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The retention of tactile stimulation with young and elderly adults

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THE RETENTION OF TACTILE STIMULATION WITH YOUNG AND ELDERLY ADULTS

by

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TO ROBERT, LISA, AND JULIA

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CHAPTER I

Introduction

The purpose of this study is to test the retention of sensory experience in the modality of light-touch with both young and elderly subjects. Based on previous literature, it is expected that young Ss will be able to maintain more accurately the light-touch impression for a long delay period (two weeks) than older persons. The test for retention of the impression will be made immediately (two minutes) following the stimulation for one-half the Ss, and after two weeks for the remaining Ss.

The Retention of Sensory Abilities: Human subjects have demonstrated the ability to compare simultaneous and successive sensory stimuli both in the laboratory and in commonplace experience. King (1963a) in the modalities of vision and audition, along the dimension of intensity, exposed young Ss to a 74.4 mL. bright light for five seconds and other Ss to a tone of 600 c.p.s. for five seconds. They were instructed to notice the stimulus as they would be asked to reproduce it after a period of delay, varying from 2 mins. to 28 days. He found that the S's approximations made to "traces" of the intensity of the stimuli were quite stable over long delay periods. He noted that greater changes were

observed for matches made to auditory than to visual stimuli and that matches for both senses showed the largest shifts in judged intensity equivalence after the shortest delay. Along the dimension of frequency within these same modalities, King (1963b) exposed some Ss to a flashing light of 25.0 c.p.s., and others to a tone of 1000 c.p.s. Ss were asked to approximate the flash rate of the former and the pitch of the tone following delays of either 2 mins., 1, 7, 14, or 28 days. King reported that the approximations made to the "memory" of the frequency characteristic of the sample stimuli were stable over long and short delays. He reported a constant error in the direction of raised frequencies for both modalities for all delay intervals. Again, he indicated that judged equivalence of frequency showed the greatest shift after the shortest delay period. King's data on the dimension of duration (1963c) still within the same modalities agree with his previous findings. Ss were asked to make a non-verbal approximation of the duration of a light stimulus and other Ss, a tone stimulus, following the same delay schedule as mentioned above. Again, he found that the approximations were quite stable for both modalities over all delay periods. He reported a consistent underestimation for interval judgements of both visual and auditory stimuli. The greatest error in judged temporal equivalence was after the shortest delay.

King (1965) investigated the effects of short term delay using the same experimental approach as before (1963 a, b, c) and utilizing delays of 15, 30, and 60 seconds. He found accurate and stable reproductions of the standard stimulus over all delay periods.

Verbal Learning and Memory Functioning: There is a large amount of literature indicating that elderly subjects exhibit deficit behavior relative to memory functioning. Ruch (1934) compared elderly and young Ss in their performance on a pursuit rotor task, first in direct vision, then in mirror vision and three lists of paired-associate materials. He hypothesized that older Ss should show greater deficit in any learning situation requiring the reorganization of existing habits, less deficit where earlier experiences can be used in new learning. His paired-associate lists, then, differed in the degree to which they utilized or contradicted earlier learning. He found that the young-old difference was greater for the mirror than the direct vision perceptual motor task. Among the verbal tests, differences were greatest for the interference material, less for the nonsense task and least for familiar word associates. He concluded that older Ss have the least "deficit" in learning materials which are compatible with habitual material and greatest "deficit" where new learning contradicts earlier habits.

Korchin and Basowitz (1957) compared young and elderly Ss on three verbal learning procedures differing in the degree to which prior experience might be expected to facilitate or block present learning. They found that both groups performed best on the word associate task but little difference was found between the learning of nonsense syllables and false equations. The older groups was significantly poorer on all three procedures, but this group was proportionately more deficient in the learning of materials in which the facilitative effects of prior experience were minimized.

