequence the deeper processing produced relatively *faster* passage of time judgments. Once again, therefore, passage of time judgments and duration judgments seem to be dissociated: events can differ significantly in reported passage of time, while being virtually

identical in judged duration (Wearden, 2008b), and faster or slower passage of time can be associated with longer or shorter duration judgments.

Another experiment attempted to manipulate both information-processing load and contextual change in combination. Participants received displays of letters and were directed to activate a counter every time they saw an E (low information-processing condition), or either an E or A (high information-processing condition). To produce differences in contextual change, letter strings were either presented in white on a black background (low contextual change) or alternated between white letters on a black background and green italic letters with a green box surround on a black background (high contextual change). These two manipulations have considerable face validity. It seems true by any reasonable definition of information processing that searching for two letters involves a higher load than searching for one. In addition, the manipulation of letter color, letter font, and background color has been a standard manipulation in studies of context-dependent memory. Thus, in terms of current understanding of "context," our different conditions involve different amounts of contextual change.

Figure 14.4 shows duration estimates (upper panel) and passage of time judgments (lower panel) from the different conditions. There were no significant effects on retrospective duration judgments of either information-processing load or the contextual change manipulation, nor any interaction between the two. In contrast, passage of time judgments were significantly higher when information-processing load was greater, but there was no effect of contextual change, nor any interaction with contextual change. The effect of information-processing load on passage of time judgments is, of course, the same effect as shown in figure 14.2.

The results shown in figures 14.2, 14.3, and 14.4 come from a much larger series of studies of retrospective timing and passage of time judgments carried out over the last few years in the first author's laboratory, and their results are depressingly representative of those obtained more generally. Attempts to manipulate retrospective duration judgments by changing the content of the period to be judged sometimes produce significant effects (figure 14.2), and even, on occasion, dramatic differences between conditions (figure 14.3). On the other hand, as Wearden (2008b) showed, some manipulations produce little or no effect on duration judgments, even though these seem to clearly involve differences in the amount of "information processing" or "contextual change" between conditions (e.g., figure 14.4). The factor that does reliably manipulate retrospective duration judgments is, of course, the actual duration of the events timed. Although judgments may not be accurate, they are invariably sensitive to differences in real duration. There is no doubt that participants are exhibiting sensitivity to actual duration in retrospective timing studies, so they must be basing their judgments on *something* that has occurred during the interval, but discovering exactly what they are using is proving difficult, in spite of the fact that previous theory sometimes works well (e.g., figure 14.2). An obvious problem is defining what exactly is meant by "information processing" or "contextual change." Results from our experiment

