EFFECT OF LIST LENGTH AND WORD FREQUENCY ON CUED RECALL AMONG BLIND, DEAF AND NORMAL STUDENTS

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ABSTRACT

This study compared the effect of list length and word frequency on cued recall among blind, deaf and normal students. Thirteen blind, deaf and normal students each were conveniently drawn from Aboh Boys Secondary School, Aboh Mbaise, School for the Deaf, Ofekata Orodo, and Rochas Foundation College, Owerri, all in Imo State, Nigeria. The participants who were in SS 1 to SS 3 were between the ages of 17 – 25 years with a mean age of 20.90. A 2 X 2 factorial design was employed while one-way ANOVA and One-Way MANOVA were used for data analyses. Findings showed that normal students performed better in cued recall rate, list length cued recall and word frequency cued recall than their deaf and blind counterparts. The study recommends that since the visual and auditory senses affect cognitive abilities, visually impaired and deaf students should be recognized as disadvantaged and should be given more special treatment both in educational and non educational settings. In so doing, the disabled will gain more access to better education and lead better lives.

INTRODUCTION

Man would have been a conundrum without memory. Without memory, learning and some other cognitive activities would not take place and we would not remember the way to our schools, offices, faces of our loved ones, our houses, even who we are!. Indeed, memory sustains almost every aspect of human and animal activities. Except for the annoying-moments when memory fails or when someone we know is afflicted with memory loss, most of us do not think about how much everything we say or do depends on how smoothly our memory systems operate (Schacter, 1996, 1999, 2001). We rely on our memory systems to carry out similar plans every day of our lives. Human memory systems truly are remarkable when we think of how much information we put into our memories and how much we must retrieve to perform all of life's activities (Willingham, 2004). Cognitive psychologists have immensely studied and are still studying memory with keen interest (Tulvin & Pearstone, 1966; Scarborough, 1972; Meyer & Anderson, 1991; Nobel & Shiffin, 2001). The evolution theory of memory hypothesizes that memory, like learning, arose as a response to environmental demands and serves an adaptive function.

Memory allows the individual to retain information about their environment and themselves and thereby survive. It also allows the people to retain information about adaptive mechanisms that permit them to repeat helpful behaviours and avoid repeating harmful ones. Memory is a process in which information is encoded, stored, and retrieved (Santrock, 2005). Encoding allows information that is from the outside world to reach our senses in the forms of chemical and physical stimuli. Storage entails

that we maintain information over periods of time. Finally, retrieval of information that we have stored is locating it and returning it to our consciousness.

Human activities involve different memory tasks which are studied separately. The first memory task is referred to as item recognition memory task. Here, individuals need to judge whether an item and a context are associated. An example is recognizing ones car key from ones house and office keys. The second is free recall memory task, where individuals need to recall items associated with a given context. An example is recalling all about a given class lecture. And the last one is cued recall memory task, where individuals use one item to recall another item that is associated with the given item. An example is giving hints to the individual(s) for easy recall (as in provision of clues such as synonymous pairs of things or words and opposite). The cued recall memory task is the facet of memory task being examined in this study.

One of the variance between recognition and recall is the list length effect. The list length effect refers to the phenomenon where participant's performance decreases as the list gets longer. Adding more items to a memory list decreases the proportion of items recalled (Raaijmakers & Shiffrin, 1981). However, there are series of papers demonstrating that there is no list length effect when confounding variables such as time are controlled (e.g. Dennis & Humphreys, 2001; Criss & Shiffirn, 2004; Dennis, Lee & Linnel, 2008). Kennel and Dennis (2010) argue that long lists are treated "unfairly" compared to short lists because long lists require more time to review. The list length effect could be eliminated if extra time is apportioned to the long list instead of allowing the same amount of time in the study of both lists.

Another difference between free recall and recognition is the word frequency effect. Word frequency effect refers to how often a particular word is used in our daily life. Previous studies on free recall have shown that people perform recall tasks better when asked to recall pure high frequency word list as opposed to pure low frequency word list (e.g. Deese, 1960; Postman, 1970; Ward, Woodward, Stevens & Stinson, 2003). Pure high frequency word list are lists of words that we often come across (e.g. money, spoon, paper, food). Low pure frequency word list are lists of words that we do not often encounter (e.g. misty, gully, ivory) and mixed word lists are a combination of pure high and low frequency list.

There are so many explanations for the high frequency advantage in recall process. One explanation is that because we come across high frequency words a lot in our daily life, they are more readily available in our minds and are thus more retrievable (Madan, Glaholt & Capian, 2010) as opposed to low frequency words which we do not encounter very often in our daily life.

