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TEMPORAL INVENTORY ON MEANING AND EXPERIENCE: A STRUCTURE OF TIME*

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ABSTRACT

Beliefs of nonscientists concerning meanings and experiences of time were assessed by developing and administering a sixty-five-statement questionnaire, the Temporal Inventory on Meaning and Experience. The statements reflected a broad range of conceptions of time and temporal experience which have been expressed by physicists and psychologists. The findings reveal an interesting factor structure of beliefs about physical time, personal time, and duration experience. Comparisons of the beliefs of the respondents with scientific theories and evidence produce insights and implications on the study of time and consciousness.

INTRODUCTION

Over two thousand studies on the conception and experience of time have been published, most of them within the past few decades [1-3]. Much of the recent interest might be attributable to the central role of time in the flow of human experience, or the stream of consciousness. Physicists have long recognized the fundamental nature of time. The relatively recent assertion that it is necessary to include the consciousness of an observer in any adequate description of a physical system suggests the importance of psychological studies of temporal experience. Psychologists have attempted to meet the challenge by studying a large number of factors that affect the conception and experience of time.

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Several previous studies have explored a wide variety of symbolic or verbal metaphors of time that people might employ [4]. In contrast, the present study assesses beliefs[1] of nonscientists concerning meanings and experiences of time that have been proposed by physicists and psychologists. There are several reasons for investigating the beliefs of nonscientists concerning scientific conceptions of time. First, the beliefs of scientists studying time are amply documented in archival journals, but virtually nothing is known about nonscientists' beliefs about scientific theories and findings concerning time. Second, beliefs of nonscientists probably depend more heavily on temporal experience than do beliefs of scientists, which presumably are based on empirical evidence. Third, evidence concerning temporal experience is predominantly obtained by studying nonscientists, and the results of these experimental studies may be influenced by the beliefs of individuals who serve as research participants.

Consider further this third reason. In hundreds of experimental studies, participants have been asked to make various kinds of temporal judgments, and the data have been used to support or reject hypotheses concerning effects of manipulated variables on temporal experience. Conclusions may be unwarranted, however, if participants' covert beliefs affect the data. Some participants might make judgments in such a way as to compensate for effects of a manipulation on their actual experience [5]. Similarly, there might be a "double system" or "double strategy" of duration judgment, one being "impressionist" and the other "analytic." [6, 7] The impressionist strategy may involve a more direct effect of a manipulation on temporal consciousness, whereas the analytic strategy may involve a less direct effect influenced by the person's conceptions of time. Even an impressionist strategy, however, depends on a person's choice of a factor on which to focus attention.

It is for these reasons that it is important to question nonscientists about time and effects on temporal experience. Surprisingly, few temporal inventories have been developed. Most previous work of this kind has simply explored relationships between personality and attitudes toward the past, the present, and the future. Taken together, several studies exemplify this rather narrow orientation. Ricks, Epley, and Wessman constructed a Temporal Experience Questionnaire assessing "various ways of experiencing, arranging, and using time." [8, p. 103] For example, each respondent was asked to indicate the degree to which he or she is characteristically disposed "to proceed in an orderly way toward goals set long in advance." Roos' Time Reference Inventory focused on individual differences in temporal perspective—that is, "orientation toward the past, present, and future." [9, p. 34] A representative item was: "I believe the happiest time of my life is in the [Past/Present/Future/Age. . . .]." Calabresi

[1] It is important to recognize that the data are reported beliefs, and that we are using such reports to infer actual beliefs. We usually use simply the term *beliefs* throughout this article for ease of exposition.

and Cohen also explored the relationships between personality and attitudes toward time. A sample item was: "It makes me a little uncomfortable to think about my future." [10, p. 434] Others studied relationships between personality and preference for poetic metaphors of time such as "the thrust of foward purpose." [4, pp. 236-237]

To our knowledge, no one has systematically investigated beliefs about physical time, nor beliefs about the effects of various factors on duration experience. We first describe the questionnaire and the findings. We then compare the reported beliefs with those held by physicists and psychologists who have commented on the nature of time and temporal experience, thereby suggesting the content of the present inquiry.

METHOD

Inventory

An attempt was made to identify all major physical and psychological viewpoints on physical time, personal time, and duration experience and to generate at least one statement reflecting each viewpoint. Obviously, value judgments were made in order to restrict the set of statements to a reasonable length. A pilot study was used to delete, revise, and add statements. The final sixty-five-statement questionnaire is referred to here as the Temporal Inventory on Meaning and Experience (TIME). Table 1, which appears later, includes a verbatim copy of each statement. The focus here is on the construction of the TIME.

At the top of the first page was the heading, "TIME QUESTIONNAIRE," and these instructions:

> We are interested in your beliefs, or opinions, about time, both *physical time* and *psychological time*. There are no "correct" or "incorrect" answers on this questionnaire, so just respond to *each* item in accord with your beliefs, or opinions. . . .

A standard computer sheet was used.

The TIME consisted of four parts. Part A contained sixteen statements concerning physical time. The statements were common-language "translations" of most of the important viewpoints of physicists, past and present. The general description was: "The statements in Part A are concerned with general/philosophical views on *physical time* . . . . In Part A the word 'time' refers to *physical time*, not psychological time." The rating scale was labled from 1 (strongly disagree) through 5 (strongly agree). The extensive literature on the psychology of time was perused, and statements for Parts B, C, and D were written to reflect a broad spectrum of concerns and hypotheses. Part B contained twenty-three statements concerning personal, or psychological, time: "The statements in Part B are concerned with your personal concepts of time

and the way you relate to time." The rating scale was the same as in Part A. Part C contained thirteen statements concerning duration experience in passing (i.e., experienced duration, or prospective duration experience): "The statements in Part C are concerned with your experience of time as it is passing." The rating scale was labeled from 1 (very slowly) through 5 (very quickly). Part D contained thirteen statements concerning duration experience in retrospect (i.e., remembered duration, or retrospective duration experience): "The statements in Part D are concerned with your memory of a past period of time." The rating scale was from 1 (very short) through 5 (very long).

Four alternative forms were generated. The initial form contained a randomization of the order of the statements within each part. In addition, at random each statement was worded in one of two opposing versions. This was accomplished either by changing some words, by omitting or inserting the word *not*, or by reversing the clauses. A second form contained a re-randomization of both order and wording. The third and fourth forms contained a reversal of both order and wording relative to the first and second forms.

Respondents

The TIME was distributed to all 451 students attending two introductory psychology classes at Montana State University. A total of 403 of them completed the inventory. An approximately equal number of each of the four forms were returned. Respondents included 228 females and 175 males. Their mean age was 19.7 years. There were 72.5 percent, 17.4 percent, 5.2 percent and 5.0 percent first-, second-, third-, and fourth-year students, respectively. Declared major curriculums varied greatly and were fairly representative of students at the university. The median number of high school or college physics courses completed was .2; a majority (61.8%) reported no formal physics background.

