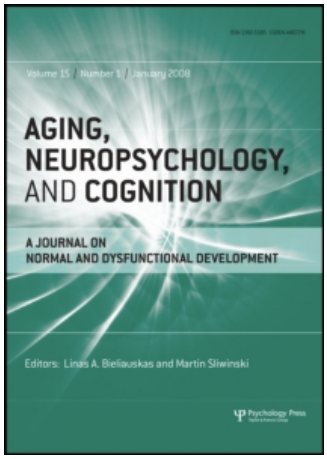

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Memory Deficits Among Alcoholics: Performance on a Selective Reminding Task

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Memory Deficits Among Alcoholics: Performance on a Selective Reminding Task

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ABSTRACT

This article compared alcoholics and healthy controls on the Buschke Selective Reminding Task. Alcoholics demonstrated deficits in memory and learning when compared to healthy controls, even when controlling for age. Examination of the alcoholic sample initially showed that age predicted memory deficits; however, age was no longer a significant predictor once the number of years of heavy drinking was entered into the regression equation. Findings suggest a direct link or mechanism of action between alcohol use and memory impairments, above and beyond effects of age or education.

It is well established that alcoholics experience cognitive deficits in comparison to healthy controls (Ryan & Butters, 1980). These deficits may also extend to the area of memory (Zhang et al., 2005), and possibly the ability to learn new material (McGlinchey-Berroth et al., 2002). Evidence differs, however, as to whether any memory or learning deficits experienced by alcoholics worsen with age (e.g., Oscar-Berman et al., 1993; Sullivan et al., 2005). In general, the processes underlying memory and learning impairments among alcoholics are not well understood. This current article investigates the nature of memory loss and learning problems in alcoholics in conjunction with the aging process, using the selective reminding task (Buschke & Fuld, 1974).

Memory problems have been associated with alcohol use both during consumption and with abuse over time. For instance, administration of ethanol during the selective reminding procedure has been found to result in

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significantly lowered long-term memory (Tiplady et al., 1998, 1999). A variety of more stable memory deficits have been found in alcoholics. There is some evidence that general memory functioning may be poorer in alcohol-dependent adults than demographically matched controls (Rosenbloom et al., 2005). Most studies, however, have found specific memory deficits among alcoholics. For instance, Saxton et al. (2000) found that subjects with alcohol-related dementia showed impairment on free recall, but not verbal recognition memory, compared to controls. Chronic heavy use of alcohol has been related to prospective memory deficits, that is, the ability to remember everyday tasks (Heffernan et al., 2004, 2002). A number of studies have found that alcoholics also have problems with remembering the context or source in which information appears, although not the information itself (Sullivan, Shear, Zipursky, Sagar, & Pfefferbaum, 1997; Weingartner et al., 1996).

There is some evidence that alcoholics' memory problems may be related to learning difficulties. Nichelli, Pollam, and Sorgato (1983) found that chronic alcoholics displayed learning deficits on both the selective reminding task and a classical word list memory task. Sherer et al. (1992) found that alcoholics performed better than brain-damaged subjects but worse than normal controls on a task of memory similar to the selective reminding procedure but in which all words were repeated each trial. Alcoholics also showed impairment in relation to controls on measures of learning but not delayed recall (Sherer et al., 1992). Chronic alcoholics have also been found to be more susceptible to interference in verbal learning and memory tasks (Blusewicz et al., 1996).

AGING AND MEMORY

Gradual memory decline happens with age (Dixon, 2003; Trahan & Larrabee, 1993), including immediate visual memory declining in late old age (Giambra et al., 1995). There is a theory that cognitive decline among alcoholics with age may be quicker than among healthy controls; however, evidence for this has been mixed. On one hand, Oscar-Berman et al. (1993) did not find support for the theory that alcoholics age quicker (e.g., their memory did not decline significantly compared to their IQ, and their IQ did not significantly decline with age more than healthy controls). On the other hand, Sullivan et al. (2005) found that alcohol is associated with greater verbal memory impairment, which increases with age and is related to atrophy of specific brain structures. Moreover, Munro et al. (2000) found that memory skills, including learning and recall of word lists, and immediate and delayed recall of visual stimuli, did not recover with abstinence among older alcoholics. This is in contrast to other studies that have shown that memory may be regained with abstinence (e.g., Reed et al., 1992; Rourke & Grant, 1999).

