Turkish Journal of Geriatrics
2014; 17 (3) 290-298

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RESEARCH

HOW DO OLDER AND YOUNGER ADULTS DIFFER IN DIRECTED FORGETTING?

ABSTRACT

Introduction: The aim of the present study is to compare younger and older adults in terms of directed forgetting, using both abstract and concrete memory materials.

Materials and Method: 50 healthy younger (aged 17-24 years) and 46 healthy older (aged 65-84 years) volunteers were included in the study. After a directed forgetting study phase in which abstract and concrete words were presented, the participants were given recall and recognition tasks.

Results: In the light of ANOVA results, the main (p <0.001 0.01, in recall respectively; p <0.001 0.01 and 0.01, in recognition respectively) and interaction effects of age, instruction type and concreteness level in both recall and recognition were found to be significant (p <0.01 0.001 and 0.001, in recall respectively; p <0.001 0.01 and 0.001, in recognition respectively), except for the main effect of concreteness level in recall (p=0.11).

Conclusion: It was concluded that the younger subjects showed an abstractness effect only in recall tasks, while the older participants displayed a concreteness effect in both recall and recognition tasks. Thus, the mind that tends to retrieve abstract materials in youth tends to retrieve more concrete materials in old age. In addition, with aging, people tend to process more irrelevant information by disrupting the inhibition mechanism.

Key Words: Aging; Memory; Inhibition.

ARAŞTIRMA

YAŞLI VE GENÇ YETİŞKİNLER YÖNLENDİRİLMİŞ UNUTMA AÇISINDAN NASIL FARKLILAŞIRLAR?

ÖZ

Giriş: Bu araştırmanın amacı, genç ve yaşlı yetişkinleri somut/soyut bellek materyali kullanarak yönlendirilmiş unutma açısından karşılaştırmaktır.

Gereç ve Yöntem: Araştırmaya 50 sağlıklı genç (17-24 yaşları arasında) ve 46 sağlıklı yaşlı yetişkin (65- 84 yaşları arasında) gönüllü katılmıştır. Somut ve soyut sözcüklerin sunulduğu bir yönlendirilmiş unutma çalışması sonunda katılımcılara hatırlama ve tanıma görevleri verilmiştir.

Bulgular: Varyans analizi (ANOVA) sonuçları ışığında, hatırlamada kelimelerin somutluk etkisi değişkeninin temel etkisi hariç (p=0,11) hatırlama ve tanımada yaş, yönerge türü ve kelimelerin somutluk düzeyi değişkenlerinin temel etkileri (hatırlamada sırasıyla, p <0,001 0,01; tanımada sırasıyla, p <0,001 0,01 ve 0,01) ve ortak etkileri (hatırlamada sırasıyla, p <0,01 0,001 ve 0,001; tanımada sırasıyla, p <0,001 0,01 ve 0,001) istatistiki olarak anlamlı bulunmuştur.

Sonuç: Genç yetişkinlerin sadece hatırlamada soyutluk etkisi gösterirken, yaşlı yetişkinlerin ise hem hatırlama hem de tanımada somutluk etkisi gösterdiği sonucuna ulaşılmıştır. Yani, gençlikte soyut hatırlamaya eğilimli zihin, yaşlılıkta daha fazla somut materyale yönelmektedir. Ayrıca, yaşlanmayla birlikte inhibisyon mekanizmasının bozulması sebebiyle kişiler daha fazla ilgisiz bilgiye yönelmektedir.

Anahtar Sözcükler: Yaşlanma; Bellek; Ketleme.

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Geliş Tarihi: 27/04/2014
(Received)

Kabul Tarihi: 22/07/2014
(Accepted)

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INTRODUCTION

In a model directed forgetting (DF) study, participants were presented with some words to study and during the presentation they were given directions; specifically, that some words must be remembered and some words forgotten. In other words, while subjects encoded each item they also encoded which were to be remembered (TBR) and which were to be forgotten (TBF) with the help of instructional cues. In this case, "directed forgetting effect" refers to a greater proportion of correct TBR items than of correct TBF items on a retention test (1). Two types of processes take place in directed forgetting; while participants direct all their cognitive processes to remembering TBR items by grouping them in their mind, they discriminate TBF items from TBR ones to forget them.