A total of forty respondents was selected for a subsequent retest reliability study. Selection was random subject to the constraint that ten had previously completed each form. The reliability study was conducted approximately eight weeks after the initial administration.

Procedure

The TIME was distributed, and the students were asked to complete it at home and return it the following day in order to receive some course credit. To ensure confidentiality, each respondent remained anonymous.

For the reliability study, respondents were telephoned and asked if they would be willing to participate in a psychological study in order to receive some class credit. They were told that they had been randomly selected. Each was given a copy of the same form that had been completed and was asked to respond again to the statement.

RESULTS

Standardization of Statements

In order to calculate a meaningful correlation matrix, the relationship between the wording version of each statement and the rating scale was standardized. First, the mean rating was calculated separately for each of the two wording versions of a statement. The wording version that received the higher mean rating was designated the *standard-wording version*, and the other was designated the *alternate-wording version*. Finally, the rating scale of each respondent who received the alternate-wording version was reversed.

Table 1 shows both versions of each statement, as well as the combined, standardized mean response (M_c). The overall mean response is 3.04 before standardization of wording version, so there was no strong tendency toward response bias. The overall mean response is 3.58 after standardization of wording version. The two sets of means (standard- and alternate-wording) were subjected to a multivariate comparison, using the Biomedical Program BMDP3D [11]. The profile of means on the standard-wording versions differs from that on the alternate-wording versions [$T^2 = 818, F(65, 201) = 9.52, p < .001$]. However, calculating the proportion of variance explained by wording version is more revealing, and these values are reported in Table 1. The mean ω^2 is only .04.

Table 1. Factor Structure, Statements, and Summary Statistics

Factor 1—Remembered Duration: Activity (Change) *VP* = .113 *IC* = .80

D01 When I remember a period of time during which I *had little to do/was busy*, it seems _____ compared to an identical period of time during which I *was busy/had little to do.*
$M_c = 3.94 \pm .06$ $\omega^2 = .00$ $C = .56$ $FL = .70$ $r = .75$

D02 When I remember a period of time which I spent doing something *unpleasant/pleasant*, it seems _____ compared to an identical period of time which I spent doing something *pleasant/unpleasant.*
$M_c = 4.00 \pm .06$ $\omega^2 = .00$ $C = .50$ $FL = .66$ $r = .69$

D03 When I remember a period of time during which I did something *boring/interesting*, it seems _____ compared to an identical period of time during which I did something *interesting/boring.*
$M_c = 3.99 \pm .06$ $\omega^2 = .00$ $C = .56$ $FL = .63$ $r = .74$

D04 When I remember a period of time during which I did things in *just one place/several different places*, it seems _____ compared to an identical period of time during which I did things in *several different places/just one place.*
$M_c = 3.59 \pm .06$ $\omega^2 = .00$ $C = .45$ $FL = .59$ $r = .38$

Table 1 (Cont'd.)

D05 When I remember a period of time during which I performed a *single kind of task/several different kinds of tasks*, it seems _____ compared to an identical period of time during which I performed *several different kinds of tasks/a single kind of task*.
$M_c = 3.65 \pm .05$ $\omega^2 = .00$ $C = .44$ $FL = .56$ $r = .39$

D06 When I remember a period of time during which I was *waiting/not waiting* for something to happen, it seems _____ compared to an identical period of time during which I was *not waiting/waiting* for something to happen.
$M_c = 3.78 \pm .06$ $\omega^2 = .03$ $C = .34$ $FL = .41$ $r = .45$

D07 When I remember a period of time which I spent in *an unchanging/a changing* environment, it seems _____ compared to an identical period of time which I spent in *a changing/an unchanging* environment.
$M_c = 3.37 \pm .06$ $\omega^2 = .00$ $C = .33$ $FL = .31$ $r = .28$

Factor 2—Experienced Duration: Activity (Change) $VP = .093$ $IC = .73$

C01 When I *am busy/have little to do*, time seems to pass _____ compared to when I *have little to do/am busy*.
$M_c = 4.35 \pm .04$ $\omega^2 = .03$ $C = .51$ $FL = .63$ $r = .83$

C02 When I am doing something *interesting/boring*, time seems to pass _____ compared to when I am doing something *boring/interesting*.
$M_c = 4.52 \pm .04$ $\omega^2 = .01$ $C = .49$ $FL = .57$ $r = .95$

C03 When I am doing things in *several different places/just one place*, time seems to pass _____ compared to when I am doing things in *just one place/several different places*.
$M_c = 3.93 \pm .05$ $\omega^2 = .10$ $C = .35$ $FL = .50$ $r = .85$

C04 When I am doing something *pleasant/unpleasant*, time seems to pass _____ compared to when I am doing something *unpleasant/pleasant*.
$M_c = 4.41 \pm .04$ $\omega^2 = .00$ $C = .40$ $FL = .48$ $r = .92$

C05 When I am performing *several different kinds of tasks/a single kind of task*, time seems to pass _____ compared to when I am performing *a single kind of task/several different kinds of tasks*.
$M_c = 3.96 \pm .05$ $\omega^2 = .02$ $C = .39$ $FL = .38$ $r = .70$

C06 When I am spending time in *a changing/an unchanging* environment, time seems to pass _____ compared to when I am spending time in *an unchanging/a changing* environment.*
$M_c = 3.88 \pm .05$ $\omega^2 = .00$ $C = .42$ $FL = .37$ $r = .63$

C07 When I am *not particularly waiting/waiting* for something to happen, time seems to pass _____ compared to when I am *waiting/not particularly waiting* for something to happen.*
$M_c = 4.01 \pm .06$ $\omega^2 = .12$ $C = .44$ $FL = .30$ $r = .64$

Factor 3—Personal Time: Important Aspects $VP = .078$ $IC = .75$

B02 When I remember a period of time, how long it seems usually depends on *many factors/a single factor* (such as, how I felt, where I was, what I was doing, and so on).
$M_c = 3.32 \pm .08$ $\omega^2 = .46$ $C = .56$ $FL = .69$ $r = .54$

Table 1 (Cont'd.)