METHOD

Participants

The study was conducted on data collected from January 1998 until December 2002. Data from a total of 176 alcoholics and 35 healthy subjects who were not alcoholic were utilized for this study. Alcoholic subjects were recruited from among all of the alcoholic patients admitted to the National Institute of Alcohol Abuse and Alcoholism (NIAAA) inpatient unit at the Clinical Center of the National Institutes of Health (NIH). Nonalcoholic comparison subjects were recruited through the Normal Subject Office of the Clinical Center of NIH. All subjects were interviewed with the Structured Clinical Interview for DSM-III-R (Spitzer et al., 1990) and information on recent and chronic alcohol use was obtained from structured research questionnaires (Eckardt et al., 1978). All subjects provided written informed consent to participate in the study, which was approved by the NIAAA Institutional Review Board.

All alcoholic patients met DSM-III-R criteria for alcohol dependence; those who met the criteria for alcohol abuse, but not alcohol dependence, or who had a history of delirium tremens or psychotic disorders were excluded. In addition, patients who demonstrated signs of dementia or Korsakoff's disease were excluded; any patient with a Mini Mental Status exam score of 25 or below was excluded. No subjects were thiamine deficient at admission. Subjects with a history of intravenous drug use at any time during their life or substance dependence other than alcohol or tobacco in the 6 months preceding admission were excluded. The comparison subjects had no disorders meeting DSM-III-R criteria and reported no first-degree relatives with a history of alcoholism or problem drinking. None of the comparison subjects reported drinking more than three drinks a day on a regular basis. On the basis of history, physical examination, blood chemistry, and a negative urinary drug screen, all subjects were judged to be medically healthy. At the time of testing, none of the alcoholic sample had consumed alcohol for weeks, allowing a period of detoxification. We waited 3 weeks because we were able to hospitalize patients for only 4 to 5 weeks. Since they were hospitalized, we could be very confident that they were not drinking alcohol. If we had waited several months all subjects would have been outpatients and we would have had to rely on self-report augmented by blood values sensitive to alcohol consumption which are not nearly as reliable indicators of alcohol use as a locked inpatient unit. If we had only studied subjects who did not return to drinking this could have affected our results in two ways: since the relapse rate in alcoholism is very high (> 50% in 6 months), our sample would have been smaller. In addition, it is possible that cognitive function may affect time to relapse.

Subjects were not matched for education for several reasons. There were an unequal number of subjects among the alcoholic and control groups;

since the difference in size was so great, matching for education would have greatly reduced the number of subjects in the alcoholic group and would have reduced power. Since education has been shown to be an important variable when studying memory deficits among alcoholics (e.g., Zhang et al., 2005), it was decided to keep all participants and to control for education in all analyses. Age ranged widely, but was similar in the two groups; the age range for the controls was 20 to 63, and for the alcoholics 19 to 67.

Measure of Memory

The selective reminding task used in the current study has been described in other article (Weingartner et al., 1983b, 1996). In short, a list of 12 words is read to the patient and the patient is asked to recall as much as possible. Then the patient is reminded of the words they did not remember. This procedure is repeated eight times. The Buschke selective reminding task (Buschke & Fuld, 1974) has been widely used to measure memory impairments in dementia, head injury, aging, child development, drugs, and therapies (for a review, see Kraemer et al. (1983)).

Buschke and Fuld (1974) have proposed that the selective reminding procedure is a measure of episodic memory, specifically including storage to and retrieval from short-term and long-term memory, item learning, and list learning. The original version had four subscales, including sum of recall, long-term storage, long-term retrieval, short-term recall, consistent long-term retrieval, and random long-term retrieval. Burkart and Heun (2000) analyzed the psychometric properties of the selective reminding procedure among the elderly population. They conducted a principal components analysis on its subscales and found only one factor. They suggest that the selective reminding task measures a mixture of semantic memory, episodic long-term and short-term memory, and working memory, but that it cannot differentiate among them. In a study of normal adults, Trahan and Larrabee (1993) found that the Trial 12 score for long-term storage may be a better measure of forgetting than the other measures, both from a theoretical and practical standpoint. They used a standardized version of Verbal Selective Reminding Test devised by Levin (Levin et al., 1982). For the current study, the following measures were utilized: number of trials, total score, long-term storage, score on Trial 8, and long-term storage on Trial 8. These were chosen to represent a variety of measures of memory that the Buschke Selective Reminding Task may capture, since there is not a generally agreed upon, standardized score that can be calculated from the Buschke Selective Reminding Task.

