

## MANUAL REACTION TIMES AND ERROR RATES IN STUTTERERS<sup>1,2</sup>

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*Summary.*—In this study 18 stutterers and 18 nonstutterers were presented trials on which they should press a button as fast as possible, intermixed with trials which required no responding. Stutterers had slightly faster reaction times but also made slightly more errors, that is, they tended to press the button when they should not have done so. As neither difference was significant, it was concluded that stutterers did not differ from normal speakers in manual reaction speed, nor did they choose a different speed-accuracy trade-off criterion for the given task.

Manual reaction times of stutterers have often been studied to assess general motoric or central problems in timing and coordination. A slightly diffuse pattern emerges from several studies. For a simple key-pressing task, Luper and Cross (1978) reported that stutterers were significantly slower than normal speakers, on the average 28 msec. Prosek, Montgomery, Walden, and Schwartz (1979) and Reich, Till, and Goldsmith (1981) obtained nonsignificantly slower reaction times of, respectively, 5 and 15 msec. on comparable tasks. Borden (1983) registered silent finger-counting times. Finger counting obviously requires a higher grade of manual motor coordination than key-pressing and so is more analogous to speech production. Stutterers were 114 msec. slower than controls in a delayed response condition, in which the response to be given was presented 1 sec. prior to the signal to initiate the response, and 150 msec. in an immediate response condition, in which response and response signal were presented simultaneously. These differences were not significant, though.

The key-pressing tasks discussed above typically required subjects to respond as fast as possible to a certain stimulus, which appeared at unexpected moments in time. Reaction times measured in such fashion clearly depend, amongst others, on a subject's choices on a speed-accuracy trade-off dimension. One can speed up at the cost of errors, i.e., reacting when the response signal was not (yet) present. Unfortunately, none of the aforementioned studies has reported figures on such errors. Therefore, the purpose of the current investigation was to examine error rates in relation to manual reaction times to compare speed-accuracy trade-off strategies between stutterers and normal speakers. We did so by intermixing go trials: signals which

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indicated that a button should be pressed as fast as possible, with no-go trials: signals to which no reaction should be made.

## METHOD

### *Design and Procedure*

A trial started with an asterisk (\*), presented in the midst of a computer screen for 1 sec., as a warning sign. A short period after the warning sign had disappeared, two graphemes were displayed, 1.5 cm left and 1.5 cm right from the middle of the screen. This was also accompanied by a short buzz. Graphemes were either two *as* or two *bs*. The *as* represented a go trial: subjects were instructed to press a button as fast as possible. The *bs* formed a no-go trial: subjects were not to press the button. For the go trials feedback about the reaction time appeared on the screen, following the button press. For the no-go trials this feedback was a text of disapproval when the button was pressed, reading "Wrong, you should not have pressed." When subjects had not reacted to a no-go signal after 2 sec., a text of approval appeared, reading: "Correct, you have not pressed." All types of feedback remained for 2 sec. on the screen. The next trial started automatically 1 sec. later.

The response interval, i.e., time between the disappearance of the warning sign—the asterisk—and the presentation of the response signal—*as* or *bs*—was either 1000, 1500, or 2000 msec. Each interval length had an equal chance of occurrence on a trial, irrespective of the previous trials. Also, the chance on a go signal was .75 for each trial, no matter how many go trials had already preceded.

The experimental task included 6 practice trials, 2 of which were always no-go trials, and 30 real trials. Subjects were instructed to keep a finger on the button and to concentrate on the feedback.

### *Subjects*

Eighteen stutterers, ranging in age from 21 to 50 years, and 18 normal speakers, ages 20 to 49 years, participated in the experiment. Both groups included 3 women and 15 men and were matched for age (within 5 years). Moreover, over-all they had the same education (two classifications were employed: low and average education, versus higher and academic education). Three stutterers were in therapy at the time of the experiment. The other stutterers had been through one or more therapies in the past. All stutterers considered themselves as still stuttering. None of the normal speakers had experienced any speech or hearing disorders in the past. Prior to the experiment, subjects read a passage of 418 syllables. Stutterers were disfluent on  $6.1 \pm 10.9\%$  of the syllables, normal speakers on  $1 \pm 0.8\%$ . Moreover, on the Speech Situations Checklist (Brutten, 1975), stutterers scored  $103 \pm 57$  on

the factor of Emotional Response and  $98 \pm 54$  on the factor of Speech Disorganization.

### RESULTS AND CONCLUSIONS

Reaction times were measured with an accuracy of 1 msec. Table 1 shows the mean reaction times for stutterers and nonstutterers for the three response intervals.

TABLE 1  
MANUAL REACTION TIMES (MEANS AND STANDARD DEVIATIONS) IN MSEC. OF  
STUTTERERS AND NONSTUTTERERS WITH VARIOUS DELAYS OF RESPONSE SIGNAL

n	Subjects	Response Signal Interval					
		1000 msec.		1500 msec.		2000 msec.	
		M	SD	M	SD	M	SD
18	Controls	411	77	401	70	401	54
18	Stutterers	365	73	371	88	357	63

These data indicate a trend towards shortening of reaction times when the response interval became longer. This may be a consequence of the fact that the uncertainty of when to respond decreased after more time had passed. Table 1 further illustrates that stutterers were somewhat faster than controls. A two-factor analysis of variance was carried out on the mean reaction times. Neither the response interval nor the group effect was significant.

Stutterers as a group received 113 no-go trials (of a total of 540 trials), on which they made 35% errors. Nonstutterers produced 30% errors on 114 no-go trials. This difference in error rate was not significant on a chi-squared test. It might suggest an explanation, though, why stutterers were also a bit faster than the controls. They simply waited less long to process the response signal. As a major conclusion, however, we have to stick to the nonsignificance of the group differences. Our results then indicate that stutterers' manual reaction times equal those of nonstutterers, in line with observations by Prosek, *et al.* (1979) and Reich, *et al.* (1981). Moreover, they suggest that stutterers did not employ different speed-accuracy trade-off criteria on the simple reaction-time decision task employed here.

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