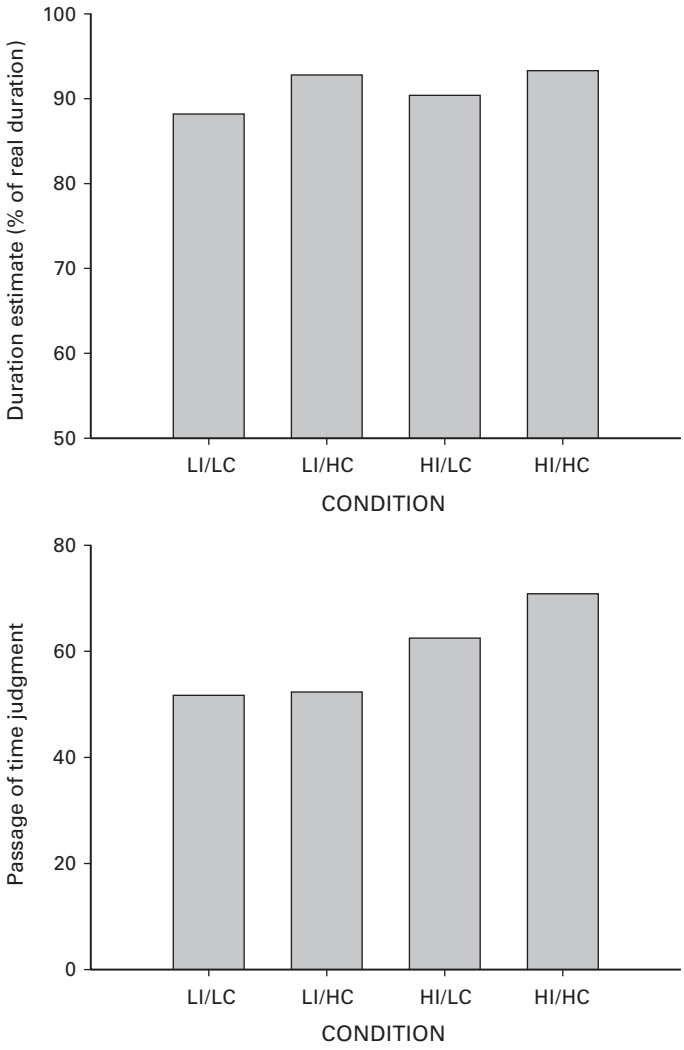

Figure 14.4

Upper panel: Retrospective duration estimates (percent of real duration) from four different conditions: LI, low information load; LC, low contextual change; HI, high information load; HC, high contextual change. Lower panel: Passage of time judgments from the same conditions. The scale runs from 0 (slowest possible) to 100 (fastest possible), with 50 as "normal."

show that increasing information-processing load by making the same task more or less difficult, or varying the "depth" of processing, which presumably change processing type, do not have equivalent effects on retrospective timing.

On the other hand, passage of time judgments appear very sensitive to content of the events timed. We have found that if film clips are used, clips judged as more exciting almost always receive "faster" passage of time judgments than boring ones, although effects on duration judgments are unpredictable (sometimes exciting clips are judged as relatively longer, sometimes shorter, with no effect often being found). Passage of time judgments seem to be affected by hedonic qualities of the events experienced, with more pleasant-exciting-involving events being associated with faster passage of time. So, it appears that "time flies when you're having fun" (or at least the fun that laboratory experiments can provide), but this does not translate reliably into judgments of duration. We return to this question later, in a discussion of the way in which "time flies" outside the laboratory.

Another experiment attempted to explore potential correlates of passage of time judgments, but in addition tried—so far as we know for the first time in an experimental study—to try and capture what might be described as "feel judgments." "Feel judgments" reflect the common situation that events "feel" longer than a person knows them to be. So, in response to the question, "How long were you in the queue for?" a person might reply, "Only five minutes, but it seemed a lot longer." The five-minute duration estimate might be retrospectively or prospectively produced or might come from observation of a clock, so can be completely accurate, but something about the experience of this particular interval is conveyed in the answer.

The experiment attempted to capture "feel judgments" by presenting the same film clip (which lasted 150 seconds) four times. The first duration judgment was retrospective, the subsequent ones presumably prospective, but, as the upper panel of figure 14.5 shows, this judgment hardly changed at all (and did not change significantly) with repeated viewings. This is perhaps only expected, as the events repeated were identical. On the other hand, when people were asked how long the interval "felt," judgments significantly, and very markedly, increased with repeated viewings. Obviously, from a single experiment it is difficult to be absolutely sure what is being measured, and further work is needed, but the commonplace dissociation in real life between how long a person knows an interval to be and how long "it feels" clearly transfers to a laboratory study, and what this dissociation actually means might be elucidated by further work.

The center panel of figure 14.5 shows passage of time judgments for the repeated viewings, with lower values indicating slower passage of time, as well as judgments of how much attention was paid to the clip, with lower values indicating "less attention." In accord with intuition, both measures decreased with repeated viewings, so changes in the "feeling" of duration were associated with ratings of slower passage of time and decreasing attention. The lower panel shows ratings of how much participants enjoyed or liked the film, how exciting they thought it was, and how it engaged, bored, or annoyed them. Once again,