One of the problems with the selective reminding task is that it has not been standardized, with studies using a variety of words, list lengths, number of trials, and scoring procedures (Kraemer et al., 1983). Kraemer et al. (1983) conducted a test of the mathematical theories underlying the model,

which was then verified on a number of patient samples. They concluded that the results of the selective reminding task can be reliable and valid, and that most problems occur when attempting to create multiple lists with equivalent difficulty and reliability. Since the current study utilizes one list that was administered one time to each patient, these potential weaknesses of the selective reminding task are not applicable to the current study. Twelve-word lists have been indicated to be adequate for seriously demented patients, and a 5-trial test has been deemed adequate (Kraemer et al., 1983). The version of the selective reminding task utilized by the current study exceeds these criteria.

Measures of Estimated Intelligence

Intelligence was estimated by two subtests of the Wechsler Adult Intelligence Scale - Revised (WAIS-R; Wechsler, 1981)—Vocabulary and Block Design. These two subtests have previously been used as a "short-form" of the WAIS-R to estimate IQ, with reasonably good results (Silverstein, 1982, 1983). In the standardization sample, vocabulary highly correlated with Verbal IQ, while Block Design highly correlated with Performance IQ (Wechsler, 1981).

Statistical Analysis

Differences among groups were tested by using multiple analysis of covariance (MANCOVA). Analyses were run for each of the memory measures, with age entered as a covariate for each analysis. Additional analyses were run among only the alcoholics. Correlations were utilized to explore the relationship among a number of variables and the memory scores. Hierarchical regressions were employed to test the independent contributions of subject variables (age, education, and intelligence) and alcoholism (years of heavy drinking) on memory functioning. Age, education, and intelligence were entered in the first step, to control for the effects of subject variables when analyzing the effect of alcoholism, operationalized as years of heavy drinking, which was added in the second step.

RESULTS

Results from MANCOVAs are presented in Table 1. The omnibus test was significant, Rao's R (5, 204) = 2.61, $p = .026$. There were significant differences between alcoholics and healthy controls on all measures of memory, including number of trials, total score, long-term storage, score on Trial 8, and long-term storage on Trial 8 (see Table 2). Least Standard Difference (LSD) post-hoc tests were conducted on diagnosis; and means for each group are presented in Table 2. Alcoholics took more trials on the task, $p = .001$. They had lower total scores, long-term storage, score on Trial 8,

TABLE 1. ANCOVAs for Selective Reminding Task with Age as Covariate

Dependent Factors Variable	F (1, 208)	Mean Square Effect	Mean Square Error	p
Number of Trials				
Diagnosis	9.07	27.92	3.08	.003
Total Score				
Diagnosis	8.62	1090.30	126.41	.004
LTS				
Diagnosis	5.18	0.12	0.02	.024
Score on Trial 8				
Diagnosis	4.39	13.88	3.16	.037
LTS on Trial 8				
Diagnosis	3.91	0.14	0.04	.049

LTS = long term storage.

TABLE 2. Means and Standard Deviations for Selective Reminding Task and Demographics for Each Group

	Means (Standard Deviations)		
Study Variables	Alcoholics (n = 176)	Healthy Controls (n = 35)	All Groups (n = 211)
Number of Trials	7.96 (1.77)	6.91 (1.67)	7.79 (1.79)
Total Score	72.26 (11.89)	80.06 (9.24)	73.56 (11.84)
LTS	0.77 (0.16)	0.85 (0.12)	0.78 (0.16)
Score on Trial 8	10.12 (1.89)	11.03 (1.31)	10.27 (1.83)
LTS on Trial 8	0.82 (0.20)	0.91 (0.13)	0.83 (0.19)
Age	39.90 (9.25)	34.23 (10.36)	38.96 (9.65)
Education	14.06 (2.60)	17.76 (3.37)	14.69 (3.07)

LTS = long term storage.
Standard deviations presented in parentheses.
Values vary slightly in some analyses due to missing values.

and long-term storage on Trial 8 than healthy controls, p = .000, .003, .006, .010, respectively.

