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ABSTRACT

Two stimuli of either small or capital letters were presented successively by tachistoscopic projectors. College students serving as subjects were requested to respond "yes" if the first stimulus (only one letter) was physically identical to or the same name of one of the letters in the second stimulus. The display size of the second stimulus was one, two, and four letters. Reaction time was a linear function of display size. Response type (positive and negative) affected both the intercept and the slope of reaction time function. These results were explained by response bias and rechecking operations. Finally, the reaction time function for physical match was faster in intercept and slower in slope than for name match. Differential encoding processes and parallel matches were suggested. (Author)

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Scanning for physical and name matches[1]

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Posner and Mitchell (1967) found that it is about 70 msec. faster to respond same to a pair of letters which are physically identical e.g. AA, than it is to respond to a pair which have only the same name, e.g. Aa. In subsequent studies (Posner and Keele, 1967; Posner et al, 1969) they consistently obtained similar results. Furthermore, when the presentations of the first and the second letters were delayed, the advantage of physical match correspondingly decreased. On the other hand, it appeared that name match time was relatively independent of delay. Posner and his associates interpreted this decreasing RT difference of physical and name matches as the loss in efficiency of the visual match. However, there are several questions remained to be answered. First, right before the moment of comparison, are both visual information and its name available or not? Second, are physical and name matches processed serially or in parallel? The present study is an attempt to study these questions.

In a visual-detection experiment, Atkinson et al (1969) have been able to show that RT was a linear function of display size. This finding supports the notion that visual scanning is exhaustive. Borrowing Sternberg's two-stage model (1967), intercept and slope perameters of the linear RT function can be conceptualized as reflecting encoding processes and scanning rate respectively.

A visual-scanning situation with both small and capital cases of letters was employed to approach the questions mentioned before. If both visual information and its name are available for match, comparison of slope parameters will make it possible to decide whether the match is serial or not. If they are not available simultaneously, the difference of intercept parameter will indicate the differential encoding processes for visual information and its name.

Method

Twenty five undergraduate female students at University of Connecticut were run as Ss. They took the introductory course of Psychology and their participations were one of the course requirements. However, extra credits were given for reward. Two of them were discarded because of high error rates and slow RTs and three of them, because of failure of apparatus.

Both small and capital cases of ten letters were used, i.e., B, D, E, G, T, F, L, M, N and H. Target stimulus was alway only one of twenty characters. In a session of 120 trials, these twenty characters were randomly but without replacement presented to each S under each of 3 display sizes. Probes are either one, two or four letters with identical case (small or capital). Number of probes (display size) and mixed randomly, but evenly, in each blocks of 60 trials under the constraint that identical condition (same display size and same case of letters) appeared again at least 4 trials later. There were 2 sessions (4 blocks) with total of 240 trials for each S. There were 80 different four-letter and 40 two-letter combinations respectively.

Two slide projectors were used. One of them projected the target stimulus and the other, probes. The presentation time for the present situation is 500 msec. for each stimulus and the inter-stimulus interval was about 10 msec.

Ss were instructed to press "Yes" key (always at S's right hand side) if letters in probe contained the target stimulus regardless of cases of letters or to press "No" key otherwise. Four blocks of 60 trials were run for each S. Blocks were factorially designed. Intertrial interval was about 5 sec. There was about 5 minutes of rest between blocks.

After each trial, S was told her RT. And after each block, her performance was briefly reviewed. For example: "You are requested not to make an error rate higher than 5%. In the last block, you made about a 10% error rate. Furthermore, your RTs were a little bit slower than average." Also they were told that the average RTs were around 500 msec. The instruction that, "You have to respond as fast and as accurately as possible," was repeatedly said to them before each block.

Reaction times (RT) and response type (Positive and negative, R) were recorded. Two Ss were found to have no improvement in RTs after two blocks of practice and had an error rate about 10% also; they were discarded. The total experiment was run for each S in one day and it lasted about one hour.

Results and discusssion

Mean latencies were computed based on all correct responses in each of 12 conditions (i.e., 3 levels of display size, L, 2 levels of match, M, and 2 levels of R) for each of 2 sessions of 120 trials for each S. The relative frequencey of error was less than 5% in 11 of 20 S in the second session and never exceeded 7%. Since only the main effect of Session was found with no interactions, the following discussion was mainly based on the data in the second session. An analysis of variance was performed on the mean latencies. All main treatment and significant interactions was presented in Table 1.

