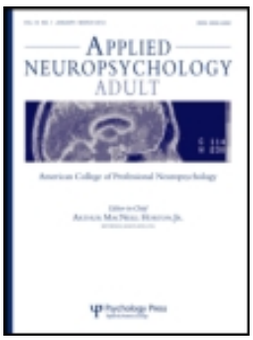

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The Effect of Aging on Script Memory for Typical and Atypical Actions

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When typical and atypical information about a situation are presented, the atypical is found to be better recognized. This phenomenon is referred to as the "typicality effect." To test whether the typicality effect is age related, 41 younger and 36 older participants listened to two scripts that consisted of typical and atypical activities. The recognition was scored in two ways—with and without taking confidence rating into account. The two scoring systems yielded a similar pattern of results. Nevertheless, the weighted scores analyses were more sensitive to group differences than the unweighted scores. The older adults demonstrated typicality effect with the false alarm and hit rates corrected for false alarms scores but not with the hit rate score. A key factor in understanding the effect of age on the typicality effect is taking into consideration the conservative response bias found in the older group. The clinical contribution of these findings, in terms of assessment and remediation of age-related memory impairment, is discussed.

Key words: typical actions, atypical actions, memory, young adults, old adults

Substantial evidence indicates that older adults perform more poorly than younger adults on a variety of memory tasks, including free recall, cued recall, and recognition (Kausler, 1994; Light, 1991). One of the most common assertions is that old age is characterized by a reduction in processing resources. Because of this reduction, the amount of effort allotted in processing is inadequate for the proper encoding of new information. This is why older adults, when encoding new information, tend to rely more on prior knowledge and overlearned processes that have remained relatively well preserved (Hess, 1985; Hess & Slaughter, 1990; Mantyla & Backman, 1992; for discussion, see Light, 1991).

An important concept relating to the processing of new information is the "schema." The schema is an abstract generic knowledge structure that represents the necessary and characteristic attributes of a conceptual system, as well as the typical relations among such attributes (Graesser, Gordon, & Sawyer, 1979). The schema becomes consolidated as more experience with the object, concept, or situation is acquired. The schema also allows for the relatively automatic perception and encoding of similar events. Therefore, arduous processing of each element is not necessary. In effect, the appearance of only a small number of typical elements is necessary to activate the appropriate schema. This automatic processing allows for the freeing of cognitive resources in working memory for the processing of new information that is atypical and therefore not consistent with generic schematic expectations (Friedman, 1979; Mantyla & Backman, 1992). The level of typicality of new information has a differential influence on memory ability for the information, that is, atypical details are better recognized than typical, expected details. This phenomenon is referred to as the "typicality effect" or the "consistency effect" and has been found to exist in various areas, such as in the study of pictures (Friedman, 1979), scripts (Graesser et al., 1979; Hess, 1985; Light & Anderson, 1983), and daily living scenes (Mantyla & Backman, 1992; Pezdek, Whetstone, Reynolds, Askari, & Dougherty, 1989). However, generalizations should be made cautiously. It is possible that schemas associated with different types of content may be organized and may function in qualitatively different ways. Thus, it might be the case that inferences about schema-based effects drawn from one domain may not be applicable to others.

This study focuses on the typicality effect as related specifically to scripts. Scripts were used in this experi-

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ment because of their ecological validity. A script is defined as a common and well known activity, consisting of a sequence of typical actions. For example, "getting up in the morning" consists of a number of typical actions such as brushing teeth, getting dressed, eating breakfast, and the like. The typicality effect can be observed in the area of scripts, in which irregular actions that are atypical of the script are remembered better than the typical actions (Graesser et al., 1979; Hess, 1985; Light & Anderson, 1983).