Two different methods are used in directed forgetting tasks: Item-by-item and list methods (2). In the item-by-item method, subjects are presented with a set of words, each of which is accompanied by an instruction to either remember or forget. In the list version, participants are presented with two lists of words. After the first list is read to participants, half of them are presented a "remember this list" instruction, while the other half are given a "forget this list" instruction. The second list is then presented with a remember instruction and at the end all the subjects are requested to remember as many words as possible from both lists, irrespective of the previous forget instruction. In directed forgetting studies, it has been observed that the age-related effect is reliably larger in the item-method than in the list-method studies (3).

In the present study, younger and older individuals were compared on a directed forgetting task using the item-by-item procedure. In the literature, both younger and older people significantly show the directed forgetting effect, but this effect is observed in young adults more than older ones (3). Zacks, Radvansky and Hasher (4) concluded that, compared to young ones, older participants recalled more TBF items than TBR in an immediate recall test, retrieved more TBF items in either delayed recall or recognition tests, and took a longer time to reject TBF items in an immediate recognition test. These results are explained by the view of reduced inhibition with aging. Thus, older individuals, in comparison with young people, are less able to ignore irrelevant information and consequently recall more TBF items.

Sego, Golding and Gottlob, (5) in their study using both list and item-by-item methods, observed the evidence of the directed forgetting effect for both younger and older groups, but the effect for older individuals was less than for the younger. Although this effect appeared in both recall and recognition tasks in the item-by-item method, it emerged only in recall in the list procedure. In that research, decreased inhibition of irrelevant information by older adults was supported as well. Although the elderly subjects recalled fewer TBR items, they recalled TBF items as well as the younger participants did. In conclusion, although the elderly obtained lower scores for TBR and TBF items, their scores were close to the young participants' scores.

In connection with this issue, Aguirre et al. (2) compared young-old and young adults' memory performance using the list method with selective forgetting procedure. The difference between standard directed forgetting and selective forgetting procedure (SDF) is that participants can selectively forget some information previously learned in SDF. With this respect, in that research participants were presented with List 1 consisting of information about two personality characters (Tom and Alex). In the second list, it was given information about other personality (Joe), and then the participants in forgetting condition were asked to forget items belonging to Tom. It was suggested that SDF entails more memory inhibition than nonselective procedure (standard DF procedure), because both selecting and suppressing specific memories require higher executive control. Supporting their hypotheses, older participants did not show SDF compared to young ones, namely they had so impaired performance to forget items and this finding verified inhibitory-deficit framework. They concluded that finding age-related differences in terms of cognitive control was definitely based on task demands.

On the other hand, Titz and Verhaeghen (3) in their meta-analysis draw the conclusion that a forget cue is more effective for younger people. In the literature, there is only one study that examines directed forgetting processes with abstract and concrete words (6). In that study, which measured ERP, researchers reached the conclusion that responding with concrete words has advantages over responding with abstract words, and this concreteness effect includes more contextual information in the TBF condition than in the TBR. In this sense, the present study is the first that compares younger and older adults in terms of directed forgetting by using concrete/abstract memory material.

The main motivation of the present study was to explore DF in item-by-item method with abstract and concrete materials and to make comparisons between memory performances of older and younger people. In the light of the literature, two hypotheses were proposed: 1). As it was mentioned in the

literature, younger participants will show more DF effect than older participants will. 2). Since remembering concrete materials is easier for them, older participants will indicate greater DF effect for concrete words compared to for abstract ones.

Materials and Method

Sample

The research sample was composed of younger and older participants living in Sivas and Tekirdağ provinces. 50 healthy young adults 17-24 years of age (24 women, 26 men) and 46 healthy older adults 65-84 years of age (16 women and 30 men) were included in the study. Thus, total number of participants is 96. Mean of age was 20.22 (SD= 2.43) in the younger group and 70.2 (SD=4.86) in the older group. The subjects were volunteers selected from all educational levels; while the average years of education in the younger group was 10.88 (SD=2.71), it was 9.87 (SD=3.9) in the older group. According to statistical analysis, any significant difference between two groups was not found with respect to year of education, $t(94) = -1.78$, $p > 0.001$. The younger participants consisted of individuals working in private or public institutions, while the elderly subjects were living in their homes, met the criteria for "healthy elderly", and were not working.

