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The Effects of Presentation and Processing on Explicit Memory in Older Adults

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Abstract: Forty eight older adults watched words presented on a computer monitor and took a test of word recall. Results reveal a main effect for presentation, processing and an interaction of presentation and processing. These findings suggest the possible use of compensatory mechanisms for preserving memory by older adults.

Introduction

Dementia is a culturally pervasive neurological disease that presently has no cure. The profound prevalence of dementia within our society calls for prevention techniques that can slow, mitigate or even reverse the effects of memory loss (Santacruz & Swagerty, 2001). I examine memory-enhancing strategies such as presentation and processing in older adults who do not suffer from cognitive impairment, in hopes that what is learned in normal aging populations can benefit those at risk of developing dementia.

I directly measured explicit memory, the conscious recollection of previously presented stimuli (Craik, Govoni, Naveh-Benjamin, & Anderson, 1996; Whiting & Smith, 1997). Roediger and McDermott (1993) and Schacter (1987) characterized explicit memory tests as tasks performed with intention, instructing participants to recall or recognize stimuli they had previously seen. In cross-sectional and longitudinal studies examining age-related declines in memory, older participants tended to score lower than younger participants on explicit memory tasks (Anooshian, 1997; Carroll, Byrne, & Kirsner, 1985; Ellis, Ellis, & Hosey, 1993; Greenbaum & Graf, 1989; Lorsbach & Morris, 1991; Lorsbach & Worman, 1990; Naito, 1990; Parkin & Streete, 1988).

Explicit memory tasks measure supraliminal memory processes which are driven by strong feelings of event or scene recollection (Aggleton & Brown, 1999; Gardiner, 1988; Gardiner & Java, 1990; Gardiner & Java, 1991; Gardiner, Java & Richardson-Klavehn, 1996; Jacoby, 1991; Rajaram, 1993; Tulving, 1985; Wagner, Verfaeille, & Gabrieli, 1997; Yonelinas, 2002) and subliminal processes which lack a conscious experience of an actual event (Khilstrom, 1990; Khilstrom, Barnhardt, & Tataryn, 1992a; Khilstrom, Shames, & Dorfman, 1996; Roediger & McDermott, 1993; Szymanski & MacLeod, 1996; Toth, 1996). The priming task, which is only minimally affected by age, is a classic methodology for studying subliminal processes (Kiefer, 2007; Light & Singh, 1987). Category exemplar generation tasks capture both conceptual and perceptual subliminal processes. The distinction between the cognitive resources that drive supraliminal and subliminal processes begins to blur when examining the interaction of meaning-based encoding with consciousness (Srinivas & Roediger, 1990).

Craik and Lockhart (1972) showed that deep or semantically-processed stimuli had a higher rate of recall than shallow or physically-processed stimuli such as those employing subliminal cognitive processes. Bradshaw and Anderson (1982) also showed how elaboration and thematic-relatedness can strengthen memory processes through the semantic integration of memory traces. Hence, Bradshaw and Anderson's (1982) study draws parallels between thematic-relatedness, a variable used in the present study, and levels of processing theory, shedding light on the role of neural networks in memory consolidation.

Purpose of Study

In contrast to recent studies examining the relationship between relatedness, elaboration, and explicit memory (Bradshaw & Anderson, 1982), I analyzed the effect of presentation timing and thematic-relatedness on the explicit memory of older adults in the current study.

The emphasis on semantic content during conscious awareness should yield a compound effect on explicit memory performance because supraliminal processes require the effortful application of cognitive resources that spark neural network activation.

Methods

Variables of Interest

I operationally defined deep processing as the presentation of thematically-related words from two thematic categories (Zoo Animals and Vegetables). I defined shallow processing as the presentation of randomly generated, non-thematically-related words. I defined supraliminal presentation as the condition of seeing a series of ten words for 2 seconds each. Subliminal presentation was defined as the condition of seeing a series of ten words for .04 seconds each.

Procedure

I recruited forty-eight older adults over the age of 55 from two Sacramento senior service agencies. Before the day of the experiment, I randomly assigned the participants to one of four video conditions. On test day, I greeted each participant individually, showed the participant to his or her seat in front of the laptop, and led the participant through the informed consent procedure. I, then, provided the participant with a demographic questionnaire.

Next, I started the video assigned to the participant. Within each video, the supraliminal condition had one thematic phase and one non-thematic phase. The subliminal condition also had one thematic phase and one non-thematic phase. After the video was complete, I administered the free recall exam by giving the participant a pen and a piece of lined paper. After I read the instructions to the participant, I quietly left the room.

