Examining the Effect of Interference on Short-term Memory Recall of Arabic Abstract and Concrete Words Using Free, Cued, and Serial Recall Paradigms

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Abstract

Purpose: To see if there is a correlation between interference and short-term memory recall and to examine interference as a factor affecting memory recalling of Arabic and abstract words through free, cued, and serial recall tasks. **Method**: Four groups of undergraduates in King Saud University, Saudi Arabia participated in this study. The first group consisted of 9 undergraduates who were trained to perform three types of recall for 20 Arabic abstract and concrete words. The second, third and fourth groups consisted of 27 undergraduates where each group was trained only to perform one recall type: free recall, cued recall and serial recall respectively. Interference (short-term memory interruption) was the independent variable and a number of recalled abstract and concrete words was the dependent variable. The used materials in this study were: abstract and concrete words classification form based on four factors was distributed to the participants (concreteness, imageability, meaningfulness, and age of acquisition), three oral recall forms, three written recall forms, and observation sheets for each type of recall. Also, three methods were used: auditory, visual, and written methods. **Results**: Findings indicated that interference effect on short-term memory recall of Arabic abstract and concrete words was not significant especially in the case of free and serial recall paradigms. The difference between the total number of recalled Arabic abstract and concrete words was also very slight. One other the hand, we came to the conclusion that Pearson's correlation between interference at these memory recall paradigms (M: 1.66, SD= .47) and the short-term memory recall (M: 1.75, SD= .43) supported the research hypothesis that those participants with oral interruptions tended to recall slightly less Arabic abstract and concrete words, whereas those participants with no oral interruptions would tend to recall slightly more Arabic abstract and concrete words, r = .713, p< 0.01. **Conclusions**: Interference as a factor affecting short-term memory recall didn't show any significant effect where there was a noticeable increase or decrease in the number of recalled words; although, it is moderately yet positively correlated to short-term memory recall.

Keywords: abstract words, concrete words, words recall, free recall, cued recall, serial recall, recall effects, interference, short-term memory

1. Introduction

Psycholinguistically, language in general operates under different levels as illustrated in figure 1 below, (Scovel, 1998).
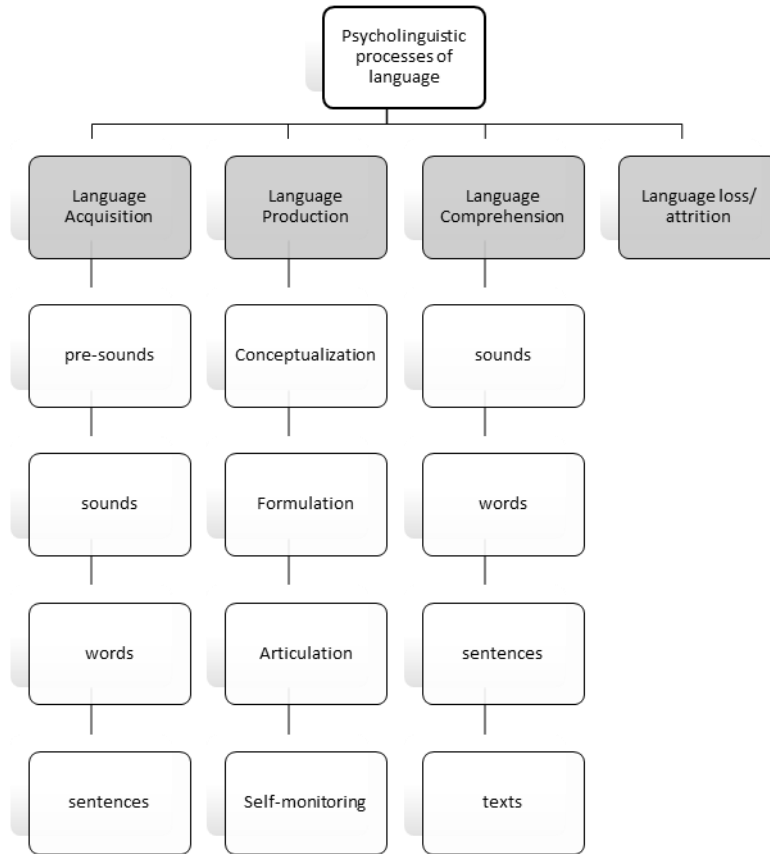
Figure 1. Psycholinguistic processes of language

Human memory plays a critical role in all the above levels in terms of: storage, recall, and encoding, (see Byrne, 2003; Baddeley, 1999; Baddeley, 2004; Parker, Wilding & Bussey, 2002). However, a number of both external and internal factors can affect these processes in general and each in particular. The possible factors that can affect memory recall are listed in figure 2. (See Menzel, 2008; Baddeley, 1999; Parker, Wilding, & Bussey, 2005; Noordman-Vonk, 1979; Eichenbaum, 2002; Byrne, 2003).
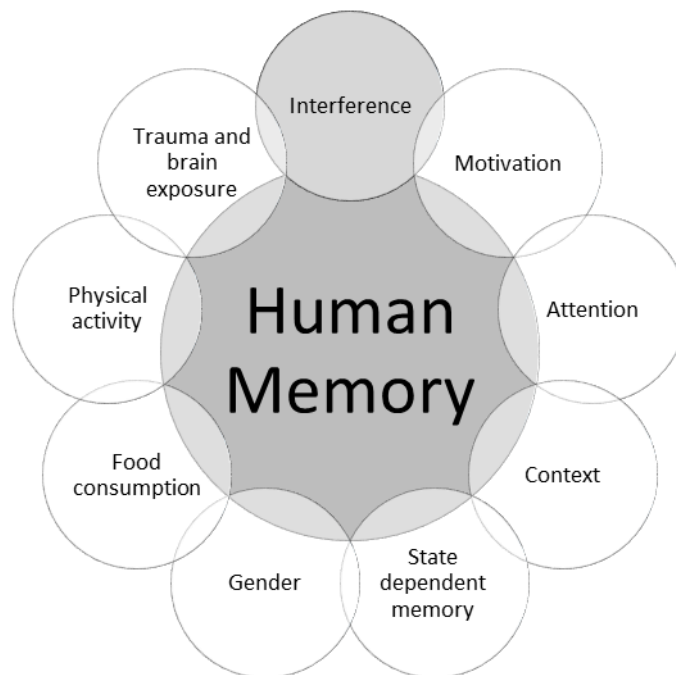

Figure 2. Factors affecting human memory recall

The effect of interference on memory recall of Arabic abstract and concrete words using free, cued, and serial recall paradigms is the scope of this paper. Interference refers to 'irrelevant information that enters the focus of attention and impairs performance', (Mackay-Brandt, 2014, para 1).

There are basically two major theories in regard to interference and memory recall: one is called Interference Theory

and the opposing theory to it is Decay Theory. In the former theory, it is proposed that retrieval of previously encoded information is hindered by newly encoded information, (see Rieber & Salzinger, 1998). In the latter theory, it is proposed that the result of information retrieval failure is due to memory decay and attrition other than the newly acquired information, (see Thorndike, 1914).

When talking about interference; however, two types of interference are differentiated (see figure 3, adapted from Rich, 2014). The first type is called proactive interference and the second type is called retroactive interference. The proactive interference is defined as, '… the interference effect of previously learned materials on the acquisition and retrieval of newer materials', (Teague, Langer, Bored, & Bender, 2014, para. 1). An example of this type of interference is 'in everyday life would be a difficulty in remembering a friend's new phone number after having previously learned the old number, (ibid). On the contrary, retroactive interference is referred to '... conditions in which new learning interferes with old learning. Forgetting may be due to decay, a failure to reinstate the context of initial learning, or interference', (Rich, 2014, para. 1).
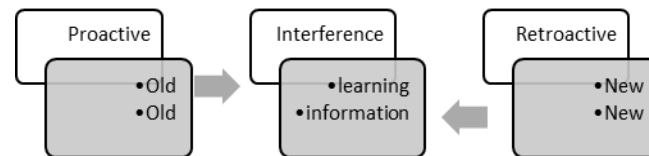

Figure 3. Main difference between proactive interference and retroactive interference

Campoy, 2011 conducted a study about retroactive interference on short-term memory and word-length effect. Two experiments were carried out to see if word-length effect on short-term memory is the result of generated greater level of retroactive interference by long words. It was concluded that '… long words produce more retroactive interference than short words, supporting an interference-based account for the word-length effect', (ibid, p. 1).

