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Are There Developmental Differences in Reality-Monitoring?

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The question addressed by the present experiment is whether the ability to distinguish between veridical and imaginal memory representations changes with age. Second-grade, fourth-grade, and sixth grade children (8, 10, and 12 years old) and college students were shown pictures of familiar objects. Each picture was presented one, two, or three times and, interspersed with these presentations, subjects were asked to imagine each picture zero, one, or three times. Subsequently they were asked to judge the presentation frequency of each picture. For all groups, imagining the pictures resulted in inflated estimates of event frequency. However, contrary to the idea that children have a particularly difficult time discriminating externally generated from internally generated memories, one analysis indicated adults were actually somewhat more affected than children by the imagination trials.

Many of us have had the experience of discovering that a conversation or other event we believed had actually occurred took place only in our imagination. In addition, it is commonly thought that children are particularly susceptible to confusing real and imagined events. This notion based

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on everyday observation is not a new idea. For example, Piaget first suggested in 1929 that children have difficulty discriminating between thoughts and the things thought of, and that they display amnesia about the origins of knowledge and mistake memories of dreams for memories of waking events. Piaget also concluded that children do not reliably discriminate between "the psychical and internal [as opposed to] the material and external" until about the age of 11 or 12 years old.

Such a general confusion between external reality and the self might be manifested in a variety of ways. Here the primary focus was the process of *reality monitoring*, or discriminating memory representations of past perceptual events from memory representations of past imaginations (Johnson, 1977). The ability to distinguish between veridical and imaginal memory representations might particularly be expected to improve with age since other metamemory processes show developmental trends (e.g., Brown, 1975; Kreutzer, Leonard, & Flavell, 1975). There are, of course, many types of imaginal events that produce memories which might be confused with perceptually-derived memories. For example, there are re-representations of perceptual experience or remembering something previously experienced; elaborative and associative processes which augment, bridge, or embellish ongoing perceptual experiences; novel combinations of information which produce fantasy events that take place in some sense only in our imagination. The present experiment is concerned with the first of these; that is, are adults better able than children to distinguish memories for externally-generated events from memories for internally-generated re-representations of those events?

Several methodological problems had to be resolved before a reasonable attempt could be made to address the general problem of reality monitoring. A number of paradigms might be useful in this context. For example, confusion between factual and imaginal representations might be reflected in intrusions of thematic material in recall (e.g., Bartlett, 1932), false recognitions of words related to list items (e.g., Cramer, 1972, 1973; Underwood, 1965), and false recognition of inference sentences which are not necessarily true but which are likely or reasonable in light of past experience (e.g., Johnson, Bransford, & Solomon, 1973; Sulin & Dooling, 1974). However, these tasks were not selected because it is not always clear that the critical interpretation or imagination processes take place prior to the test, if they occur at all; thus these tasks do not necessarily reflect confusion among memories. Memory for the gist or structure of information may lead to errors in recognition or distortions in recall even when the false information was not previously represented in memory (Johnson, Note 1; Johnson, Taylor, & Raye, 1977). In addition, across age groups, there may be changes in the probability that inferences, associations and other spontaneous thought activities take place, as well as changes in response biases on subsequent tests (e.g., see Lindauer & Paris, 1976).

Johnson, Taylor, and Raye (1977) and Johnson and Raye (Note 2) have recently introduced a task which provides greater control over subjects' covert responses. Events are presented varying numbers of times. Interspersed with these presentations are trials where subjects are asked to generate the items. Subjects subsequently judge the frequency with which the externally presented events appeared. The confusion of factual with subject-generated representations is reflected by the degree to which increasing the number of subject-generated events inflates judgments of presentation frequency. The original studies using this task demonstrated that adults do indeed confuse the frequency of these two types of events since both overtly producing or merely thinking about words (Johnson et al., 1977) or imagining pictures (Johnson & Raye, Note 2) resulted in inflated estimates of external frequency.

This task was expected to be especially useful for comparing the ability of various age groups to discriminate between the sources of memory representations. In many tasks, there are substantial differences in performance between children and adults, but recording and estimating the frequency of external events seems to be much less subject to developmental differences (e.g., Hasher & Chromiak, 1977, Experiment 1).

METHOD

Design

During a sequence of alternating presentation and imagination trials, students looked at and were asked to imagine colorful pictures of common objects. Following this phase of the experiment, students were asked to judge the number of times they had *seen,* as opposed to had imagined, each picture. Students were selected from each of four grade levels, second grade, fourth grade, sixth grade, and college. Over the course of the experiment, each picture was seen either one, two, or three times, and students imagined items occurring at each of the three presentation frequencies either zero, one, or three times. The design was thus a 4 (grade levels) $\times$ 3 (presentation frequency) $\times$ 3 (imagination frequency) factorial with the last two variables occurring within subjects.