Results

Dependent Variables

With a 2x2x4 mixed repeated-measures factorial design, I examined the effects of my independent variables on my two dependent variables, "hits" and "false alarms." "Hits" represented the number of words the participant correctly identified as presented during the study phase. "False alarms" represented the number of words that the participant incorrectly identified as presented during the study phase.

Main Effects and the Interaction of Processing and Presentation

Participants correctly recalled more words presented for 2 seconds than words presented for .04 seconds, $F (1, 44) = 220.90$, $p < .001$, semi-partial $\eta2 = .46$. Supraliminal presentation yielded more correctly recalled words in thematic conditions than non-thematic conditions, $F (1, 44) = 109.13$, *p* <

.001, semi-partial $\eta^2 = .14$. Older adults may exhibit higher explicit memory performance when words belonging to a theme or category are presented within conscious awareness, likely because they are able to process the information more deeply. The number of hits in thematic conditions was significantly higher than the number of hits in non-thematic conditions, Mean difference = 2.96, $p < .001$. There were more false alarms produced in supraliminal presentation conditions than in subliminal presentation conditions, $F (1, 44) = 10.05$, $p < .001$, semi-partial η2 = .10.

Discussion

Conclusions

      Past research indicates that older adults are more likely to use semantic associations than younger adults when performing serial recall tasks (Golomb, Peele, Addis, Kahana, & Wingfield, 2008). Moreover, Englekamp and Wippich (1995) found that, for older adults, word-relatedness enhances memory of subliminally presented words. Conversely, younger adults remember more words that are not related to each other in priming tasks than do older adults (Englekamp & Wippich, 1995). Younger adults may not use categories to facilitate memory performance during the completion of memory tasks to the same degree as older adults.

      By depicting the relationship between presentation and levels of processing, my study demonstrated the importance of supraliminal effortful processes on semantic facilitation of explicit memory. This claim is further supported by evidence from Monti et al. (1996), who showed how meaning-based encoding processes through the engagement of supraliminal memory processes enhance conceptually-driven aspects of memory tasks. Conclusively, the results from my study and previous research exemplified the pivotal role that semantic associations play on conscious processes during explicit memory tasks.

Strengths and Weaknesses

      The study's design strengths bolstered its internal validity. Using two thematic categories instead of one category eliminated the possibility that recall could be affected by category type instead of the intended independent variable, relatedness. I also ensured that the two thematic lists had equal variances of relatedness ratings so one category did not contain words of higher relatedness than the other category.

      To accomplish the task of using two different relatedness categories, I used the partial counterbalancing measure to present the four relatedness conditions in every possible order, thus eliminating the possible confounding effect of a previous phase influencing memory for words presented in a subsequent phase. By ensuring that the first condition of each video was supraliminal, I minimized the level of anxiety half of the participants would feel if they saw a subliminal series of words as their first study phase.

      In contrast to these strengths, various methodological limitations surfaced during the development of my study's experimental design. The small sample size of forty-eight participants increased the risk of Type II error. The small sample size may have underestimated the number of significant memory score differences between the levels of the two independent variables: relatedness and presentation.

      A small sample size also hindered my ability to draw generalizable conclusions about the entire senior population. Taking a convenience sample from a select group of senior communities may not have adequately captured the true population mean with a high degree of confidence. If I were to conduct this

study again, I would allot more time to participant recruitment in hopes of increasing my sample size to at least 100 participants.

My decision to draw a convenience sample instead of a random sample limited the representativeness of my subject pool. Because I did not collect a random sample, the economic, educational, and health characteristics unique to the senior communities sampled may have biased the results in favor of individuals with high levels of self-esteem and active lifestyles.

Future Directions

Assisting cognitive aging through modern technology and educational media creates a dynamic transmission of knowledge throughout younger and older generations. To further analyze the relationship between relatedness and presentation, one might want to incorporate elements from human-computer interface psychology literature to produce websites that will facilitate the engagement of older adults. The results of such a study may also have important applications in the design of educational curricula in senior centers.

Dementia is characterized as a gradual yet irreversible erosion of the aging mind. Semantic associations and processing time are two compensatory mechanisms that can amplify neural network activity in older adults providing cognitive aging with a buffer against memory loss. The augmenting effect of effortful processing and deep encoding on memory consolidation provides a positive outlook for the aging population. As a result of strengthened memory processes, the enhanced neural network activation mirrors the complex interplay of meaning and consciousness as it forever shapes our human experience and survival.

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