Wimer and Wigdor (1958) were concerned with the existence of memory loss with age over a constant time interval with the degree of learning held nearly equal for both young and elderly Ss. Retention differences were studied both with and without interpolated interfering activity. Paired-associate word lists were used and young and old Ss were divided into two groups. The first group (A) learned the list and rested 15 minutes. Group B learned a second list immediately following the first; both groups were tested for retention of the first list at the end of 15 minutes. Their results indicate no differences in retention for old and young Ss in group A. In group B, their results were not as conclusive but they report that age groups do not seem to have been differentially affected by the interpolated learning. Wimer (1960b) in a similar study to

the above, used a longer learning task and longer retention interval. His results show a significant age related loss in retention over a 24 hour period.

Wimer (1960a) used incidental and intentional learning of word-color relationships. He found significant age loss in the amount learned under the intentional conditions but no differences were found under the incidental condition. He conduded that young and elderly Ss must be tested at the same age before one can state that there is no age loss in learning under these conditions.

Tactile Stimulation and Embedded-Figure Tasks: Axelrod and Cohen (1961) in another line of investigation, noted that elderly Ss compared with young Ss, exhibit deficit behavior on versions of the Gottschaldt embedded-figure task. They raised the question as to whether this poor performance was modality specific or whether it transcended modality, thereby implying a generalized difficulty in ignoring extraneous perceptual information. They compared young and elderly adults in their performance on visual and tactile hidden-figure tasks and found that performance on both embedded-figure tasks were significantly poorer in the elderly group. Thompson, Axelrod and Cohen (1965) did a study comparing elderly and young Ss on their performance involving visual identification of forms that had been previously palpated. There were

three arrays of forms, differing in abstractness, and two conditions, successive (palpate and then identify) and simultaneous (palpate and search array at same time). They found no significant differences in palpation, but elderly Ss took significantly longer in searching the visual arrays and made more errors than the young. The authors concluded that there may be a selective impairment of "searching behavior" with age.

Statement of the Problem: The present study investigates both the short and long delay of stimulus "trace" phenomena in the modality of light-touch with both elderly and young Ss. A pilot study indicated that subjects (mean age 45.5) years are able to retain the impression of light-touch for a period of one week. We wish to know if this impression can be retained for a longer period of two weeks. If so, an analogy may be drawn between vision and audition and this less primary modality of light-touch. Does the deficit behavior described by Ruch (1934), Korchin and Basowitz (1958), and Axelrod et al (1965) for aged Ss in verbal learning and in tactile and visual stimulation occur in this modality also? King (1963) reports greater changes observed for matches when a shift from the most primary modality (vision) was made to a less primary modality (audition). The present study will indicate whether in the modality of light-touch, impressions can be maintained for a period of two weeks.

CHAPTER II

Method

Subjects: Two groups of male subjects were used, twenty Ss per group. One group had a mean age of 35.3 years, the other a mean age of 66.8 years. The elderly Ss were all residents of the domiciliary of the Hampton, Va. Veterans Administration Hospital and were both Caucasian and Negro. The young subjects, with the exception of two of them, were patients at the Hampton Veterans Hospital. The remaining two consisted of one graduate student in Psychology, and a Ph.D. Clinical Psychologist. These last two were included as some of the original young sample had left the Hospital and hence, the experiment.

All subjects were tested individually and all subjects received the same standard stimulus, 5.07 and the same eleven hairs for retest purposes. One half of each group was retested following a two minute delay and the other half was retested following a two week delay.

Apparatus: The apparatus is the Semmes-Weinstein Pressure Aesthesiometer consisting of twenty nylon monofilaments which range in diameter from .06 mm to 1.14 mm. Each filament is embedded at one end in a plastic rod handle. The free end of each filament is 38 mm in length. The force required to bend

each filament by pressing against the tip was measured on a chemical balance. (Semmes, et al, 1960) The common logarithm of the force was used in computation of thresholds. This measure was related to the serial order of the filaments (based on their diameters) in an approximately linear fashion, and a scale of stimuli with approximately equal intervals is the result. Semmes, et al (1960) shows the diameter and the logarithm of the force of each filament and presents the relationship between log force and frequency of response in a separate group of twenty normal subjects.

