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The Effects of Distraction on the Simple Reaction Time of Normal and Retarded Students

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THE EFFECTS OF DISTRACTION ON THE SIMPLE REACTION TIME OF NORMAL AND RETARDED STUDENTS

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INTRODUCTION

Driver education for the mentally retarded is consistent with the national effort to habilitate the handicapped. When safe driving practices are learned, the individual may, in time, become more independent in terms of mobility and job possibilities, thus advancing one more step toward becoming a useful member of our society.

A recent study by Gutshall (1968) failed to establish a relationship between driving ability and intelligence. However, consistent evaluation (Egan, 1967; Williams and Little, 1966) confirms that the driving ability of the mentally retarded is of marginal proficiency and requires special programming (McPherson and O'Leary, 1969; Page, 1968).

As a licensed teenage driver, the mentally retarded student will encounter the same freedoms and dangers which await the novice driver. In particular, the high school student drives primarily during the late afternoon and at night. According to a report of the National Safety Council (Lederer, 1966), there were ten persons killed for every 100 million vehicle miles travelled in darkness, while four died for every 100 million miles travelled in daylight.

Translated into practical realities, one would question how well the mentally retarded student will compare with the

normal student in coping with the typical elements of his environment and his generation while driving an automobile. The compulsion which the teenager has for extraordinarily loud rock-and-roll music has invaded his automobile. When this distraction is added to the constant physiological re-adjustments and vigilance necessary for night-time driving, a volatile situation may develop. Whether the normal and retarded student will continue the safe operation of his automobile under these conditions requires an intelligent appraisal.

The length of time necessary for a driver to react to an emergency or rapidly developing situation is referred to as braking reaction time. Although reaction time can not be utilized as a basis for determination of successful driving ability and decision-making (Greenshields, 1936), preliminary findings by Kahn (1955) indicate that the braking reaction time scores of the retarded student seem to fall within the normal distribution of reaction times for the general population. Such consistency of performance, under controlled conditions, provides a tool whereby an appraisal of noise and irregular visual stimulation may be behaviorally observed. The results may provide some meaningful implications for the driving safety of all students, regardless of ability.

PURPOSE OF THE STUDY

Statement of the Problem

The purpose of this study was to investigate the possible effects of auditory and visual distraction on the simple reaction time performance of normal and mentally retarded high school students. Specifically, these tests were concerned with assessing the effect of various combinations of loud popular music and bright flashing lights upon an individual's ability to attend to a simple reaction test device.

Importance of the Study

Education proceeds on the assumption that when the effects of unsafe habits and distraction are illustrated, understood, and proven to be personally detrimental, then safety education may be an efficient deterrent to traffic accidents. The results of these tests were studied for possible applicability to driver education programs for normal and mentally retarded students.

Limits and Scope

Driving an automobile involves the mastery of a series of complex tasks and understanding of multiple situations. Simple reaction time is one act in an integral series of responses involved in meeting and avoiding emergency situations.

Within the scope of this study, distraction was utilized to determine its effect on simple behavior and, as such, this restricts comprehensive application without further investigation of these results beyond the scope of this study. Further investigation of the effect of distractors upon other aspects of driving will facilitate the development of some generalization.

TERMS USED IN THE STUDY

The following terms require defining within the scope of this study:

1. Simple reaction time, as used in relationship to the subjects of the study, refers to the scores attained on the measurement device, The American Automobile Association Simple Reaction Timer #15.

2. Auditory distraction, as used in the study, refers to measurable effects on simple reaction time while listening to loud popular (rock-and-roll) music.

3. Loud music, as used in this study, refers to a maximum, yet comfortable listening level considered typical of the current listening habits of adolescents.

4. Visual distraction, as used in this study, refers to the measurable effect of extraneous oscillating lights upon simple reaction time performance.

5. The mentally retarded student, as used in this study, was classified as educable mentally retarded, with intelligence quotients between 55 and 80 (Cruickshank and Johnson, 1967).

6. Mental retardation refers to subaverage general intellectual functioning which originates during the

developmental period and is associated with impairment in adaptive behavior (Heber, 1962).

7. Normal students, as used in this study, have intelligence quotients between 90 and 120, with the majority having I.Q.'s of 100 or better.

8. AAA, as used in this study, refers to American Automobile Association.

HYPOTHESES

1. The null hypothesis of no significant differences between the simple reaction times of normal and mentally retarded students under conditions of no distraction, auditory distraction, visual distraction, and audio-visual distraction was postulated.

2. The null hypothesis of no significant changes in simple reaction time, under conditions of distraction as contrasted by no distraction between each group was postulated.

3. The null hypothesis of no significant changes in simple reaction time, under conditions of distraction as contrasted by no distraction within each group was postulated.

REVIEW OF THE LITERATURE

Extensive research has been conducted comparing the simple reaction times of normal and mentally retarded subjects. However, virtually nothing has been written in regard to the effects of distraction on simple reaction time. A few investigations have been published, discussing the effects of loud music and interfering visual stimulation upon the behavior of man. This summary of the investigations closely related to the one at hand will attempt to draw some parallel applications.