Furthermore, Risser, McNamara, Baldwin, Scerbo, & Barshi (2002) studied the interference effects on the recall of heard and read words. Two experiments where the first one examined effects of simultaneous interference and the second one examined the effects of post-task and/or subsequent interference. It was concluded that both visual and verbal interferences are equivalent.

 In fact, studies of interference effects have not been only conducted on human, but also on non-humans. Consider, for instance, the study of (Lewis & Kamil, 2006) who examined interference effects on the memory for serially presented locations in Clark's nutcrackers. Results of the two experiments approved effect of interference both proactive and retroactive during recall of spatial information by nutcrackers.

Henson, Hartley, Burgess & Flude (2003) investigated in four experiments, 'effects of irrelevant speech, articulatory suppression, temporal grouping, and paced finger tapping on these two tasks [item probe and list probe tasks]' (p. 1307). Findings reported limited evidence for the proposed aim of the study in spite of inferred reasonable interpretations.

 In depth, Oberauer & Lewandowsky (2008) tested 'three hypotheses of forgetting from immediate memory: time-based decay, decreasing temporal distinctiveness, and interference' (p. 544); using three models of serial recall, 'the primacy model, the SIMPLE (scale-independent memory, perception, and learning) model, and the SOB (serial order in a box) model' (ibid). It was concluded that, 'purely temporal views of forgetting are inadequate' (ibid).

Moreover, Darby & Sloutsky (2013) examined, 'proactive and retroactive interference effects' (p. 2130); in children and adults. Results indicated stability of these effects among the two targeted groups. Thus, it is proposed that there might be vital role of 'associative complexity as a possible modulator or proactive interference' (Darby & Sloutsky, 2013, p. 2013) in the investigated age groups.

Further, Balota, Cowan, & Engle (1990) investigated suffix interference in the recall of linguistically coherent speech. Four experiments were conducted and results indicated that, 'auditory memory interference can take place for linguistically coherent speech, although magnitude of the interference decreases as one increases the level linguistic structure in the to-be-recalled materials' (p. 446).

One more study is Turvey & Weeks (1975) studied effects of interference and rehearsal on the primary and secondary components of short-term retention. Findings of the study consolidated the view that 'proactive interference is limited to long-term store and that items in short-term store are impervious to the influence of prior traces' (p. 119).

(Lustig, May, & Hasher, 2001) investigated 'the possibility that working memory span tasks are influenced by the interference…' (p. 199). Findings suggested the validity of the view that interference influences on span.

Another study examined the effect of retroactive interference on memory recall using two phases: learning and recognition for three types of visual passwords: faces, objects, and abstract imagery. It was concluded that, 'overall

recognition was better for abstract images than for pictures of people and object imagery' (UKEssaysa, 2014, p. 6).

One more study was conducted examining the effect of interference on remembering words in short-term memory. The researcher made use of 24 unrelated words, selected randomly, and 24 participants with no neurological and/or psychiatry record. Results indicated that the number of recalled words was more in the group where no interference was occurred. On the contrary, less number of recalled words was found in the case of group where interference was occurred. Thus, the difference between the two groups was insignificant, (UKEssaysb, 2014).

One more study was conducted by (UKEssaysc, 2014) investigating the effects of chunking and distraction on short-term memory recall. Twenty male and female undergraduates participated in the study, using two types of recall stimuli: related and unrelated words with ten lists of words in each type. In each type, the recall process was carried out with and without distraction. Results proposed significant effect of interference on short-memory recall in that it decreases recall changes and the number of recalled items. Also, results suggested that related and/or chunked words help improve memory recall as compared to unrelated and/or un-chunked words which showed less recalled words even in the case of non-interference, (ibid).

In 1997, Nairne, Neath, & Serra examined the effect of proactive interference role in the word length effect. Two experiments were carried out and it was concluded that 'proactive interference is an important source of forgetting in immediate memory tasks' (p. 544).

The trend of research applies to Tulving & Arbuckle (1963). They studied two sources (separation and evaluation effects- input and output) intratrial interference in immediate recall of paired associates. The study was based on the assumption that a certain learned item is recalled immediately after its presentation and if it cannot be recalled after interval retention regardless of its length, then it must have been forgotten. A major conclusion was that 'probability of recall of an individual item is greatly affected by the position of the item in the input and output sequence' (p. 333).

It has been mentioned above that human memory undergoes three main processes as illustrated in (figure 4) below (see Baddeley, 2004; Baddeley, 1999; Atkinson & Shiffrin, 1968; Randall, 2007; Byrne, 2003; Parker, Wilding, & Bussey, 2002).
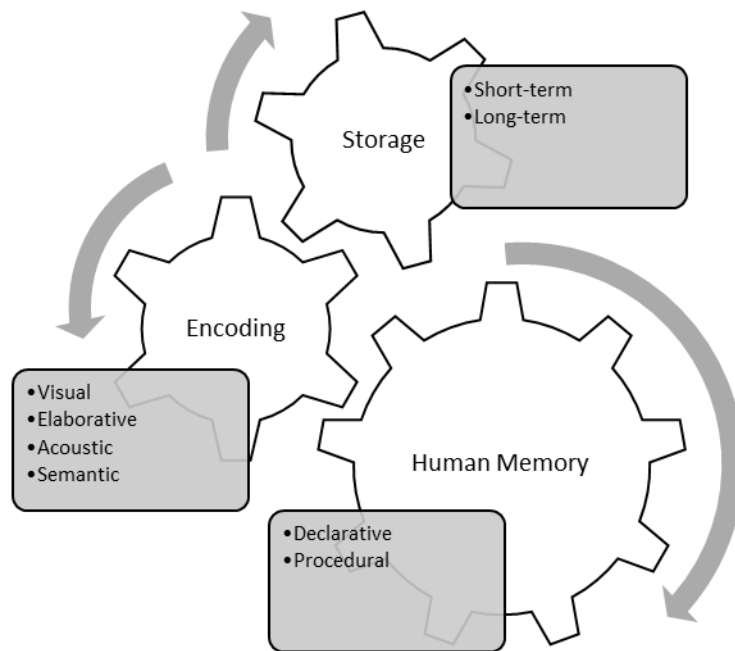

Figure 4. Human memory core processes

A large number of studies have been conducted investigating concreteness effect in particular and abstract and concrete words recall in general. A number of these studies are reviewed shortly below.

One of these studies is Harad's & Coch (2009). They investigated the concreteness' effect on the ability of processing words and backward recall. 14 normal adults participated in the study where 120 abstract words and 120 concrete words were used. It should be noted that 60 words from each type were old and 60 words were considered as new. Memory tasks including press button judgment were used as tools of this research. It was concluded that concrete word are more remembered than abstract ones. The researchers supported their empirical conclusion with that concrete words have more "meaning-based features" than do have the abstract ones, (Walker & Hulme, 1999 in Harad& Coch, 2009, p. 1).

Another study related to the same perspective is West's & Holcomb (2000). They conducted an experimental study claiming supporting the previously finding that concrete concepts and/or words over abstract ones in terms of cognitive processing. The study consisted of 36 student in the age range (19-23) divided into through groups where each group represents one investigated level: imagery, semantic and surface levels. The researcher made use of Reaction time (RE)

and Even-Related brain Potential (ERP) as tool measurements for their research. The ERs were shorter in both the imagery and semantic tasks for concrete words than abstract ones specially the imagery task. Besides, concrete words elicited more negative ERPs than abstract ones.

