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A Correlational Investigation of the Relationships Among Nutrition-Related Attitudes and Behavior, Body Mass, and Learning and Verbal Memory Performance in College Students

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The present study investigated the potential relationship between eating attitudes, nutritional knowledge and learning and memory among a sample of college students. Participants completed self-report measures of nutrition-related behavior, knowledge and attitudes. The California Verbal Learning Test (CVLT-2) was used to assess verbal learning and memory performance. Results indicated that poor nutrition-related behavior tended to interfere with learning, as assessed by parametric correlation analyses. Problematic eating behaviors such as excessive dieting and oral control were associated with less efficient verbal learning. Although the relationship between participants' total learning scores and overall index of nutrition did not reach statistical significance, the findings indicate that the intermediary components of learning are related to self-report measures of eating attitudes and nutritional knowledge. The implications of these findings along with future directions are discussed.

Keywords: nutrition, college students, learning, memory

Poor eating habits are common among college students. Empirical research suggests that in the transition from high school to college, students become increasingly susceptible to poor nutritional behaviors (Ferrara, 2009). For example, some students develop a pattern of skipping essential meals while others rely on physiologically inefficient sources of nutrition, such as junk food (Ferrara, 2009). In the case of increasing junk food consumption, this pattern of behavior may contribute to poor nutrition, weight gain and other health risk factors (Anderson, Shapiro, & Lundgren, 2003). Further, students transitioning from high school to college are more susceptible to gaining weight, which is of particular concern as research suggests that weight gain among college students places young adults at later risk of obesity-related health problems (Anderson et al., 2003). Researchers have found that students engage in different eating and lifestyle behaviors once they enter college because of peer influence and poor organizational management skills (Harris & Bargh, 2009). A contributing source stems from reported increased alcohol consumption and television watching, exacerbating weight gain and contributing to poor academic performance (Economos, Hildebrandt, & Hyatt, 2008). There is a growing body of research that suggests that poor nutritional behavior, including resultant weight gain, is more prevalent among minorities and students of lower socioeconomic status. African American and Hispanic/Latino students have the lowest fruit and vegetable intake (Adams & Colner, 2008) and have higher rates of obesity (Flegal, Carroll, Ogden, & Johnson, 2002). Furthermore, Harris and Bargh (2009) found a correlation between the viewing of television advertisements and unhealthy food choices. The lack of available resources promoting healthy eating and the exposure to unhealthy food advertisements are problematic among college students when not well-moderated (Harris and Bargh, 2009).

Cognition research in the area of nutrition among

college students is limited. From the perspective of neuropsychology, adequate nutrition is essential for healthy brain functioning, optimal learning, and academic performance. The negative effects of poor nutrition have received support across neuropsychological investigations of malnutrition. Lezak (1995) notes that poor nutrition "gives rise to a variety of neurological and neuropsychological symptoms, including sensory and reflex abnormalities, depressed mood, and impairments on memory, abstract reasoning, and visuoconstructional tests specifically" (p. 275). This has been confirmed in a study by Li, Dai, Jackson, and Zhang (2008), in which poor nutrition and overweight classification resulted in reduced visuospatial analysis as assessed by performance on a block design task. Furthermore, Trockel, Barnes, and Egget (2000) found that nutrition-related health behaviors affected the academic achievement of the students sampled, as measured by grade point average. Further supporting these findings, Adams and Colner (2008) conducted a study where they found associations between higher fruit and vegetable intake, healthier life choices, and a tendency toward better academic performance. Taken together, these results provide a foundation for researchers to explore how components of nutrition (e.g., food intake, weight gain/loss) are related to learning and other neuropsychological processes that support academic achievement.

