

Factors Influencing on the Reaction Time of Japanese College Students

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INTRODUCTION

Fundamental principles concerning the factors which cause the variation of reaction time (RT) have been established as follows.¹⁻⁵⁾ 1) RT is gradually shortened as both the physical and the mental development progresses from 4 year to the adlescential stage (approximately 18-20 year). However, this value is gradually prolonged after this stage until the age reaches to about sixty and followed by an abrupt increase which may be due to the progress of senilization. 2) The difference of sex does not influence on the value of RT, and 3) the repetition of the experiment effects hardly on the value of RT.

Nevertheless, it is naturally considered that there may be some individual differences and it may not be ignored that an individual shows a daily difference when the experiment is repeated during several days. These variation should be depending on either physical or mental conditions of subject during experiment. The authors aimed to elucidate the relationship between RT and motor skillness and attempted to establish some criteria of RT of Japanese college students as a first step. In this paper, we like to show how the value of RT is influenced by the difference of sex, the change of stimulating frequency, the succession of experiment, through the data by means of one light RT and two light choice RT.

METHOD

Subject. - Ten male and ten female volunteers whose age ranged between 19 and 22 year old were selected at random from the students of a nationally supported university.

Apparatus. - Block diagram of the apparatus and its experimental arrangement are outlined in Fig. 1. The apparatus was consisted of a vertical board and a switch box on which a pair of push-button was set 45 cm apart (left and right). On the vertical board, a pair of square red lamp (2.5×3.5 cm) was also put 45 cm apart (left and right) and the height of lamp was adjusted so that each subject can watch the lamp at the eye-level.

Procedures. - Each subject sat on a chair placed in front of a table on which the apparatus is situated and the distance between the vertical board and the face of subject was set 70 cm. Subjects were assigned to push the button when the lamp was lighted and the time required to put lamp off was measured as RT. It was designed the lamp of left hand can only be operated by the push button switch of left hand and the lamp of right hand can only be operated by the push button switch of right hand. The experiment was consequently performed during five days and each subject made a series of the experiment (from a to e, see below) in every day.

Measurement of RT. - Prior to the experiment, signals for "light on" were once recorded in a bound of magnetic tape and the lamps were electronically lighted on by reproducing the recorded signals. Signaling mode was divided into five groups as follows.

- a) the left lamp is on in every three seconds. (L_3)
- b) the right lamp is on in every three seconds. (R_3)
- c) the left lamp is on at random in the intervals between 2 seconds and 5 seconds. (L)
- d) the right lamp is on at random in the intervals between 2 seconds and 5 seconds. (R)
- e) the lamp of each side is on at random ; the lighting intervals were set between 2 seconds and 5 seconds. ((L)/R, L/(R)).

Schematic diagram of experimental instrument and its arrangement were drawn in Fig. 1 and the signaling intervals were set based on the number from the random number table.⁶⁾ The signals for "light on" and "light off" were recorded in magnetic tape and these data were processed by a minicomputer (ATAC 401, NIHON KODEN KK, Tokyo, Japan). Sequential histograms were plotted on an oscilloscope which was attached to the minicomputer and photographed (Fig. 2, 3, 4). After this procedure, all data were read out to paper tape and finally processed by a middle-size computer (FACOM 231, FUJITSU KK, Tokyo, Japan).

