Implicit Memory Effects When Using Pictures With Children and Adults: Hypermnesia Too?

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ABSTRACT. Pictorial stimuli were used to investigate implicit- and explicit-memory phenomena in 3 experiments. The general procedure involved the presentation of a series of pictures during a study phase, followed by an implicit-memory test and an explicit-memory test. In the implicit-memory test, participants were presented with picture fragments and were instructed to write down what the fragment looked like. In the explicit-memory test, participants were asked to make a yes/no recognition decision regarding each picture. For children, implicit memory for pictures was robust when they were tested after a 48-hr interval, but that effect declined after 1 week; a similar implicit-memory effect for pictures was seen with college students; and the time course of the implicit-memory effect for pictures among college students (all short intervals of less than 1 week—1, 2, 3, 4, and 5 days) produced a more elevated implicit-memory performance than during the immediate testing condition. Hypermnesia may have been the cause of the increase in memory performance over the short intervals.

Implicit-memory performance has often been studied using verbal stimuli (e.g., Graf & Mandler, 1984; Rajaram & Roediger, 1993; Tulving, Schacter, & Stark, 1982), but do similar effects occur with nonverbal stimuli, such as pictures? Implicit memory is demonstrated when information obtained earlier is used in a later task, with the key manipulation being that no overt connection is given to the participants about the relationship between earlier experimental events and the later task. The beneficial effect of implicit memory is often expressed as priming, the elevated performance on a task for certain stimulus items, compared with baseline or control-item performance. That is, priming is thought of as a marker or an index of implicit memory in operation.

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Implicit memory is a robust phenomenon, occurring among college students (Graf & Mandler, 1984; Tulving et al., 1982), the elderly (Light & Singh, 1988), amnesics (Shimamura, 1986; Squire, Shimamura, & Graf, 1987), and even those in the early stages of Alzheimer's disease (Landrum & Radtke, 1990).

Implicit-memory testing differs from the more traditional type of explicit-memory test. In explicit-memory tests, participants are overtly instructed that there is a connection between a presentation of items and a subsequent memory test. Participants are given specific instructions to remember items for a later test. In young adults, explicit-memory accuracy is superior to implicit-memory accuracy (Richardson-Klavehn & Bjork, 1988; Tulving et al., 1982). However, what has been particularly intriguing in this area is the dissociation between implicit- and explicit-memory performance. For example, with Alzheimer's and amnesic patients, explicit memory may be at chance (guessing) levels, but implicit-memory effects are still present (demonstrated by a significant amount of priming). In the elderly, a similar dissociation is often seen, with intact implicit-memory performance but explicit-memory performance that is inferior to that of young adults. Even in young adults, dissociations are prevalent in the study of retention-interval effects. Although implicit memories may be stable over time, explicit memories typically decline (Tulving et al., 1982).

As the study of implicit memory has progressed, so has the precision of its measurement. Implicit-memory tests can be subdivided into various types. An implicit-conceptual-memory test involves the presentation of stimulus items followed by a priming-type task, whereas an implicit-perceptual-memory test requires participants to identify a fragmented stimulus as quickly as possible (Adler, 1993; Rajaram & Roediger, 1993). For example, an early implicit-memory test was Jacoby and Dallas's (1981) perceptual-identification task, in which participants in an earlier portion of the experiment viewed words displayed for 30 ms each. In a later phase, a second set of words was presented and the participant was told to read them aloud. Priming occurred when participants read aloud the words they had previously seen for 30 ms; it did not occur with words that they had not previously seen. In the studies discussed above, implicit-memory performance was sensitive to past perceptual experiences.

The majority of implicit-memory research has used verbal (word) stimuli; in the present study, I examined the effects of pictorial stimuli on implicit memory. Pictures have been used in implicit-memory tests by Weldon and colleagues (Roediger, Weldon, & Challis, 1989; Weldon & Jackson-Barrett, 1993; Weldon & Roediger, 1987), and pictures have long been used in explicit tests of memory (e.g., Shepard, 1967; Standing, 1973).