Schank and Abelson (1977) proposed the "Script Pointer + Tag" hypothesis to describe the nature of the encoding process responsible for the typicality effect, specifically in the area of script memory. They suggested that each typical action is represented in memory by a single pointer that relates it to the generic script (i.e., the script pointer). By contrast, every atypical action is represented by a separate functional–organizational unit (i.e., the tag). When a given schema is activated, so are the highly probable script actions; therefore, the participant has difficulty differentiating between typical actions that were previously mentioned and those that were not. In this way, the rate of false alarms for typical actions is greater than the rate of false alarms for atypical actions. In essence, then, the typicality effect reflects the qualitative difference in the way that typical and atypical actions are encoded in memory.

There are contradictory findings regarding whether the typicality effect is age-related. Light and Anderson (1983) found that young adults recalled and recognized more information from studied scripts than did elderly participants. However, both groups demonstrated a typicality effect of the same magnitude; that is, atypical items were better discriminated than typical items in memory, to the same extent, for both age groups. Thus, processes involved in the memory of typical as well as atypical information are insensitive to age (see also Zelinki & Miura, 1988). Conversely, in his work with script actions, Hess (1985) found that younger and older adults not only differed in the amount of script actions correctly recognized but also in the appearance of a typicality effect. The elderly participants did exhibit a typicality effect, although of reduced magnitude relative to the younger adults. On the basis of these results, Hess (1985) and Hess and Slaughter (1990) argued that two types of associations are probably involved in this task: script-based association and contextual association. Script-based association, which is less sensitive to age, is activated during presentation and is involved in the memory of typical information. Contextual association, which is age sensitive, is necessary for distinguishing between the different types of information and is involved in the memory of atypical information.

This inconsistency of experimental results concerning the consequences of age for the typicality effect demands further clarification. In this study, we conducted a modified version of the Light and Anderson (1983) experiment. In most studies, confidence rate is not taken into account in memory judgment performance. Light and Anderson did ask their participants for a confidence rating, but unfortunately, in their data analysis the participants' rating was collapsed and applied as a dichotomy. Taking into account the confidence rating of the participants could help to detect the contribution of the groups' response bias to their memory performance (see McCormack, 1981). Thus, in this study, two methods of memory measures were applied: In the first method, confidence rating was not taken into account in memory judgment performance; in the second method, participants' confidence ratings were used for the weighting of their memory judgment answers. This second method was applied to create a more sensitive memory measure that takes into account the participant's degree of certainty in identification (appeared) and rejection (did not appear) judgment. This method more accurately reflects the participants' memory judgment, and as such, it is expected to be more sensitive to group differences, when they exist, than an all-or-none method. Should both methods yield identical results, such a finding would reinforce the significance of the results and would reinforce Light and Anderson's theoretical conclusions.

Methods

Participants

The sample consisted of two groups—41 younger and 36 older participants. The younger adults group consisted of 22 women and 19 men. Ages ranged from 18–35 years [mean (M) = 23.80 years]. Education ranged from 11–18 years (M = 13.32 years). The older adults group consisted of 24 women and 12 men. Their ages ranged from 65–86 years old (M = 74.56 years). Education ranged from 7–22 years (M = 13.00 years). Level of education in both groups did not differ significantly, $t(75) = 0.54$, $p > .05$. The older adults were retired people, the younger group consisted of students and younger participants who volunteered for the study. Participants from both age groups were recruited from towns in central Israel with middle-income populations. All participants were reported to be in good

health and had no uncorrected vision or hearing problems. All the elderly participants were alert and oriented to time and place when tested. Participants in both groups were proficient in Hebrew and had no history of mental illness, neurological disease, alcoholism, or drug abuse.

Materials

The scripts applied in this study were a Hebrew translation of the scripts taken from the Bower, Black, and Turner (1979) study. The two scripts consisted of two scenarios: "eating in a restaurant" and "shopping at the supermarket." There were two versions of each script. In each version, there were 16 activities, of which 12 were typical and 4 were atypical of the given situation.

The definition of typicality/atypicality of actions was derived from a pretest of 30 participants in which participants were asked to rate the typicality of a list of 37 actions for each script on a range from 1 (*very typical*) to 6 (*very atypical*). Thirty-two actions were chosen from the results of this pretest, 24 of which were rated as typical, and 8 of which were rated as especially atypical.