C07 When I am *not particularly waiting/waiting* for something to happen, time seems to pass _____ compared to when I am *waiting/not particularly waiting* for something to happen.*
$M_c = 4.01 \pm .06$ $\omega^2 = .12$ $C = .44$ $FL = .52$ $r = .64$

B03 My past will always be *less/more* important than my present or my future.*
$M_c = 3.56 \pm .07$ $\omega^2 = .28$ $C = .36$ $FL = -.46$ $r = .51$

B04 My present will always be *more/less* important than my past or my future.
$M_c = 3.54 \pm .06$ $\omega^2 = .11$ $C = .37$ $FL = .43$ $r = .65$

B05 My future will always be *more/less* important than my present or my past.*
$M_c = 3.56 \pm .06$ $\omega^2 = .10$ $C = .39$ $FL = .41$ $r = .28$

Factor 4—Physical Time: Constant Progression $VP = .073$ $IC = .69$

A01 The rate of passing of time is *constant/variable*; that is, time *does not/may* speed up or slow down.
$M_c = 3.84 \pm .07$ $\omega^2 = .00$ $C = .43$ $FL = .61$ $r = .52$

A02 Time *is/is not* like the flowing of a river, because time *passes/does not pass* continuously and inseparably.
$M_c = 4.02 \pm .06$ $\omega^2 = .00$ $C = .43$ $FL = .60$ $r = .90$

A03 Time *is/is not* progressive; that is, time *always moves/does not always move* forward from the past to the future.
$M_c = 4.17 \pm .06$ $\omega^2 = .00$ $C = .47$ $FL = .54$ $r = .72$

A04 Time *is not/is* an energy (like light); it *is impossible/may be possible* to tap and control time.
$M_c = 3.99 \pm .06$ $\omega^2 = .00$ $C = .25$ $FL = .35$ $r = .74$

A15 Time *is not/is* a space-like dimension, because it *is impossible/may be possible* to change the direction or rate at which a person passes through time.*
$M_c = 3.24 \pm .07$ $\omega^2 = .00$ $C = .36$ $FL = .34$ $r = .73$

A05 *No events/Events* can occur *without/even without* the passing of time.
$M_c = 4.12 \pm .06$ $\omega^2 = .01$ $C = .25$ $FL = .32$ $r = .73$

A08 Time *is/is not* composed of discrete units of duration which occur one after another.*
$M_c = 3.35 \pm .06$ $\omega^2 = .00$ $C = .34$ $FL = .31$ $r = .41$

Factor 5—Duration Experience: Challenge $VP = .064$ $IC = .69$

B06 My experience of the passing of time usually depends on *many factors/a single factor* (such as, how I feel, where I am, what I am doing, and so on).
$M_c = 3.17 \pm .08$† $\omega^2 = .50$ $C = .54$ $FL = .61$ $r = .45$

C08 When I am doing something *challenging/easy*, time seems to pass _____ compared to when I am doing something *easy/challenging*.
$M_c = 3.52 \pm .06$ $\omega^2 = .04$ $C = .31$ $FL = .51$ $r = .40$

D08 When I remember a period of time during which I did something *easy/challenging*, it seems _____ compared to an identical period of time during which I did something *challenging/easy*.
$M_c = 3.10 \pm .06$† $\omega^2 = .14$ $C = .32$ $FL = .41$ $r = .65$

Table 1 (Cont'd.)

Factor 6—Physical Time: Clocktime $VP = .051$ $IC = .62$

A06 Time *is/is not* cyclical; that is, time *always moves/does not always move* in a repetitive circle.
$M_c = 3.25 \pm .07$ $\omega^2 = .02$ $C = .39$ $FL = .54$ $r = .31$

A07 A clock *is/is not* a valid instrument to use in measuring time.
$M_c = 3.52 \pm .06$ $\omega^2 = .00$ $C = .33$ $FL = .43$ $r = .62$

A08 Time *is/is not* composed of discrete units of duration which occur one after another.*
$M_c = 3.35 \pm .06$ $\omega^2 = .00$ $C = .34$ $FL = .41$ $r = .41$

Factor 7—Physical Time: Realism $VP = .049$ $IC = .60$

A09 Physical time *exists/does not exist*; it is *not just/just* an "invention" of the mind.
$M_c = 3.81 \pm .06$ $\omega^2 = .01$ $C = .31$ $FL = .51$ $r = .63$

A10 Physical time is *different/the same* for people from different cultures, because physical time *is/is not* affected by their concepts of time.*
$M_c = 3.06 \pm .07$† $\omega^2 = .03$ $C = .55$ $FL = -.43$ $r = .39$

A11 Physical time *does not depend/depends* on the consciousness of an observer.
$M_c = 3.27 \pm .07$ $\omega^2 = .07$ $C = .30$ $FL = .39$ $r = .42$

A12 A distinction *can/cannot* be made between past, present, and future time when referring to physical time in the universe.
$M_c = 3.71 \pm .06$ $\omega^2 = .00$ $C = .19$ $FL = .32$ $r = .63$

Factor 8—Personal Time: Past Unimportant $VP = .046$ $IC = .60$

B07 I *do not tend/tend* to focus my attention equally on the past, the present, and the future.
$M_c = 3.27 \pm .06$ $\omega^2 = .01$ $C = .44$ $FL = .59$ $r = .52$

B08 I *do not tend/tend* to focus my attention primarily on the past, rather than the present or the future.
$M_c = 4.01 \pm .05$ $\omega^2 = .02$ $C = .38$ $FL = .37$ $r = .55$

B09 My experience of time *can change/never changes* greatly during altered states of consciousness.
$M_c = 3.95 \pm .06$ $\omega^2 = .02$ $C = .26$ $FL = .34$ $r = .66$

B03 My past will always be *less/more* important than my present or my future.*
$M_c = 3.56 \pm .07$ $\omega^2 = .28$ $C = .36$ $FL = .32$ $r = .51$

Factor 9—Duration Experience: Environmental Familiarity $VP = .046$ $IC = .66$

C09 When I am in *a familiar/an unfamiliar* environment, time seems to pass _____ compared to when I am in *an unfamiliar/a familiar* environment.
$M_c = 3.17 \pm .06$ $\omega^2 = .01$ $C = .54$ $FL = .68$ $r = .40$

D09 When I remember a period of time which I spent in *an unfamiliar/a familiar* environment, it seems _____ compared to an identical period of time which I spent in *a familiar/an unfamiliar* environment.
$M_c = 3.16 \pm .06$ $\omega^2 = .01$ $C = .31$ $FL = .50$ $r = .42$

Table 1 (Cont'd.)

Factor 10—Duration Experience: Daydreaming $VP = .045$ $IC = .60$

C10 When my attention is focused on *some task/my daydreams*, time seems to pass _____ compared to when my attention is focused on *my daydreams/some task*.
$M_c = 3.26 \pm .06$ $\omega^2 = .04$ $C = .39$ $FL = .56$ $r = .29$

D10 When I remember a period of time during which my attention was focused on *my daydreams/some task*, it seems _____ compared to an identical period of time during which my attention was focused on *some task/my daydreams*.
$M_c = 3.13 \pm .06$† $\omega^2 = .06$ $C = .31$ $FL = .49$ $r = .38$

Factor 11—Personal Time: Conscious and Rational $VP = .042$ $IC = .61$

B10 My experience of the passing of time is a result of *conscious, rational/unconscious, intuitive* processes.
$M_c = 3.24 \pm .05$ $\omega^2 = .03$ $C = .51$ $FL = .61$ $r = .36$

B11 When I remember a period of time, how long it seems is a result of *conscious, rational/unconscious, intuitive* processes.
$M_c = 3.22 \pm .05$ $\omega^2 = .06$ $C = .37$ $FL = .49$ $r = .26$