In cued recall, participants are typically presented with lists of paired words, one of each of the paired words will be the cues (items which will help the recall of partner pairs) and the other of the same pair will be the target. They are both studied together by the participants in the study phase of the experiment, later the opposite pairs which are the targets will be removed from the cues and the participants are asked to recall the target with a provision of the cues.

During human activities, sensory information is being taken in by our sensory receptors and processed by the nervous system. Sensory memory is the first level of

memory. Sensory memory retains the brief impression of a sensory stimulus after the sensory stimulus has ended. The information stored in the sensory memory is long enough to be transferred to the short term memory and afterwards to the long term memory if further processed. There are three types of sensory memory, iconic memory (sight) which can last for 500 milliseconds (Sperling, 1963), echoic (hearing) and haptic memory (touch). In this study, we are going to look at those of sight and hearing, thus, we are going to see whether sensory disability has any effect on cued recall which is a facet of memory.

Statement of the Problem

Sensory disability can involve any of the five senses, but for educational purposes it generally refers to a disability related to hearing, vision or both. Sensory disabilities could affect access to visual and/or auditory information. It exists in the forms of blindness, deafness or blind-deaf respectively.

Usually, when there is a deficit in sensory ability, it results to sensory disability which consequently affects memory recall. Normal individuals, for instance students, are likely to recall certain memory tasks such as list length and word frequency better than blind, deaf or deaf-blind students as a result of their possession of a dual sensory trace. However, there is a paucity of research in this direction as the above assertion is just a theoretical hunch especially among Nigerians. This resulted in scepticism on the side of the researchers concerning this assumption and thus generated the interest in investigating whether possession of dual sensory trace will result in significantly better cognitive ability.

Purpose of the Study

The general purpose of this study is to identify whether cognitive ability (cued recall) differ among blind, deaf and normal students. Specifically the study will seek to find out whether:

1. Normal students will perform better than blind and deaf students on cued recall rate.
2. Normal students will perform better on short list lengths cued recall than their blind and deaf counterparts.
3. Normal students will perform better on long list lengths cued recall than their blind and deaf counterparts.
4. Normal students will perform better on high word frequency cued recall than their blind and deaf counterparts.
5. Normal students will perform better on low word frequency cued recall than their blind and deaf counterparts.

Empirical Review

Meyer and Anderson (1991) supported Paivo's dual coding theory. In an experiment performed to isolate the effects of words and pictures on building representational and referential connections. Four conditions were compared: words – with – pictures, words only, pictures only, and control. 48 college students participated and a recall test and problem solving test was administered. Results indicated that, as predicted, the

words-with pictures group performed significantly better than the other groups on the problem solving tests.

Nobel and Shiffrin (2001) tried to explain the list length effect in cued recall by applying retrieval process from REM model (retrieving effectively from memory model) using the item noise approach. The general idea was to calculate a likelihood ratio by comparing the item cue to every studied pair that was stored and choose the most related pair to produce targets. One hundred and one volunteers from introductory psychology courses at Indiana University participated in exchange for course credit.

Tulvin and Pearstone (1966) asked participants in their study to remember lists of words which were arranged in groups, with each group falling under categories such as: animal, goat, cow, dog, profession, teacher, engineer, doctor, furniture, chair, table, bed. The participants were not asked to learn the category names. Later, half of the participants were asked to recall as many as the original words as possible when provided with the category names (cues). The other group of participants were asked to recall the words but were not given any category names (cues). Not surprisingly, those who had been given the cues recalled far more than those who were asked to engage in free recall without cues. The participants in the study were 36 Washington University undergraduates.

Rundus and Atkinson (1970) carried out a study on the rehearsal process free recall, in which 25 Stanford undergraduate female students served in an initial one hour experimental session. Nine lists of twenty nouns were presented in the first session and five lists were presented in the second session. A trial involved the presentation of the list followed by a two minute written free recall test on that list. The discovery made in this study was that the number of recall was seen to be a function of the number of recall items.

Adam's Dual Study (1976). Adam engaged thirty five (35) students at Carnegie Mellon University to show that the retrieval of information from memory store depends on verbal and pictorial traces. This result shows that when one trace (verbal or pictorial trace) failed the other was there to help out.

