Journal of Abnormal Psychology
1994, Vol. 103, No. 3, 565–569

0021-843X/94/$3.00

Hypnotic Underestimation of Time: The Busy Beaver Hypothesis

Richard St. Jean, Katie McInnis, Laura Campbell-Mayne, and Pamela Swainson

Two experiments tested the hypothesis that the hypnotic underestimation of time is mediated by attentional processing. In Experiment 1, variations in the demands placed on attentional resources produced substantial differences in the subjective estimates of identical length intervals occurring within a hypnotic context. In Experiment 2, attentional manipulation was assessed in both hypnotic and waking contexts. Time judgments were again found to vary with attentional demands but not with hypnotic context. The results are consistent with a busy beaver hypothesis, which holds that hypnotic, as well as nonhypnotic, time estimates are a by-product of the attentional processing demands of the task.

A body of literature has developed that experimentally documents the tendency of hypnotic subjects to greatly underestimate the passage of time (see St. Jean, 1989, for a review). However, it is still unclear whether this effect is intrinsically tied to the context or experience of hypnosis.

Bowers and Brenneman (1979) found that subjects administered the Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS-A; Shor & Orne, 1962) underestimated its duration by about 40%. In comparison, a subsample tested several weeks later while listening to a lecture estimated an identical block of time to be considerably longer. The fact that the hypnotic and nonhypnotic intervals were not counterbalanced and varied not only in context but also in informational content renders interpretation problematic.

St. Jean (1988) provided a more direct comparison by randomly assigning subjects to either a participant condition, in which they were administered the Stanford Hypnotic Susceptibility Scale, Form C (SHSS-C; Weitzenhoffer & Hilgard, 1962), or an observer condition, in which they watched a video presentation of an SHSS-C session. Participants substantially underestimated the duration of the testing session, by an average of 55%, whereas the estimates of the observers were relatively accurate. However, although this study successfully manipulated hypnotic versus waking context, while holding informational content constant, it did not rule out one other possibility. According to a social–psychological interpretation of hypnosis, participating subjects are actively involved in the proceedings, attentively encoding and interpreting the hypnotist's suggestions, enacting the suggested behaviors, and creating appropriate imagery (Spanos, 1991). Observing subjects, by contrast, are not required to engage in the same degree of attentional processing. It is quite possible, then, that the differences in time estimation were due to the processing demands of the task rather than to the context in which the task was presented.

Various studies have tried to link time perception with some aspect of hypnosis. Although some studies have cited greater underestimation for subjects who were more highly susceptible (Bowers, 1979; St. Jean & MacLeod, 1983), others have failed to find such a relationship (Bowers & Brenneman, 1979; St. Jean, 1988; St. Jean, MacLeod, Coe, & Howard, 1982; St. Jean & McCutcheon, 1989; St. Jean & Robertson, 1986). Attempts to link underestimation to suggested amnesia (Bowers, 1979; St. Jean et al., 1982) and to absorption (St. Jean & MacLeod, 1983; St. Jean & McCutcheon, 1989; St. Jean & Robertson, 1986) have not succeeded in establishing a stable relationship. Because hypnotic susceptibility in general and amnesia and absorption in particular have traditionally been considered to be central to the experience of hypnosis (e.g., Bowers, 1976/1983; Hilgard, 1965; Kihlstrom, 1985), the lack of a stable correlation with time estimation makes it unlikely that underestimation uniquely indexes periods of hypnotic involvement.