Furthermore, Schwa, Akin & Luh (1992) examined the concreteness effects of automatic-imagery, strategic-imagery, and context availability hypothesis predictions to recall abstract and concrete words. The researchers conducted three experiments supporting the view that abstract words "are remembered more poorly than concrete materials", (Paivio, 1971, 1986 in Schwa, Akin & Luh, 1992, p. 96). The researchers concluded that their research with results supporting the "strategic-imagery view of concreteness effects in free recall", (ibid).

An important study is Fliessbach's, Weis, Klaver, Elger, & Weber (2006) who examined abstract and concrete words processing on the basis of the notion that concrete words are generally better than abstract ones in terms of more successful remembering. The study was based on two theories, both supporting the view that concrete words, but not abstract ones are more accurately remembered. The first theory is called Dual-Coding Theory and the second one is called Context-Availability Theory. The former theory states that concrete words are over abstract ones because they possess "dual coding … in the form of a verbal and sensory code", (p. 1413). The latter theory states again that concrete words are over abstract ones because they possess "a more accessible semantic network", (Fliessbach, Weis, Klaver, Elger, & Weber, 2006, p. 1413). The researcher made use of the even-related Functional Magnetic Resonance Imaging (fMRI) technique as a tool for testing their proposed prediction. Twenty one (21) subjects without any neurological or psychiatric history in the age range (19-43) participated in the study. The material of the study was 180 abstract words and 180 concrete words, selected and identified as among the most frequent German words. The drawn conclusion was in favour of more significance in the case of concrete words over the abstract ones in terms of activated places in the brain.

The same applies to Dahlstrom and Ultis (2014) who investigated the view that concrete words but not abstract ones are generally recognized more by humans. Using an attractor network "a recurrent neural network designed to settle to a stable output over time", (p. 1) the researchers attempted to analyse the human behaviour towards language processing. It was concluded that the concrete words are more recognizable than the abstract ones, not because of their highly intensive representation, but of being more "reinforced" (p. 6) in terms of learning [input].

Immediate Free Recall (IFR) has been used by (Dukes & Bastian, 1966). They used abstract and concrete words using a list of 10 abstract words and 10 concrete words, more specifically nouns. The words were shown to the participants by a projector twice. It was concluded that the participants recalled more concrete words than abstract ones.

The roles of word concreteness and word valence in immediate serial recall has been assessed by Tse & Altarriba (2009). The researchers conducted two experiments using word-label and word-laden pairs of words. Five lists of positive concrete words, five lists of negative concrete words, five lists of positive abstract words, and five lists of negative abstract words in the first experiment. In the second experiment, the researcher used five lists of neutral abstract words and five lists of neural concrete words plus the twenty lists used in the experiment 1. The participants were 20 in Experiment 1 and 20 in Experiment 2 who are native-speaker of English Language. A compatible computer with E-Prime was used for data-analysis purposes. Results indicated that concrete words are more recalled than abstract ones, yet positive ones are more recalled than negative ones. These results are also the same in the second experiment in addition to that positive and neutral words are more remembered than negative words.

(Lagishetti & Goswami, 2012) conducted a study examining the effectiveness of concreteness on differentiating between abstract and concrete words processing. A minor aim of this study was also observing any gender differences in relation to abstract and concrete words processing. The participants were 20 neuro-typical adults (10 males and 10 females) whose first language is Kannada Language. The instrument of the study is DMDX software and an accompanying software called (TimeDX). The researchers made use of 100 selected abstract and concrete words measured on 3-point scale (1: abstract, 2: unrecognized, 3: concrete). Reaction times for both abstract and concrete words were measured and results revealed significant differences between occurring reaction times for abstract and concrete words in favour of the concrete ones. Gender differences were not observed during the study and the researchers conclude that concreteness is an effective variable for distinguishing between abstract and concrete words processing.

The same is true for Hanley, Hunt, Steed & Jackman (2013). They examined concreteness' effect on abstract and concrete words' production. Two experiments were conducted where in 56 undergraduates from the University of Essex participated in Experiment 1 and 58 participated in Experiment 2. 68 words where 34 are abstract and 34 are concrete with their dictionary definitions were used to measure the productions of the words in terms of semantic lexical weighs and phonological lexical weighs. Findings indicated that "poor performance during attempts to retrieve abstract words from their dictionary definitions… associated with more omissions, more alternates, and more TOTs (tip-of-the-tongue-state) than is the case for concrete words", (p. 374).

On the basis of the above presented literature, it could be seen that previous studies accounted for either interference effect on memory recall of words or concreteness effect on memory recall but not the two as an integrated topic. In this study, the researchers investigated the validity of the following hypotheses:

1. Participants will recall more words in non-interference recall processes than in the interference recall processes; and
2. Participants will not recall the same number of abstract and concrete words in non-interference and

interference processes [less/more abstract words than concrete ones].
3. There might be a [correlation] between interference and memory recall of Arabic abstract and concrete words.

2. Method

2.1 Sample

The population of interest in this study is all university students in the undergraduate level who meets the following criteria: 1) native-speakers of Arabic Language; 2) registered in the university as undergraduate students; and 3) typical neurological and clinical history. The following table (2) shows the characteristics of the subjects in this study.

Table 1. Characteristics of subjects

Age range	20-24
Mother tongue language	Arabic Language
Dialect	Saudi Arabic Language
Ethnicity	Arab
Other languages	English (EFL use)
Gender	Male (single and married)
Nationality	Saudis
Specific characteristic	Be enrolled in a BA programme in the university level (King Saud University).

Probability sampling method, mainly stratified sampling method was used in this study where one class out many available classes was picked randomly to take part in this study. The class has 36 students from the college of Engineering who are enrolled in prerequisite English Language course in the College of Languages and Translation, King Saud University, Riyadh, Kingdom of Saudi Arabia, in 2013, late December. The class was divided randomly into two four groups as shown in table (2) below.

Table 2. Population distribution

Task type	Group 1	Group 2	Group 3	Group 4
Free recall				
Cued recall				
Serial recall				
Interference	No	No	No	Yes

The selected sample is aimed to be representative of the population of interest and that reached results are generalizable for populations with similar characteristics. In other words, the study investigates a language acquisition topic from both cognitive and psycholinguistic perspectives and the targeted population is native speakers of Arabic so external effects like time, place and people cannot affect the generalizability of this study as long as they have similar characteristics to the above mentioned ones.

2.2 Measures

Two measures were used in this study: one is a list of 20 Arabic abstract and concrete words and an observation sheet of the observed effects of recall types.

To start with the first measure, a list of 20 Arabic words where 20 are abstract and 20 are concrete were used in this study. The words were selected on the basis of semantic relationship where one word could relate to another in terms of meaning but differ from one another in terms of concreteness. For instance, the words: mind and brain which are both semantically related but actually different from one another. It should be noted that by stating semantically similar is to mean that they share same associations and a person can think of both words when provided by certain cues and/or associations.

The list of the 20 abstract and concrete words were selected to measure abstract and concrete words processing and recall through free call tasks. The list of the words, yet more procedural issues could be followed in the procedures section below and in the appendix.

Both validity and reliability were calculated in this used measurement tool. In detail, in the case of construct validity:

both face and content validities were calculated to represent translation validity. Face validity was calculated by the principal researcher and another PhD student of Arabic Language from the Department of Arabic Language and Literature, College of Arts, King Saud University, Riyadh, Kingdom of Saudi Arabia. Both of them indicated very good face validity for the list of the words. For content validity, again, the list of the words was divided into two types in terms of content: abstract and concrete, yet in terms of semantic relationship between the abstract and concrete pair of words. In other words, the abstract word must have an association with the concrete words in order to be included in the list; otherwise, it will be excluded and replaced by another pair of words. One type only of criterion-related validity, namely, predictive validity, was calculated in this study (see tables 3 & 5 below).

To move to reliability, two types of reliability were calculated: inter-rater and internal consistency reliability. Inter-rater reliability was measured by the principal researcher who divided the words into two lists: abstract and concrete words on the basis of the following criteria: concreteness, imageability, meaningfulness (Paivio Norms), and age of acquisition, (MRC Psycholinguistic Database, 2013). The list of words was rated twice to make sure that the list of the abstract words are those with negative significant concreteness, zero or negative imageability, and vague and/or ambiguous meaning(s), and the concrete words are those with positive significant concreteness, high or positive imageability, and clear-cut meaning(s). Tables (3-5) below display and summarize the calculated validity and reliability types and their values.