In addition, a small stand approximately 3 ft. x 1½ ft. is used during the initial stimulus presentation. It is cut out in the center and covered with a curtain, enabling the subject to put his arm through the board and restricting his vision so that he is not able to see the stimulus presentation.

Procedure: Light-touch has been selected as the modality to test. The test procedure is a form of the method of comparison where a single choice is made from eleven of the kit stimuli to approximate the standard stimulus, which is also from the kit. All subjects were exposed to a standard stimulus of known physical value, 5.07. For half of the subjects in each group, a two minute delay occured and then they were asked to choose, from a series of stimuli, the one that felt "most like" the original stimulus. The remaining

subjects in each group were asked to make the same choice following a delay of two weeks.

The test stimuli consist of the five hairs on both sides of the standard stimulus as they appear in the kit. The values of these hairs are as follows (in ascending order): 4.17, 4.31, 4.56, 4.74, 4.93, 5.07 (standard), 5.18, 5.46, 5.88, 6.10, 6.45. The presentation of the stimuli at the time of retest was counter-balanced to account for anticipatory errors characteristic of the method of limits. Thus, subject one during the retest used the stimuli in descending order, subject two, in ascending order, etc. All stimulus contact was for approximately one second with approximately three seconds between contacts on retests. According to Geldard (1953), the stimulus for felt pressure is set up within the pliable cutaneous tissues and removal of a stimulus should result in re-arousal of pressure sensations. The three second time lapse between stimulus applications should have allowed for the dissipation of the pressure sensations. (Semmes, et al, 1960)

All subjects were tested in a small room with a minimum of extraneous stimulation present. The subject was seated at a table and given the following instructions: "Each of these plastic sticks has a hair on the end of it. (Demonstrate) Since the hairs are of different sizes, some of them feel different than others. I am going to touch you on your wrist with one of these hairs. In a few moments (or, a few weeks) I will have you touch your wrist with a series of hairs to see if you can pick out the one that feels most like the hair I touched you with at first."

Subjects were then asked to present their left wrist so that the Examiner could mark an X on the palm of the wrist approximately one inch from the radius of the wrist. All subjects were then told: "Please put your hand through this curtain so that you will not see which hair I am going to use. Please say 'touch' when you feel the hair." All subjects were touched on the X with the same stimulus, 5.07, from the kit.

Following a two minute delay, half the subjects from each group received the following instructions: "Now I would like you to start here (indicate) and test yourself with these hairs. Please tell me which one feels most like the one I used on you at first."

After a delay of two weeks, the remaining half of the subjects from each group were returned to the room and given the following instructions: "Two weeks ago I touched you on your wrist with one of these hairs. Today, I would like you to start here (indicate) and touch yourself with these hairs and tell me which one feels most like the one I used at first."

Table 1 illustrates the experimental design.

TABLE I

Experimental Design

Two minute delay	Two weeks delay
Old Recall Scores	Old Recall Scores
Young Recall Scores	Young Recall Scores

CHAPTER III

Results

Age and Delay Comparison: One subject failed to return following the two week delay period for retest (young S). Thus, a two factor analysis of variance was done using Winer's procedure for unequal cell frequencies. (Winer, 1962) Table II presents the analysis of variance results for the effects of age, delay periods and the interaction of those two factors. A significant level of .05 was selected and the results indicate that there were no significant main effects or interaction. Recall scores did not differ significantly for young and elderly Ss and recall scores for the two delay periods did not differ for either young or elderly Ss.

Accuracy of Recall Scores: To obtain an indication of the accuracy of the Ss with respect to the standard stimulus, each Ss recall score was subtracted from the standard stimulus value and a series of T tests were done. (Winer, 1962) Table III presents the results of these tests on differences. The difference scores for the young Ss between the two minute and two week condition were not significant. Similarly, a comparison between the two minute and two week delay periods for elderly Ss revealed no significant differences. In addition, differences between young and elderly Ss at the two minute delay and at the two week interval were not significant.