Review of Auditory and Visual Distraction

Auditory Distraction

The automobile radio has traditionally been considered an aid in keeping the driver alert. Highway experts (Skelton, 1960) emphasize that although the turnpikes have been engineered and built to provide maximum safety and comfort for high-speed travel, the very nature of this type of ride can lull the driver into a false sense of security. "Highway hypnosis", a state of mind which makes him unable to react in time to avoid danger, can be combatted by chewing gum, rest stops, and other minor diversions. Skelton further states that "state troopers and truck drivers recommend that

tuning the radio to loud or fast-playing music serves to keep the driver alert [p.17]."

Results of studies by Brown (1965) maintained that listening to a radio while driving has the effect of producing more stable, steady maneuvering and increases the lapse of time taken to reach a destination. The physiological effect of relaxing music produced a slight decrease in heart rate and excitability while still assisting the driver in staying alert (Soibelman, 1948). However, Kontz and McDonald (1968) discovered that the driving speed and unnecessary manipulation of the brake and steering wheel increased with associate increases in the tempo and volume of the music.

The extraordinary volume at which teenagers listen to music is a concern of educators and medical specialists. Recent articles on loud music in Time Magazine (1968) and Today's Health (1966) warn that the average music intensity of rock-and-roll is from 108 to 120 decibels. This exceeds the noise intensity of power mowers and approaches the intensity of a pneumatic riveter. Rodda (1967) indicates that sound or noise of less than 80 decibels intensity does not cause occupational deafness, but that deafness increases are linear when the noise surpasses 80 decibels intensity [p.28]. Furthermore, impulsive noises (i.e., noises which have a rapid rise and fall of intensity) were determined to be more detrimental to the ear than noises of continuous intensity. Singleton (Time, 1968) warned that temporary

hearing impairment of 11 decibels and higher have been diagnosed due to sustained loud rock-and-roll music. He further stated that, "Despite the youthful resiliency of their inner ears, many teenagers are suffering at least temporary hearing impairment. Over a prolonged period of listening to music at extreme intensity, damage to the nerve fibres of the auditory nerve will probably occur [p.47]."

Translated into behavioral effects on a vigilance task, Broadbent warned that "intense noise requires man to be continually alert to the stimuli which reach his ears and there is literally not a second in which he can think of other things throughout the lengthy period of his work (Buckner, 1963, p. 55)."

In assigning some relevance to the increasing complexity of noise upon task performance, Buckner (1963, p. 17) discovered that "on an easy task, arousing conditions improve performance, while on a difficult task, arousing conditions have a detrimental effect on performance."

Visual Distraction

Visual acuity is particularly demanding for night-time driving. Kearney (1967, p. 190) indicates that "it takes 45 minutes for the average eye to become completely night-conditioned". Furthermore, man's night vision is about one-sixth of his day vision in acuity and one-seventh in contrast (the ability to distinguish one object from another).

Hurvich and Jameson (1966) discuss the many adjustments necessary for adaptation to various levels of light intensity. The critical and more latent adjustments of the eye are those required in changing from light to darkness. Under normal situations of approaching vehicle headlights, one and one-half seconds or more are required for readjustment of the eye to darkness and the surrounding imagery.

Direct contact with multiple visual distraction, such as flashing advertising lights and signs are often the cause of irritation and annoyance in performing a motor act (Johnson, 1963). However, an extensive study by Slak and Brozek (1965) indicates that intermittent illumination produces no gross detrimental effects on perceptual motor performance. Zaccaria and Bitterman (1952) concluded that fluorescent flicker does not have a detectable effect on visual efficiency.

Literature on Simple Reaction Time

Cation, Mount, and Brenner (1951, p. 101) summarize, in the following statement, the traditional concepts held regarding simple reaction time tests:

> Reactions to visual and auditory stimuli are made more or less continuously by the automobile driver, particularly on a heavily-travelled street or highway. Individual differences exist in the speed with which drivers are able to respond to these stimuli. Measurements of reaction time have been traditionally included in experimental test batteries to predict accident susceptibility of drivers, on the premise that the number of accidents or the accident-rate of an individual driver is partially a function of his reaction time.

However, the reported correlations between reaction time and accident rate have been disappointingly low (Greenshields, 1936). One explanation tested by Cation, et al. [p.102] is that the "slow reactor" soon becomes aware of his handicap and makes adjustments or compensations accordingly in his driving habits.

Evidence produced in reports by the American Automobile Association (Reports #47 and #69) suggest slightly different conclusions:

(a) the variability of an individual's reaction time is about the same as the variability among individuals of the same age group;

(b) a larger test sample (1425 men and women) consisting of five age groups, produced facts suggesting that reaction time steadily increases with age from ages 15 through 70 years.

The AAA Driver Education text (1965) clearly suggests the importance of age, low visibility, eyestrain, distractions, alcohol, and fatigue as definite factors in influencing reaction time.

The AAA (1965) states that "in test situations the average driver stops the simple reaction clock in 0.44 seconds [p.97]." Cation, et al. (1951) selected data which suggests that "typical" adult reaction time ranges from .348 to .563 seconds, with a mean of .433 seconds. The standard

deviations ranged from .0156 to .0983 seconds, with a mean of .0393.