In all of the experiments of the present study, the picture-fragment identification task was based exclusively on picture stimuli. In the picture-fragment identification test, participants are given degraded pictorial stimuli and told to record the first word that came to mind. My goal in this series of experiments was to expand current knowledge of how picture stimuli operate under implic-
Several questions motivated the present series of experiments. First, are implicit-memory effects present in children? Adler (1993) has noted a recent interest in this area, and if implicit memory is robust in a number of populations, might it also be present in children as well? The experiments reported here were part of a longer sequence of studies designed to compare the persistence of implicit memories over time of children, young adults, and those with Alzheimer’s disease. A popular notion in Alzheimer’s disease research is that in the latter stages of the disease, the patient regresses toward a more childlike state. In the long-range study, the number of persons with Alzheimer’s disease was prohibitively small (n = 6); thus, those data are not reported here.

I also wanted to investigate the long-range persistence of priming effects in implicit-memory tasks. Previous word-stimuli studies have found effects to last from less than 2 hr (Graf & Mandler, 1984) to at least 2 weeks (Tulving et al., 1982), and even as long as 16 months (Sloman, Hayman, Ohta, Law, & Tulving, 1988). More recent work, however, has indicated that some of the wide range of results may be related to the specific type of implicit-word task used (e.g., word-stem completion, word-fragment completion, anagrams; Roediger, Weldon, Stadler, & Riegler, 1992). Is implicit-memory performance with pictures found in children? If so, how long does the priming effect last? What are the parallel effects for young adults, in terms of the magnitude of implicit memory for pictures and the time course for those effects?

My final goal in the present series of experiments was to examine in more depth the changes that occur in retention intervals lasting 1 week or less. What are the patterns of increases and decreases in implicit- and explicit-memory performance seen at the second testing interval?

I conducted three experiments. Experiments 1 and 2 were parallel longitudinal studies involving implicit-picture priming in children (3rd graders) and young adults (college students). In Experiment 3, I further explored an unexpected increase in performance after 48 hr.

**Experiment 1**

My goal in Experiment 1 was to extend understanding of the implicit-memory-picture phenomenon in two directions. Explicit memory has been studied in children (Ballard, 1913; Brown, 1975; Keeney, Cannizzo, & Flavell, 1967), but what about implicit memory? What is the time course for implicit-memory performance for pictures?
Method

Participants and design. Twenty-two third graders participated in this study as volunteers. Informed consent was obtained from parents as well as children before participation in the experiment was allowed. A 2 x 4 design included the variables priming (presented, control) and retention interval (immediate, 48 hr, 1 week, 6 months). To clarify the change in priming over time, I present the results in two different formats, with three retention intervals (n = 22) and four retention intervals (n = 18).

Materials. I selected a pool of 84 pictures from the Snodgrass and Vanderwart (1980) norms. Four slides were reserved as practice slides (two for implicit memory, two for explicit memory). I divided the remaining 80 slides into two 40-slide sets, A and B. The slides for the picture-fragment identification task were prepared by copying the full image and then randomly deleting portions of the image, typically leaving less than 50% of the original image intact as a picture fragment.

Procedure. In the initial design of the study, five retention intervals were desired: immediate, 48 hr, 1 week, 6 months, and 1 year. Participants were presented with Slide Set A (40 slides) or B (40 slides) at the initial testing session. With the five testings, each set was then subdivided into five subsets of 8 slides each (A1, A2, A3, A4, A5, B1, B2, etc.). Wherever possible, slides sets were counterbalanced so that some participants viewed Set A as presented slides (with Set B as control slides), whereas others viewed Set B (with Set A as control slides). An implicit-memory test at a particular interval might involve the presentation of A2B2 fragments—16 implicit-memory test slides, 8 that participants had seen during the study phase and 8 that were new. The explicit-memory test followed the implicit-memory test on the same A2B2 slides.

Participants were presented with 40 slides (A or B) for 5 s each and were told that they would later be tested on their memory of those slides. Before the explicit-memory test, however, implicit memory was tested. (Participants were not told that they were being tested; the procedure was presented as a picture game to pass time until the "real" test, the explicit-memory test.)

This implicit (8 presented and 8 control slides) and explicit (8 presented and 8 control slides) sequence was repeated for the same participants 48 hr later, 1 week later, and 6 months later. In the explicit-memory tests, participants receiving pictures were asked to make a yes/no decision as to whether they had seen the pictures before. Throughout the experiments, "correct" in the explicit-memory condition referred to the sum of reporting "yes" on previously seen items and reporting "no" on the items not previously seen.

