

## A WATCHED POT SOMETIMES BOILS: A STUDY OF DURATION EXPERIENCE \*

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Accepted November 1979

The 'watched pot' phenomenon – the lengthening of duration experience when one is attentively and perhaps impatiently waiting for some event to occur – was studied in three experiments. In them, each observer attended for a duration of 270 sec to a liquid-containing beaker on an electrical burner. Observers who were told that the experiment concerned time perception (prospective paradigm) reproduced the duration as longer than those told that it concerned visual perception (retrospective paradigm). In the prospective paradigm, reproductions were longer if the liquid did not boil than if it did, and an interruption (task-unrelated questioning) shortened reproductions if the liquid did not boil but had no effect if it did. In the retrospective paradigm, if there was boiling or questioning or both, reproductions were longer than if there was neither. Results have implications for hypotheses about duration experience.

The 'watched pot' phenomenon is mentioned frequently in literature on human duration experience. It refers to the lengthening of duration experience when one is attentively and perhaps impatiently waiting for some event to occur. Many theorists have used the phenomenon as a real-world example to illustrate and support their theories. However, all previous evidence pertaining to the phenomenon is either anecdotal or indirect. The major objective of the present study is to provide some direct, ecologically valid evidence on the phenomenon. A number of theories seem to be able to explain the phenomenon, and they are somewhat diverse. Another objective of this study, therefore, is to

\* We gratefully acknowledge the assistance of Lois Todd, who was an experimenter in experiments 2 and 3, and Robert Schartmann, who was an experimenter in experiment 3. We also thank Douglas Kenrick for suggesting the Rosenthal (1978) analysis. Marjorie A. Reed is now at the University of Oregon. Requests for reprints should be sent to Richard A. Block, Department of Psychology, Montana State University, Bozeman, Montana 59717, U.S.A.

suggest emphases for developing and refining explanations of duration experience.

A perusal of recent attempts to explain the watched-pot phenomenon reveals that different theorists emphasize somewhat different factors which may produce the phenomenon. Fraisse proposed that "when a feeling of time arises, our attention turns selectively to the duration and time seems to pass more slowly" (1963: 216). He also asserted that waiting is a basic condition arousing a feeling of time. Schiff and Thayer (1968) agreed with Fraisse, and some of their evidence indicates that waiting is an important factor which lengthens duration experience. Ornstein attributed the phenomenon to an "increase in vigilance", which, he speculated, "should result in a greater amount of awareness of input, and consequently a lengthening of duration experience" (1969: 112). Underwood and Swain (1973) criticized Ornstein's assumption that an increase in vigilance was necessary. They preferred to explain the phenomenon in terms of a hypothesis that emphasizes selectivity of attention, and suggested that "when attention is narrowed, an interval is perceived as being greater than when attention is less selective" (1973: 105). In a subsequent article, Underwood also said that "attending to and counting the passage of time" (1975: 291) might be involved. This notion, which dates back at least as far as James (1890), is prominent in many contemporary discussions of duration experience. In the most extensive recent discussion of the phenomenon, Doob (1971) emphasized other factors, including the importance of the boiling to the cook, the frustration caused by non-attainment of the goal during the period spent waiting, and the fact that the cook is "passing temporal judgment" (1971: 199). He also suggested that engaging in a distracting activity which is so satisfying and absorbing that the person forgets the passing of time might reduce or eliminate the phenomenon.

In spite of the abundance of speculation, to our knowledge no study has empirically investigated the watched-pot phenomenon in an ecologically valid way. We decided to investigate it in a rather direct, obvious manner. The general procedure was simple: each observer was induced to attend for a duration of 270 sec to a liquid-containing beaker on an electrical burner. Then the observer was asked to make two different kinds of temporal judgment—a reproduction and a verbal estimation of the duration (see Bindra and Waksberg 1956). Three independent variables were manipulated. One variable, which was used in all three of