The current study explored associations between self-reported nutrition behavior and learning and verbal memory performance. Learning is defined here as the process of acquiring new information and modifying previously learned information. Learning requires many supporting cognitive processes such prefrontal cortex-based working memory, short-term memory, and other intermediary processes that support long-term memory storage facilitated by the hippocampal region of the brain, such as encoding, maintenance, and retrieval (Lezak, 1995). It was hypothesized that poor nutrition behavior (i.e., skipping meals, restrictive eating, lower knowledge of adequate health and nutrition) and higher Body Mass Index (BMI) scores would be statistically correlated with learning and memory performance. Specifically, a positive correlation was predicted between knowledge of good nutrition-related behavior and verbal learning and memory performance. Negative correlations were predicted among BMI scores and poor nutrition-related attitudes and verbal learning and memory performance.

Method

Participants

Participants were 52 undergraduate psychology students. All participants reported English as their primary language. There were 10 male (18%) and 42 female (82%) participants. The mean age was 21.78 with a standard deviation of 5.95. Of the total of 52 participants, 30 reported on their weight resulting in 22 missing cases for this variable. Of the 30 participants, the mean weight was 155.82 lbs (SD = 41.77) and the mean BMI was 14.47 (SD = 8.4). Further analysis of participants' BMI scores indicated that 72% of the participants fell in the underweight category, 10% within the normal range, and 18% in the overweight range. The racial/ethnic composition of the sample was as follows: 23% African-American, 44% White, 23% Latino/Hispanic, 8% Asian, and 2% identified as other.

Measures

Body Mass Index (BMI) is an anthropometric measure that provides a reliable estimate of a person's body fat and body composition. The BMI is used by the Centers for Disease Control and Prevention as an indicator of risk for weight-related illness. BMI measures have been used in previous research (Li, Dai, Jackson, & Zhang, 2008) and permit researchers to screen for weight categories that can contribute to increasing health problems. The BMI is calculated using the following formula: weight (lb) / [height (in)]2 x 703. Standard categories of adult BMI classification are as follows: Below 18.5 is underweight, 18.5-24.9 is within normal limits, and scores greater than 25 are in the overweight and obese ranges.

Eating Attitudes Test – 26 (EAT-26; Garner & Garfinkel, 1979) is a widely used, valid, and reliable measure of nutrition and risk of eating disordered behavior. Validity and reliability studies in support of the EAT-26 as a measure of nutrition and risk for eating disorders are well-established (Lee et al.,

2002; Mintz & O'Halloran, 2000). The scale has 26 questions that participants respond to with six possible choices (always, usually, often, sometimes, rarely, never). Sample items include: "Have the impulse to vomit after meals" and "Feel extremely guilty after eating." Behaviorally oriented questions assessed by the EAT-26 measure include, "Ever made yourself sick (vomited) to control your weight or shape?" and "Ever exercised more than 60 minutes a day to lose or control your weight or shape?" The scale provides a total score as well as scores on three subscales: dieting, bulimia and oral control. Higher scores indicate more problematic eating behavior. Total scores above 20 are indicative of atypical eating behavior.

Nutrition Knowledge Survey (NKS; Parmenter, & Wardle, 1999) is a measure that tests knowledge of healthy eating and adequate nutrition that can affect one's dietary behavior. According to the authors, nutrition knowledge serves as a proxy for nutrition-related behavior. Support for this stems from a series of empirical investigations demonstrating strong positive relationships between nutrition knowledge and eating behaviors (Hawley, & Williams, 1991; Hoogenboom, Morris, Morris, & Schaefer, 2009). The measure takes the form of a test that provides a score of overall food and nutrition knowledge. The NKS also provides four independent subscales: Dietary Recommendations (e.g., How many servings of fruit and vegetables a day do you think experts are advising people to eat?), Sources of Foods/Nutrients, Choosing Everyday Foods, and Diet-Disease Relationships (e.g., Do you think these foods help prevent heart disease?). The scale has well-established internal consistency as demonstrated by Cronbach's alpha ranging from .70 to .95 (Parmenter & Wardle, 1999).

California Verbal Learning Test -2 (CVLT-2; Delis, Kramer, Kaplan, & Ober, 2000) is a verbal list learning task that assesses learning and memory functions. The CVLT-2 involves a series of 16 orally presented words that are presented over five trials. This provides a measure of learning and allows the researcher to plot a learning curve over the five list learning trials. The measure also provides indices of short- and long-term memory under various conditions, including an interference condition and learning characteristics. These conditions are administered at the completion of the five active list-learning trials. For the current study, the five list-learning trials were examined in addition to interference list-learning and immediate free and cued recall memory performance.