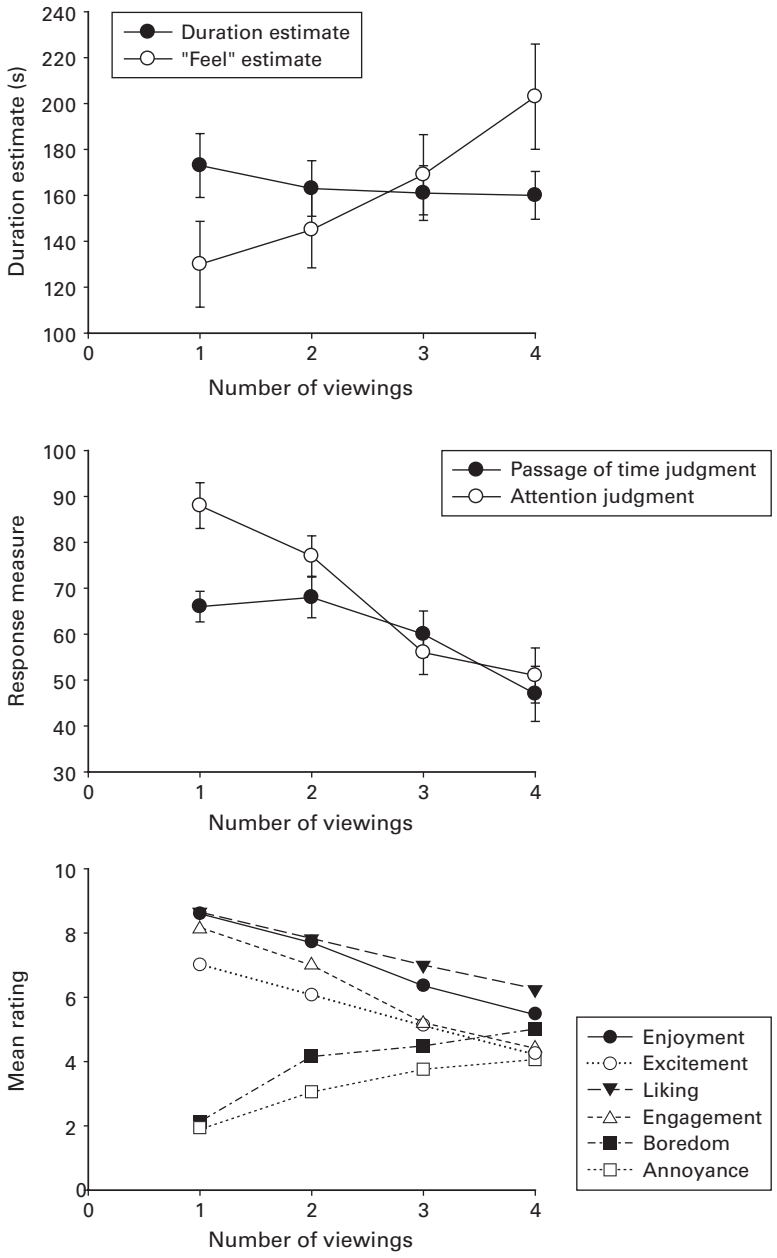

Figure 14.5

Upper panel: Duration estimates and "feel estimates" (in s) as a function of repeated viewings. Center panel: Passage of time judgments, and ratings of attention paid. Scale runs from 0 (slowest/least) to 100 (fastest/most). Lower panel: Ratings of enjoyment, excitement, liking, engagement, boredom, and annoyance as a function of repeated viewings. Scale runs from 0 (least) to 10 (most).

higher scores indicate more of the quantity rated. Boredom and annoyance increased with repeated viewings, whereas "positive" ratings decreased, and ratings on all scales changed significantly over repeated viewings.

The data in the lower part of figure 14.5 show similar variation in passage of time judgment and hedonic features of the participant's experience, and this fits with the common notion that hedonically positive events are the ones for which "time passes quickly," although the "time" that is affected appears to be passage of time judgment, rather than retrospective duration judgment, which has little systematic relation to event content, at least in our studies.

The "feel" experiment also shows ways in which laboratory studies can be designed to try to capture aspects of real-life time experiences, which may not simply relate to judged duration. How validly the procedures used in these experiments capture aspects of real-life time experiences is hard to judge, but they represent a transition between "psychophysical" studies of duration, usually involving very simple stimuli such as tones or patches of color, and investigations that try to find what people report happens in "real life," and it is to a study of this type that we now turn.

14.2 Time outside the Laboratory: When Does "Time Fly" or "Drag"?

In one of the few studies of passage of time judgments, Flaherty (1991) suggests that "extraordinary circumstances make for abnormal temporal experiences" (Flaherty, 1991, 77). Flaherty examined 326 narratives taken from popular biographical books and 316 stories taken from undergraduate students during interviews, and focused on incidents in which subjective time appeared to pass more slowly than objective time. Data from the narratives and the interviews were coded according to whether they were higher or lower in complexity than "average" activity: 41.1 percent of descriptions contained reference to a lower than average level of complexity, and 58.9 percent referred to situations of higher than average complexity. No descriptions reported a slowing of the passage of time under normal circumstances. Flaherty concluded that there was a U-shaped relationship between the level of stimulus complexity and the passage of time, with both extreme complexity and low levels of complexity leading to a slowing in the passage of time.