For purposes of expanded testing of other factors related to reaction time, the internal consistency of the act is standard and easily understood. Klemmer (1956), in giving a definition, stated that "the only uncertainty in a simple reaction time test is time uncertainty. He knows exactly what the stimulus will be and what the response will be [p.179]."

Comparison of Reaction Times: Normal and Retardate

It has been observed that the mentally retarded perform within the general population range of reaction times (Jackson, 1969; Meiller, 1969; Kahn, 1955). An unpublished report (Meiller, et al., 1967) which failed to establish a correlation between intelligence, reaction times, and the ability to qualify for a driver's license, discovered a group mean reaction time of .599 seconds with a range from .43 to .84 seconds.

Comparative tests of simple reaction time of normal and mentally retarded subjects, utilizing different apparatus, produced the following conclusions:

(a) mentally retarded, in addition to being slower, were more variable between and within subjects (Berkson and Baumeister, 1967; Baumeister and Kellas, 1968);

(b) reaction time tended to be more variable at the lower mental ages than with the high mental age subjects (Ellis and Sloan, 1957; Jones and Benton, 1968);

(c) both normal and retarded subjects were similarly affected by increase in task complexity. Indications showed that intelligence was correlated with reaction time (Hawkins, Baumeister, Koenigsknecht and Kellas, 1965).

Distraction and Reaction Time

A study by Sen and Clark (1968) concluded that auditory distraction, i.e., background noise and conversation, or visual stimulation (Cromwell and Foshee, 1960) are ineffective as distractors. Distraction decrements were not significantly greater for either retarded or normal subjects. An interesting study by Spradlin, Cromwell, and Foshee (1959) failed to differentiate various levels or types of retardation under conditions of auditory stimulation.

The most significant study applicable to this problem was by Pascal (1953). His study of the effect of distracting noise on reaction time of mental defectives, noted a rapid curve of adaptation to adverse conditions and a return to the mean or nondistracted performance level. However, some subjects in this test failed to adapt and others gave evidence of completely disrupted performance.

Preliminary conclusions from these studies suggest that loud auditory stimulation may temporarily disrupt the reaction times of some subjects. Generally, most people quickly

adapt to visual stimulation and are not affected in performance of activities by this distraction. Only the combined effects of auditory and visual distraction may have a definite effect upon task performance. Based on the support of the literature, considerable differences in reaction times between normal and retarded subjects were anticipated, but the effect of the distractors was assumed to be universal.

METHOD

Subjects

The subjects for this study consisted of 60 adolescents equally divided between those enrolled in regular education and special education programs.

The 30 normal senior high school students were from 15 years, 3 months in age, to 17 years, 3 months. The average age was 16 years, with a standard deviation of 6.7 months. Seventeen students were enrolled at the senior high school at Port Angeles, Washington; the remaining thirteen students were from the senior high school in Ellensburg, Washington. This group was equally divided between boys and girls who were selected from study hall periods. The intelligence or competence of each normal student was verified by the guidance and counseling staff of both schools.

The 30 educable mentally retarded students ranged from 15 years, 1 month in age, to 19 years, 11 months. The average age of this group was 17 years, with a standard deviation of 18.37 months. The special classes at Port Angeles junior and senior high schools provided an initial group of 24 subjects. The remaining six students were volunteers from the older students attending the junior high school in Ellensburg. The intelligence test records were made

available through the Special Services offices of the school districts. The educable retardates had been tested on the WISC or Stanford-Binet and had I.Q.'s in the range of 61-81 with a mean I.Q. of 70.38. All subjects were free from gross sensory or motor impairment.

The essential criterion which was met by each subject in this study was that they were not presently practicing driving or had a driver's license. This was used to minimize any practice factor which might have developed with the use of the accelerator or braking device of an automobile.

Apparatus

For testing purposes, secluded hallways with minimal light were chosen, to simulate dark environmental conditions.

The portable AAA Automatic Reaction Time Device #15 consists of two connected components. One section is a panel 10" x 10" on which is mounted a brake and accelerator pedal. This accelerator is electronically connected to a signal unit. The upper unit consists of red and green lights which are mounted in the front of the cabinet. The green light indicates that the accelerator is depressed and that the test is working. When the red light comes on, the subject is to depress the brake as quickly as possible. The timer, with a large 4" dial, is mounted inside the cabinet, visible only to the examiner. When the subject responds to the red light, the timer is stopped and read to the nearest

1/100 second. The automatic operation emits the signal at random intervals from 1 to 8 seconds.

For purposes of this study, a facilitating unit was constructed to elevate the reaction time device and house the visual distraction mechanism. The reaction time device was placed upon this unit, which elevated all lights to an approximate eye level when the subject was seated. The face of the unit measured 19" x 20". On the exact horizontal plane with the reaction timer were placed four 10-watt yellow electric light bulbs. Two of the bulbs were placed on either side of the timer device. An additional two bulbs were placed at peripheral angles toward the subject. Flasher units were placed behind each light bulb, which oscillated at random intervals.

The auditory unit consisted of instrumental tape recorded portions of a popular stereo record entitled In-A Gadda Da Vida, performed by a musical group known as the "Iron Butterfly". This record was selected by ten young men from Quigley Hall at Central Washington State College. The criteria used in selecting this music was based on the popularity of the selections and their ability to attract attention.

