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Shared and Separate Processing Among Bilinguals Knowledge Recall

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Abstract
The study aimed at examining the hypotheses of shared and separate knowledge recalling among bilinguals by answering the following questions:

1. Are there statistical differences between means of free recall attributed to the type of the second time display of the word?
2. Are there statistical differences between means of the free recall attributed to gender?
3. Are there statistical differences between means of free recall attributed to the type of the word second time display, gender, and the interaction between both?

The researcher selected (60) common Arabic words and considered them list 1, their Arabic equivalents are considered list 2 and a third list represented their translations. The class-maker site displayed the lists. Time interval between one word display and the other was two seconds and between the different lists ten seconds.
Significant differences attributed to the type of the second time display of the word on free recall means were found. Sheffe test calculated the post hoc comparisons results to find the paired differences between the means, statistical differences were found between the third group and both the first and second groups in favor of the third group. Statistical differences attributed to gender were found on the free recall in favor of females. Differences in means and standard deviations of the free recall attributed to interaction between gender and type of the second time display of the word were found. Differences functionality computed by the variance analyses and found insignificant, f-value scored 0.683 and a significance of (0.510), the performance of the third group was better than the first and second groups for males and females.
Keywords: bilinguals, separate information processing, shared information processing.

1. Introduction

Language is the attribute that distinguishes human from other living creatures, it is a social and psychosocial feature in human life, and it is the basic vehicle of communication between human beings. Language is defined as a social institute that imposes its rules on individuals, it transfer compulsory from one generation to the other, from the time the individuals derived private language forms from older forms descending from primitive forms constantly and from one origin or various origins.

More than three thousand systems of sounds and symbols are found. Human beings use symbols and sounds to communicate. Some countries use more than one language this fact paves the way for the emergence of bilingualism. Bilingualism plays a vital role in understanding different types of science and literature. Often scientists publish their research and studies in different languages, translations are required to understand them. Proficient individuals in more than one language appear, their appearance contribute in spreading the phenomena of bilingualism (Al-Tall, 1984).

Bilingualism phenomenon is widespread in modern civilizations, and many scholars examined different disciplines of it, but still there is no comprehensive definition for it. Carlos and his colleagues (1985) cited several definitions of bilingualism, “fluency of the skills of both languages”, “the fluency of one skill of the second language” and “possessing one skill of the language such as listening, speaking, or reading.” From these definitions, the researcher of the current study concludes that bilinguals are fluent in using the different skills of two languages. Al-Qa’ud (1997) offered another definition of bilingualism “existence of two levels of two languages in a single language environment”, that is one language of writing and reading which is the language of culture, literature, and thought and another language for the daily life.

Al-Kholi (1998) said that there are two dialects in Arab communities: colloquial and eloquent, and these dialects are considered a type of bilingualism. In psychology, education and other field’s bilingualism caught researcher’s interest (Al-Tall, 1984). Rex (1965) as a psychologist was interested in bilingualism and examined its effect on multiple thinking, achievement, and memory.

The study of bilingualism increased academically and on daily life basis (Kurland and Falcon, 2001). Linguistic psychologist focused on the linguistic contrast phenomenon to identify the relationship that connects the two languages systems (mother tongue and second language) among bilingual children, and to identify the psychological mechanisms included in their language processing. This focus increased based on the discussion on the type of the lingual construct impact on cognitive development, employment and mental representations among bilinguals (Abd Al-Muti, 2002). Two cognitive development contradicted currents searched in the intellectual development of bilinguals. The first represents Piagetian school, the advocates of the school

considered the cognitive development un-subject to language, or subjected to little (Piaget, 1959). Thus, Piaget denies the language importance in knowledge construct. Sinclair (1969 cited in Az-Zayat, 1995) supported the second current; he proposed that language is an important tool in expressing abstract thought.

Psychologists attempted to explore the relationship between the two languages in the memories of bilinguals. The first study examining bilingualism conducted by Peal and Lambert (1962, cited in Pintom 1997, p.22) compared bilinguals and monolinguals of the same age and found that bilinguals enjoyed a more flexible cognitive employment more than monolinguals. Other studies like Liedtke and Nelson who found high levels of ability in the tasks of terminology formation among bilinguals, and Okoh (cited in Letebure and Hilly, 1997, p.14) examined bilingual children ability to use counterfactual thinking and rules discovering.