Subjects

The grade school children were students at a suburban Catholic school. The mean ages of the children were 8 years and 8 months, 10 years and 7 months, and 12 years and 9 months for second-, fourth-, and sixth-grade groups, respectively. The school serves a middle class to upper middle class neighborhood. All children received parental consent to participate.

The college students were enrolled in a summer term introductory psychology course. At each grade level there were 16 subjects.

Materials

Thirty-six pictures representing common objects that would be familiar to young children were selected from children's picture books and photographed in color for slide presentation. The 36 pictures were assigned randomly to the nine conditions produced by the factorial combination of three presentation frequencies (1, 2, 3) and three imagination frequencies (0, 1, 3). In all, 72 slides were presented: 12 pictures were shown once, 12 pictures were shown twice, and 12 were shown three times. On each presentation trial, nine different pictures were shown successively. On each imagination trial, subjects were asked to imagine six different items. That is, items with presentation frequencies greater than one were repeated across, not within, trials. Similarly, repetitions of imaginations occurred across, not within, trials. Items were assigned to both presentation and imagination trials and positions within trials randomly, with the restriction that no item ever be imagined prior to its initial presentation and that items from different conditions be distributed as similarly as possible throughout the sequence. This procedure was then repeated to make up a second sequence of materials. No item was used in the same condition in both assignments. The order of items for testing on the frequency judgment task was arrived at by constructing two random assignments of items. Each presentation sequence was used equally often with each final test sequence creating four sets of materials.

Procedure

All subjects were tested individually. The grade school children were tested in an unused classroom and were called from their own classrooms according to a random assignment across the three grade levels. Children and teachers were given appointment slips each morning. The college students signed up for appointments and were tested in a small experimental room. At each grade level, four students were assigned randomly to each of the materials sets for a total of 16 subjects per grade.

The instructions were written for the youngest children and were modified slightly for the oldest children and college students. Students were instructed that they would see pictures on a screen and were shown two examples which were not pictures from the experimental set. They were also told that there would be special trials on which they would be asked to remember the pictures in a "special way." They were told that this "special way" of remembering consisted of making "a picture in your mind" of the slides they would see. They were then asked to do this for the first example slide. To encourage them to actually imagine a picture we asked them a simple question about the first example slide they saw (the slide was an alligator and they were asked what color it was). They were then asked to imagine the second picture (a mailbox), and a question was asked about it (Was it open?). Questions about the slides were included as part of the instructions in order to encourage students to imagine the pictures as accurately as possible. During the experiment itself, subjects were not questioned about the content of the pictures.

The alternating sequence of eight presentation and eight imagination trials was explained. In the presentation trials slides were shown for 4 sec with a .8 sec slide-change interval. On the imagination trials, the experimenter gave the name of a picture each 5 sec. Students were informed of the nature of each trial, presentation or imagination, as it was about to begin.

After this sequence of presentation and imagination trials was completed, the experimenter changed slide trays and told subjects that their memory would be tested in a new way. Each picture they had seen on presentation trials was presented one at a time and subjects were asked to make a judgment of the number of times they had seen it. The request for frequency judgments of presentation events was clarified by using each example slide. Subjects were asked how many times they had seen the example slide on the screen. If an estimate other than one (the actual count) was given, subjects were further instructed that we wanted them to tell us only the number of times they had actually *seen* it (that we were not interested in the number of times they had imagined it). All subjects then agreed that they had seen the example slide only once. The sequence of 36 slides was then presented one at a time, with subjects making judgments at their own pace. If no judgment was given, the subject was instructed to guess.

RESULTS AND DISCUSSION

Two dependent measures were calculated and analyzed: the mean and median judged frequency averaged across the four items at each combination of the independent variables. Because there were few discrepancies, only those analyses using the means will be reported.

Judgments as a Function of Presentation Frequency

The mean judged presentation frequency as a function of presentation frequency for each imagination frequency and each age group is shown in Fig. 1. Judgments increased as actual presentation frequency increased [$F(2, 120) = 397.56$, $MS_e = .32$, $p < .01$]. The interaction between grade level and presentation frequency was also significant [$F(6, 120) = 3.34$, $p < .01$]. As can be seen by comparing the three left panels with the one on the right in Fig. 1, this interaction was primarily a consequence of the somewhat steeper slope for the college students as compared to the grade-school children.

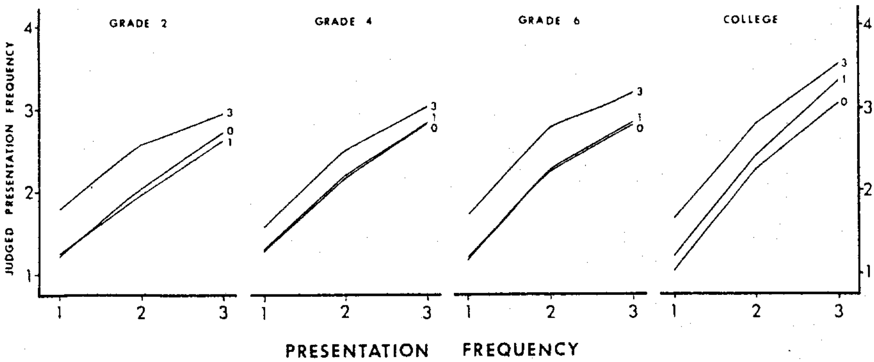

FIG. 1. Mean judged presentation frequency as a function of presentation frequency. Each panel represents a different age group and, within each panel, each line represents a different number of imagination trials.