The taped music was played through a Sony recorder, model No. TC-200 and listened to by means of Sony headphones DR-3A. The selection group listened individually to portions of the music and were requested to use high volumes

which they most often preferred for listening. The average of individual choices established the recorder volume level for purposes of the test.

Procedure

The operation of the reaction timer was demonstrated to each subject, who was encouraged to adjust the chair and foot pedal position so that comfortable, quick responses could be facilitated. Three or four practice responses were conducted, in order to become familiar with the device. The examiner emphasized the concept of speed-of-response to the red light.

The AAA Manual (1965) instructs the subjects as follows: "Keep your right foot on the accelerator to keep the green light on. As soon as the red light comes on, step on the brake as quickly as possible [p.3]." To these instructions the examiner added, "Wait for me to nod my head and 'mouth' the word "go" each time. I need to write down your score. All right, let's try it, and do your best!" A delay of 3-4 seconds between trials separated each response. Approximately one minute of rest was given between each test variation.

Four sets of eleven reaction time sequences were tested, including reaction trials with no distractors, reaction trials under auditory distraction, reaction trials under the influence of visual distractors, and trials with combined

auditory and visual distraction. The initial response was discarded, based on research by Pascal (1953) which indicates extremely latent scores to initial or novel stimuli. The ten remaining trials for each category comprise the recorded scores.

Upon completion of the testing, the data was arranged for final statistical analysis. The raw data was presented to the data processing center at Central Washington State College which, in turn, provided a statistical analysis.

Treatment of Data

The "t" test was employed to determine if statistically significant differences existed between reaction times of the normal and retarded groups. Secondly, a double "t" test determined the 'mean of the differences of the means', which examined whether inter-group effects of distractors was significantly different, for the normal and retarded groups. Finally, a single "t" test determined if significant intra-group differences existed as a result of various distractors. The formula examined the 'mean of the differences of the means', i.e. no distraction vs. audio-visual distraction.

RESULTS

Results of "t" test on group differences in simple reaction times are shown on Table 1. A significance at the .001 level of confidence for all test conditions ("t" = 12.572 no distraction; "t" = 14.206 auditory distraction; "t" = 13.813 visual distraction; "t" = 15.273 audio-visual distraction) was found favoring the normal students, thus rejecting the null hypothesis as stated.

Table 2 presents a statistical analysis of the data for significant inter-group differences between the effect of various combinations of distraction upon the simple reaction times of normal and mentally retarded groups. Only on one subtest, utilizing the double "t" (testing for the mean of the difference of the means), can the null hypothesis of no significant difference be rejected. Comparison of differences for retarded and normal groups under the condition of no distraction vs. auditory distraction ("t" = 2.35) indicated a significant difference at the .05 level of confidence. All other comparisons failed to reach critical value of .05, thus maintaining the hypothesis of no significant difference.

The intra-group comparison of simple reaction time to reaction times under conditions of auditory, visual, and

audio-visual distraction are statistically analyzed and data presented in Table 3. Normal subjects, when compared for differences on the basis of no distraction to auditory distraction and no distraction to visual distraction reaction times, produced no significant difference. The combined effects of audio-visual distraction produced a sufficient decrement in simple reaction time ("t" = 4.378) which reached the critical value of .001.

Auditory distraction produced a reaction time decrement with the mentally retarded group ("t" = 2.111) which was statistically significant at .01 level of confidence. Visually distracted reaction times did not statistically differ from non-distracted reaction times. However, like the normal group, the mentally retarded students were adversely affected by combined audio-visual distractors ("t" = -5.322) which is significantly different at .001, favoring the no-distraction reaction times.

Therefore, the null hypothesis of no significant intra-group differences in simple reaction times as affected by auditory and audio-visual distractions was rejected. Visually distracted reaction times failed to differ significantly from non-distracted reaction times and upheld the null hypothesis of no significant difference.

TABLE 1

STATISTICAL ANALYSIS OF THE DIFFERENCES
IN SIMPLE REACTION TIMES
OF TWO GROUPS

Simple reaction time scores recorded to
1/100 second elapsed time.

	NORMAL STUDENTS		RETARDED STUDENTS		
	Mean	Standard Deviation	Mean	Standard Deviation	"t"
No Distraction	40.620	7.453	52.313	14.282	12.572*
Auditory Distraction	41.580	7.539	55.373	15.032	14.206*
Visual Distraction	40.420	6.670	54.320	16.102	13.813*
Audio-Visual Distraction	43.893	7.290	59.040	15.553	15.273*

N = 30

df = 598

* = Significant at .001 level of confidence

TABLE 2

INTER-GROUP STATISTICAL ANALYSIS OF SIGNIFICANCE OF DISTRACTION ON SIMPLE REACTION TIME

	"t" tests		
	ND vs. A	ND vs. V	ND vs. AV
Retarded vs. Normals df = 30	-1.307	-1.531	-2.35 *

TABLE 3

INTRA-GROUP STATISTICAL ANALYSIS OF SIGNIFICANCE OF DISTRACTION ON SIMPLE REACTION TIME

	"t" tests		
	ND vs. A	ND vs. V	ND vs. AV
Normal Group df = 30	-1.387	.314	-4.378**
Retarded Group df = 30	-2.111*	-1.551	-5.322**

Key: ND vs. A = no distraction vs. auditory distraction

ND vs. V = no distraction vs. visual distraction

ND vs. AV = no distraction vs. audio-visual distraction

* significant at the .05 level

** significant at the .001 level

DISCUSSION

A comparative study was conducted on the differences between the simple reaction times of normal and mentally retarded students, with particular emphasis upon the effects which various distractors have on reaction time.