TABLE II

Analysis of Differences in Recall Scores as a Function of Age and Delay Period

Source	df	ms	F
A (Age of Ss)	1	.0051	.0001 N.S.
B (Delay periods)	1	.0184	.0005 N.S.
A X B	1	.08	.0022 N.S.
Within Cell	35		

$F_{.05}(1, 35) = 4.12$

TABLE III

Analysis of Difference Scores of

Young and Elderly Subjects for Various Delay Periods

Young Ss
2 min.: 2 week

T_{obs} = .946 N.S.
T (17, .975) = 2.11

Old Ss
2 min.: 2 week

T_{obs} = .294 N.S.
T (18, .975) = 2.10

All Subjects
2 min.: 2 weeks

T_{obs} = .39 N.S.
T (37, .975) = 2.03

All Subjects
old: young
$T_{obs.}$ = .924 N.S.
T (37, .975) = 2.03

2 Week Delay
young: old
T_{obs} = .949 N.S.
T (17, .975) = 2.11

2 Min. Delay
young: old
T_{obs} = .397 N.S.
T (18, .975) = 2.10

The difference scores for all Ss in the two minute condition and, again, in the two week condition were not significant.

Direction of Errors: To determine whether or not the direction of errors was significant, a series of Chi Square tests were done. (Siegel, 1956) Table IV presents these findings. The Chi Squares done between the expected and obtained frequencies of errors for elderly and young Ss on the two minute recall scores and on the two week recall scores were not significant. The Chi Square involving the expected and obtained frequencies of errors between all elderly and young Ss was not significant. Additional Chi Squares done between the two minute and two week delay periods for young and again for elderly Ss were not significant.

Table V presents the means and variances for young and elderly Ss at both delay periods.

The results indicate that there are no age differences in the ability to recall this type of sensation and that immediate and long term recall are not significantly different. The tests on differences of recall scores from the standard stimulus value indicate that the recall scores are quite accurate both for elderly and young Ss and for short and long delay periods. The tests for the significance in error direction indicate that neither elderly or young Ss tend to over or underestimate the standard stimulus value either for short or for long delay periods.

TABLE IV

Chi Square Analysis of Direction of Errors in Young and Elderly Subjects

Condition	Observed X^2	Critical X^2
Two minute recall scores	X^2=2.10 N.S.	X^2(2, 5%) = 5.99
Two week recall scores	X^2=1.46 N.S.	X^2(2, 5%) = 5.99
Total recall scores	X^2=3.10 N.S.	X^2(2, 5%) = 5.99
Recall scores young subjects	X^2=3.18 N.S.	X^2(2, 5%) = 5.99
Recall scores elderly subjects	X^2=.992 N.S.	X^2(2, 5%) = 5.99

TABLE V

Means and Variances for Young and Elderly Subjects at Various Delay Conditions

	2 mins.	2 weeks
Young:	$\bar{X}$ = 4.70 s = .3755	$\bar{X}$=5.34 s = .646
Old:	$\bar{X}$ = 5.20 s = .4789	$\bar{X}$ = 5.31 s = .4668

CHAPTER IV

Discussion

It was suggested in Chapter I that young Ss would be able to maintain more accurately the light-touch impression over a long delay period than older Ss. The expected deficit behavior on the part of the elderly Ss was hypothesized on the basis of earlier studies with the aged. In the area of verbal learning, Ruch (1934), and Korchin and Basowitz (1958), Wimer (1960b) all reported age deficits in recall of paired-associate lists. Axelrod and Cohen, (1961) and Thompson, et al (1965) report that older Ss show deficits in identification of tactually presented stimuli.

The results of the present data analysis indicate that there is no age deficit in the area of the retention of the light-touch impression. Further, the data indicate that both young and elderly Ss can maintain an accurate impression over both short and long delay periods. There is no consistent over or underestimation of the stimulus by either age group at either delay period. These findings support King's research in the retention of sensory abilities within the modalities of vision and audition. (King, 1963, a, b, c) His findings were that young Ss can accurately maintain the impression of a visual or auditory sensation for periods from 15 seconds (1965) to one month (1963). The present study within

the modality of light-touch tends to confirm King's hypothesis of the development of a persistent and accurate "trace".