Bilingualism represents a special case of the cognitive mental processing that transforms symbols and forms into meanings, ideas, and perceptions to assimilate, understand, and form them in a cognitive framework as a part of the semi-permanent cognitive construct of the individual (Az-Zayat, 1965). The individual must be able to pay attention to words and imagine things that refer to them, able to control language stimuli and pay attention to heard and read words to acquire and understand the second language. (Moor, 2006)

Scholars shed more light on the relationship of the two languages in the bilingual memory by the two hypotheses of knowledge separate processing and knowledge shared processing. The separate hypothesis says that there are two separate processing operations "separate storages" of the language among bilinguals, where another language through translation might recall a certain stored language. The second hypothesis says that there is one processing operation "one storage" among bilinguals, this means the stored material might be recalled in both languages. (Al-Tall, 1984)

The separate processing was supported by Olav (1974), he found that meanings organization is different in the two languages of the bilingual, that is to say remembering the words in the mother tongue is better than the second language.

Abu-Rabia and Siegel (2002) assessed the skills of reading, language and working memory among 56 Canadian children ages (9-14 years) of Arab origins. Half of the children were bilinguals and half were monolinguals. Education language was English and Arabic was used at home. Children reading and language used was tested, they read meaningful and non-meaningful words. Bilinguals scores in reading semi-words and pronunciation were higher than monolingual children scores, this result support the separate processing hypothesis.

Xue, Dong, Jin, and Chen (2004) studied the hypothesis of one neural network in processing language among bilinguals who are not proficient in their second language. Twelve university students participated in the study, their mother tongue is Chinese, and their proficiency in English was limited. The students' performance in the tasks using their mother tongue was better compared with their performance in the second language (i.e. performance in Chinese is better than performance in English); this result supports the separate processing hypothesis.

Kim, Byun, Lee, Gaillard, and Theodore (2011) used brain magnetic resonance imaging for 24 Ukrainians speaking English as a second language while performing tasks in both languages. Activation in the right hemisphere was stronger and clearer compared with the left hemisphere while using the second language (English). This result supports the separate processing hypothesis as well.

Zara (1977) explored the hypothesis of cognitive shared processing among bilinguals, she confirmed that free recall means of words in both mother tongue and second language in image and linguistic expressions is equal by conducting several experiments.

Michael (1978) examined whether languages processing is shared or separate, and if processing information of one language affects the other. Individuals proficient in English as a mother tongue and French as a second language participated in the study. Differences were not significant in recalling words in both languages. This result supports the shared processing hypothesis.

Gutierrez, Clellen, Calder, and Weismer (2004) compared the performance 44 proficient and non-proficient bilingual and monolingual Latino children performance on a language-processing task and a dual-processing comprehension task. The researchers concluded that bilingual's process language in the shared storage.

Pascal and De Abreu (2011) studied bilingual and monolingual students' working memory while performing language tasks. Both of the groups processed their tasks equally in shared processing storage.

The current research comes to add to the previous literature on bilinguals shared or separate processing of language tasks. The author of the research benefited from the previous literature specially in selecting the sample using post surveys to determine the bilingual students. The researcher adapted the tests of the study vocabulary selection and recalling tests depending on Boko (1982) methodology. However, it differed from the previous literature in examining Arab bilingual students processing and recalling operations.

1.1. Study Problem

Previous studies on bilinguals shared or separate processing in recalling knowledge vary. This means the

translation of the information occurs through using two separate storages, this leads to efficacy differences in using the second language compared with the mother tongue, or it means using one storage while processing information leads to equal efficacies in using the two languages. Scarcity of research in bilingual's efficacy using separate or shared processing of knowledge among Arab students prompted the researcher to explore it for its important to the educational process.

The study sought to answer the following questions:

1. Are there statistical differences at (α=0.05) between means of free recall attributed to the type of the second time display of the word?
2. Are there statistical differences (α=0.05) between means of the free recall attributed to gender?
3. Are there statistical differences (α=0.05) between means of free recall attributed to the type of the word second time display, gender, and the interaction between both?

1.2. Significance of the Study

The study explores separate and shared processing in recalling language among bilinguals. Many individuals are speaking and learning another language for the purpose of studying and communicating. Major research and experiment findings are published in languages different from the mother tongue. Theoretically, the study may add updated knowledge to the educational thought, and it is hoped to be the core for future further studies. Scarcity of local and Arab studies in this domain urged the researcher to carry out this study.