Three tests/scales were used for the purpose of selecting healthy subjects and screening: the Standardized Mini Mental Test (SMMT), the Geriatric Depression Scale (GDS) and the Functional Activities Questionnaire (FAQ). The people who got ≥25 points on the SMMT; ≤ 11 points on the GDS and ≤ 15 points on the FAQ in 2 or more activities for those 60-69 years of age, and ≤ 9 points on the FAQ in 3 or more activities for the 70 years of age and above, were not included in the sample. Young participants who got ≤ 17 points on the Beck Depression Inventory (BDI) were not included in the study. In addition, people who reported having neurological or psychological disorders, and using drugs that affect cognitive processes or having given up using this kind of drug recently, were not included in the sample. The mean scores and standard deviations of the scanning tests/scales and the exclusion criteria are summarized in Table 1.

The research received ethical approval (the verdict of Cumhuriyet University Faculty of Medicine, Medical Research Local Ethics Committee numbered 2013-07/15 and dated 02.07.2013), and before the study began, the written consent of all subjects was obtained using an Informed Consent Form.

Table 1— Means and Standard Deviations of Scanning Test/Scales and Exclusion Criteria

BDI (Younger)	M= 7.36	score ≥ 17
SD= 3.97		
SMMT (Older)	M= 28.09	score ≤ 25
SD= 1.26		
GDS (Older)	M= 5.3	score ≥ 11
SD= 3.13		
FAQ (Older)	M= 1.33	score ≥ 15 for 60–69 years of age in 2 or more activities; score ≥ 9 for 70 years of age and above in 3 or more activities
	SD= 0.57	

Materials

Tests and Scales Used For Screening

Standardized Mini Mental Test (SMMT)

The SMMT is a short test used to diagnose delirium and/or dementia, especially in the elderly, developed by Folstein et al (7). Validity and reliability studies of the Turkish version of this test, used for diagnosing mild dementia, were conducted by Güngen et al (8). The test, used in the assessment of general cognitive functions, is composed of 11 items grouped under five main headings: record memory, orientation, attention and calculation, recall, and language. The highest possible total score is 30.

Geriatric Depression Scale (GDS)

This scale, developed by Scheikh and Yesavage (9) is used to identify the people in the elderly population at risk of depression. Validity and reliability studies for the Turkish version of this test were conducted by Ertan and Eker (10). The internal consistency coefficient of this test was determined to be .91 and retest reliability to be .74. There are 30 "Yes-No" questions in the scale. In scoring, every answer in favor of depression is scored as 1 point while every answer against depression is scored as 0; the total score is taken as the depression score.

Functional Activities Questionnaire (FAQ)

The FAQ is a short questionnaire assessing the everyday life activities of elderly individuals (for example, paying bills, going shopping alone, and keeping financial accounts) (11). The questionnaire is usually answered by the respondents themselves; if a respondent is a patient it is answered by one of his first-degree relatives. Each performance related to 10

daily life activities is scored between 0 and 3. Scoring 15 or more points in the 60-69 age group for 2 or more activities and 9 or more points in the 70 years of age and older group for 3 or more activities indicates a disorder of functional activities, and that the elderly person is dependent on someone else. In a study to establish norms for the Turkish adaptation of the FAQ, carried out on a sample of Turkish people 50 years of age and above, it was found that age and education level had a significant effect on FAQ scores, while there was no effect of gender (12).

Beck Depression Inventory (BDI)

This 21-item scale was developed by Beck (13) to determine the level of depression. Reliability and validity studies on the Turkish adaptation was carried out by Hisli (14). In Turkish form of the BDI, it was found that a split-half reliability was 0.74 and a criterion validity coefficient was 0.63 (14). According to the scoring, 0-9 = minimal, 10-16 = mild, 17-29 = moderate, and 30-63 = severe depression. When breakpoint of the test was examined in the Turkish form of BDI, it was concluded that 17 and above points refer to depression treatment. This is because, the breakpoint of BDI in this research was accepted to be 17 and above points.