Table 3. Reliability & validity results of abstract and concrete words scale

Reliability	Statistical tool & result		Validity	Statistical tool & result	
	Tool	Result		Tool	Result
Inter-rater	Pearson	.80, .80, .78	Face	2 raters	High
Internal	Cronbach	.82	Content	Categories	Excellent
			Predictive	Pearson	.49
			Concurrent	Uncalculated	
			Convergent	Uncalculated	
			Discriminant	Uncalculated	

Table 4. Internal consistency reliability of the abstract and concrete words scale

Feature	Corrected Cronbach's Alpha	Cronbach's alpha if item deleted
Concreteness	.71	.78
Imageability	.70	.78
Meaningfulness	.69	.80
Concreteness and abstractness	1.00	.71

Table 5. Construct validity of the abstract and concrete words scale

Feature				
	R value	R Value	R value	R value
Concreteness	.46	.47	.40	.80
Imageability	.46	.44	.37	.80
Meaningfulness	.46	.44	.38	.78
Age of acquisition	.40	.37	.38	.49
Concreteness and abstractness	.80	.80	.78	.49

*Indicates insignificant values, ** indicate low level validity, all other values are significant at the 0.01 level.

The second measure was an observation sheet where in the administrator of the research was provided with to document his observations following the given instructions in the provided sheet (see appendix)

2.3 Design

A four group quasi-experimental randomized design was used in this study. The design can be depicted in notational form as:

R	X- 1, 2, 3	O 1	O+ 1, 2
R	X- 1, 2, 3	O 2	O+ 1, 2
R	X- 1, 2, 3	O 3	O+ 1, 2
R	X- 1, 2, 3	O 4	O- 1, 2

where:

R = indicates that the groups were randomly assigned

X- = indicates words processing methods (1 = auditory, 2 = visual, and 3 = writing), (-) indicates that it is non=treatment research

O = indicates the measurement tools used in the study

O = the first O stands for the observation sheet for recall types (1: means only free recall task without short-term memory interruption, 2 means cued recall task without short-term memory interruption, 3 means serial recall without short-term memory interruption and 4 means free, cued, and serial recalls with short-term memory interruption)

O = the second O stands for observing which type of words comes over which, that is abstract words are better recalled than content words or vice versa. The numbers in lower case stand for (1 = abstract words, and 2 = concrete words, and more generally retrieved and non-retrieved words), (+) means the possibility that number of recalled words increases when a short-term memory interruption does not occur and (-) means the possibility that number of recalled words decreases when is a short-term memory interruption occurs.

The first three groups were compared to the fourth group to see first if words recalling is correlated with interference and then to see if interference affects word recall. The independent variable was the short-term memory interruption—represented by intended explanatory oral interruptions from the test administrator. On the other hand, the dependent variable was the number of recalled abstract and concrete words in the non-interference group and interference group.

2.4 Procedure

Between 01.02.2014 and 01.03.2014, the study was conducted and all the following procedures were arranged and followed.

Data collection: an observation sheet for documenting the observed effects was designed where the subjects were first provided with a list of 20 words and asked to classify them into both abstract and concrete words. Before that, the students are provided with very basic information about the differences between abstract and concrete words. Moreover, they were introduced with related terms to classification process: concreteness, imageability, meaningfulness (Paivio Norms), and age of acquisition, (MRC Psycholinguistic Database, 2013). Having done that, then the list of words was presented to the students using three methods:

1. Auditory methods: the administrator of the research reads the words aloud to the students;
2. Visual method: the administrator of the research presents the list of words to the student using an Over-Head Projector (OHP) and powerpoint slides where each word is presented as a card (pictures are may be provided next to each word); and
3. Writing method: the administrator of the research asks the students to read the words aloud and write them from the over-head projector in the paper-notes they are provided with.

The next step was asking the students to start recalling the words they can recall from both abstract and concrete words. Of course, the same procedures will be followed to the four groups with following differences:

1. Group one attempted only free recall (no interference);
2. Group two attempted only cued recall (no interference);
3. Group three attempted only serial recall (no interference); and
4. Group four attempted free, cued and serial recalls (short-term memory interruption).

Authenticity: the students were informed by their instructor and were given the chance to take part or not before being the subjects of the study. Having agreed, the students are assured to have full authenticity about the collected data and restricting its use for research purposes only. Needless to say, all the above procedures were officially documented using a consent form signed by each student confirming his free willingness to participate in the study.

Measures administration: the two used measures were administered by the instructor of the course after being trained by the one of the researchers. The instructor was provided with all kinds of instructions that should be followed (detailed procedural issues can be seen in the appendix).

Time and environment of the measurement tools: the study was conducted in the College of Languages and Translation, King Saud University, Riyadh, Kingdom of Saudi Arabia. Each student was called individually into a well-prepared classroom with comfortable chairs, over-head projector, good air conditioning, and lightening. The used time for all the above described steps to be performed was about 26 minutes (4 minutes for each for those who were assigned to recall 20 words, and 2 minutes for each for those who were assigned to recall only 10 words).

Administering: the following steps were followed for administering the measurement tools in this study:

1. the administrator of the research provides the students with the list of 20 words requesting them to classify

them into two lists: abstract and concrete words;

2. the administrator of the research collects the words' lists from the students;

3. the administrator of the test makes sure that none of the students has any words lists remaining with them;

4. the administrator of the test reads the list of words aloud (abstract-concrete or concrete-abstract) to the students;

   a. the students are requested to say the words which they can recall;

   b. the administrator of the research documents the recalled words in both cases; and

5. the administrator of the research presents the words to the students using an over-head projector (OHP) requesting them to:

   a. read them silently;

   b. read them either aloud, finger pointing or lips-moving; and finally

   c. write them down

      • the students are requested to note down the words they could recall

Assessing: the researchers but not the administrator of the research (the instructor of the course) does the calculations for the following:

1. Number of recalled abstract words as opposed to number of recalled concrete ones.

Recall prompts: firs letter prompt, miming and or sign-language in addition to semantic associations were provided in some cases (see appendix for more details).

Preliminary analysis steps: Using the 17th version of SPSS (Statistical Package for Social Sciences), both descriptive and referential statistics tools were used to test proposed hypotheses in this study.

3. Results

17th version of SPSS (Statistical Package for Social Sciences) was used for the statistical analysis of the collected data. Both descriptive and referential statistics were used where different yet suitable statistical tools were used from each to serve the purposes of the study. Table (6) below presents the used types of statistical tools, the selected tools and performed functions. To remind our readers with the proposed hypotheses in this study, they are:

1. Participants will recall more words in non-interference recall processes than in the interference recall processes; and

2. Participants will not recall the same number of abstract and concrete words in non-interference and interference processes [less/more abstract words than concrete ones].