1.3. Goal of the Study

The researcher attempted to explore the hypotheses of separate and shared knowledge processing by comparing the performance of a group of bilinguals. The study aimed to identify the differences between the two hypotheses in the ability to translate knowledge by studying the impact of words, equivalences, and translations second time display in free recall.

1.4. Limitations of the Study

Generalization of the results of the study may be hindered by:

The tests validity and reliability are applicable for this selected sample and similar samples. The researcher selected the sample from the international schools in Amman/ Jordan; therefore, the results may only be valid to generalize only on the selected sample and similar populations.

1.5. Procedural Definitions

Bilinguals. When the same speaker has two different language systems (the mother tongue and the second language) and can switch between them effortlessly.

Information separate processing. When the stored information of a certain language is recalled in the other language through translation, that is there is a difference in using the second language compared to the mother tongue.

Information shared processing. When the stored information is recalled in both languages proficiently.

2. Methodology

2.1. Study Sample

The sample included (60) male and female students enrolled in international schools in Amman, they had similar proficiency in English and Arabic similarly. The researcher allocated the students to six groups each of which includes 10 students. The participants age range between 12-15 years, the age mean was 13.85 and the standard deviation scored (1.04). Table 1 illustrates the Participant's selection based on their language proficiency test.

Table 1. sample distribution

Type Gender	Group 1 received the Arabic list twice	Group 2 received the Arabic list and equivalences	Group 3 received the Arabic list and translations
Males	10	10	10
Females	10	10	10
Overall	20	20	20

To ensure the students equal proficiency in the two languages the researcher followed the following steps:

- Translation test. Each student translated several topics (science, history, literature, and geography), each topic included three paragraphs, and each paragraph includes five sentences written in the English language and required translation into Arabic. The students also translated similar topics from Arabic into English. The variance analysis showed in-significant differences in student's skills of translation from one language into another.
- Language proficiency test to label the largest possible number of words. The students followed

instructions to label words from the topics given to them in a specified time (one minute), after a rest interval of five minutes; they wrote words from the same topics in English in one minute. This procedure measures student's language proficiency to find out if they are bilinguals. The variance analysis illustrated insignificant differences in labelling words in both languages.

- Language proficiency evaluation. The researcher built a test to evaluate language proficiency. The test included reading, writing, speaking, listening, comprehending, and translating self-evaluation questions. Each student evaluated the level of these skills in both English and Arabic by selecting the answer on a five-Likert scale. The students' teachers received instructions to evaluate their student's proficiency. A high correlation was found, this result refers to the students proficiency equality in both English and Arabic.

The above tests proved that the participants are bilinguals.

Content Validity

The tests paragraphs were reviewed by (5) faculty competent professors from Yarmouk University and King Saud University, and they provided some remarks. Based on the reviewers' remarks the tests final version explanation follows.

Test Reliability

A pilot sample of 20 bilingual students completed the tests of the study to verify its construct validity. Kuder-Richardson (KR-20) formula analyzed the correct answers. Cronbach Alpha formula calculated the responses reliability coefficients and it scored (0.88).

Correcting the Test

The computer corrected tests answers; each recalled word took one point and the test points range between (0-60).

2.2. Study Tools

After reviewing the previous literature, the researcher created a computerized test for the purpose of the study.

The researcher selected the Classmaker site to display the test to the students. The test included nine icons. These icons included general information about the participants such as gender, age, grade, the original language of the mother, the original language of the father, language used at home, language used with peers, student's cumulative average, the duration spent abroad in an English speaking country.

Data analyses illustrated that English is the mother tongue of one of the parents, Arabic is home language among 43% of the students, and 57% spoke English at home. The students were studying in international schools, therefore, the language of study is English, 87% of the students spoke English with each other, and only 17% spoke Arabic. Percentage of students who spent more than three years abroad reported was 55%, two years spent percentage was 36%, and at least one year spent abroad reported by 9% of the students.

The application of the site included the three language tests; the first test included three interfaces; it included 60 common Arabic words, the second included the equivalences of the first list words, and the third included the translations of the Arabic words in English.

