Sex Differences in Episodic Memory

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ABSTRACT—*Research shows sex differences in episodic memory. These differences vary in magnitude as a function of the type of material to be remembered. Throughout the life span, verbal episodic-memory tasks yield differences favoring women. In contrast, episodic-memory tasks requiring visuospatial processing result in differences favoring men. There are also sex differences favoring women on episodic-memory tasks requiring both verbal and visuospatial processing and on face-recognition tasks. Thus, there may be a small, general episodic-memory advantage for women—an advantage that can increase by the advantage women have over men in verbal production and can be reversed by the male advantage in visuospatial tasks. In addition, environmental factors affect the magnitude of the sex differences in episodic memory.*

KEYWORDS—*sex differences; episodic memory; visuospatial; verbal*

Being able to remember events from one's past is essential for functioning in society. By now, it is well known that a number of factors, among them age and education, affect one's ability to remember. Whether one's sex also influences the ability to remember everyday events is less well researched. One reason may be that, in the first comprehensive review of this subject, Maccoby and Jacklin (1974) did not find sex differences in memory. However, the theoretical model of memory used by those researchers was different from that of current theories, which may explain why they did not find sex differences.

EPISODIC MEMORY

Although several theories of memory exist today, most investigators would agree that memory can be subdivided into two broad categories: working memory (or short-term memory) and long-term memory. Long-term memory can in turn be divided into subsystems, one being episodic memory. Episodic memory refers to the conscious recollection of unique personal experiences in terms of their content (what), location (where), and temporal occurrence (when; Tulving, 2001). Episodic memory is typically assessed by first presenting some information (e.g., episodes, words, objects, or faces), and by then asking the person to recall or recognize the earlier-presented information.

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What Impact Does Task Material Have on Sex Differences in Episodic Memory?

Although Maccoby and Jacklin (1974) did not find sex differences in memory, many more recent studies have found sex differences favoring women in episodic-memory tasks. For example, in a large population-based study of 1,000 adults between 35 and 80, we found sex differences on episodic-memory tasks in which the participants were told to try to remember lists of words, objects, or activities that had been presented earlier (Herlitz, Nilsson, & Bäckman, 1997). The difference between men and women on a word-recall task was $d = .25$ (see Fig. 1). d is computed by calculating the difference between the means of women and men, divided by the pooled standard deviation. Here, a positive value indicates that women perform at a higher level than men, and a negative value indicates that men outperform women. The closer the value is to zero, the smaller the difference. A d of .20 indicates that 59% of all women perform at a higher level than the average man. The comparable numbers for $d = .40$ and $d = .60$ are 66% and 73%, respectively. Notably, most tests used to assess episodic memory in clinical situations, such as the California Verbal Learning Test and subtests of the Wechsler Memory Scale, use similar materials as we did—that is, word lists, lists of objects, or pictures of objects. Women are typically found to perform at a higher level than men on these tests (e.g., Kramer, Delis, Kaplan, O'Donnell, & Prifitera, 1997).

Maccoby and Jacklin (1974) noted that girls excel on verbal tasks and that boys perform at a higher level than girls on visuospatial tasks. Sex differences in verbal and visuospatial tasks have since then been confirmed in numerous studies (e.g., Hyde & Linn, 1988; Voyer, Voyer, & Bryden, 1995). Because women excel on verbal-production tasks—for example, tasks requiring

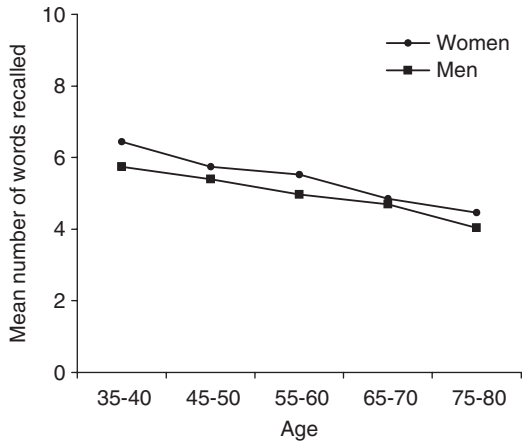

Fig. 1. Performance of 1,000 women and men on an episodic-memory task requiring participants to recall an earlier-presented list of words (Herlitz, Nilsson, & Bäckman, 1997).