Analyses were conducted on the alcoholics alone, to determine which variables are related to memory deficits. Descriptive statistics for the alcoholic sample showed that the average age of onset of alcoholism for our sample was relatively early, and that on average, alcoholics had experienced at least a decade of heavy drinking (see Table 3). The alcoholics in our sample had some college education, and approximately average intelligence as measured by Vocabulary and Block Design. Correlations among variables showed that, with the exception of number of trials, all subscales of the Buschke were highly correlated (see Table 4). Days since last drink, age of onset, and severity of alcoholism, defined as lifetime alcohol consumption divided by years of heavy

TABLE 3. Demographics Among Alcoholics

	M	SD
Days Since Last Drink	27.01	30.36
Age of Onset	25.0	8.7
Years of Heavy Drinking	12.0	8.0
Lifetime Alcohol Consumption (kg)	561.0	422.8
Severity of Alcoholism	66.9	111.4
Education (years)	13.99	2.79
Vocabulary Scaled Score	10.39	2.24
Block Design Scaled Score	9.11	2.44

Note: Severity of alcoholism is the lifetime alcohol consumption divided by years of heavy drinking.

TABLE 4. Correlations Among Study Variables In the Alcoholic Sample

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1 Number of Trials	–	−.26*	−.30*	−.35*	−.25*	.03	.06	.03	.07	−.10	−.04	−.10
2 Score on Trial 8		–	.80*	.83*	.88*	.11	−.31*	−.30*	−.21*	.21*	.18*	.33*
3 LTS			–	.91*	.89*	.05	−.24*	−.22*	−.20*	.15	.24*	.32*
4 Total Score				–	.82*	.08	−.36*	−.32*	−.24*	.23*	.25*	.35*
5 LTS on Trial 8					–	.09	−.26*	−.24*	−.17*	.20*	.21*	.32*
6 Age of Onset						–	−.44*	−.31*	.38*	.18*	.14	−.15
7 Years of Heavy Drinking							–	.82*	.44*	−.26*	.00	−.14
8 Lifetime Consumption of Alcohol								–	.37*	−.35*	.01	−.14
9 Age									–	.22*	.30*	−.34*
10 Education										–	.44*	.19*
11 Vocabulary Standard Score											–	.27*
12 Block Design Scaled Score												–

* $p < .05$.

drinking, were not correlated with memory scales; however, years of heavy drinking, lifetime consumption of alcohol, and age were all inversely correlated with several measures of memory. Education and estimates of intelligence (Vocabulary and Block Design) were significantly associated with memory.

TABLE 5. Regressions Predicting Memory Performance Among Alcoholics

	Score on Trial 8 (Model Does Not Include Years of Heavy Drinking)				Score on Trial 8 (Model Includes Years of Heavy Drinking)			
	β	Adj. R^2	ΔR^2 Step	F Model	β	Adj. R^2	ΔR^2 Step	F Model
Age	–.21*				–.09			
Education	.16				.08			
Vocabulary	.12				.11			
Block Design	.20*				.23**			
		.14	.17	7.63***				
Years of Heavy Drinking					–.22*			
						.17	.03	7.55***
	LTS Trial 8 (Model Does Not Include Years of Heavy Drinking)				LTS Trial 8 (Model Includes Years of Heavy Drinking)			
	β	Adj. R^2	ΔR^2 Step	F Model	β	Adj. R^2	ΔR^2 Step	F Model
Age	–.17				–.07			
Education	.13				.06			
Vocabulary	.15				.14			
Block Design	.19*				.22*			
		.12	.15	6.58***				
Years of Heavy Drinking					–.18*			
						.14	.02	6.17***

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Hierarchical regressions were utilized to determine predictors of memory functioning among the alcoholic sample (see Table 5). Two measures of memory were chosen: number of words correctly remembered on Trial 8, and long-term storage on Trial 8. These were chosen because they represent the culmination of the learning process that occurs during the Buschke Selective Reminding Test. Regressions showed that block design significantly predicted memory and years of heavy drinking significantly inversely predicted memory. Age, education, and vocabulary did not significantly predict memory, however.