Scarborough (1972) did a study on short term memory recall where he made all the subjects to receive 36 consonant trigrams (e.g. XGR or NRF) presented for some seconds. Forty-five (45) first year undergraduate students in psychology at the University of Sydney served as the participants and the trigrams were presented differently for each group. One group of participants saw the trigram (visual condition only), the second group heard the trigram via audio recorder (auditory condition only), and the third group saw and heard the trigrams (auditory plus visual condition). Results of this experiment showed that participants who received only visual presentation recalled better than those who received only auditory presentation and participants who received both visual and auditory information recalled best among the three groups.

Experiment by Paivio (1991) supports the importance of imagery in cognitive operations and concluded that visual, graphic and auditory cues positively impact cognition. Paivio's study compared multimodal instructions using both texts and

pictures and unimodal texts and the participants comprised 72 undergraduates at the University of Western Ontairo who were randomly assigned to the groups. The participants significantly performed better with multi-modal instructions than unimodal instructions (Gellevis, Van-Der-Meeii, Dejong and Peters, 2002).

Hypotheses

1. Normal students will significantly perform better than blind and deaf students on cued recall rate.
2. Normal students will significantly perform better on short list lengths cued recall than their blind and deaf counterparts.
3. Normal students will significantly perform better on long list lengths cued recall than their blind and deaf counterparts.
4. Normal students will significantly perform better on high word frequency cued recall than their blind and deaf counterparts.
5. Normal students will significantly perform better on low word frequency cued recall than their blind and deaf counterparts.

METHOD

Participants

Participants in this study were made up of thirty-nine (39) senior secondary school students living and schooling in Imo State, Nigeria. They were in three categories, visually impaired, deaf and dumb, and normal students. Thirteen visually impaired students were selected from Aboh Boys' Secondary School, Aboh-Mbaise, another 13 deaf and dumb students were selected from Imo State School for the Deaf, Ofekata Orodo, and 13 normal students were selected from Rochas Foundation College Owerri. All selections were made through convenience or accidental sampling method due to the limited and scarce population of blind and deaf students. The participants' ages ranged between 17 – 25 years with a mean age of 20.90 years and standard deviation of 16.77. The blind participants were all males, the deaf and dumb were made up of 5 males and eight females, and the normal students were made up of eight males and five females.

Instrument

The instrument used for the study was a self developed Words Recall Index (WRI) designed to measure memory recall. This instrument measures both long list-length and short list-length memory recalls and accommodates word frequencies of high frequency words, low frequency words, and mixed combination. These were made up of paired words of 5 – 6 letter words. Each of the two words that make a pair has the first word as the cue and the second word as the target. The short list is made up of 12 pairs of words of the aforementioned categories and the long list is made up of 24 pairs of words of the above mentioned categories. These words were also converted into Braille for the visually impaired participants and in printed papers for the deaf and normal students. The researchers carried out a face validity of the instrument by presenting the instrument to two experienced researchers and five secondary school teachers. They all confirmed the suitability of the instrument for the measurement of the intended construct. A pilot study involving 30 Pre-Degree students of Imo State

University was carried out to ascertain the reliability and inter-item correlation of the instrument. Reliability coefficients of .86 and .95 were obtained for the short list length and long list length respectively. Also, an overall reliability coefficient of .73 was obtained for the entire instrument.

Procedure

The study had three phases: the study phase, the control phase, and the test phase. The researcher allotted three minutes to all the participants in the study phase of the short list length which had words of high and low word frequencies under controlled conditions. After the participants studied the list for three (3) minutes, the control phase took over in order to control for rehearsal (this lasted for two minutes) and the last stage was the test phase during which the participants were asked to reproduce the targets with the help of the cues. On each pair, the cues were on the left hand side of the pair and the targets were on the right hand side. In the study phase, the participants studied the pairs (the cues and targets) and later in the test phase the targets were detached from the cues, then the participants were asked to recall the target words with the help of their opposite cue words. This was successfully done by giving the deaf and normal student-participants another test paper which had no targets unlike the study phase which had both (this they completed with pen), the blind participants did theirs through specially reproduced Braille version of the instrument and gave their answers through typewritten sheets.

Design and Statistics

A 2 X 2 factorial design was used for the study. This was because the independent variables (list lengths and word frequencies) had two major levels each (i.e. long and short list lengths; high and low word frequencies). The statistics used were the One-Way ANOVA and One-Way MANOVA on SPSS version 17. One-Way ANOVA was used to analyse students' recall scores based on their overall list length and word frequency levels while One-Way MANOVA was used to independently analyse recall scores for the list length and word frequency levels of the three different groups.