the experiments reported here, concerned the instructions given at the outset of the experiment. Observers in the *prospective* paradigm were told that the experiment was concerned with time perception and that a duration judgment would be requested, while those in the *retrospective* paradigm were told that the experiment was concerned with visual perception and that they would later be asked some questions about what they observed in the beaker. It was assumed that observers would be attending to the passage of time more in the prospective than in the retrospective paradigm. If attention to time is important, as some theorists have claimed, then judgments should be greater in the prospective than in the retrospective condition. Others (Hicks *et al.* 1976; Miller *et al.* 1978; see also Fraisse 1979) have found such differences in duration judgments under these two paradigms. Another variable, which was used in experiments 1 and 3, involved the presence or absence of task-related content, the boiling of the liquid in the beaker during the duration. We thought that the *boiling* condition might lead to different judgments than the *no-boiling* condition, and that the effect of this variable might depend on the paradigm used. In a recent literature review on duration experiences, Block (1979) agreed with others that attention to time is important, but perhaps only in the prospective paradigm. In that paradigm, the *no-boiling* condition might lead to a lengthening of experienced duration compared to the boiling condition, since attention might be distracted from time in the latter condition. On the other hand, Block concluded that judgments in the retrospective paradigm depend on certain aspects of memory, and that such judgments might be based on the remembered amount of change in cognitive context. It seems plausible that these aspects of memory might be influenced by the boiling, and that remembered duration might be longer in the boiling condition. A final variable, which was used in experiments 2 and 3, involved the presence or absence of task-unrelated content, answering a few questions asked by the experimenter during the duration. Manipulating this variable represented an attempt to assess the influence of engaging in a distracting activity. We thought initially that the *questioning* condition might produce effects similar to those produced by boiling, and the *no-questioning* condition effects like those produced by no-boiling.

## Experiment 1

Experiment 1 investigated effects of two variables that were expected to be important – paradigm (prospective or retrospective) and task-related content (boiling or no boiling). As noted, we expected to find an effect of paradigm as well as an interaction between paradigm and task-related content.

### Method

#### Observers

A total of 48 introductory psychology students, 24 female and 24 male, volunteered for the experiment. All received some class credit for participating. None of the observers reported having any previous information about the purpose of the experiment, and none had participated in any experiments on psychological time. There were three different experimenters. Each of them ran two observers of each gender under each combination of paradigm and task-related content. Assignment of observers to conditions was block-randomized for each experimenter.

#### Apparatus and procedure

Observers were tested individually in a small room. Before each arrived, an electrical burner (Hamilton Beach Fifth Burner, Model No. 812-2) was positioned on a table. An asbestos screen and a 600 ml beaker (Pyrex) were placed on the burner, and 120 ml of water were put in the beaker. A smaller, 50 ml beaker, which contained 30 ml of red-colored water (one drop of red food coloring was added to the water), was placed inside the larger beaker, and both were heated to  $43 \pm 2^\circ\text{C}$ . The experimenter wore a white laboratory coat, and an electronic stopwatch was concealed in one pocket of the coat.

When the observer arrived, he or she was seated in a chair in front of the table, at a distance of about 0.5 m from the burner. The experimenter asked the observer to remove all jewelry (including watches), commenting that “we’ll be working with chemicals”. Then the experimenter removed the smaller beaker from within the larger one and gave instructions. Each observer in the prospective paradigm was told:

This is an experiment in time perception. I am going to combine this red liquid with the liquid in the large beaker and apply some heat. I want you to observe the beaker carefully until I tell you to stop. Then I will ask you to estimate the interval between the time I poured in the red liquid and the time I told you to stop observing. Please do not count or otherwise keep track of time during the interval.

Each observer in the retrospective paradigm was told:

This is an experiment in visual perception. I am going to combine this red liquid with the liquid in the large beaker and apply some heat. I want you to observe the beaker carefully until I tell you to stop. Then I will ask you some questions about what you observed.