Two recognition tests were administered, one for each script. Each recognition test included 32 actions in random order—16 from the script just presented and 16 actions as distractors taken from the second version. A questionnaire concerning personal demographic information was used as a distractor.

Procedure

Participants were tested individually and were told that the experiment deals with memory ability. Instructions were as follows: "I am going to read you a story that is approximately 20 sentences long. Try to remember as many details as you can because afterwards you will be asked some questions concerning the story." Participants were then told the title of the first script ("eating in a restaurant" or "shopping at the supermarket") and the script was then read out loud to them.

Subsequently, participants were told the following:

> I am about to read you 32 sentences. Your task is to decide, for each sentence, whether the sentence appeared in the story you just heard (either "eating in the restaurant" or "shopping at the supermarket"). You are to rate the level of your certainty on this scale.

The scale ranged from 1 (*certain that the sentence appeared*) to 5 (*certain it did not appear*). Sentences were then read to the participants one at a time; on hearing the sentence, participants made their recognition and rating judgments.

After the test of the first script, participants filled in the personal questionnaire. In addition to gathering demographic information about each participant, the questionnaire also served as a distractor task between the scripts. Immediately after the questionnaire, the second script was presented and tested in the same manner as outlined regarding the first script. The order of the script presentations was counterbalanced, as was the specific version of each script.

Results

Preliminary analysis of the results indicated that memory for the two scripts did not differ, nor did the order of presentation have a differential effect. Thus, the results for both scripts in the different orders of presentation were combined. Participants' recognition of the scripts was scored in two ways: with and without taking their confidence rating scores into account. The difference between the two sets of measures is in the mapping of scores onto ratings. The "unweighted" measure assigns scores for new and old items based on a single cutting point in the confidence rating; the "weighted" measure reflects the full range of confidence rating. Three measures were derived and analyzed for the weighted and unweighted scoring methods: hit rate (HR), false alarm rate (FA), and corrected hit rate (CHR), derived by subtracting the FA score from the HR score.

Unweighted Recognition Scores

As in the Light and Anderson study (1983), the confidence rating scale was converted to a simple dichotomy of "yes" and "no" in this scoring system. The scale ranged from 1 (*certain that the sentence appeared*) to 5 (*certain it did not appear*). Scores of 1 and 2 were considered as *yes*. Mean (and standard deviations) of percent weighted HR, FA, and CHR scores of typical and atypical actions for the older and younger groups are presented in Table 1. A mixed design analysis of variance (ANOVA) was conducted on the unweighted recognition scores to analyze the effect of age group (young versus old) by the typicality of the sentences (typical versus atypical). The former is a between-sub-

jects factor, and the latter is a within-subjects factor. In the analysis of the HR scores, typicality effect reached significance [$F(1, 75) = 12.53, p < .001$], indicating that more atypical than typical actions were correctly recognized (see Table 1). Neither group main effect [$F(1, 75) = 2.11, p > .05$] nor the group by typicality interaction [$F(1, 75) = 2.78, p > .05$] reached significance. Typicality effect was the only effect that reached significance in the analysis of the FA scores [$F(1, 74) = 387.41, p < .001$]. Neither the group effect nor the typicality by group interaction reached significance [$F(1, 74) = .02, p > .05$ and $F(1, 74) = 1.22, p > .05$, respectively]. As can be seen in Table 1, the FA rate for both groups was similarly much higher for the typical than for the atypical actions. Typicality effect reached significance [$F(1, 73) = 277.66, p < .001$] in the analysis of the CHR score. This result indicates that neither age group differed on their sensitivity measure of recognition (controlling for response bias effect) [$F(1, 73) = 3.25, p > .05$] and that typicality affected both groups to the same extent [$F(1, 73) = .19, p > .05$]. Because gender distribution was disproportionate in both the older and younger groups (22 and 19 vs. 24 and 12 women and men for the younger and older groups, respectively), the possible effect of this bias on the results was tested by using gender in a full factorial design in the three ANOVAs analyzing HR, FA, and CHR. With the one exception in which men were found to have a higher HR than women [$F(1, 73) = 5.56, p < .03$], gender effect or the interactions with it did not reach significance and did not affect the pattern of results reported above.