CONCLUSIONS

As predicted, we found that alcoholics showed memory deficits compared to controls on all subtests of the Buschke Selective Reminding Task. Alcoholics took longer to learn the words included in the task, as well as having more difficulty remembering what they learned. These results were present

even when controlling for age, which has often been linked to memory decline on the selective reminding task (e.g., Trahan & Larrabee, 1993; Sliwinski et al., 1997). This supports prior research which has found memory impairments in alcoholics (e.g., Rosenbloom et al., 2005).

Closer examination of the alcoholic sample showed that, while age was associated with memory deficits, these deficits were not significant when other variables were entered into the equation. Rather, years of heavy drinking significantly predicted problems with memory and learning, suggesting a direct link or mechanism of action between alcohol and memory impairments. In this way, our findings are consistent with studies that have found chronic, heavy use of alcohol is associated with prospective memory deficits (Heffernan et al., 2002) and verbal memory deficits (Errico, King, Lovallo, & Parsons, 2002). Our finding that years of heavy drinking predicted memory performance suggests a dose effect, e.g., that increased alcohol usage is related to increased impairment. This is a result that many other studies have failed to find (e.g., Reed et al., 1992; Zinn et al., 2003, 2004). It is possible that the variable years of heavy drinking results in finding a dose effect because it includes both age and alcohol dosage.

Despite evidence suggesting a dose effect, the biological link between alcohol and memory impairment is not clear. Some studies suggest that specific areas of the brain may be related to memory deficits. Sullivan et al. (2005) found that smaller medial septal/diagonal band volume was related to verbal working memory deficits. It would seem that hippocampal volume should be related to memory deficits among alcoholics, but studies have shown that these deficits may preexist alcohol use (e.g., Nagel et al., 2005). Finally, it is possible that the cause of memory deficits may not be in the brain; one study showed that liver disease may play a causal role in memory impairments among alcoholics (Arria et al., 1991).

The current study has several limitations. The sample was composed of alcoholics who had, on average, begun drinking at a relatively early age and had a history of heavy drinking for about a decade. Our results regarding memory impairment may not generalize alcoholics with less severe or less lengthy drinking histories. In this regard, it would be helpful to conduct prospective studies investigating the development of memory deficits during the onset of alcoholism. A second weakness is that we only used one measure of memory and two subtests of the WAIS-R; in the future, use of multiple measures of memory and the full intelligence battery, in addition to other neuropsychological tests, may help clarify the nuances of these memory deficits. Third, it is not clear to what degree abstinence from alcohol can cause recovery of memory functioning in alcoholics. Our study found that days since the last drink of alcohol did not significantly correlate with a measure of memory functioning; however, other studies have found a recovery effect (e.g., Rourke & Grant, 1999). Finally, although the effects we found were significant,

they were quite modest. It appears that while memory deficits exist in alcoholics without Korsakoff's dementia, these deficits are not profound.

In summary, we found that alcoholics experience deficits in a task of memory and learning when compared with healthy controls, even while controlling for age, thereby supporting a dose effect of alcohol. Follow-up analyses showed that predictors of memory functioning and learning were a measure of nonverbal ability and (inversely) years of heavy drinking. Future research is needed to understand the development and relative permanence of such memory and learning deficits.

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REFERENCES

Arria, A. M., Tarter, R. E., Kabene, M. A., Laird, S. B., Moss, H., & Van Thiel, D. H. (1991). The role of cirrhosis in memory functioning of alcoholics. *Alcoholism: Clinical and Experimental Research, 15*, 932–937.

Blusewicz, M. J., Kramer, J. H., & Delmonico, R. L. (1996). Interference effects in chronic alcoholism. *Journal of the International Neuropsychological Society, 2*, 141–145.