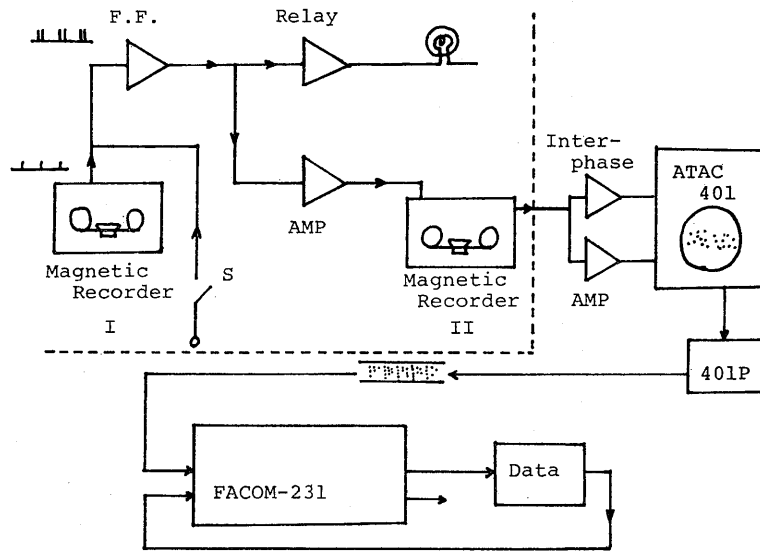
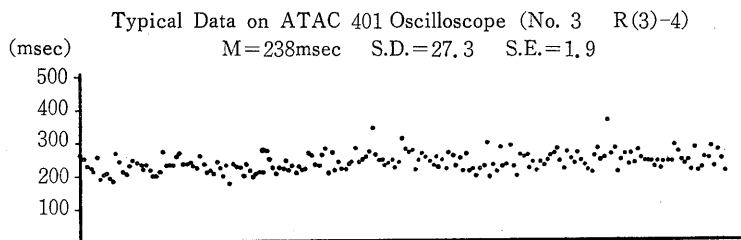


Fig. 1. Schematic diagram of experimental instruments; the part surrounded by dotted line shows the apparatus for RT recording, in the outside of dotted line, the oscilloscope and the computer system were drawn. Stimulation presented from the magnetic recorder I and RT were recorded in the magnetic recorder II. The stimulation was once delivered to FF (flip-flop circuit) and sent to the lamp through a relay circuit. Subjects were assigned to push switch S as soon as the lamp was lighted on. The pulses of stimulation and switching were successively recorded. RT is displayed on the oscilloscope of ATAC 401 and read out for punching and punched tape was transferred to the middle-size computer (FACOM 231).

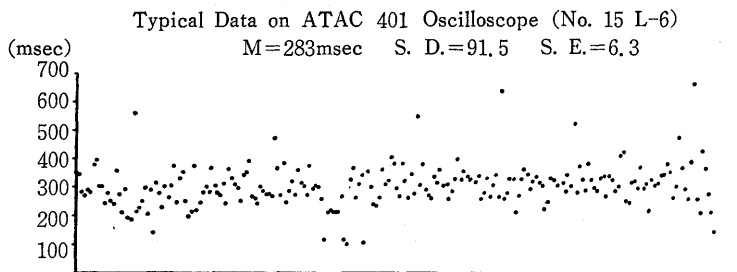


No. 3 R(3)-4
 Numerical data

00263	00250	00229	00225	00212	00257	00190	00204	00207	00194	00183	00267	00239	00124	00207
00231	00243	00239	00236	00218	00232	00216	00197	00198	00215	00274	00229	00234	00231	00259
00262	00233	00234	00237	00228	00223	00258	00233	00206	00214	00202	00238	00223	00197	00229
00173	00235	00223	00223	00200	00234	00214	00194	00204	00209	00277	00274	00249	00224	00209
00222	00218	00246	00215	00231	00206	00228	00218	00221	00268	00261	00228	00227	00263	00277
00207	00269	00213	00241	00221	00220	00233	00241	00285	00244	00252	00257	00271	00338	00262
00245	00245	00228	00237	00252	00222	00241	00309	00278	00267	00276	00216	00250	00263	00254
00242	00230	00257	00225	00248	00281	00267	00253	00224	00251	00212	00262	00207	00217	00196
00222	00226	00298	00194	00228	00208	00284	00227	00234	00287	00224	00198	00259	00253	00257
00220	00237	00212	00241	00231	00244	00256	00264	00276	00238	00221	00267	00246	00227	00265
00237	00228	00213	00207	00256	00282	00243	00247	00363	00265	00282	00203	00247	00264	00227
00264	00233	00273	00247	00236	00238	00241	00224	00241	00221	00240	00238	00238	00293	00267
00246	00227	00245	00214	00284	00210	00218	00254	00251	00286	00225	00276	00249	00210	

Statistical data: M=238msec S.D.=27.3 S.E.=1.9

Fig. 2. An example of sequential histogram of continuously recorded RT. RT was measured when the stimulation was regularly presented (in every three second). Note that the values are not dispersed compared with the data recorded in Fig. 3 and Fig. 4.