Operational Definitions

Nutrition was operationally measured through scores on the NKS, EAT-26, and BMI scores. Poor nutrition was defined as lower scores on NKS and higher scores on BMI and EAT-26. Learning and memory were operationally measured by scores on the CVLT-2. Higher scores on the CVLT-2 suggest better learning and memory performance whereas lower scores are indicative of less efficient verbal learning processes.

Procedure

The study was reviewed and approved by Caldwell College's Institutional Review Board. Participants completed the EAT-26 and NKS measures in order to assess nutrition knowledge and attitudes. After completing these questionnaires, participants were escorted to a separate room where they were weighed by a researcher using a laboratory-grade scale. The examiner then administered the five active list-learning trials of the CVLT-2 to measure verbal learning, an interference list, and immediate free and cued recall to measure short-term verbal memory.

Results

Initial statistical analysis involved frequency analysis of eating behaviors and assessed gender differences in nutrition behavior, BMI, and verbal learning and memory performance measures. Problematic eating behavior (scores above 20 on the EAT-26 measure) was observed in 10% (N = 4) of the total sample. The majority of the participants in the current study were in the healthy range for eating behavior (N = 40, 90%).

On the EAT-26, female participants reported significantly higher problematic eating behaviors, M =10.74, SD = 6.47, compared to male participants, M = 4.89, SD = 5.18, $t(41) = -2.50$, $p < .05$. This pattern also emerged on the EAT-26 Dieting Subscale, on which males scored significantly lower, M = 3.44, SD

