

## EPISODIC REFABRICATION OF BIOLOGICALLY SIGNIFICANT INFORMATION IN SCRIPT RECALL\*

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Recent theoretical attention in the study of memory processes has shifted from the perspective of cognitive architecture to an adaptionist view. This has resulted in the formulation of questions pertaining to the brain's innate capacity to organize information and build scenarios using genetic schemata to enhance the meaningfulness of material. Our study used the episodic refabrication methodology of Owens, Bower, and Black (1979) to test the evolutionary hypothesis of gender specific cognitive mechanisms which are differentially sensitive to biologically salient information. The results replicate and support the findings of others concerning the effect of scripts and schemata on episodic refabrication and also revealed significantly shorter free recall latencies for males when the to-be-recalled material was given biological relevance. These differences are interpreted in support of the adaptionist perspective.

*Keywords:* memory processes, cognitive architecture, adaptionist view, genetic schemata, enhance the meaningfulness of material, refabrication methodology, evolutionary hypothesis, gender specific cognitive mechanisms.

In Anderson's most recent book, *The Adaptive Character of Thought*, he has argued for a shift in emphasis away from the study of cognitive architecture in favor of an "adaptionist" perspective on human cognition (Anderson, 1990). Because of its emphasis on functional analysis, this adaptionist branch of cognitive science has been referred to as evolutionary psychology by Cosmides and Tooby (1988). In their words, "There is emerging a new method, here called evolutionary psychology, which is made possible by the simultaneous maturation of evolutionary biology, paleoanthropology, and cognitive psychology" (p. 302). Proceeding from this theoretical perspective, we have attempted to test a rather straight-forward prediction, deduced from evolutionary theory and formulated using the language and concepts of cognitive psychology,

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regarding the organism's ability to recall biologically significant information.

One of the most significant ideas to emerge in the past several decades is embodied in the concept of schemata and schematic memory. Bartlett, who first introduced the term, was uncomfortable with it because it was "at once too definite and too sketchy" (1932, p. 200). In its most restricted sense, schemata refers to stored information that provides a framework for remembering events. In the broader sense, Neisser (1976) maintains that schemata should be conceptualized as including plans for action. Like Anderson, Neisser has shifted his emphasis from studying what is there (structure) to studying how it is used (function).

In the planning or functional sense schemata are similar to what Alexander (1989) described as scenario-building. In his article *The evolution of the human psyche* he said, "The function of the human psyche is to do psychology" (p. 506). By this he meant we use procedural and factual knowledge to simulate alternative outcomes and vicariously experience the consequences of our actions. Alexander is arguing that brain architecture reflects a mechanistic capacity to organize information, build and revise plans, and profit from "experience" through a process of selection by consequences.

The brain's innate capacity to organize information according to pre-existing templates is at the heart of evolutionary psychology. Cosmides and Tooby (1988; Cosmides, 1989) made the important point that behavior did not evolve any more than vision evolved – the eye and brain evolved, and vision is the consequence. Similarly, behavior must be conceptualized as the result of evolved psychological (or perhaps more appropriately, cognitive) mechanisms in the functioning brain.

Whether we refer to these cognitive mechanisms as genetic schemata, mental organs (Chomsky, 1980), stimulus detectors (Eibl-Eibesfeldt, 1989), P-cognitions (Margolis, 1987), or Kant's a priori (innate) categories of thought (Hergenhahn, 1986), the emphasis is on the filtering of information from the environment through these devices for the purpose of structuring perception (Gregory, 1983).

The importance of an organizational structure for the recall of information has been shown by Ausubel (1963), Dooling and Lachman (1971), and Bransford and Johnson (1972). In these experiments, subjects demonstrated better recall for material read when presented with a title or when shown a picture to serve as an advance organizer. Only when subjects had the title or picture in advance were they able to integrate the vague references and obscure text into a meaningful whole. This illustrates the

importance of thematic organization for comprehension. The organizers are essential for reconstructing images from general knowledge and allow the refabrication of details while enhancing memory. The question is, to what extent does this advance organization shape what is remembered?