As shown in Table 1, the effect of display size was highly significant. Also RTs were linearly related to L. The best-fit equation is $RT=469.1+29.6(L)$. Not only a R effect but an RxL effect was found. Fig. 1 presents mean RTs as a function of L and R. Inspection of Fig. 1 indicates that not only the intercept but the slope varies. Since the slope difference is about 10 msec./item, a self-terminating scan (Sternberg, 1969) can account for this data. However, it is suggested that exhaustive scanning might be the case. Briggs and Blaha (1969) have demonstrated that positive and negative latencies may differ in both intercept and slope. For the former case, it might be due to response bias. For the latter case, rechecking the display information accounts for this difference. A MxR effect further suggests that the rechecking operation is identical in both name and physical matches (of Figure 3). Figure 2 compares the difference of name and physical matches in positive and negative responses in two sessions of trials. The data clearly indicate that there are only slight difference between both sessions, other than an overall decrease in RT in session two.

In comparison of name and physical matches, both intercept and slope differences were found (an M effect and a MxL effect). Fig. 3 presents the mean latencies as a function of M and L. There is about a 45.0 msec. increase for name match over physical match in intercept. This difference indicates the differential encoding processes. How the encoding processes differ can not be derived from the data in the present study. For example, 45.0 msec. difference might simply represent a time lapse for extra transformation of visual information to its name. Or it might represent that time lapse plus the decision time (e.g. decide to transform). So far as the slope was concerned, the smaller scanning rate sheds light on parallel matches. If serial matches were the case, e.g., S looking for physical match and, then, name match, the scanning rate should be slower for name match than for physical match. On the other hand, it is unlikely that S looked for name match and then physical match because the mean RTs of name match are slower than those of physical match (Fig. 2 and Posner et al, 1969).

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Table 1

Main effects and significant interactions from analysis of variance

Source	Mean Squares	F
Display size (L)	169,803	56.6**
Response (R)	268,435	35.8**
Type of match (M)	18,136	5.0*
L x R	11,463	5.8**
L x M	7,476	4.6*
R x M	19,923	10.5**

$^{**}p < .01$

$^{*}p < .05$

Footnotes

1. This study was supported by NICHHD-03932 to D. A. Wicklund and the second author. The authors are indebted to Dr. Wicklund for his advice.

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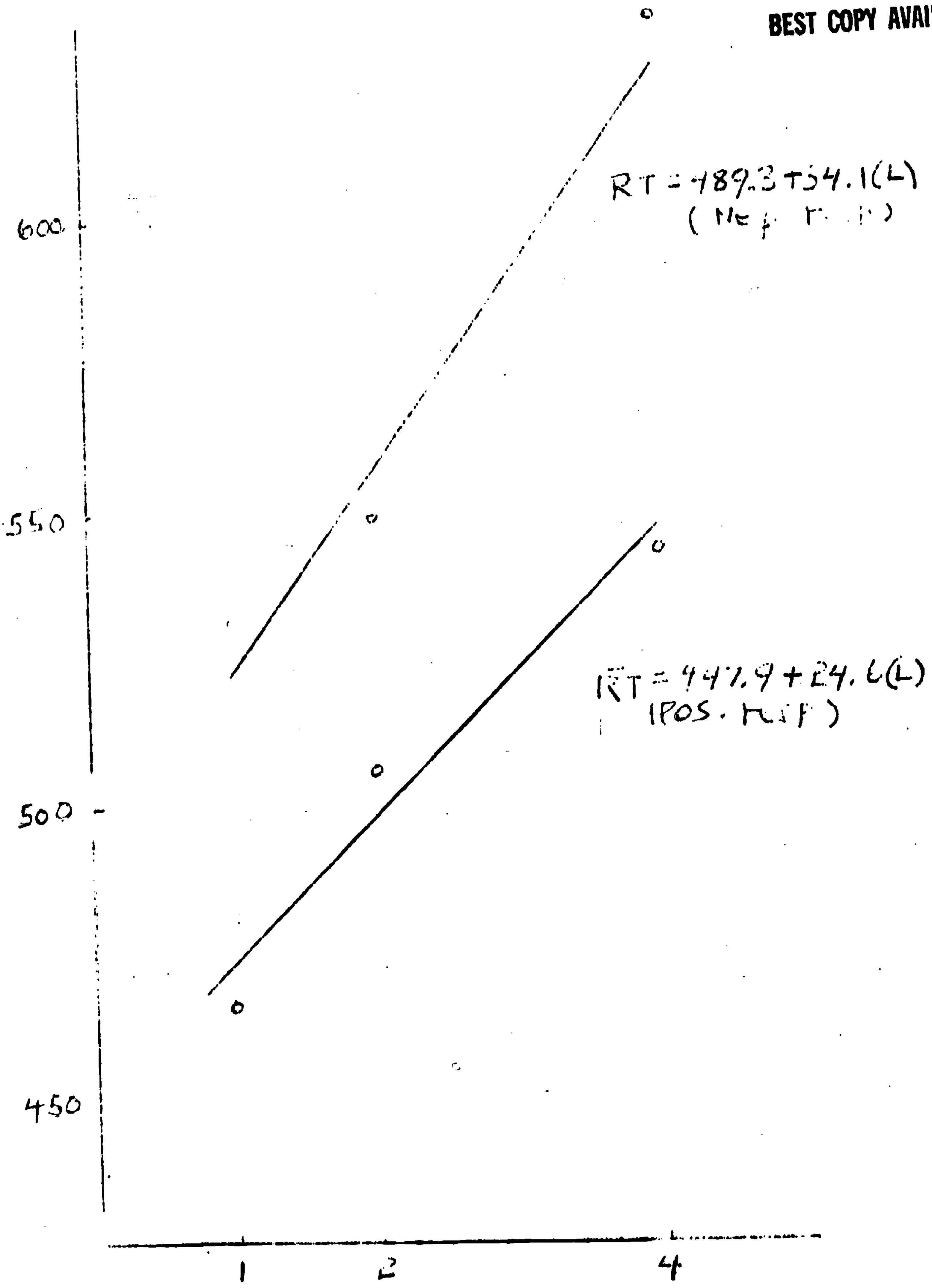