Verbal Materials Used in this Study

A list of 52 words, including 26 concrete (child, newspaper, etc.) and 26 abstract (faith, joy, etc.) words, selected from Turkish Word Norms (15), was used in the research. For the recognition test, a total of 208 prevalent words (for example, wonder-marvel-confused-hot) selected from Turkish Word Norms and consisting of two semantic and two sonic lures associated with each target word were used. The mean number of letter of all the words including lures in the recognition test used in the study was 7, ranging from 5 to 9; the mean number of syllable was 3, ranging from 2 to 4. The words that had average word frequency were chosen from Turkish Word Norms to be used in the research. In this line, all concrete and abstract words used in the research were equivalent to each other in every aspect.

Procedure

All subjects were tested individually. All words were presented with lower case letters in the 'Arial' font on a 33 X 21 cm computer screen. After each word was presented for 2 s, 'RRRRRR', for "remember" or 'FFFFFF', for "forget" appeared on the screen and was presented for 3 s. That is, the subjects were asked to keep some of the words in mind (recall), while not bearing others in mind (forget). After the research words were presented, half of them following the instruction 'remember' , the other half following the instruction 'forget', the participants were subjected to a free-recall task and, regardless of the instruction (remember or forget), they were asked to recall as many presented words as they could and write them on a blank sheet of paper. For this task, the participants were given 10 minutes. Next, they were given a recognition test in which the target words were presented with 4 distractor words (unstudied and semantically and phonologically associated with the target words). The subjects were asked to mark the words they believed they had studied. The experiment took approximately 1 hour.

Results

A 2 (age: young and older) x 2 (level of concreteness of the words: concrete and abstract) x 2 (instruction type: remember and forget) factorial ANOVA with repeated measures on the last factor was used for data analysis. The means, the standard deviations and percentages of abstract and concrete words correctly recalled and recognized with instructions of R or F are summarized in Table 2 and Table 3.

Recall

According to the results of the ANOVA, the main effects of age and instruction type on recall scores were significant

Table 2— Means, Standard Deviations and Percentages of Abstract and Concrete Words Correctly Recalled With Instructions of R or F

2X2X2	R WORDS		F WORDS	
N=96	Younger	Older	Younger	Older
Abstract	M=3.38 (%26) SD= 1.79	M=0.77 (%5.9) SD=	M=2.16 (%16.6) SD=1.6	M=0.8 (%6) SD=0.93
Concrete	M=2.58 (%19.8) SD=1.62	M=1.13 (%8.7) SD=0.88	M=1.54 (%11.85) SD=1.43	M=1.22 (%9.38) SD=1.17

Table 3— Means, Standard Deviations and Percentages of Abstract and Concrete Words Correctly Recognized With Instructions of R or F

2X2X2	R WORDS		F WORDS	
N=96	Younger	Older	Younger	Older
Abstract	M=6.62 (%51) SD=3.04	M=2.54 (%19.5) SD=1.8	M=5.32 (%41) SD=2.74	M=3.27 (%25) SD=2.17
Concrete	M=6.8 (%52.3) SD=2.9	M=4.17 (%32) SD=2.61	M=5.02 (%38.6) SD=2.9	M=3.89 (%30) SD=2.35

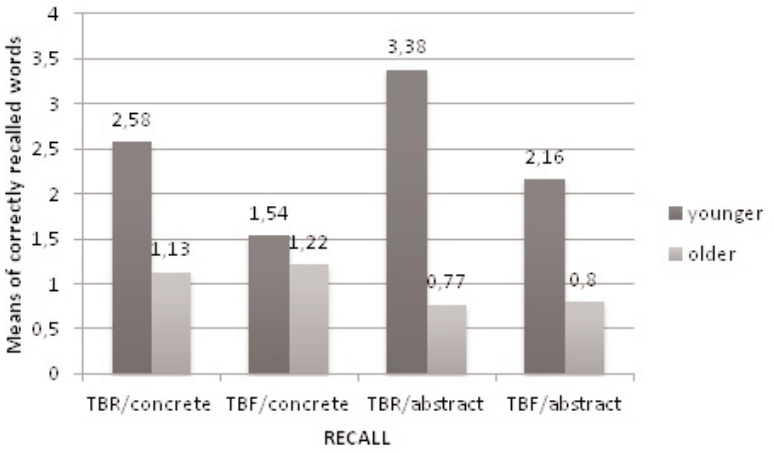

Figure 1— Means of correctly recalled words.