When the reaction times of normal and mentally retarded students were compared, the retarded group scored significantly higher (Table 1) than the normal students. The deviation of scores within the retarded group was twice that of the normal group. This supports the conclusions of Baumeister and Kellas (1968) that the simple reaction time of the mentally retarded is considerably more latent than the normal subject and is characterized by greater variation or lack of consistency of response. However, a study by Cation, et al. (1951) failed to substantiate the hypothesis that variability of reaction time is positively correlated with susceptibility to automobile accidents. The subjects in that study were of random selection, which suggests that further study of the greater variability as well as slower reaction times of the mentally retarded may produce some correlation with susceptibility to automobile accidents.

When an examination of significant changes between each group reaction time was conducted, the reaction times of the

mentally retarded subjects under conditions of audio-visual distraction were significantly increased. This is contrary to the findings of Spradlin, et al. (1959), which suggest that increased complexity of distractors did not effect mentally retarded subjects more than normal subjects. An examination of the data suggests that as scores increase, variation or uncertainty within the respondent may also increase. A probable correlation exists between distractibility, reaction time, and intelligence.

The data of Table 2 suggests that the reaction times of the mentally retarded were significantly different than normal subjects under conditions of audio-visual distraction. The analysis of data in Table 3 indicates that the difference between simple reaction times and audio-visually distracted reaction times is significant at .001 for both groups. Under test conditions utilizing single distractors, the normal subjects were not significantly affected. However, auditory distraction was sufficiently effective to produce an increase in reaction time for mentally retarded subjects.

The conclusions of a recent study by Sen and Clarke (1968) suggest that "a highly significant factor in determining a subject's susceptibility to distraction from external stimuli is the level of difficulty of the task [p.59]." They further suggest that distractibility is related to factors of duration, intensity of the distractors to the task,

and relevance of the distractors influencing performance. The conclusions of a study by Broadbent (1954) support the current evidence that audio-visual distraction is a highly significant factor in increasing simple reaction time and, as such, may produce greater increases in complex reaction time or complex behavior such as automobile driving.

SUMMARY

It was concluded in this study that intensive distraction produced significant differences in simple reaction times of normal and mentally retarded students. Furthermore, the reaction times of the mentally retarded were significantly longer and more variable than those of the normal students.

The instrument used in this study was the American Automobile Association, Simple Reaction Timer #15. Tests of reaction time were administered to the normal and mentally retarded groups prior to their having had any driving experience.

The raw data was gathered from each of the four subtests of simple reaction time under conditions of no distraction, auditory distraction, visual distraction, and audio-visual distraction. This data was analyzed by means of various types of "t" tests to find if there were any significant differences resulting from distraction.

The differences in reaction times between groups was found to be significantly high at .001 level of confidence. The normal students reacted significantly faster than the retarded students.

Audio-visually distracted reaction times of the retarded were significantly higher than the normal students (.05). All other tests of inter-group differences were not significantly high to differentiate between the two groups.

On intra-group differences, only the audio-visual distractor was significantly detrimental to reaction time (.001) for both normal and retarded groups. Trials by normal students showed no significant differences between simple reaction time and other reaction times affected by single distractors. The mentally retarded students had significant differences in simple reaction times compared with auditorily distracted reaction times (.05).

Additional studies are needed to accurately evaluate the general significance of the differences found in this study and the actual driving situation.

Research Implications

The evidence illustrates increasingly that significant differences in reaction times between normal and retarded subjects exist. This may encourage further examination of the significance of latency in the total response to an emergency situation (Aetna, 1946). The linear increase in reaction time associated with age (AAA 1966) points to a need for examination of older normal and mentally retarded subjects relative to the extent of decrement of reaction time.

Heretofore, researchers have not investigated the effects of loud music on automobile driving and other situations. The fact that distraction produced significant differences in simple reaction time suggests that studies of errors in the actual driving situation could be analyzed.

The emphasis in safety education today is more and more directed toward influencing attitudes. If the data from this and future studies illustrate the effects of distractors upon driving behavior, these causes of traffic accidents may be reduced.