If the observer had any questions, they were answered by paraphrasing the appropriate instructions. Then the experimenter adjusted the temperature setting (which the observer could not see). For observers in the boiling condition, the temperature was set for maximum heat. For those in the no-boiling condition, the temperature was set at a very low heat setting. After a few seconds, the experimenter poured the red liquid into the large beaker and simultaneously started the concealed stopwatch. Then the experimenter sat down behind a wood partition, about 1 m behind and to one side of the observer, so that the experimenter was mostly out of sight. For observers in the boiling condition, the liquid began to boil after  $240 \pm 10$  sec had elapsed, so that the liquid boiled for about the last 30 sec of the duration [1]. For observers in the no-boiling condition, the liquid did not change in appearance. When 270 sec had elapsed, the experimenter stood up and said, “Stop observing now”, thereby delimiting the end of the duration. A wood partition was placed between the observer and the burner, which was then turned off. This was done so that changes in the beaker would have no further effect and so that duration judgments would be made under constant conditions.

The observer was then asked to reproduce the length of the interval between when the red liquid was poured and when the experimenter said to stop observing. He or she was told to say *start*, wait quietly for “as long as the interval seemed to you”, then say *stop*. The observer was told not to count or similarly keep track of time during the reproduction. The experimenter then was seated as before, and the reproduction was timed. After the reproduction, the observer was asked to estimate the interval again, this time by verbally stating the number of minutes and seconds it lasted.

In a postexperimental interview, each participant was asked to give his or her opinion about the saying, “A watched pot never boils”. The experimenter also asked whether or not the observer consciously adjusted the estimates in order to compensate for the effect described by the saying. Finally, the observer was debriefed and asked not to discuss the experiment with other potential participants.

### Results and discussion

A  $2 \times 2$  (Paradigm  $\times$  Task-related Content) factorial analysis of variance and two planned comparisons were performed separately on the reproduction and verbal estimation data. The mean and standard error of the mean for each combination of variables is shown in table 1. Consider first the reproductions. Contrary to our expectations, there was no significant main effect of paradigm [ $F(1,44) = 2.59$ ,  $MS_e = 2752$ ], although the overall means (259.2 sec in the prospective and 234.8 sec in the retrospective condition) differed in the expected direction. There was also no significant main effect of task-related content ( $F < 1$ ). There was, however, a significant interaction between paradigm and task-related content [ $F(1,44) = 8.56$ ,  $MS_e = 2752$ ,  $p < 0.01$ ]. Planned comparisons tested for an effect of content in each paradigm. In the prospective paradigm the mean reproduction was signifi-

[1] The experiment was conducted at an altitude of about 1500 m, at which water boils at a temperature of about  $95^\circ\text{C}$ .

Table 1

Mean reproductions and verbal estimations (in sec) under each combination of paradigm and content in experiment 1.

	Paradigm	Content	
		No boiling	Boiling
Reproductions	Prospective	278.0 ± 12.6	240.3 ± 7.7
	Retrospective	209.3 ± 15.0	260.3 ± 20.4
Verbal estimations	Prospective	287.8 ± 23.5	298.1 ± 36.1
	Retrospective	258.3 ± 26.5	291.3 ± 24.2

Note: Each mean is shown plus or minus its standard error.

cantly longer in the no-boiling condition than in the boiling condition [ $t(22) = 2.44$ ,  $SE = 15.4$ ,  $p < 0.05$ ]. Conversely, in the retrospective paradigm the mean reproduction was longer in the boiling than in the no-boiling condition, an effect that was marginally significant [ $t(22) = 1.95$ ,  $SE = 26.1$ ,  $p < 0.10$ ]. This interaction represents an important finding of a variable that produces opposite effects in the prospective and retrospective paradigms. Previously, Hicks *et al.* (1976) manipulated a variable (concurrent-task response uncertainty) that decreased prospective judgments but did not affect retrospective judgments. In addition, Miller *et al.* (1978) recently found that prospective judgments increased across free-recall study trials, while retrospective judgments decreased.

For the verbal estimation data, there were no significant effects in the analysis of variance (all  $F_s < 1$ ,  $MS_e = 10069$ ). Thus, the interaction found in the reproductions was not found in the verbal estimates. One possible explanation involves the fact that verbal estimates showed greater variability. Verbal estimation involves the 'translation' of duration experience into conventional units of time. It is possible that the variability between observers in this translation obscured the finding of an effect similar to that obtained in the reproductions. Another possibility is that the verbal estimation was affected by the preceding reproduction. Since the order in which observers made the two judgments was not varied, there is no way to assess this possible confounding effect.