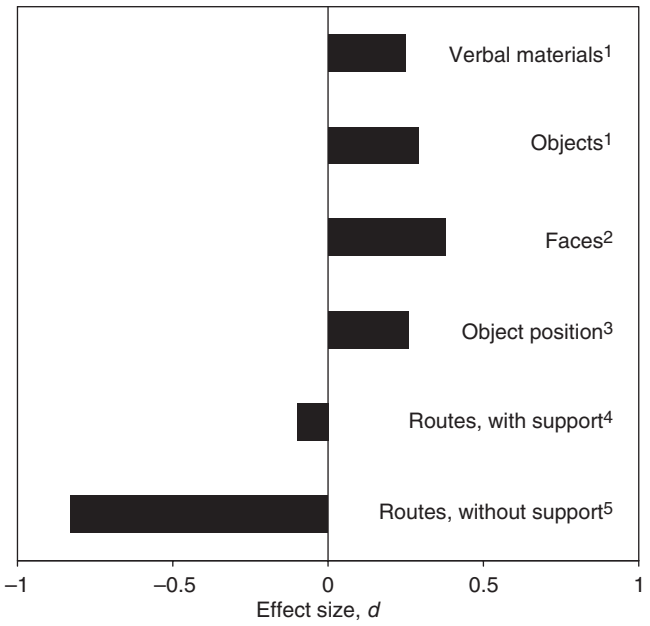

Fig. 2. Representative examples illustrating the pattern and magnitude of sex differences in episodic memory across different types of materials. The material to be remembered is, from the top, words,[1] objects,[1] faces,[2] object positions,[3] routes with environmental information,[4] and routes without environmental information.[5] A positive effect size, *d*, indicates that women perform at a higher level than men, and a negative *d* indicates that men perform at a higher level than women. Note: [1]Herlitz, Nilsson, & Bäckman (1997); [2]Lewin, Wolgers, & Herlitz (2001); [3]Voyer, Postma, Brake, & Imperato-McGinley (2007); [4]Crook, Youngjohn, & Larrabee (1993); [5]Astur, Ortiz, & Sutherland (1998).

participants to rapidly retrieve words starting with the letter *f* ($d = .33$; Hyde & Linn, 1988)—it may not be surprising that women also excel when they are asked to recall events that happened during the past year, day, or minute. Women may simply be at an advantage on such episodic-memory tasks due to their superior verbal-production abilities. Analogously, as men typically perform at a higher level than women on visuospatial tasks—such as understanding what an irregular figure looks like when it is rotated in space ($d = .56$; Voyer et al., 1995)—men can be expected to perform at a higher level than women on episodic-memory tasks requiring visuospatial processing. Although relatively few studies have examined sex differences in visuospatial episodic-memory tasks, it is clear that the pattern of sex differences is different than for verbal episodic-memory tasks (Lewin, Wolgers, & Herlitz, 2001). The magnitude of the male advantage seems to vary as a function of the extent to which the task relies on visuospatial processing versus the extent to which verbal processing can be utilized. As can be seen in Figure 2, which shows typical effect sizes (*d*) in various episodic-memory tasks, a task requiring participants to remember the route walked in a maze with little or no external information results in large sex differences favoring men (e.g., Astur, Ortiz, & Sutherland, 1998), whereas smaller sex differences are found in other route-finding tasks when external verbal information can support memory performance (e.g., Crook, Youngjohn, & Larrabee, 1993). Translated into real-life situations, a greater male advantage can be expected when walking back from the glade in a pine forest than when walking back from the museum to the hotel in Rome, as more varied and easily verbalized information is available in Rome, compared to the forest.