The recent generation of cognitively based theories of time perception (e.g., Block, 1990) offers a useful perspective for understanding hypnotic time experience. These theories may be grouped into those that are essentially memory based (Block, 1989; Poynter, 1989) and those that are processing based (Hicks, Miller, & Kinsbourne, 1976; Zakay, 1989). The division is not absolute; memory theories attempt to account for differences in processing strategy, and processing theories use memory constructs. Memory-based theories view time estimates as reconstructions based on the organization or retrievability of stored experiences. Poynter (1989), for example, presented a change-segmentation theory, postulating that time judgments are based on the number and magnitude of sensory changes as well as the organization of these events in memory. Thus, temporal segments, once remembered, can be mentally articulated as a method of reproducing duration. Of potential relevance to hypnosis is the notion that changes in the level, or effortfulness, of stimulus processing influence the segmentation of experiences and, by this moderating route, the magnitude of time judgments. There is reason to expect, then, that time judgments secured during or after a hypnotic period are sensitive to the mode of information processing used and may be relevant to the contention that hypnosis potentiates automatic processing (Bowers, 1992; Dixon, Brunet, & Laurence, 1990).

Richard St. Jean, Katie McInnis, Laura Campbell-Mayne, and Pamela Swainson, Department of Psychology, University of Prince Edward Island.

Experiment 1 was funded by a University of Prince Edward Island Senate Research Grant to Richard St. Jean. Experiment 2 was conducted by Laura Campbell as part of her undergraduate honor's thesis.

We gratefully acknowledge the assistance of Margie Loo in the data collection for Experiment 2 and Angie Birt for help in the preparation of the article.

Correspondence concerning this article should be addressed to Richard St. Jean, Department of Psychology, University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada C1A-4P3.

One of the processing-based theories, Zakay's (1989) resource allocation model, appears to offer direct implications for hypnotic time perception. Stimuli are analyzed by both a cognitive timer, P(t), which accumulates subjective time units (STUs), and a nontemporal information processor, P(i). P(t) stores STUs in working memory, which rapidly decays and is reset every time a stimulus is interpreted as the start of a new interval. Attention is necessary for the operation of P(t); the more resources allocated to it, the greater is the number of STUs accumulated. Attentional resources may also be required by P(i), depending on the complexity, importance, and processing requirements of the stimulus information presented. The more resources that are needed to meet task demands, the fewer there are available for P(t), resulting in a decreased accumulation of STUs and, hence, a decline in the magnitudes of time judgments. This model accounts nicely for the reliable finding that prospective time estimates, in which subjects are alerted in advance to the demand for accurate judgments, are substantially longer than retrospective estimates, in which the primary demand is for some form of information processing and the subsequent request for a time estimate is unexpected. Of special relevance to hypnosis is the implication that to the extent that hypnotic processing consumes attentional resources the shorter time estimates for the hypnotic period will be. That is, retrospective temporal judgments may serve as a nonreactive index of the effortfulness, or demand on cognitive resources, of mental processing during hypnosis.

The application of the time cognition literature to hypnosis requires us to bridge several gaps. Studies of hypnotic time perception have, for the most part, used retrospective estimates of intervals ranging in length from 8.5 min to 1 hr (St. Jean, 1989). Cognitive time perception studies have, for the most part, used prospective estimates of periods ranging from 4 sec to 2 min (Zakay, 1989). The cognitive literature has consistently shown that increases in the difficulty or complexity of task processing result in decreases in the magnitude of immediate time estimates (Hicks, Miller, Gaes, & Bierman, 1977; Smith, 1969; Tsao, Wittlieb, Miller, & Wang, 1983; Zakay, 1992). Although most of this research has been conducted using a prospective paradigm, some investigators suggest that the same relationship holds even in a retrospective paradigm (i.e., when subjects are not aware that they will be asked for a time judgment; Brown, 1985; Zakay, 1989). Thus, a consideration of the cognitive time perception literature, as well as our reinterpretation of St. Jean's (1988) results, leads us to suggest that this relationship may extend to the longer range of durations examined in the hypnotic literature. We hypothesize, then, that subjects will estimate a given interval, hypnotic or nonhypnotic, to be of shorter duration when task demands are heavy than when they are light.