Factor 12—Duration Experience: Emotion $VP = .041$ $IC = .62$

D11 When I remember a period of time during which I *did not feel/felt* strong emotions, it seems _____ compared to an identical period of time when I *felt/did not feel* strong emotions.
$M_c = 3.05 \pm .06$† $\omega^2 = .00$ $C = .46$ $FL = .64$ $r = .26$

C11 When I *am/am not* experiencing strong emotions, time seems to pass _____ compared to when I *am not/am* experiencing strong emotions.
$M_c = 3.21 \pm .06$ $\omega^2 = .01$ $C = .40$ $FL = .47$ $r = .34$

Factor 13—Personal Time: Attention $VP = .041$ $IC = .58$

B12 I usually pay *a lot of/very little* attention to how short or long a past (already experienced) period of time seems.
$M_c = 3.00 \pm .06$† $\omega^2 = .09$ $C = .37$ $FL = .50$ $r = .25$

B13 I usually pay *a lot of/very little* attention to how slowly or quickly time seems to be passing.
$M_c = 3.47 \pm .06$ $\omega^2 = .04$ $C = .24$ $FL = .33$ $r = .24$

C06 When I am spending time in *a changing/an unchanging* environment, it seems to pass _____ compared to when I am in *an unchanging/a changing* environment.*
$M_c = 4.01 \pm .06$ $\omega^2 = .12$ $C = .42$ $FL = -.31$ $r = .63$

Factor 14—Duration Experience: Alertness $VP = .039$ $IC = .58$

D12 When I remember a period of time during which I was *drowsy/alert*, it seems _____ compared to an identical period of time during which I was *alert/drowsy*.
$M_c = 3.55 \pm .06$ $\omega^2 = .00$ $C = .42$ $FL = .57$ $r = .43$

Table 1 (Cont'd.)

C12 When I am *alert/drowsy*, time seems to pass _____ compared to when I am *drowsy/alert*.
M_c = 3.82 ± .05 ω^2 = .00 C = .29 FL = .42 r = .48

Factor 15—Personal Time: Estimation Accuracy VP = .039 IC = .61

B14 When I am experiencing a period of time, I *can/cannot* usually estimate fairly accurately how long it is.
M_c = 3.41 ± .06 ω^2 = .00 C = .47 FL = .65 r = .43

B15 When I remember a period of time, I *can/cannot* usually estimate fairly accurately how long it was.
M_c = 3.25 ± .05 ω^2 = .01 C = .36 FL = .46 r = .21

B16 My estimation of a time period that I experienced in the past is usually *different from/the same as* my estimation of the time period when I experienced it; that is, if I think I have spent an hour doing something, when I think back on it later it *may not/will* still seem like an hour.
M_c = 3.65 ± .06 ω^2 = .04 C = .39 FL = −.34 r = .39

Factor 16—Physical and Personal Time: Cultural Effects VP = .037 IC = .58

A10 Physical time is *different/the same* for people from different cultures, because physical time *is/is not* affected by their concepts of time.*
M_c = 3.06 ± .07† ω^2 = .03 C = .55 FL = .56 r = .39

B01 The experience of time is *different/the same* for people from different cultures; it *is/is not* affected by their concepts of time.
M_c = 3.55 ± .06 ω^2 = .00 C = .34 FL = .50 r = .55

Factor 17—Physical Time: Absolute vs. Relative VP = .036 IC = .55

A13 Time *is not/is* affected by events (changes) in the physical universe.
M_c = 3.08 ± .07† ω^2 = .00 C = .39 FL = .44 r = .41

A14 Space and time are *inseparably connected/separate aspects*, and *form/do not form* a four-dimensional structure.
M_c = 3.12 ± .05† ω^2 = .00 C = .25 FL = −.38 r = .59

A15 Time *is not/is* a space-like dimension, because it *is impossible/may be possible* to change the direction or rate at which a person passes through time.*
M_c = 3.24 ± .07 ω^2 = .00 C = .36 FL = .38 r = .63

Factor 18—Duration Experience: Dreaming VP = .036 IC = .56

D13 When I remember a period of time during which I was *awake/dreaming*, it seems _____ compared to an identical period of time during which I was *dreaming/awake*.
M_c = 3.62 ± .06 ω^2 = .00 C = .43 FL = .60 r = .40

C13 When I am *dreaming/awake*, time seems to pass _____ compared to when I am *awake/dreaming*.
M_c = 3.79 ± .06 ω^2 = .00 C = .34 FL = .48 r = .41

Table 1 (Cont'd.)

Factor 19—Personal Time: Future Important VP = .034 IC = .56

B17 I *tend/do not tend* to focus my attention primarily on the future, rather than the past or the present.
M_c = 3.21 ± .06 ω^2 = .01 C = .37 FL = .57 r = .39

B05 My future will always be *more/less* important than my past or my present.*
M_c = 3.56 ± .06 ω^2 = .10 C = .39 FL = .31 r = .28

Statements Loading Less Than .30 on All Factors

A16 The passing of time *cannot/can* be measured in an absolute way; that is, one reliable clock *is not/is* sufficient to measure the passing of time in the universe.
M_c = 3.69 ± .06 ω^2 = .01 C = .22 FL < .28 r = .38

B18 A distinction *can/cannot* be made between past, present, and future time when referring to our experience of time.
M_c = 3.91 ± .06 ω^2 = .03 C = .23 FL < .28 r = .67

B19 I have *a fairly definite/only a vague* idea of what time is.
M_c = 3.34 ± .06 ω^2 = .00 C = .26 FL < .28 r = .32

B20 Time *is/is not* experienced differently by a person involved in a situation and by a person uninvolved in it.
M_c = 4.19 ± .05 ω^2 = .00 C = .35 FL < .27 r = .78

B21 I *tend/do not tend* to focus my attention primarily on the present, rather than the past or the future.
M_c = 3.19 ± .06 ω^2 = .00 C = .24 FL < .25 r = .34

B22 I am more comfortable when I *know/do not know* what time it is than when I *do not know/know* what time it is.
M_c = 3.69 ± .06 ω^2 = .02 C = .23 FL < .25 r = .43

B23 I generally *prefer/do not prefer* to have a set time for daily events, such as getting up, eating meals, and so on, *rather than doing/preferring instead to do* things unscheduled.
M_c = 3.24 ± .07 ω^2 = .00 C = .14 FL < .18 r = .61

Note: Factors are listed from highest to lowest eigenvalue. For each factor, both the proportion of common variance accounted for by the factor (VP) and the internal consistency of the factor (IC) are shown. Statements loading greater than .30 on a given factor are listed from highest to lowest rotated factor loading, with those loading on more than one factor indicated by an asterisk (*). The wording version of each statement that received a higher mean rating is given first, preceding each slash (/). For each statement, the following statistics are shown: the mean response to both versions (combined) plus or minus its standard error (M_c), with each mean not significantly greater than 3.00 indicated by a dagger (†); the proportion of variance accounted for by wording version (ω^2); the communality, or squared multiple correlation, after iteration (C); the rotated factor loading (FL); and the retest reliability, or correlation, coefficient (r). See text for more complete explanation.

