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CARDIOVASCULAR REACTIVITY AS A PREDICTOR OF ALCOHOL CONSUMPTION IN A TASTE TEST SITUATION

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The existence of a relationship between cardiovascular reactivity to signalled shock and alcohol consumption can be inferred from studies of males at increased familial risk for alcoholism. The present study examined two groups of nonalcoholic men—those with multigenerational histories (MGH) of alcoholism and family-history negative (FH−) controls—to determine whether reactivity was related to voluntary ethanol consumption in the context of a beverage taste test. High reactors, a significant majority of whom were MGH males, drank significantly more vodka and orange juice, rum and coke, and orange juice when asked to rate the flavor of three alcoholic and two nonalcoholic drinks. High reactors also consumed more alcohol on a weekly basis according to their self-report.

Sons of male alcoholics may be at four to nine times increased risk for development of alcohol dependency and abuse when compared to males without a family history of alcoholism. (Cloninger, Bohman, & Sigvardsson, 1981). A potential marker of such risk—autonomic hyperresponsivity to a range of stimuli—that is dampened by alcohol has been described as a characteristic of this group. (For review see Pihl, Peterson, & Finn, 1990.) The purpose of the present study is to assess the relationship between this characteristic of hyperreactivity and variability in the consumption of alcohol.

When viewed as a group, sons of alcoholics have been characterized by significantly increased consumption of alcohol (McCaul, Turkkan, Svikis, Bigelow, & Cromwell,

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1990). Other studies, often with mixed samples of both sons and daughters of alcoholics (Alterman, Searles, & Hall, 1989; Engs, 1990), have reported failures to find a relationship, or mixed results (Alterman, Bridges, & Tarter, 1986; George, Phillips, & Skinner, 1988; Hesselbrock, Stabenau, Hesselbrock, Meyer, & Babor, 1982; Pandina & Johnson, 1989, 1990; Schuckit & Sweeney, 1987).

Self-report is a straightforward method of measuring alcohol consumption, but the data gathered in this manner are potentially subject to bias because subjects may underreport drinking habits in accordance with social desirability. The taste-test task has been used to assess drinking habits in a variety of studies (Marlatt, Demming, & Reid, 1973; Pihl & Yankofsky, 1979; Pihl, Young, Ervin, & Plotnick, 1987) and provides a simple alternative method of assessing alcohol consumption. This task requires the subject to rate subjectively the flavor of various alcoholic beverages in accordance with a list of adjectives provided by the experimenter. The amount of alcohol the subject actually consumes during the test is left to his/her discretion, and this amount constitutes the actual dependent variable.

The present study first tested the hypothesis that men characterized by increased sober cardiovascular reactivity to signalled shock would drink more alcohol in a taste-test situation than men who were not characterized by this heightened reactivity. This study necessarily was limited to analysis of the single predictor variable of sober reactivity. It was hypothesized additionally (a) that more sons of male alcoholics with a multigenerational history of the disorder (MGH) would be reactive than men without this family history (FH −) and that MGH males would drink more alcohol than FH − males during the alcohol taste test.

Method

Subjects

Twenty-seven nonalcoholic men participated in this study. Age; education level of the subject, his father, and his mother; drug use; and socioeconomic status are presented in Table 1. Each of the 11 MGH subjects had an alcoholic father, paternal grandfather, and at least one other alcoholic first-degree male paternal relative. These MGH subjects were obtained from the Douglas Hospital-McGill University Alcohol Research Facility. At this institution alcoholics and their families are screened according to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-III-R; American Psychiatric Association, 1987) using the National Institute of Mental Health Diagnostic Interview Schedule (NIMH-DIS; Robbins, Helzer, Croughan, & Ratcliff, 1981) and are asked to participate in a variety of studies. Family members unavailable for interview were screened for psychiatric status using the Family History Research Diagnostic Criteria (FH − RDC; Endicott, Andreasen, & Spitzer, 1975). The interviews for both schedules were conducted by a mental health professional.

The 16 FH − subjects had no alcoholism in their family for two previous generations. These FH − subjects were obtained through advertisements placed in various Montreal-area newspapers and were contacted initially by telephone. Those knowledgeable about the mental and physical status of their relatives and who fulfilled FH − requirements were asked to participate in the study. These subjects then were interviewed personally by a mental health professional, using the FH − RDC.

Subjects eligible for participation in this study were neither alcohol abusing nor dependent according to DSM-III-R and NIMH-DIS criteria and had scores of <5 on the Michigan Alcoholism Screening Test (MAST; Selzer, 1971). Subjects with family histories of psychotic illness were excluded from participation. All participants were asked to avoid alcohol for 24 hours and food for 4 hours prior to testing. Each individual was paid $5/hour for his participation.

Table 1
Demographic Data by Reactivity Groups

Measure	High reactors *M*	High reactors *SD*	Low reactors *M*	Low reactors *SD*
Age	23.4	3.3	22.4	3.2
Years of education	13.9	2.2	14.0	1.8
Years of education (father)	12.5	4.2	14.6	4.8
Years of education (mother)	12.8	3.6	14.6	4.8
Drug use (cannabis)	55.5%	–	66.6%	–
Parental divorce	27.7%	–	11.1%	–
SES (rank)[a]	56.5	11.3	55.2	16.5

[a]The values for socioeconomic status (SS) represent mean ranked index scores according to the occupation of the subject's father.