The postexperimental interview asked each participant what he or she thought about the saying, "A watched pot never boils". We were surprised by the relatively large number of participants who reported not having heard the saying previously. (Data on this are reported in experiments 2 and 3.) When each participant was asked whether he or she adjusted the estimates in order to compensate for the effect described by the saying, 33.3% replied *yes*. The frequency of reporting compensation was relatively constant across the four groups [ $\chi^2(3) = 1.00$ ], and there was no consistent tendency for compensating observers from different groups to report lengthening or shortening the judgments.

## Experiment 2

The results of experiment 1 revealed that task-related content affects temporal reproductions differently in the prospective and retrospective paradigms. This finding raises a number of questions. In experiment 2 we decided to investigate one of them: will task-unrelated content differentially affect reproductions in a similar way? To make the task-unrelated content comparable in duration to that of the task-related content (*i.e.*, boiling) in experiment 1, we decided to ask observers to answer several questions during the last 30 sec of the duration.

### Method

#### Observers

As in experiment 1, a total of 48 students, 24 of each gender, participated. Each of three experimenters ran two observers of each gender under each combination of paradigm (prospective or retrospective) and task-unrelated content (questioning or no questioning). Assignment of observers to conditions was block-randomized.

#### Apparatus and procedure

All important aspects of the experimental arrangement were the same as in experiment 1, except that only the no-boiling condition was used. Two no-questioning groups thus corresponded to the two no-boiling groups of experiment 1. Observers in the questioning conditions were interrupted by the experimenter when 225 sec had elapsed. The experimenter remained seated, mostly out of sight of the observer, but said:

Please keep watching the beaker while I ask you a few questions. Answer each one of them by giving a number. How many years old were you on your last birthday? . . .

Three simple questions were asked during the last 30 sec of the duration, and all participants were able to answer all of the questions within the allotted period. The duration was terminated as in experiment 1, and reproductions and verbal estimates were requested as before.

A postexperimental interview asked each participant: "Have you ever heard the saying, 'A watched pot never boils?'" Each was also asked about compensating for the effect of the saying.

### Results and discussion

The data, which are summarized in table 2, were analyzed as before. For the reproduction data, the analysis revealed only a main effect of paradigm [ $F(1,44) = 11.4$ ,  $MS_e = 3691$ ,  $p < 0.01$ ]. The overall mean reproduction was significantly longer in the prospective condition (289.9 sec) than in the retrospective condition (230.8 sec). This effect had been expected, although it was not significant in experiment 1. Neither the main effect of task-unrelated content nor the interaction between

Table 2

Mean reproductions and verbal estimations (in sec) under each combination of paradigm and content in experiment 2.

	Paradigm	Content	
		No questioning	Questioning
Reproductions	Prospective	317.8 ± 22.1	262.1 ± 19.3
	Retrospective	229.3 ± 12.3	232.3 ± 14.7
Verbal estimations	Prospective	313.7 ± 25.2	327.1 ± 42.1
	Retrospective	260.4 ± 20.3	263.8 ± 24.7

Note: Each mean is shown plus or minus its standard error.

paradigm and task-unrelated content was significant [ $F(1,44) = 2.26$  and  $2.79$ , respectively,  $MS_e = 3691$ ]. Planned comparisons showed a marginally significant effect of task-unrelated content in the prospective paradigm [ $t(22) = 1.90$ ,  $SE = 29.4$ ,  $p < 0.10$ ], with a longer mean reproduction in the no-questioning condition than in the questioning condition. There was no significant difference between the two conditions in the retrospective paradigm [ $t(22) = 0.15$ ,  $SE = 19.2$ ].

As in experiment 1, verbal estimates were extremely variable. Analysis of variance showed only a marginally significant effect of paradigm [ $F(1,44) = 3.96$ ,  $MS_e = 10\,286$ ,  $p < 0.10$ ].

In the postexperimental interview, 60.4% of the participants reported having previously heard the watched-pot saying, and 39.6% reported having never heard it before. There was no significant change in the frequency of the two responses across groups [ $\chi^2(3) = 4.44$ ]. A total of 39.6% of the observers said that they adjusted their estimates to compensate for the effect described, while 60.4% said that they did not. As in experiment 1, the frequencies did not change significantly across groups [ $\chi^2(3) = 0.26$ ].