Factor Analyses

Using standardized responses, a 65 X 65 triangular matrix of correlations among statements was generated.[2] At the $\alpha = .01$ level, 323 of 2080 correlations are significant [$r(401) > |.128|$], a proportion of .16. This proportion is clearly greater than chance. Each of twenty-two correlations accounts for more than 10 percent of the respective bivariate variance [$r(401) > |.316|$]. Thus, the correlation matrix is legitimately factorable.

The proportion of actually to potentially significant correlations is shown separately for each pair of the four parts of the TIME in Table 2. Statements from a given part correlate more often with other statements from the same part than with statements from the other parts. Some of the other parts also show many intercorrelations, such as Parts C and D. All parts show a substantial proportion of above-chance correlations.

Responses to each statement were significantly correlated with responses to at least one other statement. Communalities (squared multiple correlations), which are shown in Table 1, range from .14 to .56. The Biomedical Program for factor analysis—BMDP4M [11]—was used to conduct a preliminary principal-components analysis; the eigenvalue of the 65th component is .22. Thus, all sixty-five statements were retained for subsequent analyses.

Because the TIME contained a wide variety of content, a relatively large number of factors are needed to explain much of the total variance. The preliminary principal-components analysis shows that twenty-three components have eigenvalues greater than 1, which account for a cumulative proportion of .554 of the total variance. A scree test reveals that nineteen factors are substantive [12]. Several principal-factor analyses were conducted, using varimax rotation and varying the number of factors from 16 through 23. As predicted by the scree test, principal-factor analysis with varimax rotation of nineteen factors provides a reasonably simple account of the correlation matrix, and all residual correlations between variables are less than |.10|.

Table 2. Proportion of Significant Correlations between Statements

Part	A	B	C	D
A	.39	.06	.05	.05
B	.06	.19	.17	.08
C	.05	.17	.37	.24
D	.05	.08	.24	.51

Note: Table shows proportion of actually to potentially significant correlations. See text.

[2] The correlation matrix and other matrices are available upon request.

Several other kinds of factor analysis and other kinds of rotation were also explored, with similar results. For example, a 19-factor principal-factor analysis using direct quartimin rotation produces a similar factor pattern matrix, but it is not as simple. There is no need for the complexities of assuming oblique factors, however, because the highest value of factor correlation (that between Factors 1 and 2) is .24, a proportion of overlap in variance of only .06. The nineteen factors are reasonably orthogonal, so the common-factor solution following varimax rotation is reported here. The description of factors is organized by factor number, as in Table 1. In the interest of brevity, descriptions of the findings are mainly stated in terms of the mean response to each statement, rather than in terms of correlations between responses that are reflected in factor loadings. Factor loadings (*FL*) of statements that load greater than .30 on a given factor are shown in Table 1.

Factor Structure

Factor 1—Remembered duration: Activity (change)—Seven Part-D statements load on Factor 1. It includes strong beliefs that remembered duration is longer if a person had little to do, did something unpleasant, did something boring, did things in just one place, performed a single kind of task, was waiting for something, or was in an unchanging environment. Because all of these statements load together, those respondents who report that one of these situations lengthens remembered duration tend to report that the other situations also do so, and vice versa. The most salient feature of all of these situations is that there was little activity or change in context.

Factor 2—Experienced duration: Activity (change)—Seven Part-C statements load significantly on Factor 2. It includes strong beliefs that duration is experienced as passing more quickly if a person is busy, is doing something interesting, is doing things in several different places, is doing something pleasant, is performing several different kinds of tasks, is in a changing environment, or is not waiting for something. The most salient feature of all these situations is that there is a great deal of activity or change in context.

Similar statements from Parts C and D load on Factors 2 and 1, respectively. Thus, at least some respondents apparently regard the same kinds of variables as important in both experienced and remembered duration. In addition, those that are reported to make time seem to pass more quickly also are reported to make a duration seem shorter in retrospect. Other statements from Parts C and D are conspicuous in their absence from Factors 2 and 1; instead, they load on separate factors.

Factor 3—Personal time: Important aspects—Four Part-B statements load on this factor. Respondents agree more strongly that remembered duration depends on many factors than on a single factor. The personal past is regarded as less important than the present or the future, which are rated as comparably

important. Finally, a statement concerning experienced duration also loads on this factor, a finding which seems to indicate that waiting is a singularly important variable related to personal time. Those individuals who place greater emphasis on the importance of the present or the future may be more sensitive to or aware of the effects of waiting on experienced duration.

Factor 4—Physical time: Constant progression—The first factor concerning physical time reflects the ordinary human experience of time as a constant progression. Respondents tend to agree that time passes at a constant rate, is like the flowing of a river, is progressive, is not an energy, is not a space-like dimension, and is composed of discrete units. Respondents also strongly agree that no events can occur without the passing of time.

Factor 5—Duration experience: Challenge—The mean response indicates agreement that time passes more quickly if a person is doing something challenging rather than easy, although there is no consensus on how remembered duration is affected, if at all. One additional statement loads highly on this factor: Respondents agree more strongly that experienced duration depends on many factors than on a single factor. Why this statement loads on this factor is somewhat puzzling, although the intercorrelations are moderately high, so it is not loading for some trivial reason.

Factor 6—Physical time: Clocktime—Respondents tend to agree that physical time is cyclical, is validly measured by using a clock, and is composed of discrete units of duration. That these three separate statements load together suggests that some people tend to equate time with what is measured by clocks.

Factor 7—Physical time: Realism—Respondents tend to agree with three statements reflecting a realistic, as opposed to an idealistic, viewpoint on physical time—time exists; time does not depend on the consciousness of an observer; and a distinction can be made between past, present, and future time. There is no real consensus on whether or not physical time is different for people from different cultures, a statement that loads negatively.

Factor 8—Personal time: Past unimportant—Most respondents report that they do not focus attention equally on the past, the present, and the future; that they do not focus attention primarily on the past; and that they regard their past as less important than their present or their future. Another Part-B statement that loads on this factor concerns the report that the experience of time can change greatly during altered states of consciousness. Respondents who report greater agreement with this statement tend to report less focusing of attention on the past. A possible explanation is that the past becomes unimportant in many altered states of consciousness, and that the experience of those altered states affects one's "normal-state-of-consciousness" view of the past in a corresponding way. Another possibility is that a person who tends to not focus attention on the past is more likely to experience certain altered states of consciousness.

Factor 9—Duration experience: Environmental familiarity—The mean response indicates weak agreement that time seems to pass more slowly and seems longer in retrospect when in a familiar, rather than an unfamiliar, environment.

Factor 10—Duration experience: Daydreaming—The mean response indicates weak agreement that time seems to pass more slowly when attention is focused on daydreams than on some task. There is no consensus on how remembered duration is affected, if at all.

Factor 11—Personal time: Conscious and rational—Both experienced duration and remembered duration are typically regarded as being a result of conscious and rational, as opposed to unconscious and intuitive, processes. These two statements seem consistent with the reported beliefs that experienced and remembered duration depend on many factors. Apparently duration experience is considered by most to be a result of conscious, rational processes that are influenced by many factors.