RESULTS

Table 1: Summary of Means and Standard Deviations for Students' Status on Cued Recall

Status	Mean	Standard Deviation	n
Blind	15.00	10.30	13
Deaf	25.85	6.50	13
Normal	33.08	5.74	13

Table 2: Summary Table of One-Way ANOVA for Students' Status on Cued Recall

Source	Type III Sum of Squares	Df	Mean Square	F	P
Status	2152.36	2	1076.18	17.80	.000[Sig]
Error	2176.62	36	60.46		

[Sig] = Significant

From the table above, the first hypothesis which states that normal students will significantly perform better than blind and deaf students on cued recall rate is accepted. From the results a statistically significant difference was found on students cued recall rates [F (2, 36) = 17.80, P < .001]. The means obtained (Table 1) further show that normal students (M =33.08) scored higher on cued recall rate than deaf (M = 25.85) and blind (M =15.00) students.

Table 3: Summary of Means and Standard Deviations for Students' Status on list length Cued Recall

	Status	Mean	Std. Deviation	N
Short List Length	Blind	4.85	3.76	13
	Deaf	11.15	1.73	13
	Normal	11.69	1.11	13
	Total	9.23	3.96	39
Long List Length	Blind	10.15	6.95	13
	Deaf	14.69	6.14	13
	Normal	21.39	4.91	13
	Total	15.41	7.52	39

Table 4: Summary Table of One-Way MANOVA for Students' Status on list length Cued Recall

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	P
Status	Short List Length	376.77	2	188.39	30.81	.000
	Long List Length	829.90	2	414.95	11.30	.000
Error	Short List Length	220.15	36	6.12		
	Long List Length	1321.54	36	36.72		

The results in Table 4 above shows that a significant difference was found on students short list length cued recall rates [F (2, 36) = 30.81, P < .001]. The means obtained

(Table 3) further show that normal students (M = 11.69) scored higher on short list length cued recall rate than deaf (M = 11.15) and blind (M = 4.85) students. The second hypothesis which states that normal students will significantly perform better on short list length cued recall than their blind and deaf counterparts is therefore accepted.

Similarly, a significant difference was also found on students long list length cued recall rates [F (2, 36) = 11.30, P < .001]. The means obtained (Table 3) further show that normal students (M = 21.39) scored higher on long list length cued recall rate than deaf (M = 14.69) and blind (M = 10.15) students. The third hypothesis which states that normal students will significantly perform better on long list length cued recall than their blind and deaf counterparts is therefore accepted.

Table 5: Summary of Means and Standard Deviations for Students' Status on list length Cued Recall

	Status	Mean	Std. Deviation	N
High Frequency Words	Blind	7.46	2.03	13
	Deaf	8.69	.63	13
	Normal	8.77	.60	13
	Total	8.31	1.38	39
Low Frequency Words	Blind	3.54	3.36	13
	Deaf	7.23	2.05	13
	Normal	8.39	1.33	13
	Total	6.39	3.14	39

Table 6: Summary Table of One-Way MANOVA for Students' Status on word frequency Cued Recall

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	P
Status	High Words Frequency	14.00	2	7.00	4.32	.021
	Low Words Frequency	166.62	2	83.31	14.52	.000
Error	High Words Frequency	58.31	36	1.62		
	Low Words Frequency	206.62	36	5.74		

The results in Table 6 above shows that a significant difference was found on students high word frequency cued recall rates [F (2, 36) = 4.32, P < .05]. The means obtained (Table 3) further show that normal students (M = 8.77) scored higher on high word

frequency cued recall rate than deaf (M = 8.69) and blind (7.46) students. The fourth hypothesis is therefore accepted.

Similarly, a significant difference was also found on students low word frequency cued recall rates [F (2, 36) = 14.52, P < .001]. The means obtained (Table 5) show that normal students (M = 8.39) scored higher on low word frequency cued recall rate than deaf (M = 7.23) and blind (M = 3.54) students. The fifth hypothesis is therefore accepted.

DISCUSSION

The differences between memory tests such as free recall, recognition and cued recall have drawn people's attention. In the present study we focused on cued recall, list length effect and word frequency. On word frequency effect and list length effect we examined how these factors affect cued recall among blind, deaf, and normal students.

The result of the first hypothesis showed that there was a significant effect of sight and hearing on students' cognitive functioning. Normal students did significantly better with a mean score result of 33.08, the deaf students followed with a score of 25.85 and the blind students did the least with a score of 15.00. With the above results, our null hypothesis stands rejected. This finding is backed up by the study of Paivio (1991) who found that visual information is superior over auditory information in recall. Visual information is easier to remember than non visual information. This is why the normal and deaf students performed better than the blind or visually impaired students. In addition, Adam's Dual Study (1976) showed that the retrieval of information from ones memory store depends on verbal and pictorial traces. The result was that when one trace failed the other was there to help out.