With the college group omitted from the analysis, the grade by presentation frequency interaction did not approach significance [$F(4, 90) = 1.15$, $MS_e = .27$]. The absence of an interaction between age and frequency in this latter analysis replicated results reported earlier in an experiment that used words as stimulus materials (Hasher & Chromiak, 1977, Exp. 1). It should be noted that that study also had college-age students and failed to find any differences in judgments across all the age levels. The most likely source of the difference between these two studies lies with the materials, which in the present study were pictures and in the earlier study were words. There is some evidence in the literature of a developmental trend towards an inflated impact of pictures, as compared to words, on frequency judgments. While the evidence is by no means clear cut, the suggestion of an age by materials interaction may be seen in two tasks where frequency information plays a large role: verbal discrimination learning (Wilder & Levin, 1973) and frequency judgments (Ghatala & Levin, 1973).

Judgments as a Function of Imagination Frequency

The significant main effect of Imagination frequency [$F(2, 120) = 57.28$, $MS_e = .19$, $p < .01$] indicated that asking subjects to imagine the pictures increased their estimates of the actual number of times they saw the pictures. While the Grade by Imagination frequency interaction was not significant [$F(6, 120) = 1.42$], an inspection of Fig. 1 reveals a pattern to which the omnibus analysis of variance would be relatively insensitive. The confusion effect for the three groups of grade-school children was produced almost entirely by items which were imagined three times. A single imagination trial did not affect their judgments of frequency; items imagined once were given estimates equivalent to items never imagined. For college students, however, a single imagination trial did, relative to no imagination trial, increase judgments of actual frequency of occurrence (t, df = 15, = 2.83, $p < .05$). This evidently greater impact of a single imagination upon the college students as compared to the grade-school children poses an interpretational problem, since the opposite has been predicted.

One possible source of this difference might be that the children were initially less efficient generators of images than the adults. They may have had more difficulty adjusting to the experimental procedure, for example. If so, imaginations that took place on later trials should have produced a greater impact on frequency judgments than imaginations that took place on earlier trials. To consider this possibility, items imagined once were examined. Once imagined items occurred throughout the sequence of trials; therefore, for each presentation condition, the frequency judgment of the item which had been imagined earliest in the trial sequence could be compared with the frequency judgment of the item which had been imagined last in the trial sequence. At no age level was there any evidence that items imagined on later trials were assigned higher frequency judgments than items imagined on early trials. Thus there was no indication that children may have taken longer than adults to adjust to the task requirements.

Another possibility is that children and adults are equally likely to generate images on any given trial, but that adults' images are more accurate. Johnson and Raye (Note 2) found that the number of imagination trials affected frequency judgments of good imagers more than poor imagers and suggested that confusion between memories for perceptual experiences and memories for imaginations was related to the similarity between the two types of events. While this idea requires further investigation, it would explain the unexpected tendency of children to be *less* affected than adults by imagining the pictures. Children's images may have been less accurate, for example, because they could not remember a picture as well from the time it was presented to the time it was to be imagined. As a check on this possibility, items presented once and imagined once were separated for each subject into two categories, those items with the shortest delay between presentation and imagination and those with the longest delay. The frequency judgments for these two classes of items did not differ significantly for any age group nor did they show an overall tendency toward larger judgments for the short delay items. However, it should be noted that this lack of effect does not necessarily indicate that children's images were as accurate as those of adults, but may only reflect the fact that accuracy was not influenced in any of the age groups by the difference in short and long delays represented in the present experiment.

The larger issue to which this study was addressed is the problem of how we distinguish between memories for internal events and memories for external events. Do we gradually develop an ability to reality-monitor by, for example, learning to use cues associated with internal and external sources of information? Two aspects of the present results are consistent with the alternative notion that categories that represent the external, perceptual world and the internal world of imagination are well-developed by the second grade. First, the magnitude of the confusion effect was constant across the three grade-school levels. Second, even in the youngest age groups, imagining the pictures added less to judgments of presentation frequency than seeing the pictures.

Of course, attempting to recreate perceived experiences is only one type of imagination and frequency judgments are only one of many possible memory tests. The degree of confusion people show between memories for perceptions and memories for imaginations may depend on both the type of imaginal activity, the type of material and the way that confusion is measured. The present results suggest the interesting possibility that when performance depends on information as basic as frequency of occurrence (cf. Hasher & Chromiak, 1977; Johnson, 1977), and when the type of material perceived and imagined is the same, children discriminate between fact and imagination as well as (if not better than) adults.

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