Experiment 1

The first study was conducted to determine whether variations in the attentional processing requirements of a task presented within a hypnotic context would have a corresponding influence on subjects' time judgments. The basic strategy was to overload subjects' processing capacity by using a divided-attention paradigm requiring the simultaneous performance of several moderately difficult tasks. It was hypothesized that overloaded subjects would experience the task interval as passing more quickly than would nonoverloaded subjects. Hypnotic susceptibility was also included as a variable to provide further data for assessing the possible existence of a relationship with time estimation.

Method

Subjects. A total of 41 male and female volunteers, 20 selected on the basis of low scores (0–4) and 21 on the basis of high scores (8–12) on the HGSHS-A, served in the main phase of the study. All of the subjects were recruited from introductory psychology classes and received extra course credit for their participation.

Procedure. Each subject was greeted individually by a female experimenter and was informed that this session was designed to explore hypnotic responsiveness in greater detail than was possible in the group session. All subjects read and signed a consent form and then were administered the SHSS-C in the usual manner up through Item 6. At that point, subjects were randomly assigned to either a high cognitive load (HCL) or a low cognitive load (LCL) condition. As a prologue to the experimental manipulation, subjects in each condition were told that the specific purpose of today's session was to examine the role of attention in hypnotic responding.

In the LCL condition, the experimenter instructed the subject to put on a set of earphones to listen to a tape-recorded story. Subjects were further instructed to open their eyes and gaze at a blank computer screen while listening to the story. The experimenter then turned on the tape recorder and played Leonard Nimoy's 27.5-min narration of Ray Bradbury's (1951) short story "The Veldt."

In the HCL condition, the experimenter explained that she wished to determine how well the subject could do several things at once. She indicated that the subject's task was to solve a series of letter puzzles presented on the computer screen while simultaneously listening to a tape-recorded story and counting the number of times a particular name recurred in the story. A sample puzzle was presented on the computer and, when the subject indicated that the procedure was understood, the experimenter activated the tape recorder and the computer program. The computer continuously presented letter problems throughout the entire duration of the tape recording. Each correct solution caused the next problem to immediately appear. If the correct solution was not given within 10 sec, a new problem was generated. The computer automatically recorded the number of trials attempted and the number of errors made.

At the conclusion of the tape, all subjects were instructed to close their eyes and to estimate verbally, to the nearest minute, the duration of the recording. The remaining six items of the SHSS-C were administered, and subjects were alerted in the standard manner. All subjects were administered a written questionnaire that assessed knowledge of story content, asked for a second time estimate, and contained scales for rating interest and involvement. Subjects were then thanked for their participation and given an opportunity to discuss the nature of the research informally.

Results

Manipulation check. Scores on the 14-item story questionnaire served as a check on the attentional processing manipulation. If the HCL condition succeeded in overloading attentional capacity, a deficit in the encoding of story content should result. A 2 × 2 (Condition × Susceptibility) analysis of variance (ANOVA) revealed a main effect only for condition, $F(1, 37) = 10.13$, $p < .01$. Subjects in the HCL condition recalled significantly less ($M = 7.45$) of the story content than those in the LCL condition ($M = 10.4$).[1]

[1] A further indication that the cognitive-load manipulation was successful emerges from an analysis of computer task performance. Subjects attempted an average of 339 trials over the 27.5-min period, a rate of one trial every 4.9 sec, and responded correctly on 234, a success rate of 69%.

Table 1
Ratios of Estimated to Actual Time: Experiment 1

	Experimental condition	
Susceptibility	HCL	LCL
High		
M	.38	.63
SD	.23	.32
N	11	10
Low		
M	.48	.63
SD	.27	.20
N	10	10
Combined		
M	.43	.63
SD	.24	.26
N	21	20

Note. HCL = high cognitive load; LCL = low cognitive load.

The manipulation did not, however, adversely affect hypnotic responding after the story presentation. HCL subjects passed approximately the same number of remaining items ($M = 1.1$) as the LCL subjects ($M = 1.0$), $F(1, 37) = .47$.