Owens, Bower, and Black (1979) used descriptions of characters as advance organizers that allowed subjects to weave together a meaningful story from five unrelated scripts. They were able to demonstrate that subjects connected these unrelated scripts by reconstructing them into a coherent scenario about the character as described. In their study, subjects were most successful when presented with the description of a woman who thought she was pregnant. This suggests that biologically significant information activates a cognitive mechanism which provides an innate organizational structure and makes the to-be-recalled material more meaningful.

Our study utilized the Owens, Bower, and Black (1979) methodology to test the hypothesis that males and females are differentially sensitive to varying kinds of biologically significant information. More specifically, we reasoned that type of character description, either of a physical attack or of pregnancy, would vary in saliency for males and females respectively.

## **METHOD**

### **SUBJECTS AND INSTRUMENTATION**

The subjects were 40 male and 40 female college students who ranged in age from 18 to 49 with a mean age of 27.57. Informed consent was obtained from all subjects and their rights were protected in accordance with institutional guidelines.

All testing was done on a VAX 8600 mainframe computer with DEC VT 100 or Hewlett Packard 770 monitors. The communication interface between the terminals and the mainframe was made through a 2400 baud modular emulator. A program written in the computer language VAX-BASIC was used to obtain and present information to subjects during two days of testing.

### **DESIGN AND PROCEDURE**

Two levels of gender were combined with four conditions of character description, which were qualitatively distinct – (1) no advance organizer or control, (2) a neutral condition that described “Making the team”, (3) a female-salient organizer, “Pregnancy”, and (4) a male-salient organizer, “Physical attack” – to form a 2 x 4

completely randomized factorial design. The Pregnancy and Making the team organizers were identical to those used by Owens et al. (1979). The Physical attack organizer was developed specifically for this experiment and closely patterned after the Pregnancy organizer.

Upon reporting for the experiment subjects were given a brief introduction to the VT 100 keyboard and terminal. Each subject then logged on to the computer and answered a series of biographical questions. Upon completion, the computer program randomly assigned the subject to one of the four treatment conditions where the advance organizers of varying biological relevance were presented along with task instructions appropriate for Day 1 of testing. The Pregnancy organizer described a female as feeling sick when she woke up that morning and fearful that she might be pregnant. The Physical attack organizer described a male who woke up feeling stiff and sore remembering that he had been attacked the previous night. The Making the team organizer involved a male who woke up feeling anxious about being selected for the football team. Following presentation of these organizers subjects were asked to read a story which contained five unrelated scripts – making coffee, going to the doctor, buying milk, attending a lecture, and attending a party. The scripts were identical to those of Owens et al. (1979) and followed the guidelines for script construction set forth by Schank and Abelson (1977). Subjects were given 2.5 minutes to read this story after which the screen blanked, and they were asked to estimate the amount of time that had passed while they read the story. They were then thanked for their cooperation and reminded to return the next day.

When subjects logged on the computer on Day 2 they were given a free-recall test, a guided recall test, and a 30 item true-false recognition test over the material contained in the previous day's story. Response measures included number of correct responses and response latency on each memory test.

## RESULTS

As expected, the refabrication effects observed by Owens et al. (1979) were replicated in the present study. When collapsed across gender the data also supported findings by Ornstien (1969) and Kintsch and Van Dijk (1978). The most interesting finding was support for the hypothesis of an interaction between subject gender and type of advance organizer used to reconstruct their memory of the story.

The analysis of data was accomplished using a 2 x 4 Multivariate Analysis of Variance (MANOVA) with 11 response measures including: perceived time for reading the story, free recall latency (time between when the question was asked and when the subject began responding), latency of responding for each of the five scripts in the story, total number correct on the true-false recognition test, number of scripts remembered, and number of verbatim items from the scripts actually recalled. These 11 measures were used in the MANOVA for the omnibus *F*-test.

The analysis revealed a significant interaction for free recall response latency,  $F(3,72) = 2.87, p = .042$ . These interaction means are presented in Figure 1.