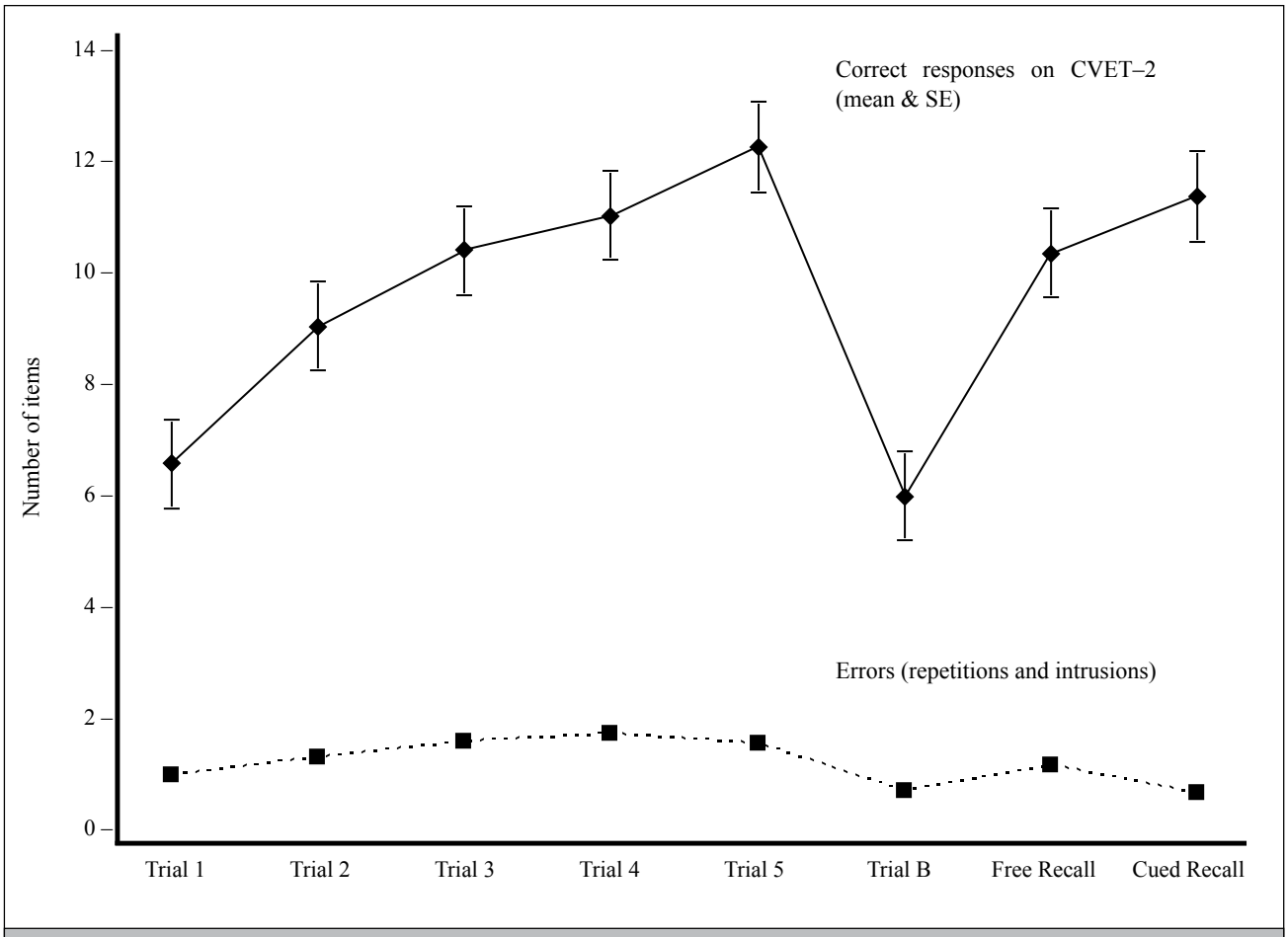

Figure 1. Total correct (mean and standard error) and incorrect (repetitions and intrusions) responses on the five list learning trials (1–5), interference list (6), free recall (7) and cued recall (8) memory performance.

= 3.68, compared to females, M = 7.50, SD = 5.42, $t(41) = -2.11$, $p < .05$. On the NKS, women scored substantially higher on knowledge of Diet-Disease relationships, $M = 6.36$, $SD = 3.14$, compared to men, $M = 3.88$, $SD = 2.80$, $t(39) = -2.05$, $p < .05$. Regarding gender differences on cognitive performance measures (CVLT-2), female participants made more intrusion errors on Trial 5, $M = .20$, $SD = .41$, compared to males, $M = .00$, $SD = .00$, $t(24) = -2.45$, $p < .05$.

The results of participants' performance on the CVLT-2 are displayed in Figure 1. Hypotheses were tested using a unidirectional analysis of Pearson's Product Moment Correlation Coefficients. The results of the correlation analysis are summarized in Table 1. Participants with higher BMI scores also tended to perform better on the CVLT-2 Trial 5, $r = .60$, $p < .01$. Higher scores on problematic eating behavior (EAT-26 total) correlated with lower performance on CVLT-2 Trial B (interference list), $r = -.38$, $p < .05$. This pattern was also observed with CVLT-2 Trial B and EAT-26 Dieting, $r = -.49$, $p < .01$, Bulimia, $r = -.40$, $p < .05$, and Oral Control, $r = .37$, $p < .05$.

Regarding CVLT-2 learning and memory performance and knowledge of nutrition, participants who had more knowledge of sources of nutrition, scored better on initial learning, $r = .34$, $p < .05$. This was also observed for the CVLT-2 Trial 1 performance and overall nutrition knowledge scores, $r = .34$, $p <$

Table 1
Pearson's Correlations for Nutrition and Learning and Memory Performance Measures