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APPENDIX

APPENDIX

RAW DATA

SIMPLE REACTION TIMES UNDER CONDITION OF DISTRACTIONS

Key: No. 1-30 = Mentally retarded students
No. 31-60 = Normal students

ND = No distraction reaction times
AD = Auditory distracted reaction times
VD = Visually distracted reaction times
AV = Audio-visually distracted reaction times

* All reaction time scores measured at 1/100 seconds

No. 1				No. 2				No. 3			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
*57	59	54	85	51	55	57	61	80	66	73	57
52	58	50	60	42	51	64	56	72	64	62	74
51	62	51	80	45	42	61	57	61	61	61	60
50	46	75	55	41	41	69	51	90	72	52	64
50	53	65	55	55	45	51	120	69	66	70	79
43	61	51	53	45	51	55	85	74	55	55	69
57	78	53	58	41	44	79	50	80	65	68	76
44	54	57	86	55	95	45	120	65	85	61	88
46	83	50	58	46	55	61	45	73	62	56	62
56	69	68	56	65	91	45	60	81	75	64	62

No. 4				No. 5				No. 6			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
65	54	55	74	45	43	50	50	38	37	38	60
60	51	50	74	40	46	67	45	38	44	42	35
64	48	55	71	43	44	38	45	38	42	35	44
52	45	50	65	38	46	41	51	39	41	35	45
58	63	47	63	40	41	43	52	45	35	45	40
55	65	45	58	37	42	37	50	35	46	35	40
56	55	60	49	41	40	40	50	30	40	41	42
60	60	60	51	42	38	43	45	45	45	39	29
57	58	56	65	55	38	45	51	44	51	43	80
55	58	60	53	39	38	40	41	37	34	37	41

No. 7				No. 8				No. 9			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
46	51	50	66	48	85	75	46	60	110	61	100
57	51	47	54	44	54	52	47	65	62	52	60
61	57	51	48	44	54	44	51	62	63	70	65
50	58	51	100	49	46	45	50	50	55	60	60
47	53	45	55	42	60	46	47	51	85	57	68
44	65	55	65	45	52	50	62	56	64	6;	94
61	50	51	56	47	50	45	45	55	66	61	78
48	55	50	60	56	49	45	50	50	95	60	70
51	76	41	76	41	54	50	46	57	60	66	60
51	52	60	66	45	50	46	46	53	87	57	68

No. 10				No. 11				No. 12			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
80	61	65	56	45	73	82	76	45	50	53	45
120	53	53	56	75	80	90	130	42	41	50	51
53	52	57	65	71	76	130	100	44	73	45	60
75	56	53	92	60	75	75	80	54	43	50	58
55	57	78	58	110	73	75	84	43	40	49	51
50	55	65	66	81	76	83	84	38	41	44	57
65	52	57	80	110	69	81	80	45	62	50	57
46	59	55	75	85	73	120	101	65	39	42	60
110	55	52	85	65	70	130	92	63	48	69	76
46	65	57	60	130	68	90	80	45	45	48	76

No. 13				No. 14				No. 15			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
35	36	43	49	45	51	43	45	55	55	65	73
35	42	38	58	45	50	46	45	53	64	65	80
52	38	70	53	42	54	48	47	65	90	77	79
43	45	82	51	43	47	41	45	58	59	80	86
46	35	62	52	48	45	40	48	59	89	95	69
44	43	53	51	37	46	47	45	76	68	75	72
51	57	45	52	41	39	45	50	75	85	63	68
46	57	54	45	55	47	43	50	65	77	75	85
59	62	47	62	47	44	45	50	53	130	61	95
65	72	45	47	42	47	44	48	52	88	76	85

No. 16				No. 17				No. 18			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
41	48	42	50	45	55	41	58	62	65	100	88
50	55	39	50	40	42	48	52	70	62	95	87
56	59	40	42	36	50	54	43	62	73	120	82
50	43	47	43	42	45	45	62	76	90	62	87
44	43	45	45	36	43	47	57	74	73	90	91
52	43	41	55	45	45	47	44	57	120	66	73
52	60	64	51	46	46	40	40	62	85	118	68
75	56	95	46	47	47	52	59	65	120	63	76
39	43	40	59	46	65	48	49	59	76	82	60
41	42	42	40	51	43	62	46	75	80	90	66

No. 19				No. 20				No. 21			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
46	51	54	65	40	51	60	45	57	75	75	58
75	63	120	57	45	46	45	50	55	51	60	57
110	59	50	57	50	47	46	66	55	48	55	59
46	55	57	67	45	46	40	52	60	59	52	56
75	62	64	59	46	44	41	50	55	63	50	53
57	100	60	67	52	44	42	55	58	51	55	59
56	65	60	71	45	40	48	50	60	95	48	51
52	50	55	60	45	59	42	55	50	52	54	52
71	56	60	63	46	41	40	40	56	57	54	52
42	58	61	55	42	51	55	96	52	58	58	65

No. 22				No. 23				No. 24			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
42	41	55	47	85	55	47	48	50	53	57	64
41	40	45	42	51	45	40	45	54	53	55	50
45	40	44	43	51	41	45	42	75	50	54	46
41	41	45	47	48	44	44	45	67	52	48	72
45	45	43	59	68	49	45	51	53	58	60	65
40	43	36	45	46	50	47	50	56	49	53	75
40	43	52	50	55	46	44	40	58	75	62	55
43	44	55	45	47	43	40	48	54	50	53	54
36	45	41	41	48	46	41	41	71	61	64	65
39	47	41	46	50	50	42	48	55	63	50	60