3. There might be a [correlation] between interference and memory recall of Arabic abstract and concrete words.

Table 6. Summary of the statistical tools used in analyzing the data of this study

Statistics type	SPSS tool(s)	Purpose of use
Descriptive statistics	Frequency	Total number of recalled words
		Total number of recalled abstract words
		Total number of concrete words
		Observed effects
	Mean	The central location of the recalled words in free, cued, and serial recall paradigms
	Standard Deviation	Measuring variability among recalled words in free, cued, and serial recall paradigms
	Frequencies: graphs	Description and comparisons purposes
Inferential statistics	Pearson	Reliability and validity issues
	Cronbach Alpha	Reliability
	Correlate: Bivariate	Getting the correlation coefficient and degree of significance and deciding on whether there is a relationship or not between the two tested variables
	Graphs: scatter-plot	Seeing in clearer way the correlation between the two tested variables and ascertaining the presence or absence of relationship between the two tested variables

There were 36 participants in this study, divided into two groups. Group 1 acted as three sub-groups where they performed free, cued and serial recall paradigms at the same time. Group 2 was divided into 3 groups, 9 in each where each groups consisting of 9 students performed only one recall type. Percentages of total recalled Arabic abstract and

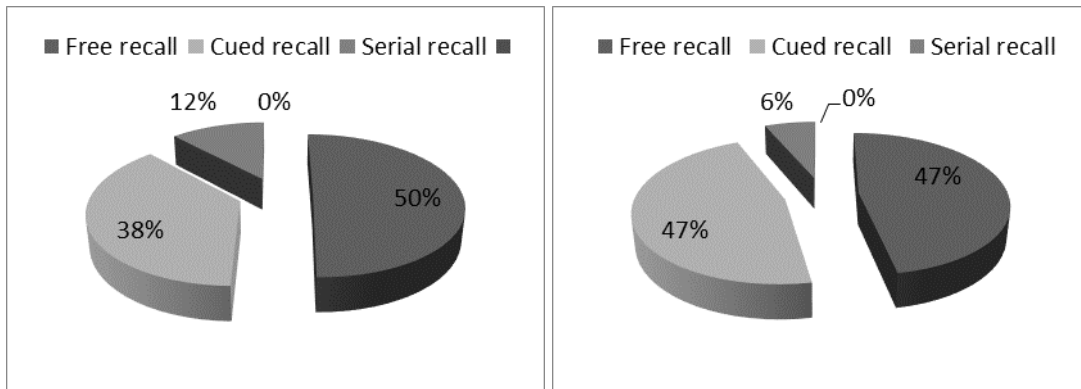concrete words in both groups are presented comparatively in figure 3 below.

Figure 5. Comparison of the performance of one (A) and three groups (B) in three recall types

Both pie charts can be read counterclockwise. The pie chart to the right side present the percentages of the three groups (the control group) (9+ 9+ 9=27) and the pie chart to the left side presents the percentages of the experimental group. In both pie charts, free recall is the highest and serial recall is lowest. The percentage of experimental group (50) is insignificantly higher than the percentage of the control group (47%). On the other hand, the percentage of the control group (47%) is higher than the percentage of the experimental group (38%) in cued recall paradigms. Similar to free recall paradigms where the percentage is higher in the experimental groups than in the control group so is it in the serial recall paradigms (12%) for the former and (6) for the latter. This very early statistics gives us an impression that there might be a [correlation] between interference and short memory recall of Arabic abstract and concrete words though the differences in percentages between two groups are not statistically different.

Detailed statistical results for the recalled Arabic abstract and concrete words in the control and experimental groups are shown in figures 4-5 below.
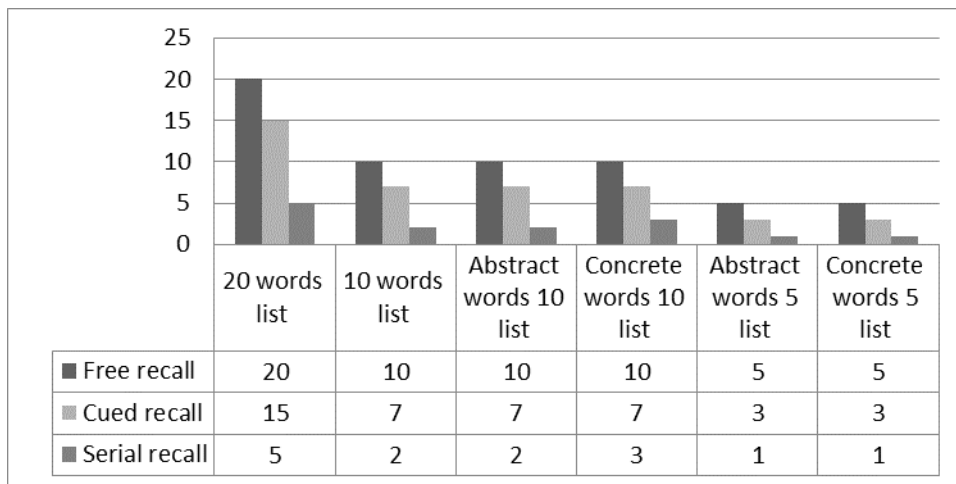
	20 words list	10 words list	Abstract words 10 list	Concrete words 10 list	Abstract words 5 list	Concrete words 5 list
■ Free recall	20	10	10	10	5	5
■ Cued recall	15	7	7	7	3	3
■ Serial recall	5	2	2	3	1	1

Figure 6. Comparison of recalled words in different performed tasks of free, cued, and serial recall paradigms

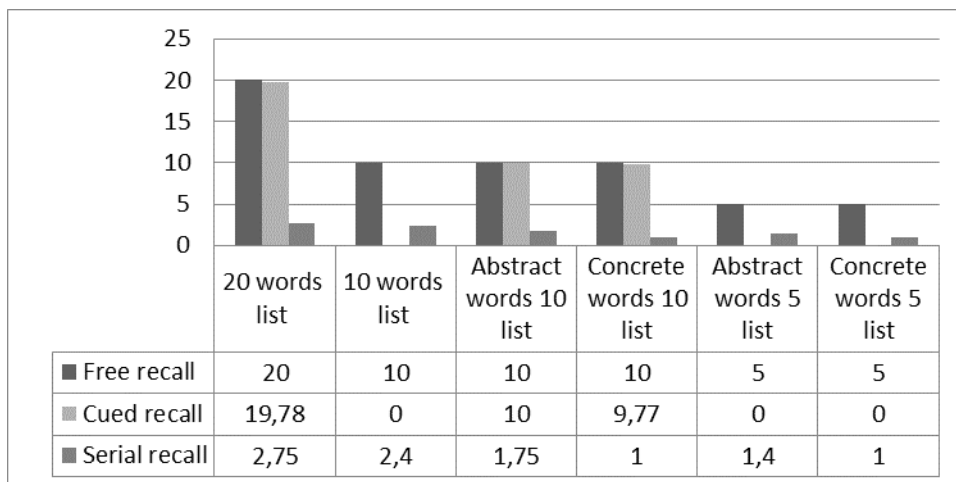|	20 words list	10 words list	Abstract words 10 list	Concrete words 10 list	Abstract words 5 list	Concrete words 5 list
■ Free recall	20	10	10	10	5	5
■ Cued recall	19,78	0	10	9,77	0	0
■ Serial recall	2,75	2,4	1,75	1	1,4	1

Figure 7. Comparison of recalled words in different performed tasks of free, cued, and serial recall paradigms

Figure 6 presents results for the experimental group whereas figure 7 presents results for the control group. In both control and experimental groups, the whole number of words was fully retrieved in free recall paradigms. In cued recall paradigms, the mean for the number of the recalled words is minimally less in the experimental group than the number of the recalled words in the control group (15) for the former and (19.78) for the latter. As for serial recall, it is surprisingly higher in the experimental group than that in the control group (5) for the former, and only (2.75) for the latter. These current results might indicate either a negative correlation or zero correlation as the differences in descriptive statistics are not significantly different between the results of short memory recall and interference.

It was also proposed in our study that abstract words are better recalled than concrete ones in free, cued and serial recall paradigms be it with or without interference. Statistical results for this claim are shown in figures 6-7) below.
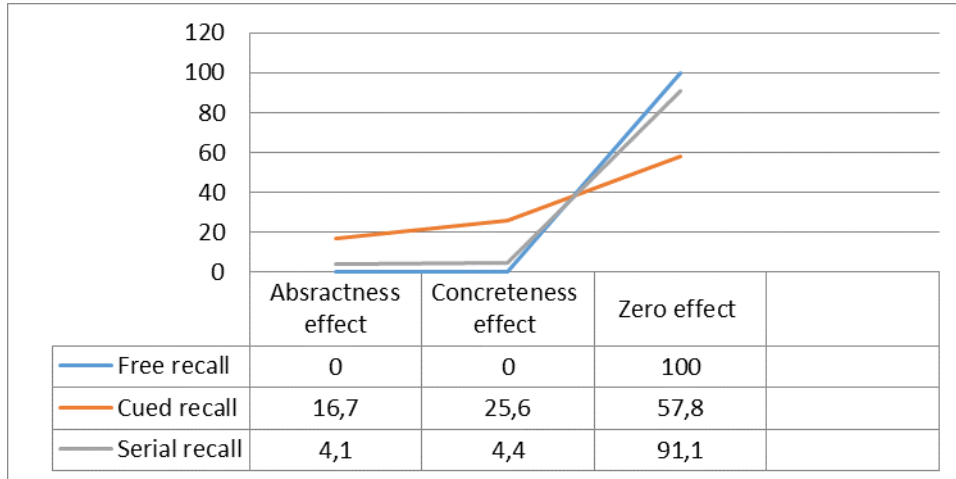

	Absractness effect	Concreteness effect	Zero effect	
—— Free recall	0	0	100	
—— Cued recall	16,7	25,6	57,8	
—— Serial recall	4,1	4,4	91,1	

Figure 8. Abstractness, Concreteness, or Zero Effect?