Table 1. *Mean (and Standard Deviations) of Percent Unweighted HR, FA, and CHR Score of Typical and Atypical Actions for Both Age Groups*

	Age Group			
	Young[a]		Old[b]	
Typicality	***M***	***SD***	***M***	***SD***
HR				
Typical	77.77	11.70	76.94	12.68
Atypical	87.13	12.76	80.31	18.26
FA				
Typical	36.56	14.72	38.08	12.41
Atypical	6.56	8.49	4.51	7.99
CHR				
Typical	43.09	15.12	38.86	15.90
Atypical	81.99	13.38	75.79	19.00

Note: HR = hit rate; FA = false alarm rate; CHR = corrected hit rate.
[a]$n = 41$. [b]$n = 36$.

Weighted Recognition Scores

The confidence rating scale ranged from 1 (*certain that the sentence appeared*) to 5 (*certain it did not appear*). An initial analysis was conducted to verify whether there was a response bias effect, summed over all test items (i.e., difference between groups in the use of the five response alternatives), like the effect found by McCormack (1981). Table 2 presents the percentage of times of 32 judgments (i.e., 16 original actions were presented for each of the two scripts), when participants chose each point on the scale of 1 to 5. As can be seen in Table 2, with the exception of point 1 (*certain that the sentence appeared*) the groups differed significantly (using *t* tests for independent samples) on all choices of points. Although the younger participants chose the middle points of the scale (i.e., 2, 3, and 4) more frequently than the older participants, older participants chose point 5 on the scale (*certain it did not appear*) more frequently than did the younger participants.

As with the unweighted recognition scores, three weighted measures were analyzed: HR, FA, and CHR. The weighted measure reflects the full range of confidence rating. When participants rated their confidence

Table 2. *Mean Percent of Times (and Standard Deviations) Older and Younger Participants Chose Each Point on the Scale*

	Age Group					
	Young[a]		Old[b]			
Scale Point	**M**	**SD**	**M**	**SD**	***t* (*df* = 75)**	**Significance**
1	41.39	13.22	46.35	11.44	1.75	$p > .05$
2	12.88	9.59	7.12	6.79	3.01	$p < .005$
3	10.59	10.75	4.51	6.27	2.98	$p < .005$
4	9.76	8.56	4.86	5.56	2.93	$p < .005$
5	25.38	13.24	37.24	11.11	4.22	$p < .001$

as 1—certain that the sentence appeared—they were given the score of 4 for that answer. At the other extreme, when the rating was 5—certain that the sentence did not appear—a score of 0 was given. Thus, ratings of 1–5 was converted respectively to scores of 4–0. Mean (and standard deviations) of percent-weighted HR, FA, and CHR scores of typical and atypical actions for the older and younger groups are presented in Table 3. A mixed design ANOVA was conducted on the weighted recognition scores to analyze the effect of age group (young versus old) by the typicality of the sentences (typical versus atypical). The former is a between-subjects factor, and the latter is a within-subjects factor. Both main effects and the interaction reached significance. Overall, the younger group had a higher HR than the older group [$F(1, 75) = 5.21, p < .03$]. More atypical than typical actions were recognized [$F(1, 75) = 11.33$, $p < .001$]. As can be seen in Table 3, the group × typicality interaction [$F(1, 75) = 5.48, p < .03$] indicates that, although the HR of the younger group was significantly higher for the atypical compared with the typical actions, the typicality of the sentences did not affect the elderly group's performance. In the FA analysis, typicality effect reached significance [$F(1, 71) = 412.91, p < .001$]. As can be seen in Table 3, FA scores were higher for the typical compared with the atypical actions. The group effect reached significance in the expected direction $F[(1, 71) = 3.88, p < .03]$, that is, the FA rate for the younger group was higher than that of the older group. The group × typicality interaction did not reach significance [$F(1, 71) = 1.86, p > .05$]. Typicality effect was the only significant effect [$F(1, 74) = 300.63, p < .001$] found in the CHR score analysis. This result indicates that the two age groups did not differ on their sensitivity measure of recognition (controlling for response bias effect) [$F(1, 74) = .39, p > .05$] and that typicality affected both groups to the same extent [$F(1, 74) = .43, p > .05$]. The possible gender effect also was tested with the weighted scores. As with the unweighted scores, with the one exception in which men were found to have a higher HR than women [$F(1, 73) = 5.55, p < .03$], gender effect or the interactions with it did not reach significance and did not affect the pattern of the results reported.