Factor 12—Duration experience: Emotion—Respondents tend to agree that time seems to pass more quickly if they are experiencing strong emotions. There is no consensus concerning effects on remembered duration.

Factor 13—Personal time: Attention—Most respondents report paying a lot of attention to the experience of duration in passing, but not necessarily to the experience of duration in retrospect. One Part-C statement also loads on this factor; however, the correlations are low, and so it will not contribute to the present interpretation.

Factor 14—Duration experience: Alertness—There is strong agreement that time seems to pass more quickly and seems shorter in retrospect when alert than when drowsy.

Factor 15—Personal time: Estimation accuracy—Most respondents report that they can usually estimate duration fairly accurately, either in passing or in retrospect. Respondents also tend to agree that a duration estimate in retrospect is usually different from an estimate in passing. This statement loads negatively; thus, individuals who tend to report greater duration estimation accuracy also tend to report that prospective and retrospective estimates do not differ.

Factor 16—Physical and personal time: Cultural effects—Two related statements, one from Part A and one from Part B, load equally on this factor. Respondents agree that the experience of time is culturally relative, but there is no consensus on whether or not physical time also is.

Factor 17—Physical time: Absolute vs. relative—The mean response reveals slight agreement that time is not a space-like dimension, but there is no consensus on whether or not time is affected by events (changes) in the physical

universe, nor on whether or not space and time form a four-dimensional structure. This bipolar factor concerns issues that distinguish Newtonian (absolute) and Einsteinian (relative) conceptions of time and space. If the response of each subject on each of these three items is multiplied by the respective factor loading, 53.1 percent of the respondents lean toward Newtonian views and 45.4 percent toward Einsteinian views; 1.5 percent consistently use the scale midpoint.

Factor 18–Duration experience: Dreaming–There is strong agreement that time seems to pass more quickly and seems shorter in retrospect when dreaming than when awake.

Factor 19–Personal time: Future important–Most respondents report that they tend to focus their attention primarily on the future. Those who report greater future orientation also agree that the personal future will always be more important than the personal past or present.

Statements loading less than .30 on all factors–Seven other statements, which are listed at the end of Table 1, load less than .30 on all factors. The mean communality of them (after factor extraction) is .24, compared to the mean of .39 for the 58 other statements.

Gender Differences

There are too few respondents of each gender to perform separate factor analyses. However, factor scores can be compared. The mean factor score on each factor was determined for both genders. The multivariate interaction of profiles is significant [$T^2 = 115, F(19, 383) = 5.78, p < .001$]. Univariate t-tests show that the mean female factor score is greater (at the $\alpha = .01$ level) than the mean male factor score on five factors, while the mean male score is greater on only one factor. The mean response of males and females was compared for each of the sixty-five statements. The multivariate interaction of profiles is significant [$T^2 = 202, F(65, 337) = 2.61, p < .001$]. The female mean is significantly greater than the male mean on twenty statements, while the reverse is true on only one statement. Thus, females tend to agree more strongly than do males with nearly one-third of the standardized statements. It is unclear whether this reflects a genuine difference in beliefs about time, a rather trivial difference in completing the TIME, or both.

Females have a higher mean factor score on Factor 1 than males (.20 vs. −.27), which is also reflected in greater mean agreement with standardized statements D01 through D05. Females also have a higher mean score on Factor 2 (.14 vs. −.18), which is also reflected in greater mean agreement with statements C01, C02, C04, and C06. It may be that females are more aware of or sensitive to certain influences involving activity or change which affect beliefs about experienced (Factor 2) and remembered (Factor 1) duration.

Females score higher than males on two factors concerning physical time. Their higher mean score on Factor 4 (.13 vs. −.18) is reflected in greater mean agreement with statements A01, A02, A03, A04, and A15. Thus, females tend to report greater belief than do males that time passes in a constant progression. Their higher mean score on Factor 6 (.10 vs. −.13) is reflected in greater mean agreement with statement A06. Females report greater belief that time is cyclical, which is perhaps attributable to the menstrual cycle.

Females also score higher on Factor 14 (.11 vs. −.14), which concerns effects of alertness on duration experience. Their mean agreement with statements C12 and D12 is greater than that of males.

The only factor on which males have a higher mean score than females (.13 vs. −.10) is Factor 15, which concerns duration estimation accuracy. Males agree somewhat less strongly than do females that experienced and remembered duration may differ (B16).

Reliability of Statements

A correlation was calculated between the rating of each statement in the first administration and that in the second. The reliability of each statement is shown in Table 1. Values of r range from .21 to .95; the overall mean is .52. The mean is .56, .47, .60, and .48 for statements from Part A, B, C, and D, respectively. There is a high positive correlation [$r(63) = .65, p < .001$] between reliability coefficients and standardized mean ratings of the sixty-five statements. Statements that were rated near the midpoint of the scale tend to be less reliable than statements that were rated toward the extremes of the scale. However, the presence of means near the midpoint of the scale implies that the other means do not simply reflect demand characteristics.

The mean agreement with each of the sixty-five statements on the original test is not significantly different from that on the retest [$T^2 = 342, F(65, 14) = .95, p = .59$]. In short, the mean reliability of the statements on the TIME is moderately high, and the mean agreement with each of the standardized statements is comparable on two tests separated by about eight weeks.

Internal Consistency of Factors

An estimate of the internal consistency of the factor solution is provided by the squared multiple correlations of the factor scores predicted from the ratings or the original variables [13]. The internal consistency estimate for each factor is shown in Table 1. Estimates range from .80 to .55; the overall mean is .63. The estimates are all high or moderately high, indicating that the observed variables account for a substantial amount of variance in the factor scores. Thus, the factors are quite stable, and the interpretations offered here are made with considerable confidence.

DISCUSSION

The TIME contains fairly reliable statements which cluster into a consistent structure of beliefs about time. Thus, we can draw implications regarding similarities and differences between the beliefs of nonscientists assessed in this study and the related beliefs of scientists expressed in the literature.

Physical Time

At least four separate factors underlie beliefs regarding physical time. Factor 4 reflects the ordinary experience of time as a constant progression, such as is expressed in the writings of Newton. Time is conceived as an independent dimension, neither space-like nor energy-like in nature, which "of itself, and from its own nature, flows equably without relation to anything external." [14, p. 6] In this view, events develop with the passage of time. Time is one-dimensional and continually "moves" forward, from past to future [15]. There may be a close parallel with the nature of human consciousness, which has been described as a "stream" of experiences progressively and inexorably retreating into memory [16, p. 239]. Of course, the rate of flow of experiences is not constant, and consciousness may be viewed as an "energy."

Factor 6 seems to reflect a rather literal equating of time with what is measured by clocks or calendars. For example, many of the respondents agree that time is cyclical. They apparently do so for a very concrete reason, perhaps involving the recurrence of *names* of hours, days, and months. Most modern physicists disagree with the cyclical notion. Along with most of our respondents, however, they agree that a clock is a valid instrument to use in measuring time.