Time estimation. The major data of interest, the initial time judgments of the tape's duration, were originally rendered as verbal estimates in minute units. To facilitate calculation of the extent to which these judgments departed from the actual duration, the data are presented as ratios of estimated to actual time. Ratios less than 1 represent underestimates; those greater than 1 are overestimates. As shown in Table 1, subjects in all conditions substantially underestimated the actual duration. ANOVA of these data indicated that only the main effect for condition was significant, $F(1, 37) = 6.24$, $p < .05$. Subjects in the HCL condition underestimated the tape's duration by about 57% ($M = .43$), and those in the LCL condition by 37% ($M = .63$). Essentially, the same pattern of data is found when the second, written, estimates are examined.

Correlations between time estimates and memory for story content, rated interest, rated involvement, and SHSS-C scores are low and nonsignificant when data are aggregated across conditions. No relationship to time estimation was found for any of the measures collected in the HCL condition: the number of trials attempted, the number of errors made, and ratings of task interest, difficulty, and enjoyment.

Discussion

The first study was designed to determine whether variations in attentional processing within a hypnotic context produce corresponding variations in the experience of the passage of time. That attentional processing was successfully manipulated is indicated by the fact that subjects in the HCL condition, a condition designed to overload available processing resources, scored significantly lower on the recall test than did subjects in the LCL condition. In addition, as hypothesized, estimates of the tape's duration were substantially shorter when subjects' attentional resources were fully occupied by task demands.

The key to understanding the hypnotic underestimation effect, then, may reside in the attentional processing requirements of the hypnotic task. Hypnotic conditions involve the subject in actively taking on the hypnotic role, attending to and interpreting the sometimes ambiguous utterances of the hypnotist, enacting the suggested behaviors, and attempting to create the appropriate experiences (Spanos, 1991). In short, the hypnotic subject may be likened to the proverbial busy beaver, so occupied with the demands of task and role that little attention may be spared to process unrelated stimuli. When task demands are increased even more, as in our HCL condition, or in negotiating the relatively challenging items of the SHSS-C, attention to the passage of time is even more sharply curtailed.

Experiment 2

Our analysis, then, suggests that if hypnotic and waking conditions could be equated in the demands placed on processing resources, time estimates would not vary between conditions. Experiment 2 was conducted to assess this possibility. The basic strategy was to present the same overloading task in both a waking context and a hypnotic context. This should ensure that, for subjects in both conditions, available processing resources are fully used.

Method

Subjects. The subjects were 60 male and female University of Prince Edward Island students who had previously been administered the HGSHS-A. All were volunteers who earned extra course credit in their introductory psychology class.

Procedure. The procedure was identical in most respects to that of Experiment 1. Each subject individually met with a female experimenter and was informed that the nature of the session was to explore hypnotic responsiveness in more detail than was possible in the group session. Subjects read and signed consent forms and were assigned by block randomization to either a hypnotic/HCL, a hypnotic/LCL, a waking/HCL, or a waking/LCL condition. Fifteen subjects served in each condition. All subjects were initially told that the objective of the study was to learn more about the skill of paying attention during hypnosis.

In the hypnotic conditions, the SHSS-C was administered up to the sixth item. The attentional manipulation, combined with the tape presentation, was introduced at this point and, when the tape was complete, the remaining items of the SHSS-C were administered. In the waking conditions, the treatments comprising the attentional manipulation were completed before hypnosis was introduced. The only change in Experiment 2 was that, based on an item analysis of the story-recall questionnaire, several items were rewritten and several others added in an effort to achieve greater discriminability.

Results

Manipulation check. A 2 × 2 ANOVA performed on the story-recall scores showed only a main effect for the cognitive-load treatment, $F(1, 56) = 32.60$. $p < .01$. As expected, HCL subjects recalled significantly less ($M = 8.97$) of the story content than did LCL subjects ($M = 13.73$). Neither the hypnotic/waking context manipulation, $F(1, 56) = .72$, nor the cognitive-load manipulation, $F(1, 56) = .26$, had an effect on response to the last six items of the SHSS-C.[2]

[2] Subjects in the HCL conditions attempted an average of 393 computer trials and responded correctly on 346, a success rate of 88%. Hypnotic/waking context did not influence either trial attempts, $F(1, 28) = 1.54$, $p > .20$, or errors, $F(1, 28) = .07$.