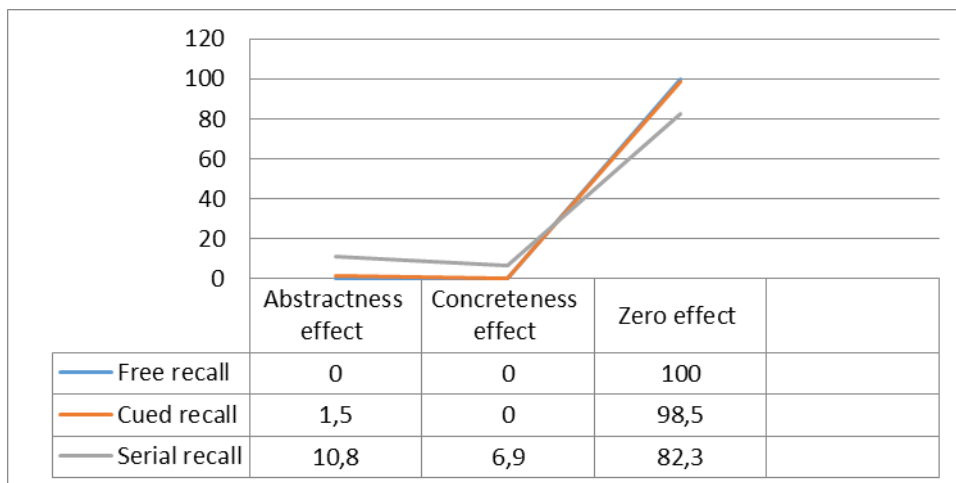|	Abstractness effect	Concreteness effect	Zero effect	
—— Free recall	0	0	100	
—— Cued recall	1,5	0	98,5	
—— Serial recall	10,8	6,9	82,3	

Figure 9. Abstractness, Concreteness, or Zero Effect?

First, it should be noted that figure 6 presents results for the experimental group and figure 7, on the other hand, presents results of the control group. According to the two figures, in both control and experimental groups (with and without interference) the effect is neither abstract (advantage of abstract words over concrete ones) nor concrete (advantage of concrete words over abstract ones), it is rather zero effect (identical number of recalled Arabic abstract and concrete words).

Both abstractness and concreteness effect remained stable and zero effect went up to (100) in free recall paradigms in the experimental and control groups.

In cued recall, there is a considerable sudden change where abstractness effects went up from (1.5) in the control group to (16.7) in the experimental group. Similarly, there is also a fast negligible change in the case of concreteness effect which picked up from (0) in the control group to (25.6) in the experimental group. Besides, there is a sharp substantial decline in the case of zero effect which deteriorated to (57.8) in the experimental group before it was (98.5) in the control group. This means clearly interference decreases recalled number of Arabic abstract and concrete words though the increase rate is slightly considerable.

In the case of serial recall paradigms, abstractness effects dropped gradually down to (4.1) in the experimental group. Similarly, concreteness effect did down to (4.4) before it was less than (7). On the other hand, zero effect increased gradually to (91.1) in the experimental group before it was only (82.3) in the control group.

To conclude, in spite of the gradual yet significant changes in the results between the two groups, it is still too early to decide whether short memory recall of words is correlated with interference or whether interference affects short

memory recall or not!

More descriptive statistics will help us reach a solid decision about this issue before starting the analysis of referential statistics. Comparisons of observed effects in both the experimental and control groups for the three types of recall are presented in figures 8-11.
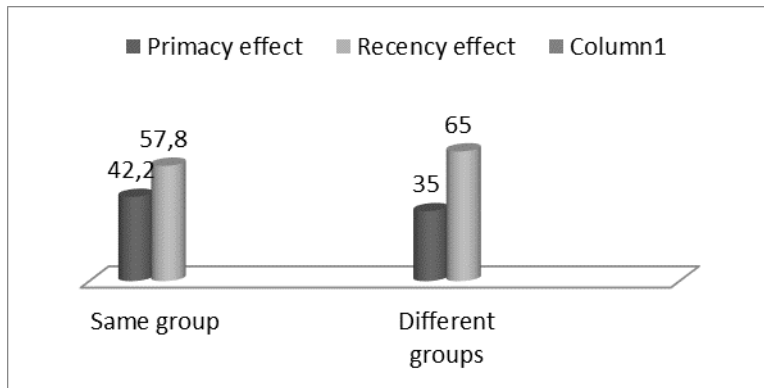

Figure 10. Effects comparison in free recall paradigms

The above bar chart presents comparatively the observed effects in control and experimental groups in free recall paradigms. There were two observed effects in free recall paradigms, namely primacy and recency effects. It can be seen clearly that in both groups recency is the most popular effect, while primacy is the least popular one.

To begin, primacy effect is more frequent in the experimental group than the primacy effect in the control group. It goes up in the former to (42.2) and then goes gradually down in the latter to exactly (35). On the hand, recency effect is more frequent in the control group than the recency effect in the experimental group. It picked up in the former to exactly (65) and then slips back in the latter to less than (58).

Thus, recency effect is generally more frequent than the primacy effect. Also, while primacy effect is higher in the experimental group and lower in the control group than the recency effect, recency effect is conversely higher in the control group and lower in the experimental group.
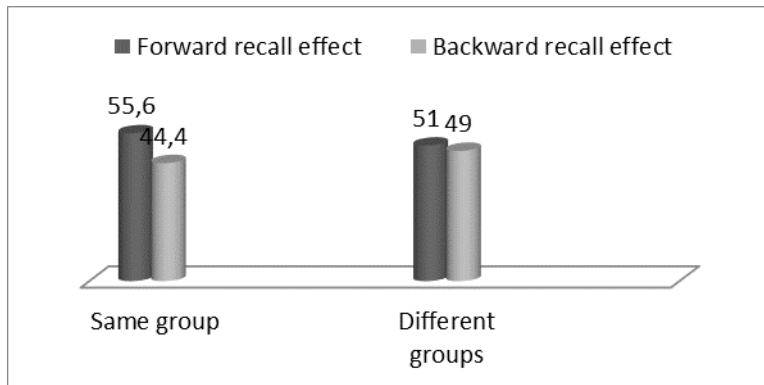

Figure 11. Effects comparison in cued recall paradigms

The above bar chart deals with observed effect in both experimental and control groups in cued recall paradigms. There were two observed effects in cued recall paradigms of Arabic abstract and concrete words, mainly forward and backward recalls. It is immediately apparent that forward recall effect is the most common observed effect and backward recall is least common observed effect.

To start, forward recall in the experimental group is more popular than it is in the control group. It improves to over (55) in the experimental group and stops at (51) in the control group. In comparison, backward recall in the experimental group is less popular than it is in the control group with only a slight change at the rate of less than (4). That is to say, it stops at less than (44) in the former and reaches (49) in the latter.