Factor 7 also reflects a rather realistic view of time. Along with physicists, the respondents agree that time exists and that a distinction can be made between past, present, and future. Somewhat paradoxically, however, our respondents do not agree that physical time is the same for all individuals regardless of their cultural concepts or their consciousness. In contrast, Einstein's theory of relativity "has nothing to do with the subjective experiences of different observers." [17, p. 455] Although physicists commonly refer to temporal experiences of different observers, this is merely an expository device; it implies nothing about time itself.

Factor 17 clearly contrasts Newtonian (absolute) and Einsteinian (relative) conceptions. As noted earlier, a majority of our respondents lean toward Newtonian views. Priestley's assertion that "after half a century . . . Einstein's theory of relativity has never taken hold of the public mind" appears to be fairly accurate [18, p. 88]. Modern physicists, of course, prefer Einsteinian views. Einstein's theory of relatively proposes that time (as well as space) changes with motion, or acceleration. Thus, space and time are regarded as inseparable aspects of a four-dimensional continuum called space-time [19]. Although modern physicists conceive of time as a "space-like" dimension, it may differ in certain ways from the three spatial dimensions. There is no solid empirical evidence that time is reversible, for example. Einstein believed that "we cannot send wire messages into the past" [20, p. 435], but certain mathematical representations (Feynman diagrams) may be interpreted in terms of a "complete symmetry with regard to the direction of time." [19, p. 183]

To summarize, beliefs of the nonscientists surveyed here often differ considerably from beliefs of scientists expressed in the literature on physical time. Our respondents tend to report more absolute and concrete conceptions of time than do modern physicists, who regard time in more relative and abstract terms.

Personal Time

At least six factors appear to underlie beliefs regarding personal time. Several of them reveal aspects of what is variously called temporal horizon, perspective, or orientation. In Factor 3, the personal present and the personal future are typically reported to be more important than the personal past. Similarly, in Factor 8 most respondents report that they do not focus attention equally on the three temporal zones; in particular, they report that they do not tend to focus attention or place importance on the past. Factor 19 reveals that the personal future is particularly important and receives much attention. These reports seem consistent with Cottle's [4, 21, 22] "circles test," in which many participants chose to represent the future with a large circle, the past with a small circle, and the present with an intermediate circle. The typical response to these statements can also be interpreted to be a positive indicator of mental health. Alcoholism [9], schizophrenia [22, 23], and especially senile dementia [23] are characterized by attention to the past at the expense of the future; and depression and mania are characterized by loss of the personal future and past [24, pp. 184-185].

Three other factors refer in general terms to personal beliefs about temporal experience. Most respondents report attending to the experienced duration of a time period, which is part of the psychological present, but not necessarily to the remembered duration of a time period (Factor 13). The tendency to believe that both experienced and remembered duration depend on many factors is consistent with psychological evidence that a number of different variables affect duration experience [24-26]. The belief that both experienced and remembered duration are a result of conscious, rational processes (Factor 11) is also in agreement with some recent cognitive theories [7, 27], as opposed to "internal clock" theories. The belief that both experienced and remembered duration are usually estimated fairly accurately (Factor 15) is in accord with results of some, but certainly not all, experiments. Accuracy of temporal judgment depends on many factors [24, 26]. Respondents also tend to report that prospective and retrospective duration estimates may differ. In fact, James [16] has speculated and others [28, 29] have found that some variables produce

opposite effects on prospective and retrospective temporal judgments. To summarize, most respondents report believing that personal time is a result of conscious and rational processes, may be affected by many factors, but nevertheless can be estimated fairly accurately. On all of these points, our respondents' beliefs do not differ substantially from psychological theories and evidence.

Duration Experience

Several theorists have distinguished between the experienced duration and the remembered duration of a time period [16, 24, 25, 30]. Respondents agree that these two different kinds of judgment may differ. However, the mean response to corresponding statements from Parts C and D of the TIME often reveals beliefs about similar effects of various factors on experienced and remembered duration. In general, a factor that is reported to make a duration seem to pass quickly is reported to make a duration seem shorter in retrospect, and vice versa.

Responses to statements loading on Factor 2 reveal a typical belief that duration seems to pass more quickly to the extent that the person is engaged in some activity or that there is greater change in context. This belief is in general accord with many findings [24, 25, 30]. Similarly, responses to statements loading on Factor 1 reveal a typical belief that duration seems shorter in retrospect to the extent that the time period contained greater activity or change in context. This stands in opposition to many findings [24, 25, 30]. A contextual-change hypothesis parsimoniously integrates much of the evidence. It says that "remembered duration is a cognitive construction mediated by a covert assessment of the remembered amount of change in cognitive context" during the time period [25, p. 195; 28, 31, 32]. In addition, the hypothesis proposes an explanation for why incongruent effects are typically found in studies of experienced duration [25, pp. 196-197]. Because our respondents incorrectly believe that remembered duration is shorter, rather than longer, if the time period contained a great deal of contextual change, the typical experimental finding apparently does not simply reflect beliefs, biases, or demand characteristics.

Consider now the other factors with loadings of corresponding Part-C and Part-D statements. On Factor-5 statements, respondents correctly believe that time seems to pass more quickly during the performance of a challenging than an easy task [33]. However, they do not believe that the remembered duration of a challenging task is longer than that of an easy task, which appears to be the case [34]. On Factor-9 statements, respondents tend to believe that time seems to pass more quickly and the duration is remembered as being shorter if they were in a familiar, rather than an unfamiliar, environment. To our knowledge, there is no direct evidence concerning experienced duration; but some research suggests that remembered duration is longer, rather than shorter, if the time period occurred in an unfamiliar environment [32]. On Factor-10 statements, there is

no strong tendency to report an effect of daydreaming on duration experience. In contrast, the extensive phenomenological and limited experimental evidence suggests that time seems to pass more quickly and remembered duration seems shorter if the time period contains daydreaming, as opposed to task performance [25]. On Factor-12, there is little or no consensus on effects of emotions. Any effects might depend on whether an emotional experience is positive or negative. Einstein's well-known comment is relevant: "When a man sits with a pretty girl for an hour, it seems like a minute. But let him sit on a hot stove for a minute—and it's longer than any hour. That's relativity." Because the type of emotion was not specified in these statements, it might be that respondents simply did not decide or agree on the type of emotion to which the statements referred. On Factor-14, respondents believe that there are strong effects of alertness or drowsiness on duration experience. Except for some related work on arousal and attentional selectivity [34, 35], to our knowledge there is little or no experimental evidence. On Factor-18, the belief that time seems to pass more quickly and remembered duration seems shorter if the time period contains dreaming, as opposed to wakefulness, agrees with phenomenological reports from other sources. The actual experimental evidence is meager [23-26].