The second test. The researchers instructed the students to right the largest possible number of words from the three letters provided. An example was the three Arabic letters (ق، ر، م); the possible words from these letters are (قمر، رقم، مرق، مقر، قرم، رمق).

The third test, the free recall test. The students filled the blank spaces of the sentences displayed with the words recalled from the previous test in a specified time of two minutes.

The researcher allocated the students to three groups:

a. Each group included twenty students (ten female students and ten male students), and each group received different instructions.
b. The first group operated the sound system and listened to a list of 60 Arabic words, there was an interval of 10 seconds. Then, the students played the same list for the second time. Then student received the test of arranging the scattered words for two minutes. Finally, the student received instructions to recall the Arabic words and write them in the specified place of the test on computer.
c. The second group listened to a list of 60 Arabic words; the students had a 10-second interval, then they listened to the list equivalent that means they listened to the Arabic list once and to the Arabic equivalents list once. The students completed the scattered words arrangement test in two minutes and they wrote the recalled words.
d. The third group listened to a list of 60 Arabic words; students had a 10 seconds interval, listened to the list of words translations that means they listened to the Arabic list for one time and to the translations for one time. The student afterword completed the scattered words arrangement test in two minutes and wrote the recalled words.

In all the tests, the interval between introducing one word and the next was two seconds.

2.3. Study Variables

The study variables include Arabic word display twice, display of the Arabic word and its equivalent, display of the Arabic word and its translation, gender, and free recall.

3. Results and Discussion

The study attempted to answer several questions, to answer the first question of "Are there statistical differences between means of free recall attributed to the type of the word second time display?" means and standard deviations of the free recall based on the type of word second time display were calculated as illustrated in table two.

Table 2. means and standard deviation of the free recall based on the type of the second time display of the word

Category			
Group 1 received the Arabic list twice	20	M.	SD.
Group 2 received the Arabic list and equivalents	20	33.70	6.845
Group 3 received the Arabic list and translations	20	36.20	6.678
Total	60	40.55	5.226

As observed in table 2 there is an apparent difference in the means and standard deviations of the free recall, this difference is attributed to the difference in second time display of the list. One-way analysis of variance indicated to find the means differences functionality as illustrated in table 3.

Table 3. one-way analysis of variance ANOVA of type of the second time introduction of the word impact on free recall

Source	Sum of squares	Freedom degrees	Mean Squares	f-value	Sign.
Between the groups	480.633	2	240.317	6.071	.004
Within the groups	2256.350	57	39.585		
Overall	2736.983	59			

In table 3, significant differences are observed at (α=0.05), the differences are attributed to the type of the second time display of the word in overall free recall. Post hoc comparisons found means functional paired differences as table 4 illustrates.

Table 4. post hoc comparisons using Scheffe' test of type of word second time introduction impact on free recall

type of word second time introduction	M.	Group 1 received the Arabic list twice	Group 2 received the Arabic list and equivalences	Group 3 received the Arabic list and translations
Group 1 received the Arabic list twice	33.70			
Group 2 received the Arabic list and equivalences	36.20	2.50		
Group 3 received the Arabic list and translations	40.55	6.85*	4.35*	

*Significance at α=0.05

Significant differences at (α=0.05) are observed between the third group and both the first and second groups in favor of the third group.

The results of one-way analysis of variance demonstrated a statistical difference attributed to the type of the word second time display on free recall. The post hoc comparisons revealed differences between the performances of both first and second groups against the third group, which received the Arabic list and translations. The differences were in favor of the third group.

Because the third group outperformed the other groups, the result support the hypothesis of separate processing among bilinguals, where the stored material in one language may be recalled through translation in another language.

This result may be explained by the assistance provided by English translations helped in recalling the largest number of the words from the list of the Arabic words. The third group listened to the words of two different languages this process stimulated their interest and focus to listen carefully which facilitated recalling the words later. Al-Arabi (1981) in his book "Learning Living Languages" asserted this fact; he linked the translation of the second language to recalling the first language.

The researcher believes that the findings of the current study agree with results of previous studies. Olav (1974) found that remembering the words of the mother tongue (English) was better than the second language (welsh). Abu-Rabia and Siegel (2002) found that bilingual children recorded higher scores in reading semi-words tasks and pronunciation compared with monolingual children. Xue, Dong, Jin and Chen (2004) study

showed individuals performance in tasks that require using their mother tongue (Chinese) was better compared to using the second language (English). Kim, Byun, Lee, Gaillard, and Theodore (2011) found that activation in the right hemisphere was stronger and clearer compared with the left hemisphere in the comparison between the mother tongue and the second language. This result supports the hypothesis of separate processing.