No. 25				No. 26				No. 27			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
41	55	60	50	44	44	40	80	40	46	39	78
36	68	41	45	62	60	45	55	46	50	41	45
36	56	45	44	44	44	53	45	35	45	53	66
40	51	40	54	42	54	39	49	54	50	47	48
39	51	53	51	38	46	44	55	50	44	65	50
45	54	37	50	37	42	42	85	50	45	94	74
53	66	52	49	41	44	65	45	54	39	48	50
42	52	40	53	37	48	40	54	53	44	45	46
40	52	43	57	40	43	43	53	52	90	49	56
40	45	40	56	52	41	40	51	47	47	63	58

No. 28				No. 29				No. 30			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
38	45	45	45	49	50	50	60	38	42	32	47
46	55	44	43	44	48	43	52	42	45	33	49
45	51	57	51	47	47	43	60	37	43	36	44
47	44	49	55	44	51	45	52	38	45	50	54
54	55	51	47	53	50	46	54	34	47	39	44
49	44	58	54	39	56	57	110	45	49	38	49
45	57	45	58	44	45	40	40	45	42	36	63
48	40	47	56	53	54	47	45	44	45	40	66
48	39	46	48	50	50	46	54	40	44	37	44
51	49	46	47	65	76	70	45	37	46	40	48

No. 31				No. 32				No. 33			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
36	40	30	39	50	43	47	42	45	45	40	41
35	35	32	35	70	52	48	57	40	38	37	44
40	34	22	39	50	46	48	43	37	40	38	40
32	36	33	34	55	46	58	40	45	51	38	45
32	34	41	39	42	49	49	38	35	41	40	41
45	39	20	39	41	48	47	59	37	35	50	40
34	30	34	40	40	50	38	41	44	45	42	50
44	30	27	35	90	50	34	60	37	44	36	39
39	34	37	41	61	56	37	46	40	41	39	44
31	34	39	34	53	61	42	47	39	34	41	46

No. 34				No. 35				No. 36			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
40	44	46	50	45	39	41	39	38	37	34	39
45	45	38	59	40	40	37	42	40	39	38	41
45	46	42	51	45	39	34	40	46	42	44	43
38	43	41	59	32	40	40	42	41	42	46	40
42	40	41	47	38	37	45	45	47	35	36	38
45	38	51	47	31	42	42	40	41	41	41	44
54	52	40	51	35	34	37	44	54	36	41	37
41	53	56	52	34	46	39	45	40	35	35	45
38	36	37	65	42	44	36	46	40	43	37	38
46	51	44	58	38	34	37	45	35	37	45	44

No. 37				No. 38				No. 39			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
42	37	37	40	39	41	37	39	42	41	37	46
41	35	35	47	36	41	34	41	38	42	40	46
41	34	39	37	30	34	37	47	37	42	50	42
41	37	44	45	37	35	39	45	37	38	36	52
65	43	50	41	34	44	42	41	42	40	46	43
44	45	44	66	44	41	40	35	37	43	42	46
38	44	42	40	40	36	38	41	40	39	45	44
43	35	40	45	46	37	40	42	40	38	40	43
37	41	34	39	37	42	40	38	37	42	41	41
38	33	49	45	34	38	41	46	46	45	40	40

No. 40				No. 41				No. 42			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
45	40	35	39	42	46	39	42	36	37	40	32
50	39	40	40	42	40	37	53	38	41	37	38
42	43	38	42	40	38	37	40	34	35	34	36
38	35	35	38	45	38	38	45	44	35	36	38
38	40	35	40	44	39	39	41	44	34	41	37
40	37	32	43	38	38	39	45	35	44	43	38
44	45	34	42	39	38	41	45	40	40	41	38
38	49	33	47	39	54	41	38	39	32	40	38
40	40	35	40	35	41	37	37	52	38	50	59
37	45	45	41	39	41	80	40	34	41	41	40

No. 43				No. 44				No. 45			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
41	40	37	40	42	41	37	45	37	39	40	41
35	37	38	44	46	38	32	45	48	38	50	37
42	34	45	41	44	44	39	50	39	37	40	38
42	38	38	43	37	40	37	45	38	39	45	37
37	38	42	42	38	35	45	46	35	41	38	69
37	44	42	44	34	42	45	45	34	35	34	35
40	40	44	46	55	40	37	44	37	41	34	42
39	37	38	42	53	35	32	52	36	37	41	41
45	40	46	50	37	32	44	55	32	38	34	47
47	43	40	47	40	41	51	45	32	40	42	32

No. 46				No. 47				No. 48			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
41	40	37	38	51	47	46	45	42	46	48	46
39	52	35	50	37	53	48	34	37	45	37	48
38	35	34	37	40	54	59	46	39	40	42	43
45	40	40	42	46	64	44	40	44	44	40	47
32	39	32	32	36	49	41	44	37	40	37	45
36	34	32	39	37	53	46	37	35	35	55	46
36	40	34	49	41	47	55	45	37	37	40	45
38	40	40	35	37	44	41	45	41	38	41	50
34	35	37	42	40	42	38	45	35	37	35	45
35	45	40	46	45	45	43	45	35	35	43	50