No. 15 L-6

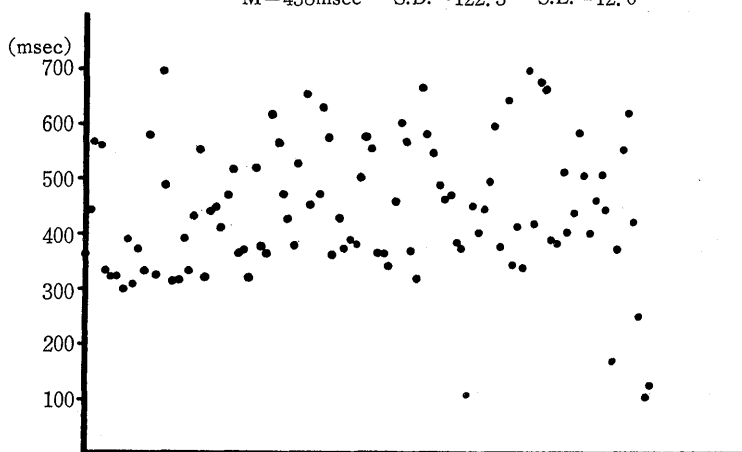
Numerical data

00349 00344 00285 00267 00290 00280 00380 00394 00302 00299 00240 00277 00249 00236 00357
 00273 00210 00293 00193 00283 00557 00215 00227 00251 00298 00206 00289 00137 00313 00277
 00226 00301 00262 00304 00372 00246 00329 00350 00249 00194 00213 00373 00220 00246 00277
 00301 00278 00368 00304 00281 00271 00311 00237 00365 00331 00308 00293 00248 00337 00350
 00390 00264 00261 00240 00298 00283 00276 00275 00267 00466 00363 00269 00383 00242 00292
 00318 00270 00357 00314 00304 00275 00373 00295 00304 00301 00261 00120 00214 00219 00215
 00213 00215 00270 00115 00101 00324 00368 00265 00311 00338 00109 00354 00304 00236 00233
 00263 00357 00311 00323 00404 00382 00297 00268 00385 00323 00258 00346 00273 00544 00306
 00380 00291 00267 00261 00336 00314 00358 00307 00309 00255 00290 00328 00400 00326 00358
 00341 00332 00278 00317 00348 00257 00280 00328 00266 00307 00343 00268 00634 00257 00281
 00327 00329 00214 00272 00329 00366 00348 00295 00324 00338 00319 00304 00223 00250 00335
 00322 00307 00318 00317 00285 00345 00306 00524 00286 00373 00330 00289 00386 00323 00297
 00289 00333 00336 00268 00339 00323 00284 00303 00413 00422 00254 00248 00316 00323 00268
 00369 00298 00314 00222 00328 00307 00316 00336 00348 00383 00353 00259 00305 00477 00363
 00295 00261 00389 00660 00258 00212 00424 00366 00276 00216 00146

Statistical data: M=283 msec S.D.=91.5 S.E.=6.3

Fig. 3. An example of sequential histogram of the continuously recorded RT. RT was measured when the stimulation was irregularly presented (at random intervals between 2 sec and 5 sec). Note that the values are generally prolonged and fairly dispersed.

Typical Data on ATAC 401 Oscilloscope (No. 12 L/(R)-4)
M=438msec S.D.=122.3 S.E.=12.0



No. 12 L/(R)-4

Numerical data

00365 00445 00565 00556 00331 00323 00324 00298 00395 00308 00375 00333 00581 00325 00694
 00486 00313 00314 00388 00330 00429 00550 00318 00440 00447 00406 00467 00517 00363 00371
 00318 00520 00375 00364 00616 00563 00471 00424 00376 00523 00655 00451 00469 00624 00576
 00360 00429 00372 00387 00383 00501 00575 00550 00359 00361 00337 00454 00600 00564 00364
 00317 00666 00577 00545 00484 00458 00468 00380 00367 00107 00449 00395 00440 00488 00594
 00374 00637 00339 00410 00334 00695 00413 00672 00660 00334 00380 00508 00397 00435 00578
 00502 00399 00458 00506 00442 00167 00369 00549 00617 00419 00251 00101 00125

Statistical data: M=438 msec S.D.=122.3 S.E.=12.0

Fig. 4. An example of sequential histogram of the continuously recorded RT. RT was measured when the stimulation was presented at random and subjects had to make a choice which lamp they should put off