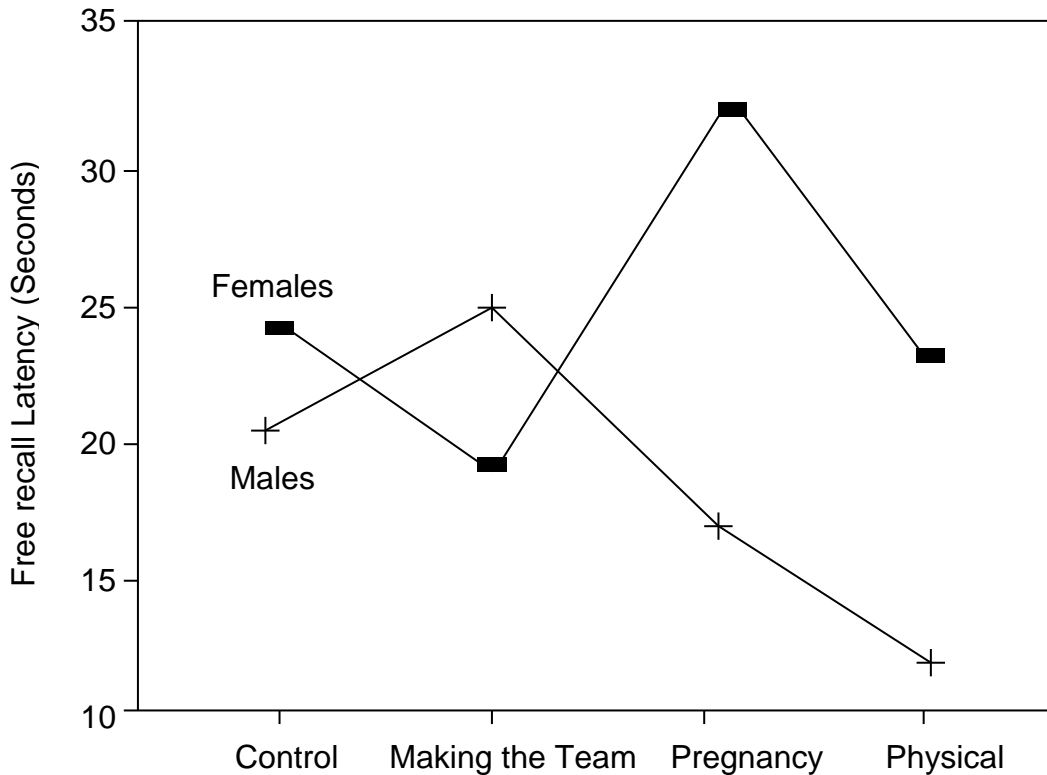


Figure 1. Free recall response latencies for male and female subjects across organizer: control (no advance organizer), neutral (Making the team), and biologically salient (Pregnancy or Attack)

An analysis of simple main effects revealed that free recall response latency was significantly longer for the Pregnancy organizer when compared to the other three for females, and that the latency of response for the Attack organizer was significantly shorter for males. Male-female comparisons across organizers revealed nonsignificant

differences for the Control and Making the team conditions, but significantly shorter latencies for males with the Pregnancy and Attack organizers ( $ps < .05$ ).

The data were further analyzed using a four-level single variable MANOVA with four response measures – including: perceived time for reading the story, number of scripts remembered, and number of verbatim items from the scripts actually recalled – to ensure design compatibility and make comparisons with existing literature possible. All four measures were used for the omnibus  $F$ -test. The analysis yielded significant effects for all of the response measures: perceived reading time,  $F(3,76) = 4.40$ ,  $p = .007$ ; number of scripts recalled,  $F(3, 76) = 9.96$ ,  $p < .001$ ; and verbatim items recalled,  $F(3,76) = 9.46$ ,  $p < .001$ .

A post hoc analysis was performed on each of these measures using Tukey's HSD test which revealed significant mean differences for each organizer group when compared to the Control group on the perceived reading time of the story measure. Significant mean differences were revealed for the script recall measure on both the Pregnancy and Attack organizers when compared to the Control or Making the team organizer. Additionally, significant mean differences were revealed on the verbatim measure for both the Attack and the Pregnancy organizers when compared to the Making the team organizer or the Control group (all  $ps < .05$ ).

