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REACTION METHODS AND THE SPEED ANTICIPATION REACTION TIME*

By

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This research is an attempt to investigate the effects of reaction methods in Speed Anticipation Reaction Test. Three reaction methods were imposed upon fifty male *Ss*: the key-pressing method (the KPM), the oral response method (the ORM) and the verbal evaluation method (the VEM). *Ss* whose anticipation reaction times (the ARTs) were fairly below the objective time showed a significant tendency to react earlier in the KPM, and to increase in the VEM and ARTs produced in the KPM. These results suggest that the KPM with motor activity has an inciting effect upon the anticipating function of hasty *Ss*, in agreement with the assumption of Maruyama & Kitamura that hasty anticipation reaction to some extent depends on the deficiency of mental inhibition to the motor impulse to react under the ambiguous situation.

Problem

The purpose of this research is to investigate the effects of the reaction methods, especially of the key-pressing method, upon the anticipation reaction time (the ART) in Speed Anticipation Reaction Test. A brief description of this test is given as under (as to the details, see Maruyama & Kitamura, 1961, 1965).

A small luminant target (the diameter: 1.0 cm) glides at a constant speed from right to left in a holizontal ditch (the length: 35.0 cm) at the 1.2 m distance from the chin-rest, and it stops behind a black screen (the length: 30.6 cm). *S* keeps up the pursuit of the target apparently gliding at the same speed, and reacts by pressing an electric key with a dominant hand when he anticipates the target just will come out

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from behind the screen. On the left side of the screen, then and there, is lit up a round small hole of the same size as that of the target, as if the target has just arrived there. The ART is the time from the target's disappearence behind the screen till the apparent reappearence from behind it, that is, till the reaction by key-pressing. The objective ART is 2080 msec.

Maruyama & Kitamura (1965) found that there exists a great individual difference in this test; subjective ARTs range from hundreds to thirty hundreds msec.

The earliest study about the effects of the reaction method was presented by Nagatsuka & Maruyama (1962). They used two methods: key-pressing and verbal evaluation methods. Verbal evaluation was a method to compare the subjective ART with the objective one according to the modified constant method, and verbally to report the judgment by the three categories method. The mean of the ARTs by the key-pressing method was compared with that of the time range reported as "just", with result that reactions of hasty *S*s whose ARTs were below 1500 msec became later in the verbal evaluation method.

Nomura (1970) studied the same problem by the method of complete series, for the reason that the modified constant method above mentioned was not necessarily fine. He gained the same result that Nagatsuka & Maruyama had; *S*s whose mean ARTs were below 2000 msec, reacted later in the method of complete series than in the key-pressing method.

Key-pressing reaction, or motor activity may be reasonably regarded as a crucial contributing factor to anticipating function in such an ambiguous and difficult situation as Speed Anticipation Reaction Test, considering the words of functionalists, H. Münsterberg & W.W. Campbell (1894), "the direct dependence of bodily movement upon ideas."

Accordingly, we investigated the effects of reaction methods in Speed Anticipation Reaction Test by using the key-pressing method (the KPM), the oral response method (the ORM) and the verbal evaluation method (the VEM).

Method

Subjects: Fifty male students were used: 8 middle school students, 19 high school students and 23 undergraduates. The mean age was 18.3. They participated in the experiments at the request of the experimenter. They were told nothing about the experiments before the participation. They were divided into two groups by the spilt-half method so as to exclude the trial order effects; one group began with the KPM, performed the VEM and then the ORM (the first series), the other group the ORM, the KPM and the VEM (the second series).

Apparatus: The apparatus consisted of four main parts: (1) A stimulus projector, an electric reaction key and a timer (the scale: 1/100 msec) to measure the ART, which have been illustrated in detail in Maruyama & Kitamura (1961). (2) A time-regulator

(the scale: 1/100 msec) made by Tateishi Denki Company, Ltd., which was used in the VEM. (3) A voice-key and a digital timer (the scale: 1/1000 msec) made by Takei Kiki Kogyo Company, Ltd., which were used in the ORM. (4) A chin-rest as high as the ditch in the screen.