In the light of these negative findings with respect to age deficit, one may ask why in this area, elderly people can perform at such a proficient level when research in other areas indicate a marked performance deficit. Perhaps the answer lies in the fact that there is relatively little interference occuring in this task over the delay periods.

In a different area (verbal learning), Ruch (1934) presented verbal paired-associate materials to elderly and young Ss. These lists differed in the degree to which they utilized or contradicted earlier learning. He found that the young-old difference was greatest for the interference material, less for the nonsense task and least for familiar word associates. Similarly, Korchin and Basowitz (1957) used three verbal learning procedures in a comparison between young and elderly Ss. These learning tasks differed in the degree to which prior experience might be expected to facilitate or block learning. One of their findings was that the elderly Ss were poorer on all three procedures, but they were proportionately more deficient in the learning of materials in which the facilitative effects of prior experience were minimized.

Axelrod and Cohen (1961), utilized both visual and tactile embedded-figures with young and elderly Ss. They reported that performances on both embedded-figure tasks were significantly poorer in the elderly group. Thompson, et al (1965) had young and elderly Ss palpate forms and identify them out of three visual arrays, differing in abstractness. They found elderly Ss showed a deficit in visual identification of tactile-kinesthetic stimuli. However, their findings did not indicate that the abstractness of the array was a factor in the elderly Ss deficit performance. The authors felt that this effect might still be demonstrated with the introduction of varying amounts of topological distortion into the array forms.

The above experiments, as contrasted with the present study, all contained an interference factor and further, required of the S more than a simple discrimination.

King (1966), using young Ss and the modality of audition, found no interference effects after presenting both higher and lower tones, white noise and no noise during the two minute delay prior to recall. The question still remains as to whether interference would produce a decrement in the accuracy of the tactual "trace" in an aged population. To answer this question, an experiment with young and elderly Ss receiving an interfering stimulus

would have to be done. If such an experiment yields results consistent with King's data (1966) then it would seem that these sensory traces are quite stable although interference does affect the formation of a higher level conceptualization.

In the search for an explanation of this stable phenomena, Head's theory of CNS functioning may be helpful. (1920) He suggested that CNS functioning is graded according to levels. With the occurrence of brain damage, Head assumed that higher processes showed deficit before lower ones. The following quotation from Semmes, et al (1960) illustrates this point.

"If it is true, as often assumed, that perception in a given modality can be disrupted independently on 'lower' and 'higher' levels, then we should expect impairments on discrimination of object qualities or on the tactual problems to occur without significant sensory deficits..."

In terms of a paradigm of learning involving registration, retention and recall, the present study offered some advantages. It involved an initial simple stimulus presentation, and registration was inferred from the subject's verbalization "touch" at the moment of contact. If Head (1920) is correct, then there would be no reason to assume an age deficit on this task as it represented a lower level of functioning than the verbal learning or tactile discrimination tasks.

This particular task may be more correctly subsumed under a detection-discrimination rubric rather than a traditional learning task. There are no changes in performance over practice periods, so that we have dealt with single presentation learning, without reinforcement and also without contiguity of traditional antecedent-consequent events. Conclusions from the present study, therefore, are not to be generalized as applicable to traditional learning-forgetting data.

CHAPTER V

Summary and Conclusions

The present study investigated the retention of a tactual stimulus of known intensity over short and long delay periods in young and elderly subjects. The subjects were presented with a standard tactile stimulus and after an appropriate delay period, were asked to choose the original stimulus from among eleven test stimuli.

It was hypothesized that young Ss would maintain more accurately the light-touch impression over the long delay period than the elderly Ss. A series of studies was reviewed showing deficit behavior of elderly Ss in the area of verbal learning and tactile discrimination. Another series of studies indicated that simple auditory and visual impressions were maintained over long and short delay periods by young subjects with considerable accuracy.