In summary, our respondents' beliefs about duration experiences are occasionally consistent with, but often run counter to, the available experimental evidence. Effects on experienced duration may be partly attributable to influences of covert beliefs, since there is a similarity between the evidence and the beliefs. Effects on remembered duration, however, are more clearly different from the beliefs reported here, and therefore are less easily attributable to such influences. It is possible that people have more accurate introspective awareness of the effects of various factors on experienced duration than on remembered duration.

CONCLUSIONS

The TIME appears to be a fruitful questionnaire for the exploration of beliefs about time. The present survey of nonscientists suggests implications for endeavors ranging from teaching concepts of physical time to proposing explanations of duration experience. Future studies using the TIME might profitably explore relationships between personality, culture, and beliefs about time. Only broad-based research efforts will accurately reflect the multifaceted nature of time, both as a physical phenomenon and a personal, cognitive construct.

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REFERENCES

1. H. Eisler, L. Linde, G. Troëng, R. Lazar, B.-M. Eisler, and Å. Hellström, A Complementary Bibliography on the Psychology of Time, JSAS *Catalog of Selected Documents in Psychology*, *10*:3, p. 55 (Ms. No. 2101), 1980.
2. E. S. Krudy, B. T. Bacon, and R. Turner, *Time: A Bibliography*, Information Retrieval, London, 1976.
3. I. Zelkind and J. Sprug, *Time Research: 1172 Studies*, Scarecrow Press, Metuchen, New Jersey, 1974.
4. B. S. Gorman and A. E. Wessman, Images, Values, and Concepts of Time in Psychological Research, in *The Personal Experience of Time*, B. S. Gorman and A. E. Wessman (eds.), Plenum Press, New York, pp. 217-263, 1977.
5. M. Arons and H. London, Correcting for Compensation in Studies of Time Estimation, *Psychonomic Science*, *17*, pp. 319-320, 1969.
6. J. A. Michon, Le Traitment de l'Information Temporelle, in *Du Temps Biologique au Temps Psychologique*, P. Fraisse, F. Halberg, J. Montangero, J. Nuttin, and M. Richelle (eds.), Presses Universitaires de France, Paris, 1979.
7. P. Fraisse, Cognition of Time in Human Activity, in *Cognition in Human Motivation and Learning*, G. d'Ydewalle and W. Lens (eds.), Lawrence Erlbaum Associates, Hillsdale, New Jersey, pp. 233-259, 1981.
8. A. E. Wessman, Personality and the Subjective Experience of Time, *Journal of Personality Assessment*, *37*, pp. 103-114, 1973.
9. P. Roos and R. Albers, Performance of Alcoholics and Normals on a Measure of Temporal Orientation, *Journal of Clinical Psychology*, *21*, pp. 34-36, 1965.
10. R. Calabresi and J. Cohen, Personality and Time Attitudes, *Journal of Abnormal Psychology*, *73*, pp. 431-439, 1968.
11. W. J. Dixon (ed.), *BMDP Statistical Software*, University of California Press, Berkeley, California, 1981.
12. R. B. Cattell, The Scree Test for the Number of Factors, *Multivariate Behavioral Research*, *1*, pp. 245-276, 1966.
13. B. G. Tabachnick and L. S. Fidell, *Using Multivariate Statistics*, Harper and Row, New York, 1983.
14. I. Newton, *Philosophiae Naturalis Principia Mathematica*, A. Motte (transl.), reprinted in *Sir Isaac Newton's Mathematical Principles of Natural Philosophy and His System of the World*, F. Cajori (rev. transl.), University of California Press, Berkeley, California, 1946.
15. G. Zukav, *The Dancing Wu Li Masters: An Overview of the New Physics*, William Morrow, New York, 1979.
16. W. James, *The Principles of Psychology* (Vol. 1), Dover, New York, 1950. (Originally published, 1890.)
17. H. Dingle, Time in Relativity Theory: Measurement or Coordinate?, in *The Voices of Time* (2nd edition), J. T. Fraser (ed.), University of Massachusetts Press, Amherst, pp. 455-472, 1981.
18. J. B. Priestley, *Man and Time*, Doubleday, Garden City, New York, 1964.
19. F. Capra, *The Tao of Physics: An Exploration of the Parallels Between Modern Physics and Eastern Mysticism*, Shambhala, Berkeley, California, 1975.

20. M. Čapek, Time in Relativity Theory: Arguments for a Philosophy of Becoming, in *The Voices of Time* (2nd edition), J. T. Fraser (ed.), University of Massachusetts Press, Amherst, pp. 434-454, 1981.
21. T. J. Cottle, The Circles Test: An Investigation of Temporal Relatedness and Dominance, *Journal of Projective Techniques and Personality Assessment*, *31*, pp. 58-71, 1967.
22. ———, *Perceiving Time: A Psychological Investigation with Men and Women*, John Wiley and Sons, New York, 1976.
23. J. E. Orme, *Time, Experience and Behaviour*, Iliffe, London, 1969.
24. P. Fraisse, *The Psychology of Time* (trans. by J. Leith), Harper and Row, New York, 1963.
25. R. A. Block, Time and Consciousness, in *Aspects of Consciousness* (Vol. 1), G. Underwood and R. Stevens (eds.), Academic Press, London, pp. 179-217, 1979.
26. L. W. Doob, *Patterning of Time*, Yale University Press, New Haven, Connecticut, 1971.
27. J. A. Michon, Processing of Temporal Information and the Cognitive Theory of Time Experience, in *The Study of Time*, J. T. Fraser, F. C. Haber, and G. H. Müller (eds.), Springer-Verlag, Berlin, pp. 249-265, 1972.
28. R. A. Block, E. J. George, and M. A. Reed, A Watched Pot Sometimes Boils: A Study of Duration Experience, *Acta Psychologica*, *46*, pp. 81-94, 1980.
29. G. W. Miller, R. E. Hicks, and M. Willette, Effects of Concurrent Verbal Rehearsal and Temporal Set upon Judgments of Temporal Duration, *Acta Psychologica*, *42*, pp. 173-179, 1978.
30. R. E. Hicks, G. W. Miller, and M. Kinsbourne, Prospective and Retrospective Judgments of Time as a Function of Amount of Information Processed, *American Journal of Psychology*, *78*, pp. 719-730, 1976.
31. R. A. Block and M. A. Reed, Remembered Duration: Evidence for a Contextual-Change Hypothesis, *Journal of Experimental Psychology: Human Learning and Memory*, *4*, pp. 656-665, 1978.
32. R. A. Block, Temporal Judgments and Contextual Change, *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *8*, pp. 530-544, 1982.
33. J. C. Loehlin, The Influence of Different Activities on the Apparent Length of Time, *Psychological Monographs*, *73*(4, Whole No. 474), 1959.
34. G. Underwood and R. A. Swain, Selectivity of Attention and the Perception of Duration, *Perception*, *2*, pp. 101-105, 1973.
35. E. D. Curton and D. S. Lordahl, Effects of Attentional Focus and Arousal on Time Estimation, *Journal of Experimental Psychology*, *103*, pp. 861-867, 1974.

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