Procedure: (1) Procedure in the KPM has been described in the section of problem or in the Maruyama & Kitamura (1961, 1965). (2) The VEM was devised so well that each of eight ARTs of each *S* in the KPM might be reproduced exactly: the experimenter manipulated the time-regulator eight times so that the hole might be mechanically lit up precisely in accord with each ART in the KPM. Keeping up the pursuit of the target, *S* had to report verbally whether the hole was lit up "earlier", "later" than *S*'s evaluation or "simultaneously or not". The VEM will be interpreted the method for *S* implicitly to examine every ART without key-pressing that he had produced in the KPM. *S* was not told that each time till the hole would be lit up was, in fact, identical with each of eight ARTs produced by himself. (3) In the series of the ORM, *S* was requested to make an oral response "now" at the moment when he anticipated the apparent reappearence of the target. The response "now" operated the voice-key, which was settled at *S*'s mouth, and stopped the timer to indicate the ART and at the same time lit up the hole. Considerable attention was paid for the voice-key not to touch the chin-rest *et al.* and not to pick up noises.

Results and Discussion

(1) Of either the key-pressing method (the KPM) or the oral response method (the ORM) was computed the anticipation reaction time (the ART) of *S* on the basis of eight ARTs. It might be considered from Table 1 and Fig. 1 that the standard deviation (*SD*), that is, individual difference of the ARTs in the KPM is larger than that in the ORM, and that the ARTs in the KPM are smaller than those in the ORM, which are more approximate to the objective ART, 2080 msec. But no significant difference was found between *SD*s or the ARTs.

Table 1. Relationship between ARTs or *SD*s in KPM and ORM.

Number of *S*s	KPM		ORM		Percentage change from (2)−(1)
	ART (1)	*SD*	ART (2)	*SD*	
50	1871 msec	885	2013 mssc	839	66.6%
(F=1.1386, df=49/49, ns), (t=0.8195, df=78, ns)					

(2) The ARTs of *S*s in the KPM, therefore, were classified into four groups in the light of the criteria in Maruyama & Kitamura (1965) in order to investigate the results further.

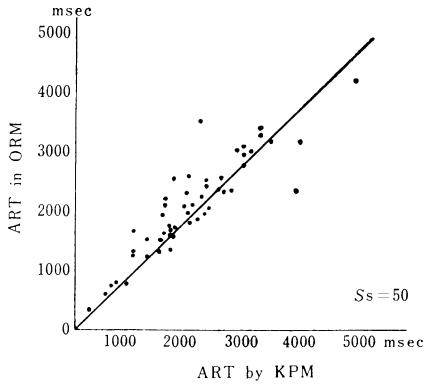

Fig. 1. The correlation of ARTs in KPM and ORM.

ART<1000 msec: hasty group (G.I)
1001 msec<ART<1500 msec: semihasty group (G.II)
1501 msec<ART<3000 msec: standard group (G. III)
3001 msec<ART : slow group (G. IV)

Table 2. Relationships between mean ages, ARTs and *SD*s in KPM and in ORM, and percentage changes from ART in KPM to that in ORM.

	Number of *Ss* (First series: second series)	Mean Age	KPM		ORM		Percentage change from (2) to (1)
			ART (1)	*SD*	ART (2)	*SD*	
G. I	8(5: 3)	15.4	698 msec	237	908 msec	422	23.1%
G. II	8(2: 6)	18.2	1367	121	1679	320	18.6
G. III	31(16:15)	19.6	2160	486	2337	564	7.6
G. IV	3(2: 1)	19.7	3981	424	3203	743	−24.3

Table 2 reveals for the first that the mean age of G.I is the smallest of all groups. G.I consists of 4 middle school boys, 2 high school boys and 2 undergraduates. This finding is consist with the result of the previous study that many *Ss* of middle school boys tend to react more rapidly (Suzuki, 1963).

As surveyed in (1), a difference between the ARTs in the two reaction methods was not generally significant. Therefore, closer examinations were carried out. As for the percentage change, (the ART in the ORM—that in the KPM)/the ART in the ORM, there exists a difference and especially that of G.I or G. IV is noticiablly large. All *SD*s in the ORM are far larger than those in the KPM, but there is no significant difference between them. And so, the difference between the ARTs in each classified group was examined with *t*-test, and Wilcoxon's sign rank test from the view point that every *S* experienced both the KPM and the ORM. As regards *t*-test, there are significant differences between the ART in the KPM and that in the ORM in G.II (two tailed *t*-test, $p<.05$), and between the ARTs in the extensive group into which G.I and

G.II united (one tailed t-test, $p<.01$). With regard to sign rank test the conditional difference between the ARTs was significant in G.I ($T=3$, $p<.025$) or in G.II ($T=1$, $p<.025$).