The findings of the present study were as follows: First, a comparison between the recall scores of young and elderly Ss across both delay periods indicated that there were no significant differences in performance between young and elderly persons. Secondly, data analysis reveals that young and elderly Ss did not differ significantly in the accuracy of their recall at either

delay period. Both groups of subjects performed equally well at both delay periods.

Finally, statistical analysis suggests that neither group of subjects systematically over or underestimated the stimulus at either delay period.

In summary, the accuracy of retention of a simple tactile stimulus impression was good in either age group. The negative findings with respect to age deficit were discussed in relation to a theory of CNS functioning. It was pointed out that the tasks in the area of verbal learning and tactile stimulation previously cited were more complex than the present task. It was then hypothesized that negative findings relative to an age deficit may be a function of task simplicity and lack of interference. The present study is a detection-discrimination problem and does not follow a typical learning paradigm.

APPENDIX

I. Differences Between Recall Scores and the Standard Stimulus

Standard 5.07	Young Ss	D	Elderly Ss	D
	4.17	.90	5.18	.11
	4.56	.51	5.46	.39
	4.93	.14	4.74	.33
	4.74	.33	6.10	1.03
2 minute delay	5.18	.11	4.74	.33
	4.31	.76	4.93	.14
	5.18	.11	5.88	.81
	4.56	.51	5.18	.11
	5.07	.00	4.74	.33
	4.31	.76	5.07	.00
	6.45	1.38	5.18	.11
	5.46	.39	5.88	.81
	5.88	.81	4.31	.76
	5.88	.81	5.46	.39
2 week delay	4.74	.33	4.93	.14
	4.74	.33	5.46	.39
	5.46	.39	5.07	.00
	4.93	.14	5.88	.81
	4.56	.51	5.46	.39

II. Diameters and Common Logarithms of the Forces Exerted by the Monofilaments Used in Measuring Pressure Thresholds (from Semmes, et al, 1960)

Ordinal Number	Force	Diameter (mm.)	Log_{10} Force (.1 mg.)
1	.0045	.0635	1.65
2	.0230	.0762	2.36
3	.0275	.1016	2.44
4	.0677	.1270	2.83
5	.1660	.1524	3.22
6	.4082	.1778	3.61
7	.6968	.2032	3.84
8	1.194	.2286	4.08
9	1.1494	.2540	4.17
10	2.062	.3048	4.31
11	3.632	.3556	4.56
12	5.500	.3810	4.74
13	8.650	.4064	4.93
14	11.70	.4318	5.07
15	15.00	.4826	5.18
16	29.00	.5588	5.46
17	75.00	.7112	5.88
18	127.0	.8128	6.10
19	281.5	1.0160	6.45
20	447.0	1.1430	6.65

III. Expected and Obtained Frequencies of Errors

	elderly	young	totals	
above 5.07	(3.5) 5	(3.5) 2	7	Two minute
5.07	(1) 1	(1) 1	2	recall scores
below 5.07	(5.5) 4	(5.5) 7	11	
totals	10	10	20	

	elderly	young	totals	
above 5.07	(6.3) 7	(5.6) 15	12	Two week
5.07	(.53)1	(.47) 0	1	recall scores
below 5.07	(3.16)2	(2.84) 4	6	
totals	10	9	19	

	elderly	young	totals	
above 5.07	(9.74)12	(9.25) 7	19	Total recall
5.07	(1.52) 2	(1.46) 1	3	scores
below 5.07	(8.71) 6	(8.28) 11	17	
totals	20	19	39	

	elderly	young	totals	
above 5.07	(.89)2	(3.31) 5	7	Recall scores
5.07	(.53)1	(.47) 0	1	young subjects
below 5.07	(5.79)7	(5.21) 4	11	
totals	10	9	19	

	elderly	young	totals	
above 5.07	(6) 5	(6) 7	12	Recall scores
5.07	(1) 1	(1) 1	2	elderly subjects
below 5.07	(3) 4	(3) 2	6	
totals	10	10	20	

( ) = expected frequencies

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VITA

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