Burkart, M., & Heun, R. (2000). Psychometric analysis of the selective reminding procedure in a sample from the general elderly population. *Dementia and Geriatric Cognitive Disorders, 11*, 74–80.

Buschke, H., & Fuld, P. A. (1974). Evaluating storage, retention, and retrieval in disordered memory and learning. *Neurology, 24*, 1019–1025.

Dixon, R. A. (2003). Themes in the aging of intelligence: Robust decline with intriguing possibilities. In R. J. Sternberg, J. Lautrey, & T. Lubart (Eds.), *Models of intelligence: International perspectives* (pp. 151–167). Washington, DC: American Psychological Association.

Eckardt, M. J., Parker, E. S., Noble, E. P., Feldman, D. J., & Gottschalk, L. A. (1978). Relationship between neuropsychological performance and alcohol consumption in alcoholics. *Biological Psychiatry, 13*, 551–565.

Errico, A. L., King, A. C., Lovallo, W. R., & Parsons, O. A. (2002). Cortisol dysregulation and cognitive impairment in abstinent male alcoholics. *Alcoholism: Clinical and Experimental Research, 26*, 1198–1204.

Giambra, L. M., Arenberg, D., Zonderman, A. B., Kawas, C., & Costa, P. T. (1995). Adult life span changes in immediate visual memory and verbal intelligence. *Psychology & Aging, 10*, 123–139.

Heffernan, T., Ling, J., & Batholomew, J. (2004). Self-rated prospective memory and central executive deficits in excessive alcohol users. *Irish Journal of Psychological Medicine, 21*, 122–124.

Heffernan, T. M., Moss, M., & Ling, J. (2002). Subjective ratings of prospective memory deficits in chronic heavy alcohol users. *Alcohol & Alcoholism, 37*, 269–271.

Kraemer, H. C., Peabody, C. A., Tinklenberg, J. R., & Yesavage, J. A. (1983). Mathematical and empirical development of a test of memory for clinical and research use. *Psychological Bulletin, 94*, 367–380.

Levin, H. S., Benton, A. L., & Grossman, R. G. (1982). *Neurobehavioral consequences of closed head injury*. New York: Oxford University Press.

McGlinchey-Berroth, R., Fortier, C. B., Cermak, L. S., & Disterhoft, J. F. (2002). Temporal discrimination learning in abstinent chronic alcoholics. *Alcoholism: Clinical and Experimental Research, 26*, 804–811.

Munro, C. A., Saxton, J., & Butters, M. A. (2000). The neuropsychological consequences of abstinence among older alcoholics: A cross-sectional study. *Alcoholism: Clinical and Experimental Research, 24*, 1510–1516.

Nagel, B. J., Schweinsburg, A. D., Phan, V., & Tapert, S. F. (2005) Reduced hippocampal volume among adolescents with alcohol use disorders without psychiatric comorbidity. *Psychiatry Research: Neuroimaging, 139*, 181–190.

Nichelli, P., Pollam, A., & Sorgato, P. (1982). Deficit subclinici di memoria. negli etilisti cronici. *Rivista di patologia nervosa e mentale, 103*, 133–145.

Oscar-Berman, M., Clancy, J. P., & Weber, D. A. (1993). Discrepancies between IQ and memory scores in alcoholism and aging. *The Clinical Neuropsychologist, 7*, 281–296.

Reed, R. J., Grant, I., & Rourke, S. B. (1992). Long-term abstinent alcoholics have normal memory. *Alcoholism: Clinical and Experimental Research, 16*, 677–683.

Rosenbloom, M., O'Reilly, A., Sassoon, S. A., Sullivan, E. V., & Pfefferbaum, A. (2005). Persistent cognitive deficitsi n community-treated alcoholic men and women volunteering for research: Limited contribution from psychiatric comorbidity. *Journal of Studies on Alcohol, 66*, 254–265.

Rourke, S. B., & Grant, I. (1999). The interactive effects of age and length of abstinence on the recovery of neuropsychological functioning in chronic male alcoholics: A 2-year follow-up study. *Journal of the International Neurpsychological Society, 5*, 234–246.