Of interest is also whether there are sex differences on episodic-memory tasks requiring both verbal and visuospatial processing. Notably, women outperform men on tasks requiring remembering an object's position, such as when playing the game Memory or when trying to remember where they last saw their keys (Voyer, Postma, Brake, & Imperato-McGinley, 2007; see Fig. 2). Thus, even though such tasks clearly require visuospatial processing, women may be able to use their verbal advantage to remember objects' positions. Are there sex differences on episodic-memory tasks requiring minimal verbal or visuospatial processing, such as when remembering unfamiliar odors? This is of interest, as the presence of sex differences on such tasks may suggest that there is an underlying sex difference in basic episodic-memory capacity that is present irrespective of the type of material to be remembered. Although not many studies have addressed this issue and more studies are needed, there are findings suggesting that women have a slight advantage over men on such tasks (Öberg, Larsson, & Bäckman, 2002).

Face Recognition

Many studies have shown that women outperform men on face-recognition tasks (e.g., Lewin et al., 2001; Lewin & Herlitz, 2002). Although face recognition cannot readily be assumed to rely on verbal processing, it was hypothesized that women can utilize their greater verbal abilities to encode faces by verbalizing them—for example, "a dark, blue-eyed handsome man." This hypothesis was investigated by showing faces without hair,

ears, or pieces of clothing in rapid succession, preventing the participants from verbalizing the faces (Lewin & Herlitz, 2002). It was found that women recognized more faces than men did, irrespective of whether verbal encoding was suppressed or not—thus providing no support for the hypothesis that women use their greater verbal abilities to encode faces. However, the results also revealed that the female recognition advantage was magnified for female faces. This tendency for females to remember faces of their own sex more accurately than faces of the opposite sex (i.e., "the own-sex effect") is found across age, so that both young girls and adult women remember more female faces, irrespective of the age of the faces (e.g., faces of young girls or adult women) and across ethnicity (i.e., ethnically familiar or unfamiliar faces). In contrast, men tend to remember male and female faces equally well (e.g., Rehnman & Herlitz, 2006, 2007). Why might this be the case?

To address this intriguing issue, we created a set of androgynous faces (see Fig. 3) and showed the same set to three groups of men and women (Rehnman, Lindholm, & Herlitz, 2007). The three groups saw the same group of androgynous faces but received somewhat different instructions—that they would be presented with a series of either (a) "female faces," (b) "male faces," or (c) "faces," and that their task was to remember the faces for a later recognition task. Interestingly, women who were told that they should remember female faces remembered more faces than women who were told to remember male faces or just faces. By contrast, men performed at similar levels across instructional conditions. In addition, women remembered more androgynous faces than men did when they were told to remember just (gender-unspecified) faces.

We interpret these findings to mean that women allocate more attention to female than to male faces. Studies on infants have shown that infant girls devote more attention to faces than infant boys do (Conellan, Baron-Cohen, Wheelwright, Batki, & Ahluwalia, 2000). Speculatively, the attention infant girls devote to faces may form the basis of women's superior face-recognition ability. Moreover, developmentally, categorization of female faces precedes that of male faces for both sexes, possibly as a result of greater early exposure to female than to male faces (Ramsey-Rennels & Langlois, 2006). With increasing age, girls may develop their interest in other females, which also might be strengthened through their interactions with other women. By contrast, developing boys may orient themselves toward other males, losing their early advantage for categorization of female faces and resulting in an absence of bias.

Fig. 3. An example of the androgynous faces used in the Rehnman, Lindholm, & Herlitz (2007) study of face recognition.