RESULTS

1) Daily difference of RT

Every value of RT obtained in each experimental day were totaled on both the right and left task and the average values of each hand task were separately calculated. In Fig. 5, successive daily changes of RT in every procedures (from a to e) were plotted. As shown in this figure, any remarkable difference of RT could not be found in every mode of procedures in each day's data. Although some data appear to show a shortening of RT with the progress of experimental date (for example, L(3) and L/R), any significant difference could not statistically be recognized between RTs of the first day and the final day. Significant difference could not be found even in the data between each day's RT. These results may indicate that the repetition of this experiment did not cause an effective influence on the RT and may suggest that the so-called training effect is excluded.

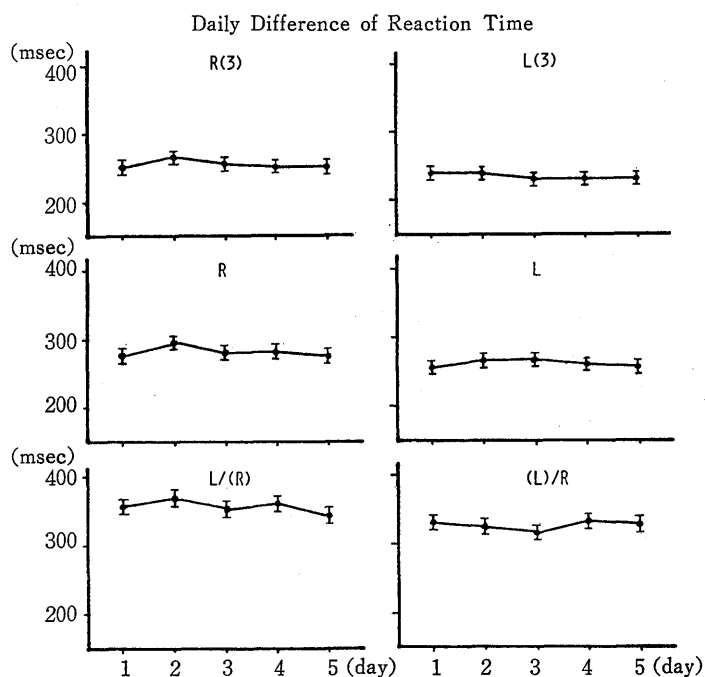


Fig. 5. Graphs in the left column show the right hand task and those in the right column show the left hand task. The daily difference of RT for regularly presented stimulation is shown in the upper row, that of RT for irregularly presented stimulation is shown in the middle row and that of RT for choice reaction is shown in the lower row. Any distinct change of RT is hardly recognized between each day values. See text.

2) Difference of RT between the right hand task and the left hand task
RT values obtained by both right hand task and left hand task through all experimental day were separately totaled and the average value of RT of both hands task were calculated.

It was previously ascertained that all the subjects participating in this experiment were the right handed. As shown in Table 1, the average value of the right hand task was 298 msec (SD; 54.6 msec, SE; 7.0 msec) and that of the left hand task was 273 msec (SD; 52.2 msec, SE; 6.7 msec). The difference is highly significant and it is revealed that the left hand responds very quickly compared with the right hand.

Table 1. Difference of Reaction Time between Right and Left Hand

	AVE. (msec)	S. D.	S. E.
Right ($R_3 + R + L/(R)$)	298	54.6	7.0 (N=60)
Left ($L_3 + L + (L)/R$)	273	52.2	6.7 (N=60)

Highly significant ($\alpha=0.001$)

Comparison of RT performed by the left and the right hand. The average was calculated from the sum of all values of RT in each mode of stimulation.

3) Difference of RT between male and female

The average value of RTs in every stimulating mode were calculated on each subject and thereafter the averages of RTs of ten male subjects and ten female subjects were separately calculated and compared. The average value obtained from the male subjects was 280 msec (SD; 15.4 msec, SE; 4.8 msec) and that from the female subjects was 290 msec (SD; 31.9 msec, SE; 10.0 msec) as shown in Table 2. It should be therefore assumed that the difference due to sex was not statistically significant.

Table 2. Difference of Reaction Time between Male and Female

	AVE. (msec)	S. D.	S. E.
Male	280	15.4	4.8 (N=10)
Female	290	31.9	10.0 (N=10)

Not Significant

Comparison of RT performed by male and female subject. Each average was calculated from the data obtained by both male and female subjects in each mode of stimulation.