Table 2
Ratios of Estimated to Actual Time: Experiment 2

	Experimental condition	
Context	HCL	LCL
Hypnotic		
M	.64	.80
SD	.47	.29
Waking		
M	.45	.92
SD	.19	.37
Combined		
M	.54	.86
SD	.36	.33

Note. HCL = high cognitive load; LCL = low cognitive load.

Time estimation. Time estimate ratios are shown in Table 2. Again, subjects in all conditions underestimated the story duration. ANOVA revealed a significant main effect for cognitive-load treatment, $F(1, 56) = 12.55$, $p < .05$, but no effect for hypnotic/waking context. Although there appears to be some interaction between context and condition, this effect was statistically marginal, $F(1, 56) = 3.14$, $p = .08$. Overall, subjects in the HCL conditions underestimated the duration of the story by 46% ($M = .54$), whereas subjects in the LCL condition underestimated it by only 14% ($M = .86$).

Correlations among time estimates and memory for story content, rated interest, rated involvement, and SHSS-C scores are low and nonsignificant when data are aggregated across conditions.

Discussion

Experiment 2 was designed to determine whether, apart from the processing demands of the task, the hypnotic context in and of itself influences time estimation. The results suggest that it does not. Although not statistically significant, the trend of the interaction cell means shows the waking HCL subjects providing shorter estimates than the hypnotic HCL subjects. If hypnosis were the important factor, any such trend would be expected to be in the opposite direction.

The major outcome of Experiment 2 was a replication of the main effect obtained in Experiment 1. In the HCL condition, in which processing demands were high, both hypnotic and waking subjects underestimated the tape's duration to a much greater extent than in the LCL condition, in which processing demands were low.

General Discussion

Both experiments confirm the hypothesis that increases in processing demands produce decreases in the magnitude of subjective time estimates. The effect of the attentional processing manipulation was particularly robust, remaining large and significant across variations in hypnotic context and hypnotic responsiveness. We interpret this effect as evidence compatible with the busy beaver hypothesis of hypnotic time estimation. This explanation holds that the processing resources of the hypnotic subject are so fully occupied by the demands of the hypnotic task that the residual capacity available for the processing of time-related, or other task-extraneous, cues is minimal. The underestimation of time associated with hypnosis, then, may simply be a by-product of the attentional demands of the hypnotic task. Substantial underestimation of the duration of a particular interval, regardless of whether it occurs within a hypnotic or nonhypnotic context, results whenever task demands exhaust the capacity of available resources to meet them.

There are, however, some additional considerations bearing on the utility of this account that need to be addressed by further research. It is possible that the HCL manipulation used in an effort to increase task demands may, by its requirement of rapid switches in attentional focus, have produced underestimation by this means alone. That is, switching of attentional focus may be confounded with the overloading of attentional resources. Future research should compare divided and undivided attentional conditions, equated in their processing requirements, against a low task-demand control.

It is also possible that underestimation could be accounted for by other theoretical mechanisms. A neodissociation account (Hilgard, 1977) might view the autonomous functioning of dissociated cognitive control systems as the chief causal agent. If temporal processing is the function of the executive control system, then any splitting off from this central agency may be accompanied by a reduction in time awareness. Kihlstrom (1992) suggested that dissociated cognitive control systems continue to consume attentional resources with the consequence, perhaps, that processing capacity is channeled away from a temporal processor. This possibility might be assessed by correlating time judgments with ratings of nonvolitional responding or some other index of dissociation.