	Eating Attitudes Test (EAT-26)					Nutrition Knowledge Survey				
Learning and Memory	BMI	Total Score	Dieting	Bulimia	Oral Control	Dietary Recommen-dations	Sources of Nutrients	Food Choices	Diet-Disease Relation-ships	Total Score
1CLVT Trial 1	-0.06	-0.14	-0.11	-0.27	0.13	0.11	.34*	0.03	0.29	.34*
2CVLT Trial 2	0.27	-0.05	-0.04	-0.31	0.22	-0.31	0.12	.36*	0.25	0.15
3CLVT Trial 3	0.19	-0.11	-0.08	-.35*	0.21	-0.19	0.17	.33*	0.22	0.19
4CLVT Trial 4	0.22	-0.12	-0.09	-0.3	0.14	-.34*	0.29	0.29	.56**	.33*
5CLVT Trial 5	.60**	-0.07	-0.08	-0.28	0.22	-0.23	0.08	0.01	0.23	0.06
6CLVT Trial B	0.14	-.38*	-.49**	-.40*	-.37*	-0.18	0.14	0.3	.33*	0.18
7CLVT Free Recall	0.01	0.24	0.16	-0.04	0.31	0.04	0.04	-0.01	0.24	0.29
8CLVT Cued Recall	0.24	0.05	0.13	-0.3	0.13	0.04	0.31	0.04	0.24	0.29

Note. CVLT = California Verbal Learning Test –2nd Edition
*$p < .05$, **$p < .01$

.05. Knowledge of healthy food choices also resulted in better CVLT-2 performance across Trials 2 ($r = .36$, $p < .05$) and 3 ($r = .33$, $p < .05$). Higher scores on the Diet-Disease Relationships subscale of the NKS correlated with better performance on the CVTL-2 Trial 4, $r = .56$, $p < .01$. Additionally, participants who had more overall knowledge of adequate nutrition tended to perform better on CVLT-2 Trial 4.

Discussion

The current study examined relationships between nutrition-related knowledge and attitudes and verbal learning and memory performance of college students. It was predicted that scores on self-report measures indicating poor nutrition-related knowledge would be associated with lower learning and memory performance. BMI scores were examined as a physical proxy for participants' history of nutritional choices. Results indicated that nutritional attitudes and knowledge were in fact related to learning. This was observed across multiple trials and during exposure to new verbal information. The link between self-report measures of problematic eating behaviors, nutritional knowledge, and impaired verbal learning is an important one to be investigated experimentally. Statistical analysis also revealed that lower nutrition knowledge of how diet contributes to disease development was inversely correlated with verbal learning. Given that lower knowledge of nutrition correlates with poor nutrition and health (i.e., poor food choices, skipping meals, lack of vitamin intake; Parmenter & Wardle, 1999), students reporting poorer knowledge of healthy nutrition behaviors may be less able to recruit the cognitive resources needed for optimal learning. This makes sense when considered in the context of the intricate physiological processes that govern learning and memory, all of which call for vitamins, minerals, adequate sleep, and a healthy diet (Lezak, 1995). Although the design of this study cannot establish direct links between biochemical processes and cognitive functioning, present findings may be sufficient to direct future inquiry in this direction.

Another methodological challenge to the current investigation stemmed from the use of the BMI, as 22 participants preferred to self-report their weight on the demographic questionnaire rather than to be weighed by the researcher. As such, participants may

have underestimated their weight resulting in skewed BMI scores. While the majority of study participants were within the normal to underweight category based on their BMI scores, the data also revealed a discrepancy between participants' BMI scores (72% fell in the underweight category) and participants' responses on the EAT-26 (90% reported healthy eating behaviors). In the future, careful consideration should be given to measures that provide accurate estimates of weight and risk for obesity and disease. Given that the current study used a nonprobability sample, with limited statistical power and unequal group distributions, future research should address the specified methodological limitations when examining these constructs.

Despite these limitations, the researchers believe that study results point to the importance of healthy nutrition habits to learning. Nutrition often suffers as college students cope with the increasing demands of adulthood. Balancing coursework, employment, and adequate self-care can be challenging, yet our research suggests that nutrition knowledge and healthy eating attitudes are both associated with enhanced learning performance. Colleges and universities are encouraged to increase programming and coursework dedicated to increasing nutrition-related knowledge among college students. This should be done early on in the process of students' college experience in order to allow opportunities to reflect on their nutrition practices and to actively modify problematic behaviors.