Scarborough (1972) experiment confirmed that those who received both visual and auditory information recalled best among three groups of participants in his study which had auditory condition only, visual condition only and auditory and visual conditions together. A juxtaposition of both systems (visual and verbal) makes the most productive cognitive ability for recall.

The result of the second hypothesis showed that a significant difference was found on student's shortlist length cued recall rates and student's long list length cued recall rates. The mean score results obtained showed that normal students scored higher with a mean score of 11.69 on short list length cued recall rate than the deaf who had a mean score of 11.15 and the blind with a mean score of 4.83. In like manner a significant difference was found on students' long list length cued recall rates. The mean scores of the normal students obtained were 21.39, while that of the deaf students were 10.15. This shows that the normal students did better in both list lengths (short and long). This result can be backed up with Rundu and Atkinson (1970) whose result was that recall was seen to be influenced by the number of items in a memory list. We recall better on shorter memory lists than on longer memory lists. This result affected all sensory status though the normal students were outstanding.

The result of the third hypothesis showed that there was a significant effect of word frequency on cued recall rates between normal, blind and deaf students. The mean scores obtained on high word frequency recall for normal, deaf and blind students

comprise 8.77, 8.69, and 7.46 respectively. Similarly, a significant difference was also found on students low frequency recall rate and the mean score results showed that normal, deaf, and blind students scored 8.39, 7.23 and 3.54 respectively. Therefore the hypothesis is accepted because the normal students performed significantly better on word frequency cued recall rate. In the same vein, all students irrespective of their sensory status, performed better on high word frequency tests. This occurrence is supported by the works of Madam, Glaholt and Caplan, (2010) who explained that the reason for this is that because we come across high frequency words a lot in our daily life, they are more ready in our mind and are thus, more retrievable as opposed to low frequency words which we do not come across very often in our daily life.

Implications of the Study

This study has both theoretical and practical significance that our physiological sense of sight is of great importance in our cognitive functioning. The study in the same vein showed that visual form of learning is more effective in retaining the information leant (this was clearly seen in the performances of the normal and deaf students who outwitted their blind students counterparts) similarly, the study showed that sight together with hearing makes the most effective learning and cognitive functioning in that individuals get dual information from their environment (this was seen in the performance of the normal students over their deaf and blind counterparts).

In another development, the study has shown that the length of a memory list affects cued recall rate irrespective of sensory status, short lists of information are recalled better than long lists or voluminous information. This was evident in the performances of each of the three experimental groups: normal, deaf, and blind students. Each group of the participants had closely related recall scores on the short list length than on the long list length.

Another significance of this study is that individuals recall words or information that they frequently come across than the ones that they rarely come across. This was clearly seen across the three groups of participants. Thus, these individuals recalled words of high frequency occurrence than mixed and low frequency occurrence irrespective of their sensory status. It can be asserted that this is because such information is readily available in their minds than less frequent ones.

Limitation of the Study

This study cannot claim to be error free or claim to be one hundred percent perfect. Some fundamental hitches were encountered in the course of this study (though the research still followed the rules of research). One, the study sample size was not large (n = 39) due to the number of visually impaired and dumb students population in secondary schools in Imo State. Another limitation of this study was that all the blind student participants were all males because of the gender specificity of the school (Boys' school).

Suggestion for Further Studies

This study has shown the outstanding performance of the normal students over the blind and deaf ones. The researcher suggests that albinos could be used for further

studies in a bid to find out the level of their cognitive abilities. Also including gender in the study as an independent variable in studying cued recall could lead to some unique findings. Mentally challenged students and maladjusted students from special schools or in special educational programmes could also be used in future studies.

Recommendations

Based on the results that the sense of sight and the senses of hearing affect our cognitive abilities, the disabled as regard to the blind and deaf students should be recognized as disadvantaged and should be given more special treatment or preference both in educational and non educational settings. In so doing the disabled will gain more access to better education and lead better lives.

Another recommendation is that teachers should put into practice dual methods of learning such as pictorial and verbal teaching methods where necessary so that whichever recall trace that fails the other would be there to help out in retrieving the information.

Conclusion

This study so far has been able to explain that visual information is very effective in the level of recall memory and and sight together with hearing makes most effective learning. It has also shown that we recall less voluminous information than vast ones irrespective of our sensory status. It also showed that we recall information we often come across than the ones we come across less often.

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