We recently conducted a study rather similar to Flaherty's, and in our work real-life time experiences were obtained using an anonymous web-based questionnaire in research conducted at Liverpool John Moores University. A total of 203 undergraduate students participated for course credit. The questionnaire involved three structured sections asking questions about passage of time after (a) drug consumption, (b) common activities, and (c) psychological states. In addition, an open-ended question was also posed to allow participants to describe an occasion in which they had experienced a distortion in the passage of time. Participants who had reported taking drugs within the last year were advised to describe a situation in which drugs or alcohol had been consumed wherever possible. For example,

In the box below please describe a situation in which time appears to have elapsed at a different rate to normal (e.g. faster or slower). Please use as much detail as possible, describe what you were doing at the time, how you felt, who you were with and whether you thought that time was passing more quickly or more slowly. Please also indicate which drugs you had taken at the time.

Responses to this question were analyzed using content analysis by two researchers. Analysis focused on reports of drug use, activity, emotion, and the direction of temporal distortion (fast or slow) within the participants' descriptions.

The upper part of table 14.1 shows the frequency with which participants reported time passing more quickly and slowly under drug-taking conditions. Examination of the data suggests that distortions in which time passed more quickly than normal were more commonly

Table 14.1

Drug	Time passing more quickly	Time passing more slowly
Alcohol	74*	6
Cannabis	9	12
Cocaine	14	0
MDMA	9	5
Ketamine	1	2
Poppers	1	2
No drug taking mentioned	32	35
Activity	**Time passing more quickly**	**Time passing more slowly**
With friends or family	58*	5
Alone	0	2
Busy	12	0
Bored (at work)	0	25
Partying (e.g., at a nightclub)	63*	6
Emotional adjective	**Time passing more quickly**	**Time passing more slowly**
Afraid	7	13
Anxious or stressed	46	58
Aroused	12	12
Bored	2	181*
Busy	149*	3
Concentrating	79*	15
Distracted	46	34
Excited or anticipating	55	31
Happy	103*	10
Intoxicated	37	9
Sad	5	71*
Tired	17	117*

reported than distortions in which time passed more slowly than normal. In particular, alcohol and cocaine intoxication appear to be associated with increases in the passage of time. When drugs were not consumed, or cannabis or MDMA were consumed, increases and decreases in the passage of time appeared equally likely. Among the qualitative reports were:-

Time flies when I'm out with friends either drinking or had some coke. Dancing, chatting. Next minute you know, it's 3 a.m.

Of respondents who reported having taken drugs, 66 percent agreed that distortions occurred more frequently when under the influence of drugs than when not.

The middle part of table 14.1 shows the frequency with which different activities were reported in participant descriptions of an event in which time was distorted. Examination of the data suggests that time passing more quickly than normal was associated with being around friends and being at parties. Both of these activities were also consistently reported in conjunction with alcohol consumption. Time passing more slowly was associated with being bored at work. There were statistically significant associations between being with friends or family and increases in the passage of time, and being at parties was also associated with increases in the passage of time. As one participant reported:

When at work and very busy time seems to fly really quickly, or when at work and not busy at all, time goes really slow and I seem to be working forever.

The lower part of table 14.1 shows the percentage of responses in each category to the question, "When time passes more quickly/slowly I am generally (tick up to 3 responses)." Examination of the data reveals that participants associated slower passage of time with boredom, sadness, and fatigue, whereas an accelerated passage of time was associated with busyness, happiness, and concentration.

With respect to effects of drugs, the study examined what people said the effects of drugs were, rather than measuring actual pharmacological effects, as in a laboratory study. With respect to alcohol, this was almost always consumed in social situations, as one participant noted:

Alcohol consumption seems to lead to time speeding up—possibly due to the fact that I am socialising at the same time and therefore having fun.

In laboratory studies, effects of alcohol are varied and complex and do not generally support the idea of time "speeding up" (e.g., longer duration estimates). A study by Ogden et al. (2011), which also provides a review of the literature on alcohol and time perception and is one of the few to examine passage of time judgments after alcohol administration, did, in fact, find faster passage of time judgments when participants were mildly or more moderately intoxicated, although there was no effect on retrospective time judgments, and effects on prospective time judgments were complex. In general, then, reports of associations between real-life time experiences and drug states may not always correspond with effects obtained after laboratory administration of the drug. Obviously, there could be many

reasons for this, such as events in the environment in which the drugs are consumed, and the fact that participants know they have taken the drug.