No. 49				No. 50				No. 51			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
49	53	42	48	34	35	34	39	33	37	34	39
43	45	35	53	32	35	35	41	30	35	22	33
60	70	45	54	34	36	35	44	36	32	24	42
46	48	45	60	32	40	34	46	37	34	33	34
44	49	46	56	33	32	42	42	35	36	24	39
49	70	42	56	31	35	37	42	32	29	29	40
50	90	57	54	35	35	50	40	29	35	60	38
46	46	49	60	32	56	33	42	28	37	30	56
45	49	51	49	29	32	35	38	39	31	34	44
51	40	44	51	32	41	30	50	28	35	22	45

No. 52				No. 53				No. 54			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
47	42	47	52	45	45	51	45	39	35	37	38
50	47	48	52	42	35	42	46	36	35	35	34
52	47	40	40	40	42	35	42	35	39	38	35
44	45	35	43	42	38	42	35	35	35	38	44
51	43	38	50	49	35	35	47	46	36	34	40
42	42	36	44	40	62	40	43	35	34	47	42
45	52	47	49	50	49	35	55	37	38	45	40
51	44	45	95	45	42	38	40	40	39	47	38
61	46	60	85	44	48	42	48	37	31	41	44
40	44	41	50	43	49	35	48	35	36	38	46

No. 55				No. 56				No. 57			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
35	40	42	42	46	48	34	40	40	40	38	45
35	39	35	39	35	38	40	47	40	34	41	36
34	40	34	44	45	42	35	42	40	40	42	50
35	36	39	66	31	35	55	44	40	45	42	56
45	52	40	40	40	37	40	37	40	43	49	50
37	57	35	35	30	36	45	40	39	68	36	43
35	70	35	49	36	35	40	42	40	44	44	45
36	44	44	48	31	34	45	40	39	65	44	35
44	40	46	45	42	40	40	38	42	45	36	40
35	37	40	56	44	35	43	39	45	40	39	45

No. 58				No. 59				No. 60			
ND	AD	VD	AV	ND	AD	VD	AV	ND	AD	VD	AV
36	42	45	44	42	54	57	38	38	39	35	38
32	42	50	40	43	34	40	54	34	35	43	45
46	42	40	39	35	45	36	40	34	39	40	36
48	42	44	44	47	44	47	42	38	51	40	37
38	47	40	40	27	40	45	41	50	35	42	40
42	40	48	34	55	45	43	44	37	34	39	37
65	44	48	40	35	54	62	40	35	45	40	38
82	45	39	50	45	44	37	42	37	41	41	37
39	41	48	40	45	64	43	55	34	44	40	41
36	37	42	41	54	60	40	44	35	34	45	45

CENTRAL WASHINGTON STATE COLLEGE

Graduate Division

Final Examination of

Franklin Dean Carlson

B. A., Western Washington State College

1958

for the degree of

Master of Education

Committee in Charge

Dr. Hyrum S. Henderson

Dr. Dohn Miller Dr. J. Wesley Crum

Samuelson Union Building

Room 213

Wednesday, May 28, 1969

10:00 a.m.

Courses Included in Graduate Study

Required Courses

Education	507	Introduction to Graduate Study
Education	570	Educational Foundations
Psychology	552	Human Growth and Development, Advanced
Spec. Ed.	414	Curriculum and Problems of Instruction for the Mentally Handicapped
Spec. Ed.	463	Special Diagnostic Techniques
Spec. Ed.	467	Maladjusted Children
Spec. Ed.	499	Seminar in Special Education
Education	600	Thesis

Courses in Field of Specialization

Spec. Ed.	414	Curriculum for the Mentally Retarded Child
Spec. Ed.	416	Education of Disturbed and Conduct Problem Children
Spec. Ed.	418	Teaching Trainable Mentally Retarded Children
Spec. Ed.	425	Educating the Slow Learner
Spec. Ed.	443	The Disadvantaged Child
Spec. Ed.	585	Administration and School Supervision of Special Education Programs

Courses Included in Graduate Study (Continued)

Elective Courses

Sociology	440	Social Psychology (Pacific Lutheran University)
Education	416	Parent-Teacher Conference (Pacific Lutheran University)
Education	473	Introduction to Counseling (Pacific Lutheran University)
Education	587	Educational Administration

BIOGRAPHICAL INFORMATION

Born: [redacted]

Undergraduate Study

Pacific Lutheran University, three summers and night classes, 1958-1966.

Extension Courses from Central Washington State College, 1966-1967-1968.

Central Washington State College, one summer, 1967.

Central Washington State College, academic year, 1968-1969.

Professional Experience:

Teacher: Elementary School, Puyallup, Washington, 1958-1960.
Teacher: Junior High School, Puyallup, Washington, 1960-1961.
Teacher: Special Education, Junior High School, Puyallup, Washington, 1962-1966.
Teacher: Special Education, Port Angeles Senior High School, Port Angeles, Washington, 1966-1968.
Administrator: Director of Head Start, Bureau of Indian Affairs School and Summer School, Port Angeles, Washington, summer 1968.

Certification:

Standard General Certificate.

Additional Training:

Head Resident, Men's Dormitory, Central Washington State College, 1968-1969.
Workshops and Conferences (as a graduate student of Central Washington State College) at the University of Oregon, Eugene; University of Washington, Seattle; Central Washington State College, Ellensburg.