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Fig. 1

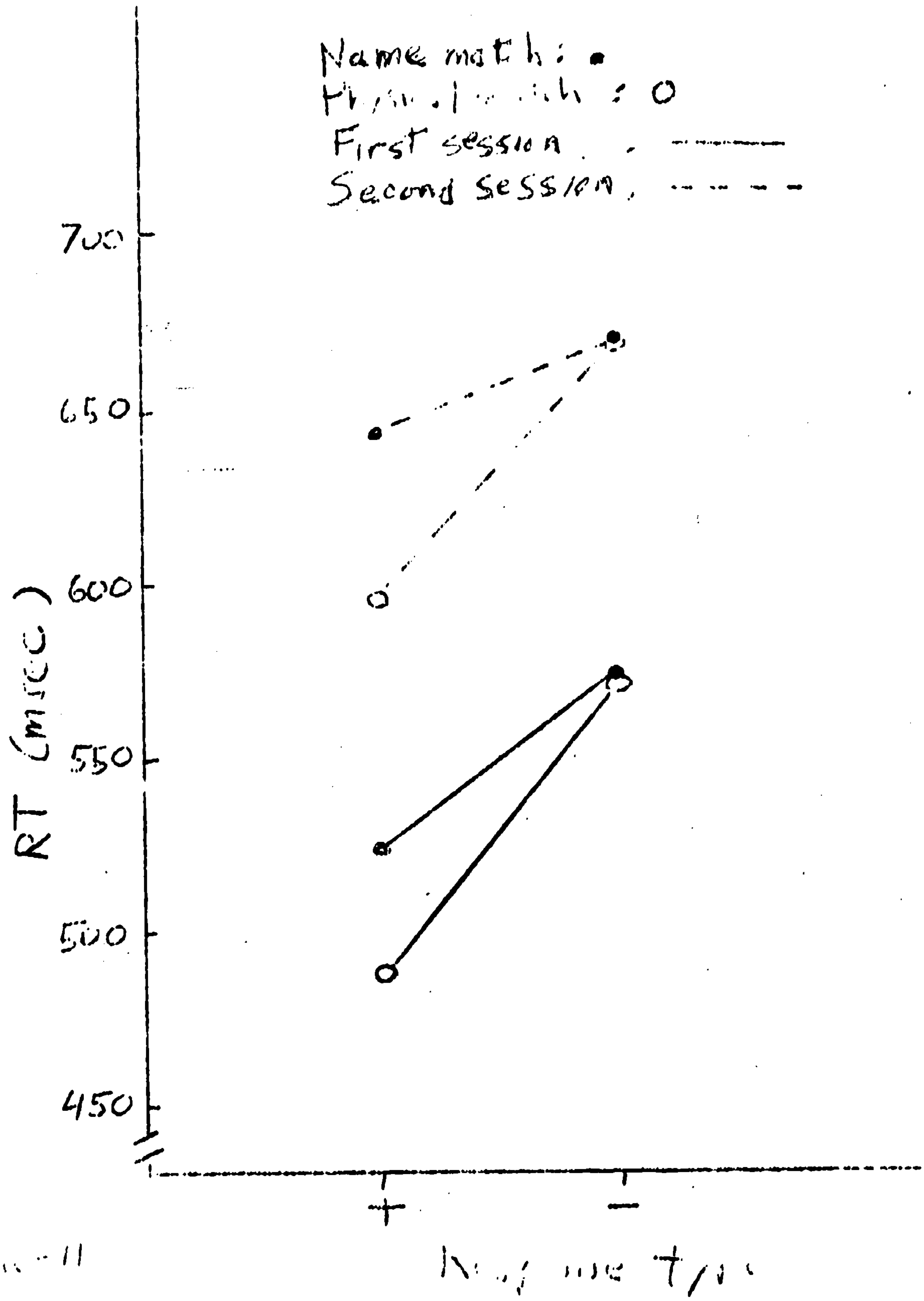
Name match : •
First session
Second session
700
650
600
550
500
450
RT (msec)
+
−

