conforms to Hunt's (1963) summary of the discrepancy hypothesis and suggests that perhaps something like Sokolov's (1960) "defensive reaction" may function in the presence of such stimuli.

The finding that the rate of habituation predicts the response to discrepancy confirms previous observations (see McCall, 1969). The fact that the habituation of first fixation (but not deceleration) predicted both the fixation and the cardiac response to discrepancy seems to obviate the initial-value criticism since it would be difficult to explain the fixation-deceleration correlation in terms of initial values (especially since the deceleration-deceleration relationship was not significant).

Cardiac habituation did not predict cardiac response to discrepancy in this study, but such was the case when auditory stimuli were used (Melson & McCall, 1969²). Perhaps the acquisition of a memory engram for a stimulus is more faithfully conveyed by the habituation of one response (i.e., first fixation) for visual stimuli and another response (i.e., cardiac deceleration) for auditory stimuli.

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NOTES

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Correcting for compensation in studies of time estimation¹

MYRON ARONS and HARVEY LONDON,
Brandeis University, Waltham, Mass. 02154

When E manipulates a variable in order to alter S's judgment of how much time has passed, S may "compensate" for the effect of the variable upon him, i.e., he may revise his spontaneous judgment in order to accord with the reality demands of the situation, thus vitiating E's hypothesis. We propose a means of correcting for S's compensation and demonstrate its usefulness in an illustrative experiment on the effect of ego-involvement on time estimation.

We are sometimes interested in the extent to which a variable affects S's judgment of passing time. For instance, we might ask both bored Ss and interested Ss to estimate how long it took for a given length of time to pass. Given the evidence (Geiwitz, 1964; Loehlin, 1959; London & Monello, in press), our expectation would be that the bored group's estimate will be longer.

We may, however, experience difficulty in confirming hypotheses about time estimation because of problems wholly extraneous to their validity. For example, Ss may "compensate" for the effect of the independent variable upon them. Suppose S has been exposed to some set of stimulus conditions which, by hypothesis, have the effect of making time seem to pass slowly and is then given a questionnaire that asks him to estimate how much time passed. Even if E's hypothesis is correct, S, given the possible reality demands of the situation, may go through something like the following thought process: "Well, it *seemed* like a long time passed—more than an hour, easily. However, I doubt very much that I've been here that long. It just doesn't seem possible that I've been here for over an hour. I guess I'll put down that 50 min passed." And thus, E's effort to alter S's time judgment is undercut.

This problem may be solved by straightforward questioning of S about any

compensation he may have done. We present below an illustrative study in which the problem of compensation was anticipated and overcome.

OVERVIEW

Iverson & Reuder (1956) have described a technique for manipulating ego-involvement. A number of studies (Meade, 1960, 1963; Rosenzweig & Koht, 1933) have used this technique to show that time passes more quickly under conditions of increased ego-involvement.

Following these studies, Ss in our high ego-involved condition were led by instructions to believe that performance on a marble-sorting task would be indicative of creative potential, while Ss in the low condition were informed that participation in the task was merely for purposes of preexperimental testing of equipment. Time judgment was measured for each S by the method of verbal estimation (MVE) (Bindra & Waksberg, 1956) and corrected for compensation.

SETTING AND EQUIPMENT

The S was required to sort marbles by color. A continuous flow of marbles was provided, with rate and order identical for all Ss. Several pseudo timing and recording devices were attached to the apparatus. A wall mirror simulated a one-way observation glass. Under the high ego-involved condition, this mirror was exposed to Ss; under the low ego-involved condition, it was covered. A tape recorder was concealed so that the revolution of the tape could provide no cues for time estimation.

SUBJECTS

Subjects were 30 paid female high-school students, aged 15 through 17, recruited at their institutions. They were randomly assigned to the two experimental conditions, one-half to each.

PROCEDURE

The E seated each S and told her that she would perform a marble-sorting task and would receive a full explanation and instructions by tape recorder.

The E then placed an opaque elbow-length glove over S's nonpreferred hand so that S would "not forget" to use her preferred hand. This ruse was devised to cover S's watch (all Ss in this experiment wore their watches on the nonpreferred hand) without arousing her suspicions about the purpose of the experiment.

As E left the experimental room, he turned on the tape recorder. The recorder gave information in the following order: (a) the rationale of the experiment; (b) a review of instructions which were also on the wall to S's left; (c) a notice to await a starting buzzer before commencing the task; (d) a starting buzzer followed by 7.5 min (450 sec) of recorded metronome beat, in

time with which S was to sort marbles; (e) a second buzzer at the end of 7.5 min.