To answer the second question "Are there statistical differences between means of free recall attributed to gender?" the researcher computed means and standard deviations of the free recall based on the variable of gender. To identify the statistical differences between the means the researcher utilized t-test.

Table 5. means, standard deviations and t-test of the gender impact on free recall

	Gender	No.	M.	SD.		Freedom degrees	Sign.
Number of words in two minutes	Male	30	35.07	5.825	-2.043	58	.046
	Female	30	38.57	7.356			

Statistical differences are observed in table 5 at (α=0.05) attributed to the type second time display of the word on the free recall, in favor of females.

Lennerberg (1967, cited in Al-Hawarneh, 2010, pp. 58-59) said that female's brain maturity occurs earlier compared with male's brains. Especially in the controlling lobe of speaking, the cortex maturity helps accelerate introducing sounds and increases the language acquisition rate, that is to say females outperform males in language abilities. Meed (1913, cited in Mansour, 1972) demonstrated that the average age when male babies start taking is 15.7 months, while female babies starts at 14.8 months. McCarthy (1930) said that the understandable responses of males score 14% at the age of 18 months and 38% of females at the same age.

To answer the third question "Are there statistical differences between means of free recall attributed to the type of the word second time display, gender, and the interaction between both?", the researcher calculated the means and standard deviations of the free recall based on the type of the second time display of the word and gender and the interaction between them as illustrated in table 6.

Table 6. means and standard deviations of the free recall based on type of second time introduction of the word and gender and their interaction

Group type	Gender	M.	SD.	NO.
Group 1 received the Arabic list twice	Male	32.70	6.848	10
	Female	34.70	7.056	10
	Totall	33.70	6.845	20
Group 2 received the Arabic list and equivalences	Male	35.00	5.416	10
	Female	37.40	7.849	10
	Totall	36.20	6.678	20
Group 3 received the Arabic list and translations	Male	37.50	4.503	10
	Female	43.60	4.088	10
	Totall	40.55	5.226	20
Totall	Male	35.07	5.825	30
	Female	38.57	7.356	30
	Totall	36.82	6.811	60

Apparent variance is observed in table 6 in means and standard deviations of the free recall based on the type second time display of the word, gender and the interaction between them. To identify the functionality of the differences the researcher used a two-way analysis of variance as seen in table 7.

Table 7. Two-way analysis of variance of the impact of type of the second time introduction of the word and gender and their interaction on free recall

Variance source	Sum of squares	F degree	Mean Squares	F value	Sign.
Group	480.633	2	240.317	6.420	.003
Gender	183.750	1	183.750	4.908	.031
Interaction	51.100	2	25.550	.683	.510
Error	2021.500	54	37.435		
Overall	2736.983	59			

In table 7 it is observed that there are statistical differences at α=0.05 attributed to the type of the second time display of the word, f-value scored (6.420) and a significance of (0.003), post hoc comparisons were used to identify the means paired differences as illustrated in table 8. Statistical differences at (α=0.05) attributed to gender were found, f-value scored (4.908) and a significant of (0.031) in favor of female students. However, the differences attributed to the interaction between the type of second time display of the word and gender at

(α=0.05) were not significant, f-value scored (0.683) and a significant of (0.510).

Table 8. Post hoc comparisons using Scheffe' test of type of the second time introduction of the word impact on free recall

Type of the second time display of the word	M.	1st	2nd	3rd
Group 1 received the Arabic list twice	33.70			
Group 2 received the Arabic list and equivalences	36.20	2.50		
Group 3 received the Arabic list and translations	40.55	6.85*	4.35*	
*Significance at α=0.05				

In table 8 it is observed that the differences were significant at (α=0.05) between the third group and both the first and the second groups in favor of the third group.

3.1. Recommendations

This study, as far as the researcher knows, is the first to tackle shared or separate processing among bilinguals whom Arabic language is the mother tongue; therefore more research is required in the field. The researcher recommends other researchers to conduct longitudinal developmental studies on bilinguals.

Comparison studies are required between the performance of monolinguals and bilinguals who learn the additional language as a foreign language but not as a second language.

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