### Experiment 3

The results of experiment 2 were puzzling, since we expected to find an interaction similar to that in experiment 1, but found only an effect of paradigm. Experiment 3 was designed, therefore, to replicate and extend the findings of experiments 1 and 2. The design was a factorial combination of paradigm, task-related content, and task-unrelated content. Thus, the design also allowed an opportunity to investigate possible effects of boiling and questioning in combination.

#### Method

##### Observers

The observers were 96 students, 48 of each gender. Each of three experimenters ran

two observers of each gender under each of eight combinations of paradigm, task-related content, and task-unrelated content, with assignment of observers block-randomized.

#### Apparatus and procedure

All important aspects of the experimental arrangement remained the same. Manipulations of task-related and task-unrelated content were performed as in experiments 1 and 2, respectively.

#### Results and discussion

A  $2 \times 2 \times 2$  (Paradigm  $\times$  Task-related Content  $\times$  Task-unrelated Content) factorial analysis of variance and four planned comparisons were performed separately on the reproduction and verbal estimation data. A summary of the data appears in table 3. Consider first the reproductions. There was a significant main effect of paradigm [ $F(1,88) = 11.4$ ,  $MS_e = 3515$ ,  $p < 0.01$ ], with longer overall mean reproductions in the prospective (286.5 sec) than in the retrospective (245.6 sec) paradigm. This finding replicates the significant effect found in experiment 2, as well as the weaker, nonsignificant effect in experiment 1. There was also a significant interaction between paradigm and task-unrelated content [ $F(1,88) = 4.32$ ,  $MS_e = 3515$ ,  $p < 0.05$ ], indicating that the presence or absence of questioning had differential effects on reproductions in the prospective and retrospective paradigms. Compared to no questioning, questioning shortened reproductions in the prospective and lengthened them in the retrospective paradigm. There was also a significant interaction between paradigm, task-related content, and task-unrelated content [ $F(1,88) = 9.54$ ,  $MS_e = 3515$ ,  $p < 0.01$ ]. This three-way interaction is most easily understood by considering the results of the planned comparisons.

In the prospective paradigm, the only one of the four planned comparisons that

Table 3

Mean reproductions and verbal estimations (in sec) under each combination of paradigm and content in experiment 3.

	Paradigm	Content			
		No boiling		Boiling	
		No question- ing	Questioning	No question- ing	Questioning
Reproduc- tions	Prospective	317.6 ± 15.1	247.4 ± 19.3	287.5 ± 14.7	293.4 ± 18.1
	Retrospective	207.8 ± 9.4	262.7 ± 19.3	265.2 ± 22.5	246.7 ± 15.2
Verbal estima- tions	Prospective	298.3 ± 35.8	267.5 ± 24.3	281.4 ± 19.5	277.5 ± 21.6
	Retrospective	258.7 ± 20.6	353.8 ± 58.5	292.9 ± 37.7	274.1 ± 23.3

Note: Each mean is shown plus or minus its standard error.

was significant was that between the two no-boiling conditions [ $t(22) = 2.86$ ,  $SE = 24.6$ ,  $p < 0.01$ ], in which questioning shortened reproductions compared to no questioning. This finding replicates the similar, marginally significant effect in experiment 2. In the boiling conditions, there was no significant effect of questioning [ $t(22) = 0.25$ ,  $SE = 23.3$ ]. The differences between the two no-questioning conditions and between the two questioning conditions were not significant [ $t(22) = 1.43$  and  $1.74$ ,  $SE = 21.1$  and  $26.5$ , respectively].