In this study, priming served as an index of the degree of implicit memory present. In this "presented-control" paradigm, participants were presented with a subset of available stimuli. These items were called presented. The remaining set
of stimuli, called control, were items that the participant had not seen. If a participant correctly reported a control item, it was considered a chance occurrence. In this entire series of experiments, presented referred to the stimulus items previously presented that the participant had correctly identified in the implicit-memory task (the “correctness” of the response was judged from the experimenter’s point of view, not the participant’s). Control referred to those items not previously presented but correctly reported by the participant on the implicit-memory task. Hence, this within-subject variable (presented vs. control) served as an index or measure of implicit memory (priming), with each participant serving as his or her own control. See other studies by Landrum (Landrum, 1993; Landrum & Radtke, 1990) for details on the use of this presented-control paradigm.

Retention interval was a within-subject variable; that is, the same third graders participated in an implicit- and an explicit-memory test immediately following the study phase, 48 hr later, 1 week later, and 6 months later. For the latter three retention intervals, only the implicit and explicit tests were conducted; the study phase was not repeated in subsequent sessions. Immediately following the study phase but preceding the explicit-memory test, the implicit-memory task was presented. Participants were presented with 16 slides (8 previously presented, 8 controls), displayed for 8 s each, and participants were given the picture-game instructions. An explicit-memory test followed: 16 slides were presented (8 previously presented, 8 controls) for 5 s each, and participants completed a yes/no recognition task. After testing at the 6-month interval, it became apparent that no further testing was necessary.

Results and Discussion

The results of participants’ implicit- and explicit-memory performance at three intervals and four intervals are presented in Table 1. I have two reasons for this dual presentation: (a) the number of participants between the 1-week test and the 6-month test decreased by 4, and (b) that particular organization of the table and the analyses of the results highlight the persistence of implicit memory over 1 week and its decline over 6 months. All significant statistical tests reported here were significant at the $p < .05$ level.

**Implicit memory, three retention intervals.** Across all three retention intervals, a significant degree of implicit-memory priming occurred, $F(1, 21) = 38.89, MSE = 1.25$. The retention interval main effect (collapsing across presented and control items) also indicated that the overall amount of responding varied across retention intervals, $F(2, 42) = 6.74, MSE = 1.21$. However, the Priming × Retention Interval interaction was also significant, $F(2, 42) = 66.30, MSE = 1.12$. These combined results suggest that whereas the amount of priming seen on each day was significant (even 1 week later), the degree of priming observed over the three intervals varied significantly. A primary source of this variance was at the 48-hr
<table>
<thead>
<tr>
<th>Condition</th>
<th>Immediate</th>
<th>48 hr</th>
<th>1 week</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implicit memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presented</td>
<td>51.7</td>
<td>52.8</td>
<td>42.6</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>21.5</td>
<td>9.6</td>
<td>28.4</td>
<td></td>
</tr>
<tr>
<td>Priming</td>
<td>30.2</td>
<td>43.2</td>
<td>14.2</td>
<td></td>
</tr>
<tr>
<td>Explicit memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>84.6</td>
<td>73.0</td>
<td>63.6</td>
<td></td>
</tr>
</tbody>
</table>

**Three retention intervals (n = 22)**

| Implicit memory    |   |     |     |          |
|--------------------|   |     |     |          |
| Presented          |   |     |     |          |
| Control            |   |     |     |          |
| Priming            |   |     |     |          |
| Explicit memory    |   |     |     |          |
| Correct            |   |     |     |          |

**Four retention intervals (n = 18)**

interval; in fact, implicit-memory performance grew over 48 hr (hypermnesia). A simple-effects analysis of the implicit-memory, presented performance indicated no significant differences, $F(2, 63) = 2.28$, $MSE = 1.93$. However, the significant interaction stemmed from the control items that did differ significantly, $F(2, 63) = 14.12$, $MSE = 0.89$. Simple comparisons of the three levels of control performance revealed that the 48-hr level differed significantly from the immediate ($F = 11.14$) and 1-week ($F = 27.56$) conditions, but the immediate and 1-week conditions did not differ significantly from each other, $F = 3.65$, ns.