Fig. 2

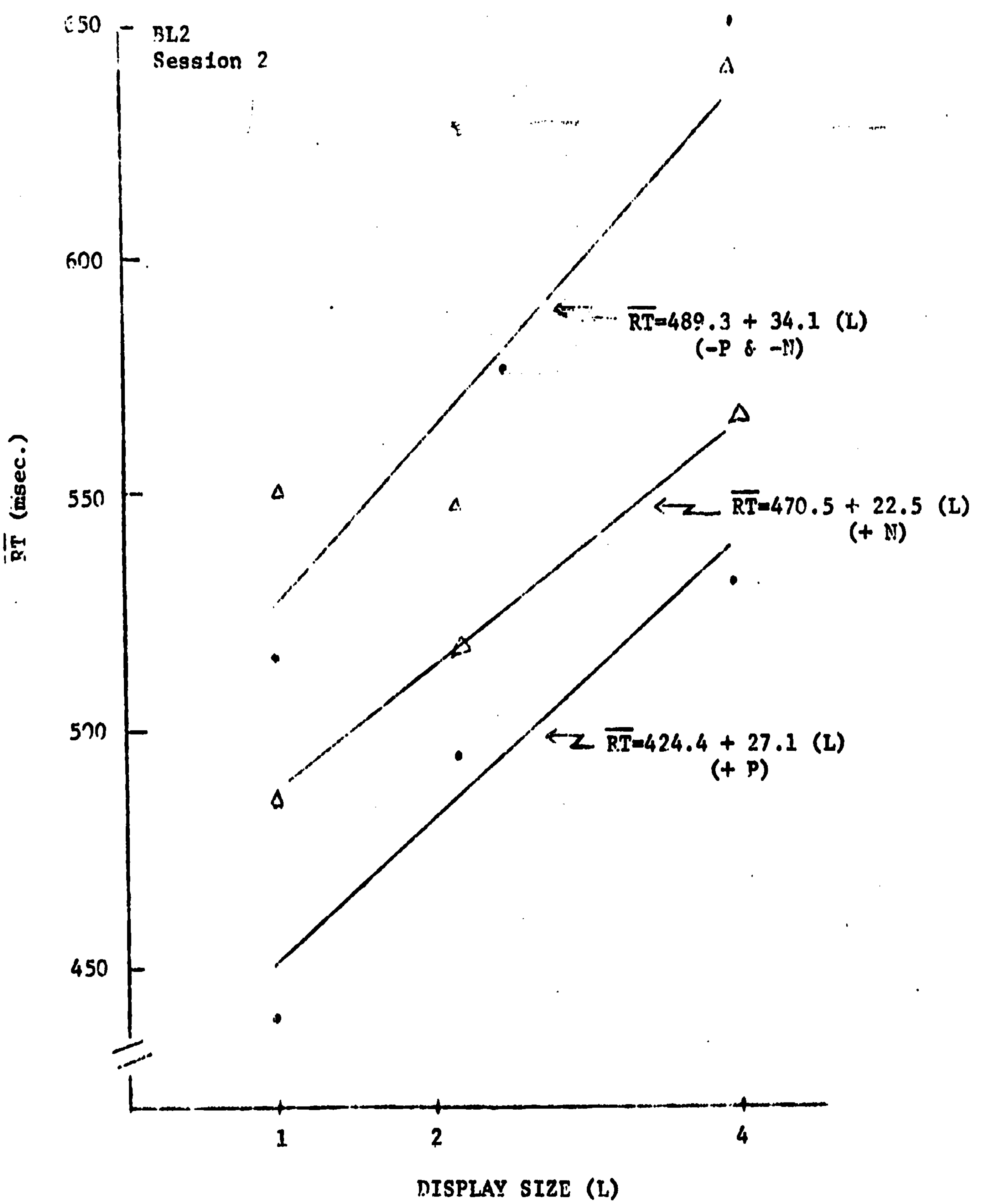

Figure 3

RT as a function of display size and

physical and name identify

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