When the second buzzer sounded, the voice on the recorder asked S to fill out a questionnaire beside her. It was on this questionnaire that S was asked, among many diversionary questions, the key one (No. 2): "Please estimate the number of minutes which passed *while* you were actually sorting the marbles, i.e., *from first to second buzzer*."

Toward the end of the questionnaire, there appeared the question designed to allow correction for compensation. This question read:

We find some people in this study have difficulty answering Question 2. In Question 2, we ask for an estimate of the amount of time which passed *while* you were sorting marbles, i.e., *from Buzzer 1 to Buzzer 2*. Rather than give us that estimate, some people say to themselves *while* answering Question 2:

(a) "It seemed like a very short time, and I know it couldn't have been, so I will estimate that *more* time passed."

Others say, while answering Question 2:

(b) "It seemed like a very long time, and I know it couldn't have been, so I will estimate that *less* time passed."

Did you, in answering Question 2, say either (a) or (b) to yourself? Yes_ No_

If yes, which did you say to yourself? (a)_ (b)_

If yes, by how many minutes did you change your first impression of the amount of time that had passed while sorting?

No. of minutes_

The number of minutes indicated by S, if any, could be subtracted from or added to her original response to Question 2, depending on whether she checked Alternative (a) or Alternative (b).

The above procedure was employed for all Ss. To create experimental conditions of high and low ego-involvement, there were appropriate alterations in (a) E's appearance and demeanor, (b) S's belief about whether or not she was being observed through a one-way mirror, and (c) the apparent rationale of the experiment. Details of these alterations, in addition to those already given, are unimportant for our present purpose and are therefore omitted.

RESULTS

Table 1 presents the results using terminology we have found useful in dealing with psychological time (London & Monello, 1969). T_c is defined as the amount of time the *clock* indicates has

Table 1
Rate of Time Passage in Clock Minutes Per Felt Minute, Before and After Correction for Compensation

Condition	Before Correction	After Correction
High Ego-Involved	1.18 (7.5/6.35)	1.33 (7.5/5.65)
Low Ego-Involved	1.32 (7.5/5.67)	.96 (7.5/7.80)
p	>.40	<.05

passed, T_f is defined as the amount of time *felt* to have passed, and rate at which time seems to pass is then defined as T_c/T_f . The table, then, shows both rate and the fraction upon which it is based for Ss in high and low ego-involved conditions, before and after correction for compensation.

A total of 12 Ss in the experiment compensated, 8 in the low ego-involved condition, and 4 in the high condition. A chi square analysis of those who compensated and those who did not across both conditions yields a nonsignificant difference. Thus, it cannot be concluded that the conditions were differentially productive of compensation.

After correction for compensation, the means in Table 1 replicate previous findings. Rate at which time seemed to pass for Ss in the high ego-involved condition was significantly greater by two-tailed t test than rate for Ss in the low ego-involved condition.

DISCUSSION

The evidence supports our suggestion that Ss in time experiments may compensate, that compensation may vitiate E_r 's hypothesis, and that E may correct for S's compensation. The very existence of published reports showing that a number of variables *do* affect psychological time indicates that E need not always correct for compensation; evidently, there are conditions under which either compensation is minimal or the effect of a given variable is powerful. Of course, there is no practical way of estimating the number of studies which have been abandoned unnecessarily, simply because E failed to realize that his Ss might be compensating.

One might argue that the compensation artifact is less likely to arise when methods of measuring time other than MVE are used. When MVE is employed, S has the opportunity, following completion of the task, to reflect as he answers a question about his judgment of time passage. Using, however, the methods of production (MP) or reproduction (MR) (Bindra & Waksberg, 1956), S's attention is partially focused upon performing the task itself as well as upon time passage. He may thus be less able to second-guess.

At any rate, when MP or MR are used, it is logically impossible to correct for compensation *after the fact* by use of a question similar to that employed in the present study. If, using MP (for example), an S is asked to perform a task for 30 min and compensates by going *beyond* the point at which it first felt that 30 min had passed, S does not know how much time he has added, and thus E cannot later correct. Nor can E later correct if S compensates by stopping *before* he feels that 30 min have passed, for once again, S does not know how much he has compensated. Similar considerations apply to the use of MR.

One possibility ensuing from this research is that of studying compensation as a phenomenon in its own right. In any event, the methodological lesson is clear. The time researcher has every reason to add routinely to his procedures a question which allows him to correct for S's compensation.

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NOTE

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