($F_{(1,94)}$=72.58, p<.001, η^2 = 0.44); $F_{(1,94)}$= 10.49, p<.01, η^2= 0.1). The main effect of level of concreteness was not significant ($F_{(1,94)}$ = 2.58, p>.001, η^2 =0.03). The interaction between age and concreteness level, ($F_{(1,94)}$ = 28.3, p <.001, η^2 =0.23) and the interaction between age and instruction type on recall scores, ($F_{(1,94)}$=12.71, p< .01, η^2=0.12) were found to be significant. In addition, the interaction between age, level of concreteness and instruction type was significant ($F_{(2.38, 223.63)}$= 13.56, p<.001, η^2=0.13) (Figure 1).

In addition, whereas any significant difference between total scores of R and F in older subjects, $\bar{x}$ =0.11, sd=0.34, p>.001 was not observed, a significant difference was found in younger participants, $\bar{x}$ =2.26, sd=0.56, p<.001.

Recognition

The main effects of age, instruction type and level of concreteness on recognition scores were found to be significant ($F_{(1,94)}$=34.64, p<.001, η^2= 0.27); $F_{(1,94)}$= 8.65, p<.01, η^2= 0.08; $F_{(1,94)}$ = 9.95, p<.01, η^2 =0.1, respectively). The interaction between of age and level of concreteness ($F_{(1,94)}$ = 11.46, p <.01, η^2=0.11) and the interaction between age and instruction type on recognition scores ($F_{(1,94)}$=15.28, p< .001, η^2=0.14) were found to be significant. Furthermore, the interaction between age, level of concreteness and instruction type was significant ($F_{(2.63,246.95)}$= 10.63, p<.001, η^2=0.1) (Figure 2).

In addition, a significant difference was found in younger participants, $\bar{x}$ =3.08, sd=0.71, p<.001, while it was not observed in older participants, $\bar{x}$ =0.44, sd=0.53, p>.001.

The pairwise comparisons of the recall and recognition scores are summarized in Table 4.

Discussion

According to the results of the study, as expected, younger participants showed the directed forgetting effect by remembering more numbers of TBR items in recall and recognition, while older participants retrieved more TBF items compared to TBR items, though the difference between the scores of them was minimal. These results are consistent with the results of Zacks et al. (4) and therefore with age-related inhibition deficit theory. Accordingly, because elderly

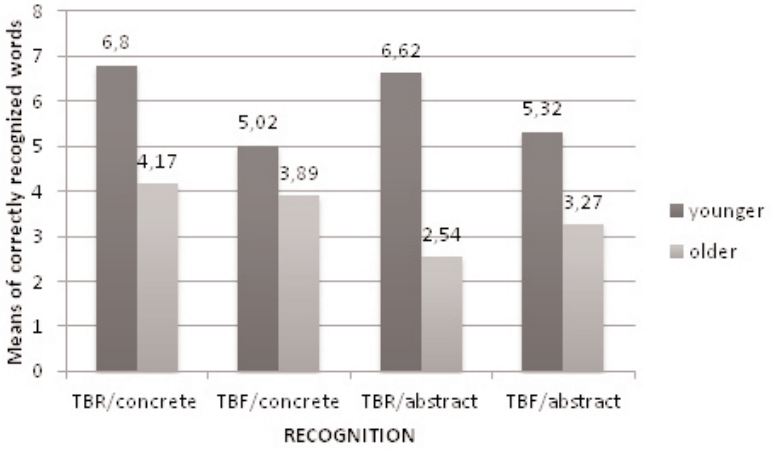

Figure 2— Means of correctly recognized words.

people have inefficient inhibition mechanisms and fail to supress irrelevant information, they recall more TBF items (16,4). Correspondingly, Hartman and Hasher (17) suggested that elderly people were more likely to have unexpected endings of sentences still available in memory, even if the information was identified as irrelevant.

In the present study, the low TBR performance of the older subjects in recall and recognition compared to the younger subjects can be explained by the results of previous research suggesting that explicit memory declines with aging (18,19).