All these taken together, it is found there is a significant difference between the KPM and the ORM; G.I and G. II tend to react more hastly by the task of key-pressing than that of oral responding.

Table 3. The comparison between ARTs in KPM and evaluations in VEM, and $D'\%$.

	Total number of evaluations	ART by KPM	"Earlier" category	"Simultaneously or not"	"Later" category	$D'\%$
G. I	64	698 msec	45(70.3%)	18(28.1%)	1(1.6%)	95.6%
G. II	64	1367	19(29.7%)	29(45.3%)	16(25.0%)	8.5%
G. III	248	2160	40(16.1%)	132(53.2%)	76(30.7%)	−31.0%
G. IV	24	3981	3(12.5%)	10(41.7%)	11(45.8%)	−57.1%

(3) Table 3 shows that in the VEM Ss modified more or less the ARTs produced in the KMP in each group. Raw frequencies in the table are the sum of eight evaluations of all members in each group. $D'\%$ is a measure to indicate the rate at which the anticipation reactions are hastier in the KPM than in the VEM. It was diverted from the percentage difference $D'\%$, which was the measure for time-order error. $D'\%$ is computed by the following formula.

$$D'\% = \frac{E-L}{E+L} \times 100$$

E: the frequency in the "earlier" category

L: the frequency in the "later" category

G.I judges the ARTs in the KPM far smaller and G.IV larger. It is numerically revealed as to G.I that hasty reactions in the KPM were inclined to be modified in the slow direction in the VEM.

Some matters are to be considered before the statistic examination of the frequency distirbutions with χ^2-test. The frequency in the "equally or doubtful" category could be distributed to that in the other categories at each rate, but it is so meaningful a frequency in itself it is to be neglected rather than distributed. A hypothesis will be, then, built up that if the ARTs were not reproduced, and such a method as the constant method were applied, the frequency in the "earlier" category and that in the "later" category would be equal. On this hypothesis the test has been applied. G. I increases absolutely the ARTs produced in the KPM when the method of key-pressing is excluded and the method of verbal evaluation is adopted ($\chi^2=91.52$, $df=1$, $p<.005$). G.III and G.IV inversely decrease the ARTs ($\chi^2=9.64$, $df=1$, $p<.005$, and $\chi^2=32.64$, $df=1$, $p<.005$).

Conclusion

Considering that the trial order difference of the key-pressing method (the KPM) and the oral response method (the ORM) was almost counterbalanced in both hasty and

semihasty group, it would be concluded that the task of key-pressing makes noticiable the tendency for hasty *S*s to react far more hastly.

As for the relationship between the KPM and the verbal evaluation method (the VEM), the former always preceded the latter in our experimentation, and the trial order difference could not be counterbalanced. According to Nagatsuka & Maruyama (1962), hasty *S*s tend to react a little more slowly and slow *S*s more hastly in the second test (the tendency of standardization), but there is little significancy. If counterbalancing were conducted, the frequency of the "earlier" evaluations would be equal to that of the "later" ones. Therefore, it was tested whether the real frequencies of them were equal or not. In the hasty and slow groups the tendency of standardization was found significantly conspicuous. This tendency might be thought due to the absence of key-pressing and, if any, to a very few trial order effects.

It is suggested from the results of comparisons between the KPM, the ORM and the VEM that the KPM has the significant effect of inciting the anticipating function of hasty *S*s in Speed Anticipation Reaction Test. It seems that the effect also antagonistically suppresses that of slow *S*s. Hasty *S*s would be considered to have a strong tendency of hasty reactions under the dominance of motor-activity, or the impulse to press the key in the KPM.

The present research may confirm, to some extent, the assumption of mental mechanism of the hasty anticipation reaction that hasty *S*s often fail in effective control or inhibition over the impulse to press the key.

There remain some matters for consideration; first, the number of *S*s assigned to hasty group was rather small, though the hasty group was sometimes extended to the semihasty one; second, the complete counterbalancing couldn't be carried out, since the verbal evaluation method always followed the key-pressing method.

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