Table 3. *Mean (and Standard Deviations) of Percent Weighted HR, FA, and CHR Score of Typical and Atypical Actions for Both Age Groups*

	Age Group			
	Young[a]		Old[b]	
Typicality	**M**	**SD**	**M**	**SD**
HR				
Typical	80.08	9.19	78.32	11.62
Atypical	88.98	9.33	79.93	18.16
FA				
Typical	42.19	12.47	40.15	12.92
Atypical	11.92	10.97	5.54	8.68
CHR				
Typical	38.44	15.52	37.85	13.96
Atypical	76.99	17.15	73.59	20.12

Note: HR = hit rate; FA = false alarm rate; CHR = corrected hit rate.
[a]$n = 41$. [b]$n = 36$.

Discussion

Although the typicality effect is well documented in younger adults, evidence concerning the existence of the effect for older adults is controversial (Hess 1985; Light & Anderson, 1983). In this study, script memory for typical and atypical actions in younger and older participant was tested. An attempt was made to maximize the sensitivity of the memory measures in two ways. First, a variety of scores were derived and analyzed (i.e., HR, FA, and CHR); second, performance was scored with and without taking into account the participants' confidence rating.

Confidence rating enabled us to detect a difference in the response bias of the two groups. The confidence rating scale ranged from 1 (*certain that the sentence appeared*) to 5 (*certain that the sentence did not appear*). As can be seen in Table 2, the groups did not differ in their tendencies to choose 1 on the scale when they were certain that the sentence did appear. However, the groups did differ in frequency of choosing the other scores on the confidence rating scale. The younger participants tended to choose the middle points of the scale more frequently than the older participants. However, the older participants tended to choose the score 5 more frequently than the younger participants. This choice by the older group reflects a conservative response bias, as previously reported in the literature (McCormack, 1981). This conservative response bias by the elderly group is reflected in the tendency toward a lower FA rate compared with the younger group when weighted scores were analyzed. An alternative way of looking at these results is that older participants were more likely than younger participants to use the extremes on the scale. Furthermore, it is possible that the younger and older participants differed in their strategy in the use of 3 response. If participants interpreted 3 as a

nonresponse, as we interpreted it in the unweighted scores analysis, then the fact that younger participants chose this response more frequently than older participants suggests that they used a more conservative response criterion than the older adults. Regardless of the interpretation, the fact remains that the younger and older participants differed in their response pattern. Taking confidence rating into account enabled us to detect the different response pattern between the two age groups.

In general, as can be seen in Tables 1 and 3, a similar pattern of results was obtained whether or not the confidence rating was taken into account. Nevertheless, in several instances, the analyses using weighted scores were more sensitive to differences than those using unweighted scores. In the HR analyses of weighted and unweighted scores, the typicality effect (i.e., more atypical than typical actions were recognized) reached significance. However, although the group effect and group × typicality interaction did not reach significance in the unweighted scores analysis, it reached significance in the weighted scores analysis. Thus, the weighted scores were more sensitive in detecting group difference in the typicality effect, as is reflected in higher HR for the atypical compared with the typical sentences for the younger, but not for the older, participants.