The net increase in priming at the 48-hr retention interval was related to continued strong performance on presented items, with a concurrent drop in the correct identification of the control item. Control items declined significantly at the 48-hr interval and rose again at the 1-week interval (see Table 1). Persistence of presented-item performance over the interval provided some evidence for implicit memory. However, what explains the decrease in control items? This was an unexpected result; the results of Experiment 2 may shed more light on this outcome. It is important to note, however, that at the 1-week interval, a significant amount of priming still occurred, but the amount of priming was significantly less than that in the immediate and 48-hour conditions. Significant priming occurred at all three intervals, as indicated by the tests of simple effects: immediate, $F(1, 21) = 50.66$, $MSE = 1.26$; 48 hr, $F(1, 21) = 93.09$, $MSE = 1.41$; and 1 week, $F(1, 21) = 11.36$, $MSE = 1.25$. 


Explicit memory, three retention intervals. The participants' accuracy in explicit-memory performance ("yes" response to items previously seen, "no" response to items not seen), was high (see Table 1, top). However, as one would expect with explicit memory, their performance declined significantly over 1 week, $F(2, 42) = 16.71$, $MSE = 3.74$, indicating typical forgetting.

Implicit memory, four retention intervals. The results changed significantly for the four-interval implicit-memory test. Four fewer participants participated at the 6-month interval than at the 1-week interval (the third graders were then fourth graders). With the fourth interval included, the main effect of priming was non-significant, $F(1, 17) < 1$, whereas the retention interval main effect and the Retention Interval $\times$ Priming interaction were both statistically significant, $F(3, 51) = 31.16$, $MSE = 1.12$, and $F(3, 51) = 32.36$, $MSE = 0.93$, respectively. The addition of the 6-month interval clearly indicated that beneficial implicit-memory performance, or priming, was nonexistent at 6 months, even though it was present at the 1-week interval. This finding of no significant priming overall occurred with the addition to the analysis of the data for the 6-month interval (this pattern of results helped determine how I divided my analysis in this section into data for three- and four-interval sections).

Explicit memory, four retention intervals. The explicit-memory recognition tests showed a pattern of results similar to those for the three-retention interval (see Table 1, bottom), with a significant decline over time, $F(3, 51) = 34.12$, $MSE = 3.48$.

**Experiment 2**

Given the implicit memory for pictures in children and the implicit hypermnnesia result found in Experiment 1, I designed Experiment 2 as a partial replication with college students. Issues of interest in Experiment 2 were whether the implicit-memory performance for pictures would be demonstrated in college students as it was in children and whether the patterns of persistence and decline in implicit and explicit memory performance would be similar.

**Method**

Participants and design. Thirty-one undergraduates in an introductory psychology course participated for course credit. I used a 2 (priming: presented, control) $\times$ 3 (retention interval: immediate, 48 hr, 1 week) design. Although I had wanted to include a 6-month interval, only 7 participants returned; I excluded their data from the analysis.

Materials. The materials were identical to those used in Experiment 1.
Procedure. The procedures followed were identical to those in Experiment 1, except that the 6-month interval was not sufficiently represented; thus, I excluded the results for that interval from the analysis.

Results and Discussion

Implicit memory. The results for both implicit and explicit memory performance are presented in Table 2. Implicit memory for pictures was significant, $F(1, 30) = 14.02$, $MSE = 1.25$, as was the Priming $\times$ Retention Interval interaction, $F(2, 60) = 60.77$, $MSE = 1.19$. These results were similar to those for the children's implicit-memory performance: gains in implicit memory at 48 hr (hypermnesia). In addition, whereas the intensity of priming may not have been as great as with the children, the time course showed no decline at 1 week; in fact, there was 22.1% priming a week later but only 19.7% immediately following the presentation of the slides. Thus, the interaction was significant because of the increase in priming at 48 hr. Tests of simple effects indicated no significant differences from the presented performance levels, $F(2, 59) < 1$, nor any significant difference between the control performance levels, $F(2, 59) = 2.42$, $MSE = 1.96$.

Explicit memory. For explicit memory (see Table 2), participants were highly accurate, overall, in recognizing previously seen pictures, but their accuracy did decline significantly over time, $F(2, 60) = 25.10$, $MSE = 3.49$. That pattern was similar to that of the children's data, in that recognition was generally good but it declined over time, as one would typically expect.