The notion, however, that underestimation is intrinsically tied to the context or experience of hypnosis is troubled by the failure of Experiment 2 to produce differences in time estimation in hypnotic and nonhypnotic conditions. It is also troubled by the apparent lack of a stable relationship between hypnotic susceptibility and magnitude of time estimates. Although two studies did report a modest negative relationship (Bowers, 1979; St. Jean & MacLeod, 1983), no such relationship occurred in either of the studies reported here.[3] Added to the previous failures to find this relationship (Bowers & Brenneman, 1979; St. Jean, 1988; St. Jean et al., 1982; St. Jean & McCutcheon, 1989; St. Jean & Robertson, 1986), the current studies raise the number to seven. Given as well the lack of a relationship with reported interest and involvement (see also St. Jean & McCutcheon, 1989), there is increasing reason to doubt that time estimation indexes individual differences in hypnotic responding. Whether the responses of the hypnotic subject are successful or unsuccessful in meeting task demands simply does not impact the subject's time judgments. Instead, it appears to

[3] Bowers (1979) found that a significant relationship between time estimation and hypnotic responsiveness emerged only after those who overestimated the interval had been removed from the data. There were 3 overestimators in Experiment 1 and 12 in Experiment 2. Removing their data did not change the outcome of any of the statistical analyses. In Experiment 2, for example, for time estimation with total SHSS-C score, $r(58) = .23$ for the entire sample and $r(46) = .20$ with the overestimators removed. It should be noted that these small and nonsignificant correlations have a positive sign. The two studies (Bowers, 1979; St. Jean & MacLeod, 1983) reporting significant relationships found negative correlations.

be the effortfulness of the attempt, not the outcome of the attempt, that determines subjective duration.

The attentional processing account that we have offered, the busy beaver hypothesis, appears better suited to some theories of hypnosis than to others. Views of the hypnotic process as active, goal oriented, and skill demanding (Coe & Sarbin, 1991; Shor, 1979; Spanos, 1991) are particularly compatible with the notion that hypnotic activities draw heavily on attentional resources. Other views of hypnosis, especially those that equate hypnosis with relaxation (Edmonston, 1991) or automaticity (Bowers, 1992; Dixon et al., 1990), appear to have difficulty encompassing the present findings.

References

Block, R. A. (1989). Experiencing and remembering time: Affordances, context, and cognition. In I. Levin & D. Zakay (Eds.), *Time and human cognition: A lifespan perspective* (pp. 333-363). Amsterdam: North-Holland.

Block, R. A. (1990). *Cognitive models of psychological time.* Hillsdale, NJ: Erlbaum.

Bowers, K. S. (1979). Time distortion and hypnotic ability: Underestimating the duration of hypnosis. *Journal of Abnormal Psychology, 88,* 435–439.

Bowers, K. S. (1983). *Hypnosis for the seriously curious.* New York: Norton. (Original work published 1976)

Bowers, K. S. (1992). Imagination and dissociative control in hypnotic responding. *International Journal of Clinical and Experimental Hypnosis, 40,* 253–275.

Bowers, K. S., & Brenneman, H. A. (1979). Hypnosis and the perception of time. *International Journal of Clinical and Experimental Hypnosis, 27,* 29–41.

Bradbury, R. (1951). The veldt. In R. Bradbury (Ed.), *The illustrated man* (pp. 7–18). New York: Bantam Books.

Brown, S. W. (1985). Time perception and attention: The effects of prospective versus retrospective paradigms and task demands on perceived duration. *Perception and Psychophysics, 38,* 115–124.

Coe, W. C., & Sarbin, T. R. (1991). Role theory: Hypnosis from a dramaturgical and narrational perspective. In S. J. Lynn & J. W. Rhue (Eds.), *Theories of hypnosis: Current models and perspectives* (pp. 303-323). New York: Guilford Press.

Dixon, M., Brunet, A., & Laurence, J. (1990). Hypnotizability and automaticity: Toward a parallel distributed processing model of hypnotic responding. *Journal of Abnormal Psychology, 99,* 336–343.

Edmonston, W. E. (1991). Anesis. In S. J. Lynn & J. W. Rhue (Eds.), *Theories of hypnosis: Current models and perspectives* (pp. 197–237). New York: Guilford Press.