4) Difference of RT due to the mode of stimulation

All RTs value in each stimulating mode through all experimental day were respectively totaled and calculated the average of each stimulating mode. The average value of group a and b (regularly given stimulation; $L_{(3)} + R_{(3)}$) was 244 msec (SD; 28.9 msec, SE; 9.1 msec) and that of group c and d (stimulation at random; L+R) was 272 msec (SD; 28.0 msec, SE; 8.8 msec) as shown in Table 3. It was recognized that there is a significant difference between these two groups. This result may indicate that subjects could respond more quickly for the regularly presented stimulation than for the randomly presented stimulation. It is assumed that subjects could roughly anticipate the period to be delivered the next stimulation when the stimulation was regularly given. On the other hand, when subjects had to make a choice which button they should push (group e procedure; (L)/R+L/(R)), RT was greatly prolonged. The average value in this procedure was 341 msec (SD; 34.6 msec, SE; 10.9 msec) and it was recognized that there is a great significant difference between this value and those of other procedures (a, b, c and d) as shown in Table 3.

Table 3. Difference of Reaction Time depending upon the Mode of Stimulation

	AVE.	S. D.	S. E.
I ($R_{(3)} + L_{(3)}$)	244	28.9	9.1 (N=40)
II (R+L)	272	28.0	8.8 (N=40)
III ($L_{(R)} + L_{(L)}/R$)	341	34.6	10.9 (N=40)

Significant Difference $I < II$ ($\alpha = 0.001$)
 $II < III$ ($\alpha = 0.001$)

Comparison of RT in each stimulating mode. ($R_{(3)} + L_{(3)}$) was calculated from the data obtained in the regularly stimulating mode (in every 3 sec.), (R+L) was from the data obtained in the irregularly stimulating mode and ($L_{(R)} + L_{(L)}/R$) was from the data obtained in choice reaction respectively. Significant difference can be recognized between I and II, between II and III.

DISCUSSION

The results that a significant difference could not be found in the RT of each experimental day may indicate that the repetition of experimental procedures gives little effect on RT. If the reading procedures are composed by more complicated and any kind of skillness is required, the shortening of RT may possibly be expected.²⁾ However, it should be considered that when RT was measured by performing a simple task, such

as in this experiment, there may not be any spare time which can be shortened by training or repetition.

It is rather interesting that a highly significant difference of RT between the right hand task and the left hand task was observed. The difference could be found in every mode of stimulation and in either male or female subject. This fact may imply that the left hand acts more quickly than the right hand to such a simple task, because it was ascertained in advance that all the subjects participating in this experiment were the right handed person and they might dominantly use their right and in every day life. The fact that even the right handed person can react more quickly to the simple left hand task may lead to an assumption that the left hand, in fundamental, can dominantly work in doing a very quick motion. Since a recently published report has suggested that the left hand can move more quickly, based on some electrophysiological data of cerebral cortex,⁷⁾ the result obtained in this experiment should be explained along with this hypothesis.

As we already predicted before the experiment, it was ascertained that the RT for regularly presented stimulation was shorter than that for irregularly presented stimulation, and the RT was further prolonged when the subject had to make a choice to light off the lamp of either side. Although the varieties and the combinations of stimulating mode were not informed to the subject either before or after the experiment, some of them seemed to become aware of that there might be some change in the stimulating frequency between the group a-b and the group c-d (regular and irregular respectively). It was investigated through an individual inquiry after the experiment was completed whether they knew the change of stimulating mode. Seven of ten subject answered "yes". However, the value obtained from them did not affect the result. It is, therefore, assumed that the expectancy of subject did not influence the length of RT. This result may be due partly to that the stimulation was given at random and partly to that the width of change of stimulation frequency was too narrow to be influenced by the subjects' expectancy.⁸⁻¹¹⁾

It was also predicted that some clues concerning the relationship between RT and the mental condition might be obtained from the sequential histogram. Both mathematical and graphical analysis was performed and the results obtained by this analysis were compared with other psychological examinations.¹²⁻¹⁵⁾ However, any crucial information was not obtained, although the data seemed to be classified into several groups. More detailed investigation should be required to clarify the relationship.

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