A dramatic typicality effect was found in the FA rate analyses (i.e., higher FA rate in the typical than in the atypical sentences) whether using weighted or unweighted scores. Similarly, in both scoring systems, the group × typicality interaction failed to reach significance. Thus, both groups showed typicality effect to the same extent when FA rate was analyzed with either scoring system. Group effect (i.e., higher FA rate of the younger compared with the older group) was detected only with the weighted scores analysis. In the analysis of the CHR, identical results were obtained with either scoring method. The groups were not reliably different from each other, and both showed the typicality effect to the same extent.

The inconsistent findings in the literature with regard to the age dependence of the typicality effect are reflected in the analyses of the different scores in this study. On the one hand, the analysis of the weighted HR scores suggests that the younger, but not the older, participants show the typicality effect. On the other hand, the analyses of FA and CHR and unweighted HR scores suggest that both age groups demonstrate typicality effect. In our opinion, therefore, a key factor in understanding the effect of age on the typicality effect is taking into consideration the older group's conservative response bias. As can be seen in Tables 1 and 3, the advantage in HR of the younger group over the older group was more pronounced with the atypical sentences than with the typical sentences. The conservative response bias of the older group is a useful strategy when applied to typical sentences, counterbalancing the tendency to respond positively to typical sentences that were not presented in the learning phase. However, conservative response bias, when applied to atypical sentences that do not look relevant to the context of the script, results in a lower HR compared with the younger group. This also explains the FA rate results, in which both age groups showed a dramatic typicality effect that reflects the higher conservative response bias applied to the atypical foil sentences. As a result, the typicality effect is demonstrated for the two groups, with the lower FA rate of the atypical compared with the typical sentences. The findings with the CHR measure also could be interpreted along the same lines. Typicality effect was observed to the same extent for both groups because this measure corrects for the response bias and thus minimizes the age-related differences between the groups.

This study demonstrated the important role of decision processes in memory, particularly when measured with a recognition test (see a recent review and meta-analysis of this issue in Gardiner, Ramponi, & Richarson-Klavehn, 2002). In addition to the theoretical implications, these findings could have an important clinical contribution in terms of assessment and remediation of age-related memory impairment. Different response criteria between two groups or two people could lead to a distorted picture of their real memory ability. As a result of a conservative response bias, an individual might mistakenly view himself or herself or be viewed by others as having deficient memory. One way of distinguishing between the strength of the memory traces and the response bias is by taking into account the FA rate in addition to the HR. The signal detection method was one of the first methods to offer a systematic approach for independent measurement of memory strength and response bias (Green & Swets, 1974). Confidence rating, as performed in this study, is an additional way to demonstrate the differences in decision criteria. Accordingly, recognition can be weighted according to the confidence the participant expressed for the particular answer.

As mentioned in the introduction, we chose to focus on the typicality effect as related specifically to scripts because of their ecological validity. In other words, scripts simulate familiar, real-life situations in which we are frequently expected to retrieve specific information (e.g., names, time, prices) encountered in the par-

ticular situation (i.e., shopping or visiting a restaurant). The results of this study indicate that older participants' memory is affected by their relatively stringent response criteria. Asking an elderly person for confidence rating could be a useful intervention tool for improving memory functioning. By being aware of one's own response criteria, as reflected by the confidence rating answers, an individual has the option to change it or to adjust it according to the situation. In some situations, adopting a more stringent response criteria could be a more appropriate strategy (i.e., when an error could be very embarrassing), although in other situations, adopting a lenient response criteria could be the more suitable strategy.

Paradoxically, our conclusion is that in this experimental paradigm, the schema has a negative effect on recognition because the typical actions "mislead" the person's recognition. In real-life situations, the schema usually has a more positive effect on recognition by making available to memory all the other possible typical items. But just like in the experimental situation, it could be the basis for false memory, the type of memory investigated in the eyewitness literature (Loftus, 1981).

Finally, this study demonstrates that the different response bias of older, compared with younger participants, could affect memory performance as measured by standard recognition tests. Taking the FA rate and the confidence rating into account was found to be a useful way to cope with this issue, while providing a sensitive scoring method.

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