Hicks, R. E., Miller, G. W., Gaes, G., & Bierman, K. (1977). Concurrent processing demands and the experience of time in passing. *American Journal of Psychology, 90,* 431–446.

Hicks, R. E., Miller, G. W., & Kinsbourne, M. (1976). Prospective and retrospective judgments of time as a function of amount of information processed. *American Journal of Psychology, 89,* 719–730.

Hilgard, E. R. (1965). *Hypnotic susceptibility.* New York: Harcourt, Brace & World.

Hilgard, E. R. (1977). *Divided consciousness: Multiple controls in human thought and action.* New York: Wiley-Interscience.

Kihlstrom, J. F. (1985). Hypnosis. *Annual Review of Psychology, 36,* 385–418.

Kihlstrom, J. F. (1992). Hypnosis: A sesquicentennial essay. *International Journal of Clinical and Experimental Hypnosis, 40,* 301–314.

Poynter, D. (1989). Judging the duration of time intervals: A process of remembering segments of experience. In I. Levin & D. Zakay (Eds.), *Time and human cognition: A lifespan perspective* (pp. 305–331). New York: Elsevier Science.

St. Jean, R. (1988). Hypnotic underestimation of time: Fact or artifact. *British Journal of Experimental and Clinical Hypnosis, 5,* 83–85.

St. Jean, R. (1989). Hypnosis and the perception of time. In N. P. Spanos & J. Chaves (Eds.), *Hypnosis: The cognitive-behavioral perspective* (pp. 175–186). New York: Prometheus.

St. Jean, R., & MacLeod, C. (1983). Hypnosis, absorption, and time perception. *Journal of Abnormal Psychology, 92,* 81–86.

St. Jean, R., MacLeod, C., Coe, W. C., & Howard, M. L. (1982). Amnesia and hypnotic time estimation. *International Journal of Clinical and Experimental Hypnosis, 30,* 127–137.

St. Jean, R., & McCutcheon, N. (1989). Does absorption mediate hypnotic time perception? *British Journal of Experimental and Clinical Hypnosis, 6,* 171–176.

St. Jean, R., & Robertson, L. (1986). Attentional versus absorptive processing in hypnotic time estimation. *Journal of Abnormal Psychology, 95,* 40–42.

Shor, R. E. (1979). The fundamental problem in hypnosis research as viewed from historic perspectives. In E. Fromm & R. E. Shor (Eds.), *Hypnosis: Developments in research and new perspectives* (2nd ed., rev., pp. 15–41). Chicago: Aldine.

Shor, R. E., & Orne, E. C. (1962). *The Harvard Group Scale of Hypnotic Susceptibility.* Palo Alto, CA: Consulting Psychologists Press.

Smith, N. C. (1969). The effect on time estimation of increasing the complexity of a cognitive task. *Journal of General Psychology, 81,* 231–235.

Spanos, N. P. (1991). A sociocognitive approach to hypnosis. In S. J. Lynn & J. W. Rhue (Eds.), *Theories of hypnosis: Current models and perspectives* (pp. 324–361). New York: Guilford Press.

Tsao, Y., Wittlieb, E., Miller, B., & Wang, T. (1983). Time estimation of a secondary event. *Perceptual and Motor Skills, 57,* 1051–1055.

Weitzenhoffer, A. M., & Hilgard, E. R. (1962). *Stanford Hypnotic Susceptibility Scale, Form A.* Palo Alto, CA: Consulting Psychologists Press.

Zakay, D. (1989). Subjective time and attentional resource allocation: An integrated model of time estimation. In I. Levin & D. Zakay (Eds.), *Time and human cognition: A lifespan perspective* (pp. 365–397). New York: Elsevier Science.

Zakay, D. (1992). The role of attention in children's time perception. *Journal of Experimental Child Psychology, 54,* 355–371.

Received November 22, 1992
Revision received December 23, 1993
Accepted January 3, 1994 ■