Experiment 3

I designed Experiment 3 to explore the implicit-picture memory effect occurring over short retention intervals. In the two previous experiments, I found that

<table>
<thead>
<tr>
<th>Condition</th>
<th>Immediate</th>
<th>48 hr</th>
<th>1 week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implicit memory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presented</td>
<td>45.1</td>
<td>44.3</td>
<td>48.3</td>
</tr>
<tr>
<td>Control</td>
<td>25.4</td>
<td>17.3</td>
<td>26.2</td>
</tr>
<tr>
<td>Priming</td>
<td>19.7</td>
<td>27.0</td>
<td>22.1</td>
</tr>
<tr>
<td>Explicit memory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>88.1</td>
<td>76.4</td>
<td>67.1</td>
</tr>
</tbody>
</table>
a 48-hr interval elicited net improvements in implicit memory in a picture-fragment completion task. My goal in Experiment 3 was to determine whether there was something unique about the 48-hr interval or whether any short interval would yield a net increase.

Method

Participants and design. Seventy-two students from an introductory psychology course participated for course credit. The 2 x 5 design included the variables priming (presented, control) and retention interval (24, 48, 72, 96, or 120 hr). I analyzed the immediate-performance condition separately. An important design difference in Experiment 3 was that retention interval was a between-subjects variable, whereas in Experiments 1 and 2, the same participant was tested at different intervals. In Experiment 3, I tested one group of participants immediately, then again 24 hr later; a second group was tested immediately, then 48 hr later, and so forth. Hence, for each of the retention intervals, the return session was always the second session for the participant.

Materials. The materials were identical to those used in Experiments 1 and 2. Instead of using five sets of 8 slides each for the multiple-retention intervals, I used two sets of 20 slides for the immediate and subsequent testing in the between-subjects design.

Procedure. The procedure followed those typical of this series of experiments: study phase followed by the implicit-memory test followed by the explicit-memory test. The key difference in this experiment was that participants were tested only twice: immediately and in their respective retention-interval condition (24, 48, 72, 96, or 120 hr later).

Results and Discussion

The results for both implicit- and explicit-memory performance are presented in Table 3. I evaluated immediate implicit-memory performance separately from that for the retention intervals (a) because of the between-subjects design of the retention-interval manipulation and (b) to assure that all of the immediate priming conditions were generally equivalent (to rule out preinterval differences).

Immediate interval. In the immediate implicit-memory picture-priming performance, there was significant priming across all conditions, \( F(1, 67) = 74.47, \text{MSE} = 1.25 \), but there was no significant difference in the degree of priming observed in the immediate session across the various intervals, \( F(4, 67) < 1 \).

Implicit memory. The implicit-memory measures I report here represent the second testing session of all the retention-interval groups (given my earlier
TABLE 3
Percentage of Correct Identifications by College Students in Implicit- and Explicit-Memory Tests, Over Five Retention Intervals: Experiment 3 (Between-Subjects Design)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Implicit memory</th>
<th>Explicit memory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Presented</td>
<td>Control</td>
</tr>
<tr>
<td>Immediate</td>
<td>42.5</td>
<td>22.5</td>
</tr>
<tr>
<td>24 hr</td>
<td>49.1</td>
<td>20.8</td>
</tr>
<tr>
<td>48 hr</td>
<td>36.7</td>
<td>11.7</td>
</tr>
<tr>
<td>72 hr</td>
<td>46.8</td>
<td>14.0</td>
</tr>
<tr>
<td>96 hr</td>
<td>58.9</td>
<td>22.3</td>
</tr>
<tr>
<td>120 hr</td>
<td>37.5</td>
<td>13.1</td>
</tr>
</tbody>
</table>

Conclusion that there were no preinterval differences in priming, I turned my attention to postinterval differences). Analysis of variance (ANOVA) indicated significant priming across all five intervals, $F(1, 67) = 154.58$, $MSE = 1.18$, but the degree of priming comparing all intervals (the Priming $\times$ Retention Interval interaction) was not significant, $F(4, 67) = 1.08$. This result indicated that the priming was equally good at all short intervals and the 48-hr interval had no special impact on implicit-memory growth. Tests of simple effects indicated significant differences among the five presented performance levels, $F(4, 67) = 5.12$, $MSE = 2.64$, but no significant differences among the control levels, $F(4, 67) = 2.33$, $MSE = 1.40$. A Tukey comparison of all five presented means (Keppel, 1991, p. 173) indicated a significant difference between the 96-hr presented performance and both the 48-hr and 120-hr presented performance.