## DISCUSSION

These data replicate and support the findings of Black and Bower (1979); Bower, Black, and Turner (1979); Bradsford and Johnson (1972); Owens et al. (1979); and others concerning the effect of scripts and schemata on episodic refabrication. These results also suggest an evolutionary psychology conception of gender specific cognitive mechanisms which are differentially sensitive to biological information contained in the material to be recalled.

Cosmides and Tooby (1988) theorized that humans have evolved cognitive mechanisms which function as triggering devices that enhance survival through selective attention to incoming information based on survival needs. In cognitive terminology when these mechanisms are activated by salient stimuli from the environment, they allow global information to take precedence over lower level information in a manner similar to that described for micro- and macro-processors by Kintsch and van Dijk (1978). Evidence for the functioning of two such mechanisms,

to ward off the threat of aggressive attack and kinship protection, was obtained in the present investigation.

In support of the prediction that global or general information is processed at a superordinate level when cognitive mechanisms are activated, we observed that the number of scripts recalled by subjects who received a biologically salient organizer was significantly higher than for control subjects or subjects who received a neutral organizer. This suggests that the biologically salient organizer triggered a cognitive mechanism which affected memory storage and/or retrieval. We also observed that subjects presented with a biologically nonsalient organizer or no organizer remembered fewer scripts in the story, but more detail of those scripts. This further supports existing literature, especially that of Neisser (1976), while strengthening the argument for the evolution of cognitive mechanisms. The evolutionary position predicts that the presence of biologically salient information will activate a hierarchical analysis which “over-rides” attending to less important default information such as the details contained in the scripts.

Alexander (1987, 1989) suggested that we have an innate interest in creating stories which can then be used as lessons which provide personal advantage when applied to our individual lives. Attending to themes and weaving the stories around them as if they were motives for the character’s actions engrosses the reader, and keeps their attention focused on the material (Owens et al. 1979). An indirect measure of this involvement is perceived reading time (Ornstien, 1969). In the present study, perceived reading time estimates were significantly shorter for subjects in the organizer groups; with perceived reading means ranging from 150 to 160 seconds, where as the mean for subjects in the Control group was 235 seconds.

The most intriguing observation from these data was an unexpected one. While an interaction between gender and type of organizer was anticipated, it was not of the form realized. The most salient organizer for females was the Pregnancy organizer and the most salient organizer for males was the Attack organizer, but their respective reactions to these character descriptions were exactly opposite! Female latency of responding was significantly longer for the Pregnancy organizer while male response latencies were significantly shorter for the attack organizer. In addition, male response latencies were significantly shorter for both Pregnancy and Attack organizers when compared to those for females.

Generalizing from paleoanthropological descriptions of hunter-gatherer life (Eaton, Shostak, & Konner, 1988), this asymmetry is easily explained if we assume a

differential selective pressure for mental activity as a function of the demands of varying physical activities; e. g., hunting, group defense, and intragroup competition for males; food gathering, child care, and social/family planning for females. Obviously these activities require different cognitive abilities. What is being suggested is that men and women differ in the way their brains process biologically salient information. Men appear more reactive and outwardly directed without hesitation whereas women evidence a tendency toward reflection and scenario-building before action. It seem reasonable to assume that scenario-building in a life-threatening situation would be selected against. Since males were more likely to be in these situations it would be predicted that they are more likely to respond in a reactive, non-scenario-building manner. Interestingly, males in the neutral group had longer latencies than males in the control group suggesting that when given an organizer in a nonthreatening situation they too were scenario-building.

It should be emphasized that, as is true for most gender comparisons, the variability within distributions far exceeded the variability between distributions. The gender differences reported here reflect mean differences and as such should be interpreted nomothetically. What we are suggesting is a tendency toward differential sensitivity thresholds for the activation of cognitive mechanisms when the environmental information being processed is biologically salient.

It was Darwin who said, "Without expectancy there can be no observation" (cited in Ralling, 1979). In the context of memory storage and retrieval Darwin's observation means that natural selection has left us with a very specific list of biological expectancies. It would seem that brain architecture reflects default parameters which are both species and gender specific.

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