There was a different pattern of results in the retrospective paradigm. In the no-boiling conditions, questioning lengthened reproductions compared to no questioning [ $t(22) = 2.55$ ,  $SE = 21.5$ ,  $p < 0.05$ ], an effect that was not significant in experiment 2. In the boiling conditions, there was no significant effect of questioning [ $t(22) = 0.68$ ,  $SE = 27.1$ ]. In the no-questioning conditions, boiling lengthened reproductions compared to no boiling [ $t(22) = 2.36$ ,  $SE = 24.4$ ,  $p < 0.05$ ], an effect that was also observed in experiment 1. In the questioning conditions, on the other hand, boiling had no significant effect on reproductions [ $t(22) = 0.65$ ,  $SE = 24.6$ ]. An additional, *post-hoc* comparison revealed that reproductions were significantly longer in the boiling and questioning condition than in the no-boiling and no-questioning condition [ $t(22) = 2.18$ ,  $SE = 17.9$ ,  $p < 0.05$ ]. These comparisons reveal that reproductions in the retrospective paradigm were lengthened when there was boiling or questioning or both, as compared to the no-boiling and no-questioning condition.

As in experiments 1 and 2, verbal estimates were extremely variable. The only effect to approach significance was a three-way interaction similar to that in the reproduction data [ $F(1,88) = 2.42$ ,  $MS_e = 12\,759$ ,  $p < 0.20$ ].

The postexperimental interview revealed that only 53.1% of the participants reported previously having heard the watched-pot saying. As in experiments 1 and 2, some reported compensating for the effect described, but there was no apparent change in frequencies across groups.

Rosenthal (1978) has recently discussed several statistical techniques for combining the results of independent studies. We decided to use the recommended method of adding  $Z$ s in order to combine comparable data; all significance tests reported here are one-tailed. When done in this way, the lengthening of reproductions in the prospective compared to the retrospective paradigm, which was obtained in all three experiments, is significant [ $Z = 4.72$ ,  $p < 0.00002$ ]. In the prospective paradigm, with no questioning, the lengthening of reproductions in the no-boiling compared to the boiling condition, which was obtained in experiments 1 and 3, is significant [ $Z = 2.62$ ,  $p < 0.006$ ]; and with no boiling, the lengthening of reproductions in the no-questioning compared to the questioning condition, which was obtained in experiments 2 and 3, is also significant [ $Z = 3.22$ ,  $p < 0.0006$ ]. In the retrospective paradigm, with no questioning, the lengthening of reproductions in the boiling compared to the no-boiling condition, which was obtained in experiments 1 and 3, is significant [ $Z = 2.91$ ,  $p < 0.003$ ]; and with no boiling, the lengthening of reproductions in the questioning compared to the no-questioning condition, which was obtained in experiments 2 and 3, is marginally significant [ $Z = 1.82$ ,  $p < 0.06$ ].

## General discussion

Taken together, the results of the present experiments suggest a number of general conclusions about the watched-pot phenomenon and the conditions under which it is experienced. First, attention to the passage of time has a strong effect on the phenomenon. Observers in the prospective paradigm, who were presumed to be highly aware of the duration while it was in progress, reproduced the duration as longer than observers in the retrospective paradigm, who were presumed to be less aware of the duration while it was in progress. It seems reasonable to assume that the prospective paradigm corresponds closely with the conditions that ordinarily produce the watched-pot phenomenon.

Other important findings of the present experiments were the two-way interaction in experiment 1, the tendency toward a two-way interaction in experiment 2, and the two- and three-way interactions in experiment 3. These interactions provide evidence that certain variables have opposite effects on prospective and retrospective duration judgments. Since aspects of the cognitive content during a duration can differentially affect prospective and retrospective duration judgments, different kinds of hypotheses are needed to adequately explain experienced duration and remembered duration (see Block 1979; Miller *et al.* 1978). There is an intriguing connection here with the assertion of James that "*a tract of time empty of experiences seems long in passing, but in retrospect short*" (1890: 624, his emphasis). Consider now the differential effects of cognitive content on experienced and remembered duration in these experiments, as well as possible explanations for the effects observed in each paradigm.

In the prospective paradigm, an interruption (task-unrelated content, like questioning) has no apparent effect on experienced duration if there are changes in task-related content (boiling) during the duration. Perhaps under these conditions observers base their duration judgments mostly on the task-related content. On the other hand, if there are no changes in task-related content (no boiling), experienced duration is longer if there is no interruption than if there is an interruption. One obvious explanation is that when the liquid is not boiling, an interruption causes attention to shift from the passage of time to the interrupting content, and experienced duration is shortened. Other explanations, such as some of those mentioned earlier, are of course possible.