DEVELOPMENTAL TRENDS AND ENVIRONMENTAL FACTORS

In research on sex differences, one focus has been on whether the magnitude of the differences varies across the life span. Explanation of the differences to some extent rests on whether or not it does. For example, a change in the magnitude or direction of sex differences around puberty would suggest that the biological (e.g., hormonal) changes taking place around that time are important in explaining the differences. With regard to sex differences in verbal episodic-memory tasks, it is clear that there are sex differences in the recall of word lists favoring girls at a young age (i.e., age 5; $d \approx .39$) and that those differences are of similar magnitude in young adults (i.e., age 15; $d \approx .43$; e.g., Kramer et al., 1997), middle-aged adults, and old adults ($d \approx .25$; e.g., Herlitz et al., 1997). The same appears to be true for sex differences in face recognition (age 9, $d \approx .47$, adults $d \approx .53$; Rehnman & Herlitz, 2006, 2007), although much less research has been conducted in this area. Thus, data seem to suggest that the major biological changes associated with development and aging do not influence the pattern and magnitude of sex differences in these episodic-memory tasks.

Another important question is whether sex differences in episodic memory exist throughout the world. Large variations in the pattern and magnitude of sex differences would suggest that cultural factors influence the differences to a considerable degree. To our knowledge, sex differences in episodic memory have been examined in 23 out of 192 United Nations member states, and although the bulk of studies come from Europe and North America, there are a sufficiently large number of studies of verbal episodic memory conducted in Australia to conclude that sex differences are present also in this part of the world. Whether the same pattern of data exists on the African continent and in South America remains unknown, whereas studies emanating from Southeast Asia (e.g., Kim & Kang, 1999) seem to indicate a similar pattern of sex differences in verbal episodic memory as in Australia, Europe, and North America.

Factors such as education and public exposure may influence the magnitude, rather than the pattern, of sex differences. This is illustrated in a study in which we compared the magnitude and pattern of cognitive sex differences in literate and illiterate older adults from Bangladesh and Sweden (Herlitz & Kabir, 2006).

The participants were tested on a brief cognitive test. In general, men performed at a higher level than women on a spatial-visualization task (drawing or forming, with sticks, a geometrical form), whereas women performed at a higher level than men on the episodic-memory task (a short word list). Among illiterate Bangladeshis, there were large differences favoring men—even on tasks for which no differences were expected, such as providing accurate information about the neighborhood they lived in. In fact, the only task in which men did not outperform women was the episodic-memory task. Illiterate Bangladeshi women, in contrast to Bangladeshi men, have little or no access to the world outside the immediate home and family. Therefore, we interpreted the results as indicating that the pattern of cognitive sex differences is similar irrespective of nationality and literacy but that the magnitude of the differences is related to both education and sociocultural factors. Importantly, the low performance of the illiterate women demonstrated the inhibiting effect restrictions in public exposure might have on cognitive performance.

CONCLUSIONS AND FUTURE DIRECTIONS

Gender influences performance on episodic-memory tasks: Women consistently outperform men on tasks that require remembering items that are verbal in nature or can be verbally labeled. However, women also excel on tasks requiring little or no verbal processing, such as recognition of unfamiliar odors or faces. In contrast, there is a male advantage on episodic-memory tasks requiring visuospatial processing. These findings suggest that women's episodic-memory advantage can increase or be reversed, depending on the nature of the material to be remembered. For example, if the material is verbal or evokes women's attention (e.g., female faces), women outperform men, whereas men outperform women on visuospatial episodic-memory tasks (e.g., remembering a route).

Are these statistically rather small sex differences in episodic memory sufficiently large to be detected in everyday life? Are the anecdotal reports claiming that men do not remember people they have met, the location of misplaced objects, or who said what at the last party as well as women do real-life illustrations of these differences? Or are such memory failures just as commonly found for women? Besides exploring sex differences in everyday memory failures, future studies should investigate whether such differences are merely a function of sex differences in other areas (e.g., verbal, visuospatial) or whether there is, in addition to material-specific effects, a general episodic-memory advantage for women. If the latter is true, empirical attention should be directed at delineating the origins of this female superiority. Could the difference be understood in terms of the different pressures evolution has put on males and females and does it have biologically plausible neural correlates? Clearly, further research is needed before we fully can understand the causes and mechanisms behind sex differences in episodic memory.

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