When the memory performance of the younger and older people was compared in terms of abstract and concrete words, it was observed that the younger people retrieved more abstract and concrete words in recall and recognition in total (both TBR and TBF words). On the other hand, when the total number of words (both TBR and TBF words) retrieved by older people was considered, it was seen that the number of concrete words was greater than the number of abstract words. This situation was different in the younger participants. When the total number of words they retrieved was examined, though the number of abstract words was greater than the number of concrete ones in recall, no significant difference between two types of words was found in recognition. While the explicit memory performance of elderly individuals is thought to be outpaced by younger people, it is an expected finding that the number of both concrete and abstract words the young subjects recalled or recognised was greater than the number of words the older participants recalled or recognized. Viewed from this perspective, it can be concluded that the older people retrieved more concrete words in recall and recognition by showing a "concreteness effect", while the young participants remembered more abstract words only in recall (not recognition) by exhibiting an "abstractness effect".

Xiao, Zhao, Zhang and Guo (6), in their study of ERP measurements with adults 18-23 years of age, observed that the subjects showed a concreteness effect by responding to TBR concrete words faster and more accurately than to abstract words in explicit memory. There is consistency between this research and the present study. Xiao et al. administered a recognition task, asking subjects to make decisions about new/old about items previously presented using ERP, while the participants in the present study were asked to remember and then to recognise the words. When the recognition results were examined in the current study, although no significant difference was found between concrete and abstract words in the TBR condition (not in TBF) for the younger subjects, that did recognise more concrete words (abstract words mean: 6.62, concrete words mean: 6.8). In this context, these two research results support each other. The results are supported by some research related to the dominance of concrete words over abstract words in recognition in the literature (20,21).

The present study has corresponding results as well as different aspects with the research cited above (2,4,5). Like the general results of these studies, it was found that older people retrieved more TBF items in recall and recognition tasks (with very little difference between TBR and TBF items) because of impaired inhibition mechanism. In the present

Table 4— Pairwise Comparisons Summary Table of Recall and Recognition Scores

Main and Interaction Effects	$\bar{x}$ (SD) RECALL	Comparisons
Age	$\bar{x}$ =1.44, sd=0.17, p<.001***	younger > older
Age * Level of Concreteness	$\bar{x}$ =4.02, sd=0.4, p<.001***	younger > older (abstract)
	$\bar{x}$ =1.77, sd=0.4, p<.001***	younger > older (concrete)
	$\bar{x}$ = 0.78, sd=0.25, p<.01**	concrete > abstract (older)
	$\bar{x}$ = 1.46, sd=0.34, p<.001***	abstract > concrete (younger)
Instruction Type	$\bar{x}$ =1.08, sd=0.33, p<.01**	recall > forget
Age * Instruction Type	$\bar{x}$ =4.07, sd=0.49, p<.001***	younger >older (recall)
	$\bar{x}$ =1.7, sd=0.46, p<.001***	younger >older (forget)
	$\bar{x}$ = 0.11, sd=0.34, p=0.75	NS (older)
	$\bar{x}$ =2.26, sd=0.56, p<.001***	recall> forget (younger)
Age*LC*IT	$\bar{x}$ =1.36, sd=0.27, p<.001***	younger>older (abstract/forget)
	$\bar{x}$ =1.45, sd=0.27, p<.001***	younger >older (concrete/recall)
	$\bar{x}$ =2.62, sd=0.3, p<.001***	younger >older (abstract/recall)
	$\bar{x}$ =0.32, sd=0.27, p= 0.23	NS (concrete/forget)
Main and Interaction Effects	**$\bar{x}$ (SD) RECOGNITION**	**Comparisons**
Age	$\bar{x}$ =2.47, sd=0.42, p<.001***	younger > older
Age * Level of Concreteness	$\bar{x}$ =5.78, sd=0.91, p<.001***	younger > older (abstract)
	$\bar{x}$ =3.44, sd=0.91, p<.001***	younger > older (concrete)
	$\bar{x}$ = 2.26, sd=0.54, p<.001***	concrete > abstract (older)
	$\bar{x}$ = 0.08, sd=0.44, p=0.86	NS (younger)
Instruction Type	$\bar{x}$ =1.32, sd=0.45, p<.01**	recall > forget
Age *Instruction Type	$\bar{x}$ =6.7, sd=0.96, p<.001***	younger >older (recall)
	$\bar{x}$ =3.19, sd=0.94, p<.01**	younger >older (forget)
	$\bar{x}$ = 0.44, ss=0.53, p=0.42	NS (older)
	$\bar{x}$ =3.08, ss=0.71, p<.001***	recall> forget (younger)
Age*LC*IT	$\bar{x}$ =2.06, sd=0.51, p<.001***	younger>older (abstract/forget)
	$\bar{x}$ =2.63, sd=0.57, p<.001***	younger>older (concrete/recall)
	$\bar{x}$ =4.08, sd=0.52, p<.001***	younger>older (abstract/recall)
	$\bar{x}$ =1.13, sd=0.54, p<.05*	younger>older (concrete/forget)