In conclusion, forward recall effect is generally more observed than backward recall effect during cued recall paradigms in both the experimental and control groups. Yet, forward recall effect has an advantage over backward recall effect in the experimental groups while the latter has an advantage over the former in the control group.
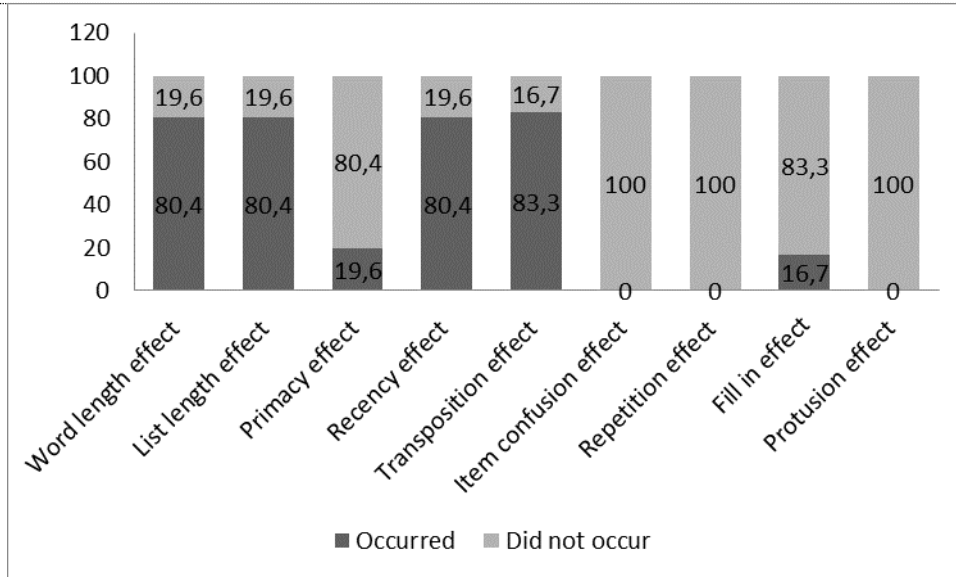
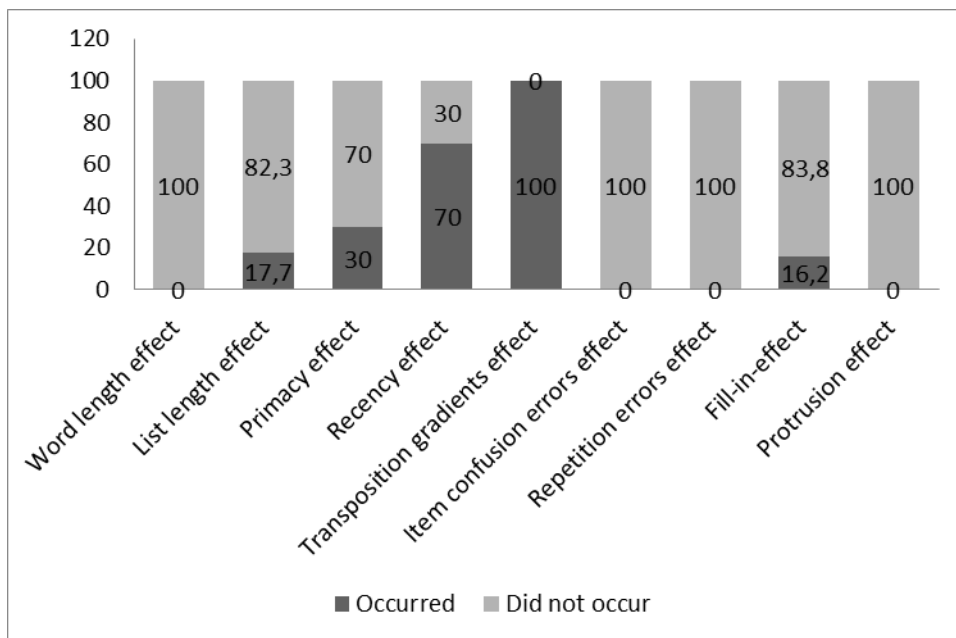Figure 12 (A). Comparison of observed effects in serial recall paradigms

Figure 13 (B). Comparison of observed effects in serial recall paradigms

The above bar charts (10-11) show the observed effects during serial recall paradigms of Arabic abstract and concrete words for both experimental and control groups. While the first bar chart represents the experimental group, the second one represents the control group. There were nine pre-specified effects to be observed—as mentioned above in the bar charts during serial recall paradigms. Generally, there are three non-observed effects in the experimental group and four in the control group.

At the beginning, while there were three non-observed effects in the experimental group (item confusion error, repetition error and protrusion effects), there were four in the control group (the above mentioned three in addition to word length effect). Moreover, the most frequent occurring effect in both experimental and control groups was transposition gradients effect with being higher for the control group (100) as compared to less than (84) for the experimental group. On the other hand, the least frequent occurring effect for both groups again was the fill-in effect with a slight difference in favour of that for the experimental group (16.7) as compared to (16.2) for the control group.

Some major differences between the two groups in regard to the observed effect include that while word length effect did not occur at all in the control group, the occurrence rate climbs rapidly yet dramatically to over (80) and non-occurrence rate slips back sharply to less than (20). One more noticeable yet sudden change is that for list length effect. The occurrence rate bottomed out in the experimental group to less than (19) after it was over (82) in the control group. On the contrary, the non-occurrence rate rose considerably yet quickly to over (80) in the experimental group after it was only less than (18) in the control group.

To sum up, some of the pre-specified effects were not observed at all in both groups and some others were observed in both groups with a preference for the occurrence of the observed effect to the experimental group.

In order to reach solid yet better results for the proposed hypotheses in this study, referential statistics tools were used. The means and standard deviations of the independent variable (interference) and dependent variable (recalled Arabic abstract and concrete words abbreviated to short recall memory) are presented below in table 7.

Table 7. Descriptive Statistics

	Mean	Std. Deviation	N
Short term memory recall	1.7523	.43218	440
Interference	1.6614	.47378	440

It can be clearly seen from the two means for the independent variable and the dependent variable that the mean for the former (M: 1.66) with a standard deviation of (SD: .47) is slightly lower than the mean for the latter (M: 175) with a standard deviation of (SD: .43). This clearly initially indicates a correlation between the two variables from one side and the effect of one variable on the other, mainly the independent one on the dependent one (interference on short-term memory recall). These above mentioned inferences are verified more in table 8 below.

Table 8. Correlations

		Short term memory recall	Interference
Short term memory recall	Pearson Correlation	1	.713**
	Sig. (2-tailed)		.000
	N	440	440
Interference	Pearson Correlation	.713**	1
	Sig. (2-tailed)	.000	
	N	440	440

**. Correlation is significant at the 0.01 level (2-tailed).

A Pearson product-moment correlation coefficient was computed to assess the relationship between interference (intended explanatory oral interruptions) and short-term memory recall (recalled Arabic abstract and concrete words). There was a positive correlation between the two variables, r = 0.713, n = 440, p = 0.000, with R2 = .508. A scatterplot summarizes the results Figure 12. Overall, there was a moderate, positive correlation between interference and short-memory recall. Increases in the the interference (oral interruptions) were correlated with increases in non-retrievable Arabic abstract and concrete words (short-term memory recall).
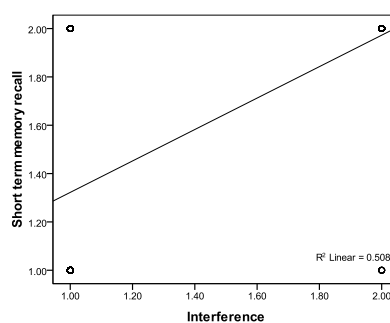

Figure 14. Direction of correlation between interference and short memory recall

Pearson's correlation between interference at these memory recall paradigms (M: 1.66, SD= .47) and the short-term memory recall (M: 1.75, SD= .43) supported the research hypothesis that those participants with oral interruptions tended to recall slightly less Arabic abstract and concrete words, whereas those participants with no oral interruptions

would tend to recall slightly more Arabic abstract and concrete words, r = .713, p< 0.01.

To conclude, the value of R is 0.713. This is a moderate positive correlation, which means there is a tendency for high X variable scores go with high Y variable scores (and vice versa). The value of R2, the coefficient of determination, is 0.508. The P-Value is < 0.00001. The result is significant at p < 0.01.