Ryan, C., & Butters, N. (1980). Learning and memory impairments in young and old alcoholics: Evidence for the premature-aging hypothesis. *Alcoholism: Clinical and Experimental Research, 4*, 288–293.

Saxton, J., Munro, C. A., Butters, M. A., Schramke, C., & McNeil, M. A. (2000). Alcohol, dementia, and Alzheimer's disease: Comaprison of neuropsychological profiles. *Journal of Geriatric Psychiatry and Neurology, 13*, 141–149.

Sherer, M., Nixon, S. J., Parsons, O. A., & Adams, R. L. (1992). Performance of alcoholic and brain-damaged subjects on the Luria Memory Words Test. *Archives of Clinical Neuropsychology, 7*, 499–504.

Silverstein, A. B. (1983). Estimating Full Scale IQs from short forms of Wechsler's scales: Linear scaling vs. linear regression. *Journal of Consulting & Clinical Psychology, 52*, 199.

Silverstein, A. B. (1982). Two- and four-subtest short forms of the Wechsler Adult Intelligence Scale-Revised. *Journal of Consulting & Clinical Psychology, 50*, 415–418.

Sliwinski, M., Buschke, H., Stewart, W. F., Masur, D., & Lipton, R. B. (1997). The effect of dementia risk factors on comparative and diagnostic selective reminding norms. *Journal of the International Neuropsychological Society, 3*, 317–326.

Spitzer, R. L., Williams, J. B. W., Gibbon, M., & First, M. B. (1990). *Structured clinical interview for DSM-III-R - Non-patient edition (SCID-NP, Version 1.0)*. Washington, DC: American Psychiatric Press.

Sullivan, E. V., Deshmukh, A., De Rosa, E., Rosenbloom, M. J., & Pfeffrbaum, A. (2005). Striatal and forebrain nuclei volumes: Contribution to motor function and working memory deficits in alcoholism. *Biological Psychiatry, 57*, 768–776.

Sullivan, E. V., Shear, P. K., Zipursky, R. B., Sagar, H. J., & Pfefferbaum, A. (1997). Patterns of content, contextual, and working memory impairments in schizophrenia and nonamnesic alcoholism. *Neuropsychology, 11*, 195–206.

Tiplady, B., Faineteau, H., Loganathan, A., Spiegelberg, M., Taylor, Z., & Wright, P. (1998). Effects of ethanol and temazepam on performance in memory and psychomotor tasks: a dose-response comparison. *Human Psychopharmacology, 13*, 285–291.

Tiplady, B., Harding, C., McLean, D., Ortner, C., Porter, K., & Wright, P. (1999). Effects of ethanol and temazepam on episodic and semantic memory: A dose-response comparison. *Human Psychopharmacology, 14*, 263–269.

Trahan, D. E., & Larrabee, G. J. (1993). Clinical and methodological issues in measuring rate of forgetting with the verbal selective reminding test. *Psychological Assessment, 5*, 67–71.

Wechsler, D. (1981). Wechsler adult intelligence scale—revised. Cleveland, OH: The Psychological Corporation.

Weingartner, H. J., Andreason, P. J., Hommer, D. W., Sirocco, K. Y., Rio, D. E., Ruttimann, U. E., et al. (1996). Monitoring the source of memory in detoxified alcoholics. *Biological Psychiatry, 40*, 43–53.

Weingartner, H., Rudorfer, M. B., Buschsbaum, M. S., & Linnoila, M. (1983b). Effects of serotonin on memory impairments produced by ethanol. *Science, 221*, 472–474.

Zhang, Y., Heeren, T., & Ellison, R. C. (2005). Education modifies the effect of alcohol on memory impairment: The third national health and nutrition examination survey. *Neuroepidemiology, 24*, 63–69.

Zinn, S., Bosworth, H. B., Edwards, C. L., Logue, P. E., & Swartzwelder, H. S. (2003). Performance of recently detoxified patients with alcoholism on a neuropsycholgical screening test. *Addictive Behaviors, 28*, 837–849.

Zinn, S., Stein, R., & Swartzwelder, H. S. (2004). Executive functioning early in abstinsence from alcohol. *Alcoholism: Clinical and Experimental Research, 28*, 1338–1346.