In the retrospective paradigm, the presence of changes in task-related

content (boiling), task-unrelated content (questioning) or both causes a lengthening of remembered duration compared to a condition in which there are no changes in content (no boiling and no questioning). This finding can be explained by a number of different hypotheses, all of which emphasize that remembered duration is based on certain aspects of memory. One such hypothesis is the contextual-change hypothesis (see Block 1979; Block and Reed 1978), which would say that there are more changes in contextual aspects of memory during the duration if there is boiling or questioning or both. Since the hypothesis proposes that remembered duration is based on the remembered amount of change in contextual aspects of memory, the finding is explained. It is of interest to note that the effects of boiling and questioning do not appear to be additive. In other words, remembered duration is not lengthened more if there is both boiling and questioning than if there is only boiling or questioning. This finding may indicate that there is a limit to how rapidly contextual aspects can change, and that this limit is reached if there is either boiling or questioning. The finding of no additivity, however, may be specific to the present procedure, in which boiling and questioning occurred simultaneously, during the last 30 sec of the duration.

All of these general conclusions pertain only to observers' reproductions of the duration. A puzzling finding of the present experiments is that there were no significant effects on verbal estimates. As noted, perhaps the verbal estimates were too variable to show any effects of the experimental manipulations, and perhaps they were influenced by the preceding reproduction. These possible explanations are supported by previous research. For example, Fraisse and his colleagues (cited by Fraisse 1963) found greater intersubject variability using the method of verbal estimation than the method of reproduction. Comparing several different methods, Fraisse concluded that "work based on the reproduction method is the most reliable" (1963: 214). Since our observers always gave a verbal estimate after the reproduction, our data are not definitive on this issue. Vroom (1976) has suggested that observers may under some conditions base a temporal judgment on the most recent temporal event in a series of estimations. Thus, in spite of explicit instructions, verbal estimation in our experiments may have been based on the reproduction rather than the actual experimental duration. Furthermore, considering that verbal estimation involves a 'translation' of duration experience into conventional temporal units, it

is perhaps not too surprising that verbal estimates in these experiments were extremely variable and showed no significant effects of the experimental manipulations.

Regarding the recent attempts to explain the watched-pot phenomenon that were discussed in the introduction, it seems that some of the factors mentioned can explain the present results, at least those found in reproductions under the prospective paradigm. As noted, the proposal that attention to the passage of time is involved in the watched-pot phenomenon (Fraisse 1963; James 1890; Underwood 1975) is supported by these findings. Waiting may also be an important factor (Fraisse 1963; Schiff and Thayer 1968). However, the results seem inconsistent with the notions that an increase in vigilance (Ornstein 1969) or selectivity of attention (Underwood and Swain 1973) produces the watched-pot phenomenon, since observers who were told only that the experiment was concerned with visual perception were probably more vigilant or selectively attentive than those who were correctly told about the forthcoming duration judgment. Both notions might apply only in the paradigm in which they were first developed, the retrospective paradigm. The present experiments are not really decisive concerning Doob's (1971) proposed factors -- importance of the boiling, frustration, "passing temporal judgment", and so on -- except that they support his assertion about engaging in a distracting activity. The major problem with all of these theorists' ideas, however, is that they have little or nothing to say about the findings of differential effects in the prospective and retrospective paradigms. As described earlier, the kinds of explanations that explicitly distinguish between processes involved in experienced and remembered duration (Block 1979) are needed to account for the differential effects in the two paradigms. The proposals of Miller *et al.* (1978) are another example of the kinds of explanations that are needed. They claimed that prospective judgments are based on "the number of subjective temporal units . . . constructed and stored" (1978: 174), while retrospective judgments are based on "the amount of content . . . remembered" (1978: 178).

In summary, the present experiments have provided the first ecologically valid evidence on the watched-pot phenomenon. The results show that certain variables have interacting effects on the phenomenon. Several different kinds of hypotheses are able to explain the effects observed. Future research of a different nature may indicate which of

these hypotheses provide reasonable explanations for the watched-pot phenomenon and other aspects of human temporal experience.

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