*p<.05; **p<.01; ***p<.001
(non-significant: NS)

study, it appeared that while older people tend to recalled more numbers of TBF concrete materials and failed to forget, the young individuals had tendency to recall more numbers of TBR abstract words than concrete ones. In recognition, both younger and older subjects retrieved more numbers of concrete words. These results indicate that processes in DF differently emerges according to features of memory materials, procedure and developmental periods. In this sense, the results coming from the present study contribute to the literature. The current research also supports the results of Zacks et

al.(4), Sego et al.(5) and Aguirre et al. (2) in that age differences in DF depend on executive control required by task.

Unlike the results of both research (4,5), it was not found DF effect for older participants although the difference TBR and TBF words was minimal in the current study. Zacks et al.(4) showed that older subjects retrieved more TBF items in comparison with younger ones but older participants also indicate DF effect. Sego et al. (5) observed this effect for older and younger participants in both recall and recognition tasks in the item-by-item method and only in recall in the list procedure. On the other side, Aguirre et al.(2) did not obtain any evidence about SDF effect for older participants. Because SDF task requires more executive control than standard DF tasks, older participants did not show any SDF.

In the present study, some reasons can be cited about that younger subjects showed DF effect but not elderly participants. Firstly, while in the other research 40 words (4) or 24 words (5) were presented to study more numbers of items (56 words) were used to study in the current study. Secondly, unlike other research both abstract and concrete words in lieu of unrelated words were employed in the present study. For these reasons, the procedure of the present study might result in more executive memory demand for older people by increasing load of memory. It can be concluded that when task demands change results in DF change along with it, and DF effect is not an effect that can be observed in all conditions for older people.

With respect to this topic, it was interesting that when the TBF items that elderly subjects retrieved in both recall and recognition were examined, it was observed that although there was no statistically significant difference between them, the number of TBF abstract words retrieved was greater than the number of TBF concrete ones. In fact, this difference was higher for recognition scores. If this finding is explored in future research in which participants are fully synchronized in terms of level of education (all subjects are high school or university graduates) and IQ level this should lead to reliable results. On the other side, in contrast to our hypothesis, though difference was very minimal the elderly participants showed less DF effect for concrete words in recall but just the opposite in recognition.

Another important issue to be mentioned that there are some research that failed to find decreased forgetting effect in older adults less than 75 years of age in list method (22,23). For this reason, in research related to DF that will be carried out in the future older participants should be divided to two groups as above or under 75 and DF processes should be taken considerations in terms of these groups. Such research might give more accurate information about DF in elderly people.

In this study, the failure to include every educational level of the participants due to limited access to healthy and literate older participants can be considered a limitation of the research. We attempted to deal with this limitation by equating the older group's average years of education with that of the younger group.

On the other hand, we suggest that this research is important in understanding and assessing mental processes, and therefore in planning required services and applications for healthy and high quality aging.

In sum, it was concluded that in directed forgetting with abstract/concrete words, younger participants showed an abstractness effect only in the recall task (not in recognition), while elderly participants displayed a concreteness effect in both the recall and recognition tasks. Thus, the mind that tends to retrieve abstract material in youth evolves to retrieve more concrete material with aging. Thus, it might be suggested that memory develops from concrete to abstract in childhood, again returns to its some concrete characteristics with aging. In addition, with aging, people tend to process more TBF items, considered irrelevant information, through the disruption of the inhibition mechanism.

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