An important aspect of the reports of passage of time in real-life situations was that anecdotes often strongly suggested that the reports were based on *inferences*, sometimes involving clock-measured time, rather than direct experiences. For example,

> After taking cocaine with 2 friends and sitting round her house after a night out which ended at approximately 3am, it seemed to all of a sudden be 7am, so therefore time had passed quicker than I thought it had.

or

> When I have consumed alcohol time passes quicker. I no longer take note of time. I generally only become aware of the time when the bar/pub I am in begins to close or someone around me makes me aware of what time it is.

These reports suggest that the judgment of rapid passage of time is occasioned by an external time marker (a clock, or the pub closing), which prompts the person to then make the judgment that time has passed quickly. Before that, they had no "sensation" of rapid time passage, and may have been not have had any clear sense of time at all, as in one report:

> After consuming alcohol, time has gone a lot faster when I have been in a nightclub and having a lot of fun from really enjoying all the music being played, concentrating only on having fun and dancing, and not what time it is.

The role of external time markers in people's judgments of passage of time, or "feel judgments," which may be closely related, is an under-researched area. All of us have had the experience of being engrossed in some activity (reading, for example), then looking up at a clock and thinking "Is it x o'clock already?" This question implies a discrepancy between clock-measured time and something else, and this may be responsible for reports of "abnormal" passage of time. There are few data on what happens in these situations. Our qualitative reports suggested that reports of "fast" passage of time were usually inferences (as in the examples above), where people had not actually experienced anything particular about time or paid attention to elapsing time at all during the event reported. On the other hand, reports of "slow" passage of time seemed to be based on direct experience, as in

> Time appeared slower, in work, on a really quiet day with hardly any customers, only two other staff members, really bored.

Here, the participant seems clearly to be reporting some phenomenal effect of "slow time" that is actually experienced during the event. Some caution is obviously necessary in interpreting anecdotes from a single study, but one possibility is that real-life time experiences can involve asymmetries. When "fast time" is reported, the report is generated on the basis of an inference, often prompted by an external time marker, without any actual "feel" of fast time during the event. In contrast, "slow time" seems to have been directly experienced

during the event itself. Obviously, further research on what happens when judgments are made about temporal aspects of real life events is warranted.

14.3 Discussion and Conclusions

Psychological judgments made in real life are complicated. The stimuli that people perceive are highly complex compared with some of the material used in psychological laboratories, and may be multidimensional in ways that make different stimuli hard to directly compare. Judgments of all kinds of psychological quantities, from duration to attractiveness, may be influenced by the current actions and emotions of observers, to say nothing of individual differences in previous experiences, biases toward certain sorts of responses, or differences in preference for one thing over another. The complexity of real life provides an excellent reason for experimental psychologists to avoid it, yet in order to explore what people experience about time in everyday life, we need to find some way of bridging the gap between psychophysical laboratory studies and events in the "real world."

A particular problem is that statements about real-life time experiences may not in reality be based directly on experiencing the event reported. When people say that "time passes quickly when you're enjoying yourself" they may, as shown above, be reporting the results of an inference based on information received from a clock or other externally timed events. Likewise, does time pass more quickly as you get older? Studies of timing in normal individuals older than students has found rather small effects of aging on performance on timing tasks (e.g., Wearden, Wearden, & Rabbitt, 1997; Wearden, 2005), and larger effects that are found (e.g., Craik & Hay, 1999) may have unspectacular causes, such as slowing in the rate of counting as people age. Perhaps the reported "speeding up" of time in the elderly is mostly an inference: when some external timing signal is received from a clock or a television program, the person infers that the day has flown by, possibly because of discrepancies between the events that they have done, or remembered, and the time cued by the external time marker. In terms of moment-to-moment time experience, older people may experience a slowing of time, just as responses in older people are often slowed by aging.

Research that is intended to help us understand real-life time experience may need methodological developments beyond increasingly sophisticated forms of tasks originally used for psychophysical prospective timing studies. What people say about time is, after all, a behavior like any other, and may not necessarily be unmeasurable objectively, or unreliable from one measurement to another. However, we do need to ask the right questions, and to develop the tools to answer them.

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