4. Discussion

The results of the current study were to some extent on contrary to our preliminary expectations. We carried out an experiment examining the effect of interference on short-term memory recall of Arabic abstract and concrete words using free, cued, and serial recall paradigms. The researchers proposed two major hypotheses along with a minor hypothesis. The statistical analysis indicated initially partial consolidation of the first hypothesis (effect of interference, the independent variable, on the number of recalled Arabic abstract and concrete words, the dependent variable). On the contrary, it indicated the approval of the minor hypothesis and the second hypothesis that (more/less abstract/concrete words will be recalled regardless of the occurring interference) and also the claim that (interference, the independent variable, might be correlated to the recalled Arabic abstract and concrete words, the dependent variable). These results are discussed below in relation to the introductory part, the previous studies and the statistical analysis.

Our first hypothesis was that participants will recall more words in non-interference recall processes than in the interference recall processes. It was assumed that the intended occurring interruptions made by the experiment administrator will negatively effect on the recall level and frequency of the experimental group. On the other hand, it was assumed that the three groups who were trained to recall without any interruptions will have the chance to recall more Arabic abstract and concrete words as compared to their counterparts. Surprisingly, the results indicated the opposite of this assumption in the case of both free and serial recall paradigms but not in the case of cued recall paradigms. The percentage of the recalled Arabic abstract and concrete words for the experimental group was slightly higher than the percentage of the recalled words for the control group; (50%) for the former and less than (50%) for the latter. Though insignificant; it refutes our hypothesis stating that interference will negatively effect on short-term memory recall. Similar to the above situation is the case of serial recall where the percentage of the recalled Arabic abstract and concrete words for the experimental group was as two times (12%) as that of the percentage of the recalled words for the control group (6%). Dissimilar to these two cases is in the case of cued recall where the percentage of the retrieved Arabic abstract and concrete words for the control group was moderately higher than that of the experimental group; (47%) for the former and only over (35%) for the latter. In effect, previous conducted studies investigating the effect of interference on short-term memory recall emphasized the effect of the former variable on the latter one which is partially contrary to the reached results in our study. We return the discussion to the significant differences in terms of research methods, environments and more importantly and used measures. These studies include: (Tulving & Arbuckle, 1963; Turvey, & Weeks, 1975; Nairne, Neath, & Serra, 1997; Lustig, May, & Hasher, 2001; Henson, Hartley, Burgess, Hitch, & Flude, 2003; Lewis & Kamil, 2006; Chiasson, Forget, & Stobert, 2009; Annis, Malmberg, Criss, & Shiffrin, 2013; UK-Essays-Editors, 2014a; UK-Essays-Editors, 2014b; UK-Essays-Editors, 2014c).

Within the first hypothesis, we also presented that the participants will not recall the same number of abstract and concrete words in non-interference and interference processes [less/more abstract words than concrete ones]. This assumption was based on previous studies supporting the view of concreteness effect (concrete words are better recalled than abstract ones). Studies supporting this view include: (Dukes & Bastian, 1966; Schwa, Akin & Luh, 1992; West & Holcomb, 2000; Fliessbach, Weis, Klaver, Elger, & Weber, 2006; Harad & Coch 2009; Tse & Altarriba, 2009; Lagishetti & Goswami, 2012; Hanley, Hunt, Steed & Jackman, 2013; Dahlstrom, Ultis, 2014). On the basis of this and with reference to (figures 6-9), the different between the recalled Arabic words is very slight in favour of the abstractness effect. This in return resulted to introducing the term zero effect indicating the similarity and/or identicalness between the recalled abstract and concrete words.

Our second proposed hypothesis was that there might be a [correlation] between interference and memory recall of Arabic abstract and concrete words. The statistical analysis indicated that the mean for the independent variable (M: 1.66) with a standard deviation of (SD: .47) is slightly lower the mean for the dependent one (M: 175) with a standard deviation of (SD: .43). This clearly indicates a correlation between the two variables from one side and the effect of one variable on the other, mainly the independent one on the dependent one (interference on short-term memory recall). Pearson product-moment correlation coefficient was computed to assess the relationship between interference (intended explanatory oral interruptions) and short-term memory recall (recalled Arabic abstract and concrete words). Pearson product-moment correlation coefficient analysis indicated a positive correlation between the two variables, r = 0.713, n = 440, p = 0.000, with R2 = .508. That is to say, there is a moderate, positive correlation between interference and short-memory recall. Increases in the interference (oral interruptions) were correlated with increases in non-retrievable Arabic abstract and concrete words (short-term memory recall).

5. Conclusions

This study examined one of the memory processes— recall in relation one of the many factors affecting memory recall— interference. In other words, the researchers accounted for the effect of interference on short-term memory recall of Arabic abstract and concrete words using free, cued, and serial recall paradigms. A four group quasi-experimental randomized design where a total number of 36 of native Arabs took part in this study. They were divided into two groups of 9 where 9 was dealt as the experimental group (performing free, cued and serial recall paradigms) and the other 27 were divided into three groups where each group performed only a recall type. The three groups were

dealt as the control group. The independent variable was the interference variable—represented by oral interruption performed by the experiment administrator. On the other hand, the dependent variable was the number of recalled abstract and concrete words in non-interference and interference groups. Findings indicated that interference effect on short-term memory recall of Arabic abstract and concrete words was not significant especially in the case of free and serial recall paradigms. The difference between the total number of recalled Arabic abstract and concrete words was also very slight. One other the hand, we came to the conclusion that Pearson's correlation between interference at these memory recall paradigms (M: 1.66, SD= .47) and the short-term memory recall (M: 1.75, SD= .43) supported the research hypothesis that those participants with oral interruptions tended to recall slightly less Arabic abstract and concrete words, whereas those participants with no oral interruptions would tend to recall slightly more Arabic abstract and concrete words, r = .713, p< 0.01. Thus, there was a moderate positive correlation between interference and short-term memory recall.

5.1 Implications

The current study has two implications: cognitive and theoretical. To start with the cognitive implication, we assumed in this study that interference represented by oral interruptions in addition to the direct proactive and retroactive interferences will affect short-term memory recall of Arabic abstract and concrete words. Our results indicated that there is a moderate positive correlation between the two variables but the effect of the former on the latter was not clear according to our presented results and conclusions. Presented data and previous studies about the effect on interference stated clearly the direct effect of interference on short-term memory recall. However, presented data about memory and cognitive processes of human memory remain arguable. There is a need for further research about the situations that interference occurrence might or might not affect short-term memory recall or even long-term memory recall in the case of proactive and retroactive interference types. For further details about this issue, please see: (Conway, 1997; Greene, 1987; Monsell & Driver, 2000; Pulvermuller, 2002; Cowan, 2005; Mense, Debney, & Druce, 2006; Pickering, 2006; Mace, 2007; Foster, 2009; Faust, 2012).

To move to the theoretical implication, it is based on the assumption of short-term memory capacity (seven plus or minus two) which can be depicted in the following equation: (M stands for short-term memory capacity)

$$7 \pm 2 = M$$

This finding needs further exploration and experimentation when presented in relation to our findings where most of the participants were able to exceed the values in this equation to become:

$$7 \pm 3 = M$$

Further details about this claim can be seen at: (Shiffrin & Nosofsky, 1994; Sprenger, 1999; Takac, 2008; Richards, Daller, Malvern, Meara, Milton, & Treffers-Daller, 2009).

5.2 Limitations and future work

This study has one limitation that both major types of interference were not directly experimented. In other words, neither proactive interference nor retroactive interference was directly investigated in the study procedures. Instead, an interference mean was used to replace the use of such two types. We expected that basing the experiment on such two common types would have resulted to more plausible results especially about the effect of interference on short-term memory recall.

Besides, further researches exploring the effect(s) of other factors affecting short-term memory recall are needed. These factors include: attention, motivation, context, state-dependent memory, gender, food consumption, physical activity and trauma and brain exposure.

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