When the immediate condition was compared with all later intervals, there was a significant Priming $\times$ Retention Interval interaction, $F(1, 71) = 7.27$, $MSE = 1.19$. To detect the nature of the change, I conducted $t$ tests comparing the immediate presented and later presented conditions and the immediate control and later control conditions. The results indicated no significant change in the presented condition performance over time (42.5% vs. 44.6%), $t(71) = 1.16, ns$. However, there was a significant change in the control condition performance over time (22.5% vs. 16.3%), $t(71) = 2.72, p < .01$.

Explicit memory. In the second sessions only in Experiment 3, the participants were accurate in their picture recognition (see Table 3), but that accuracy also varied significantly with the particular intervals, $F(4, 67) = 4.80$, $MSE = 3.36$. At longer intervals, explicit memory seemed to decline, although that trend was not strictly linear (see Table 3).
General Discussion

Summary of Experiments

In the present series of experiments, some trends emerged. For example, implicit memory for picture stimuli is an extremely robust phenomenon, as was demonstrated in all experiments. In Experiment 1, third graders were given implicit-and explicit-memory tests with picture stimuli immediately following presentation and 48 hr, 1 week, and 6 months after the initial presentation. I observed significant implicit memory through the 1-week interval but not 6 months later; however, explicit memories declined as expected. Surprisingly, implicit memories revealed hypermnesia, improving significantly from immediate testing at the 48-hr retention interval. I retested this outcome in Experiment 2 in a similar procedure with college students (but I did not test the 6-month interval). The college students also demonstrated significant improvements in implicit-memory performance at the short interval, and in both sets of participants, the source of this effect was a reduction in control items reported. In Experiment 3, I further explored the issue of whether short retention intervals produce implicit memory for pictures and found (in a between-subjects design) priming to be elevated at 1, 2, 3, 4, and 5 days after presentation.

Implicit Memory for Pictures

The present results confirm and substantially enhance our understanding of implicit memory for pictures. It has been known for some time (Standing, 1973) that college students’ explicit memory for pictures was superb, and my results echo those findings. Generally, implicit-memory performance is inferior to explicit-memory performance, except in certain populations (amnesics, Alzheimer’s disease patients).

With the within-subject testing in Experiments 1 and 2, subsequent implicit-memory tests demonstrated a decrease in the number of control items reported at a short interval, followed by an increase in the control items’ intrusions. The pattern of means (see Table 3) demonstrated the same trend in a between-subjects design. Why does control-item performance dip at a short interval but return over longer periods of time? The results of the current study offer no adequate answers to this question; this unexpected result should be examined in future studies.

Conclusions

In the struggle to understand memory, organizing prior research and theories becomes difficult. Tulving (1985) highlighted this distinction by asking, “How many memory systems are there?” When any new development occurs, often a new memory system is invented or a new process is defined. Implicit memory
may be thought of as a process that routinely occurs, even among those with
cognitive, explicit-memory impairments (Landrum & Radtke, 1990; Squire et al.,
1987). Although the implicit-explicit processing distinction (dichotomy) certain-
ly has gained importance recently, other processes do influence and interact sig-
ificantly with the explicit-implicit distinction (e.g., transfer-appropriate pro-
cessing, data-driven vs. conceptually driven processing). When one takes views
the cognitive underpinnings of memory realistically, a complex set of factors
emerges, factors that influence our everyday memory performance.

Implicit memory continues to be robust and reliable for both words and pic-
tures. When implicit- and explicit-memory tests share some characteristics (i.e.,
cued recall), similar but not identical patterns of results (memory improvement)
may occur. In addition, implicit memory for pictures occurs in children as well
as in adults, and over short intervals, there is no decline in implicit-memory per-
formance; instead, there is actual memory growth, although explicit-memory per-
formance decreases as expected over time.

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