Future research should capitalize on experimental paradigms to isolate the mechanisms involved in nutrition and cognitive performance. Biological analyses, such as examination of the roles played by lipids, ghrelin, and leptin in eating habits, should also be considered. These physiological measures are associated with obesity, hunger, nutrition and health (Klok, Jakobsdottir & Drent, 2007) and can be isolated in experimental studies to understand mechanisms by which nutrition impacts learning. Follow-up studies testing nutrition, stress, cortisol, and anxiety and learning, attention, and concentration are currently underway in order to extend the cognitive domains under study.

Neuroscience research has made significant technological advances that permit for better examination of brain-behavior relationships. Advances include the use of functional Magnetic Resonance Imaging (fMRI), Electroencephalography (EEG), and salivary biomarkers such as cortisol, both brief, non-invasive strategies that provide a wealth of information about underlying physiology. Given these advances, future research should incorporate these paradigms when examining the relative impact of nutrition on physiological processes needed for learning. By incorporating multi-method approaches, investigators will be able to better understand the issue under investigation.

References

Adams, T. B., & Colner, W. (2008). The association of multiple risk factors with fruit and vegetable intake among a nationwide sample of college students. *Journal of American College Health*, *56*, 455-461.

Anderson, D. A., Shapiro, J. R., & Lundgren, J. D. (2003). The freshman year of college as a critical period for weight gain: An initial evaluation. *Eating Behaviors*, *4*, 363-367.

Delis, D. C., Kramer, J. H., Kaplan, E., & Ober, B. A. (2000). California Verbal Learning Test–Second Edition. San Antonio, TX: Psychological Corporation.

Economos, C. D., Hildebrandt, M., & Hyatt, R. R. (2008). College freshman stress and weight change: Differences by gender. *American Journal of Health Behavior*, *32*, 16-25.

Flegal, K.M., Carroll, M.D., Ogden, C.L., & Johnson, C.L. (2002). Prevalence and trends in obesity among US adults, 1999-2000. *The Journal of the American Medical Association*, *288*, 1723-1727.

Garner, D.M. & Garfinkel, P.E. (1979). The Eating Attitudes Test: an index of the symptoms of anorexia nervosa. *Psychological Medicine*, *9*, 273-279.

Harris, J. L., & Bargh, J. A. (2009). Television viewing and unhealthy diet: Implications for children and media interventions. *Health Communication*, *24*, 660-673.

Hawley, J.A., & Williams, M.M. (1991). Dietary intakes of age-group swimmers. *British Journal of Sports Medicine*, *25*, 154–158

Hoogenboom, B.J., Morris, J., Morris, C., & Schaefer, K. (2009). Nutritional knowledge and eating behaviors of female, collegiate swimmers. *North American Journal of Sports Physical Therapy*, *4*, 139-148.

Klok, M.D., Jakobsdottir, S., & Drent, M.L. (2007). The role of leptin and ghrelin in the regulation of food intake and body weight in humans: A review. *Obesity Review*, *8*, 21-34.

Lee, S., Kwok, K., Liau, C., & Leung, T. (2002). Screening Chinese patients with eating disorders using the Eating Attitudes Test in Hong Kong. *International Journal of Eating Disorders*, *32*, 91-97.

Lezak, M.D. (1995). Neuropsychological assessment (3rd ed.). New York, NY: Oxford University Press.

Li, Y., Dai, Q., Jackson, J.C., & Zhang, J. (2008). Overweight is associated with decreased cognitive functioning among school-age children and adolescents. *Obesity, 16*, 1809-15.

Mintz, L.B., & O'Halloran, M.S. (2000). The Eating Attitudes Test: Validation with DSM-IV eating disorder criteria. *Journal of Personality Assessment*, *74*, 489-503.

Parmenter, K., & Wardle, J. (1999). Development of a general nutrition knowledge questionnaire for adults. *European Journal of Clinical Nutrition*. *53*, 298-308.

Trockel, Mickey T., Barnes, Michael D., Egget, Dennis L. (2000). Health related variables and academic performance among first-year college students: Implications for sleep and other behaviors. *Journal of American College Health*, *49*, 125-131.