Procedure

All subjects, regardless of risk status, were rank ordered and separated into two groups, 8 high and 9 low reactors, according to their heart-rate response to a signalled electric shock. The shock procedure, methods for recording heart-rate, and the formula for calculating percent reactivity were described in detail in previous studies. (See Finn & Pihl, 1987.) High reactors were those whose heart rate increased more than 7% to the shock, and low reactors were those whose heart rate increased no more than 2%. These criteria were established on the basis of previous work (Pihl & Peterson, 1991) that demonstrated that a cut-off point of 7% reactivity (and 7% alcohol-induced reactivity-dampening) separated 80% of MGH subjects from 80% of FH– subjects. This selection of a separation point resulted in the creation of subject groups of unequal sizes.

Five different beverages were used for the taste test: (a) vodka and orange juice; (b) rum and coke; (c) rye and ginger ale; (d) orange juice; and (e) water. The distilled liquors used were Troika Premium Vodka (40% alcohol), Ron Carioca White Rum (40% alcohol), and Royal Reserve Canadian Rye Whiskey (40% alcohol). Coca-Cola, Canada Dry Ginger Ale, and Minute-Maid orange juice were used as mixers. The alcoholic drinks consisted of 80ml of liquor and 320ml mixer. The two nonalcoholic drinks consisted of 400ml of orange juice and 400ml of tap water, respectively. The 400ml beverages were offered to the subjects in 500ml bottles.

Upon entering the laboratory each subject was greeted by a research assistant, who explained the procedure of the study. The subject then was given an informed consent form to sign and was interviewed with regard to demographic characteristics and levels of weekly alcohol consumption. He was seated in a comfortable armchair and attached to the electrophysiological apparatus. A pair of stereo headphones and a shock electrode also were placed on him at this time. Each subject then was instructed to relax for about 5 minutes while a 3-minute baseline period was recorded. This baseline relaxation period was followed by administration of the shock procedure.

After the completion of physiological testing each subject was brought into another room and was seated at a table with 5 different bottled beverages before him. The subject poured the desired amount of each beverage into five identical drinking glasses prior to tasting the liquid. He was instructed to rate each drink from 1 ("very much like this") to 4 ("not at all like this") for 16 different adjectives (e.g., "bitter," "sweet," tingling," etc.) Each subject was told that he could drink as little, or as much, of each beverage as he wished. After the subject completed the taste-test he was escorted out of the testing area. An experimenter entered and measured the remaining liquids in each of the glasses and bottles. Each subject then was debriefed, paid, and thanked for his participation. Blood alcohol levels were monitored to determine when the subject could leave the laboratory safely.

RESULTS

One outlier was excluded from the statistical analyses. This MGH subject consumed enough of two of the three alcoholic beverages to climb beyond two standard deviations above the respective group means for those beverages.

Demographic Data

Demographic data, presented in Table 1, were analyzed with two-tailed *t*-tests for continuous data and with Fisher's 2 × 2 Exact Probability tests for categorical data. No between-group differences emerged for measures of age, years of education, years of maternal or paternal education, parental divorce rates, percentage of drug users, or socioeconomic status.

Eight high reactors and 6 low reactors used drugs (mainly cannabis). High reactors used cannabis an average of twice per week; low reactors, an average of once per week. Members of both groups smoked an average of one marijuana cigarette per occasion. Three subjects used hallucinogens, and 2 used cocaine. Such use was limited to once per month.

Taste Test and Weekly Alcohol Consumption (High Reactors vs. Low Reactors)

t-tests were used to analyze the taste test data, rather than Multivariate Analysis of Variance (MANOVA) procedures, because MANOVA requires analysis of groups of equal variance (Huberty & Morris, 1989). One-tailed *t*-tests for groups of unequal variance revealed that high reactors drank significantly more vodka and orange juice, $F(8,17) = 7.28$, $p < .004$, $t(25) = 2.56$, $p < .009$, and more rum and coke, $F(8,17) = 6.06$, $p < .007$, $t(25.85) = 2.07$, $p < .02$, than low reactors. There were no significant group differences for rye and ginger ale. Further analysis demonstrated, however, that levels of consumption for all three alcoholic beverages were highly intercorrelated (R squares above a minimum of .68, $p < .0001$) and that the two groups differed in total taste-test alcohol consumption, as well (one-tailed *t*-test for groups of unequal variance: $F[8,17] = 6.03$, $p < .007$, $t[25.87] = 1.93$, $p < .033$).

High and low reactors also differed in their consumption of orange juice (one-tailed *t*-test for groups of unequal variance: $F[8,17] = 5.73$, $p < .008$, $t[26.08] = 2.07$, $p < .024$), but not water. Further analysis indicated that consumption levels of orange juice and water were correlated insignificantly with each other (R square = 24.47, $p < .218$) and with total alcohol consumption (R squares at or below 16.52, $p < .41$). These analyses demonstrate that the factor of thirst alone probably does not account for the intergroup differences in liquid consumption.

One-tailed *t*-tests for groups of equal variance demonstrated that high and low reactors did not differ in self-reported number of drinking occasions per week or in number of alcoholic drinks per occasion, but did differ significantly in number of alcoholic drinks per week (one-tailed *t*-test for groups of unequal variance: $F[8,17] = 11.17$, $p < .0008$, $t[23.19] = 1.84$, $p < .04$). Means and standard deviations from all these analyses are presented in Table 2.

Taste-test and Self-reported Alcohol Consumption (MGH vs. FH−)

Beverage consumption quantities also were calculated and compared for MGH vs. FH− subjects. Group differences for the alcoholic beverages were analyzed with

Table 2
Test and Self-report Weekly Alcohol Consumption by Reactivity Groups

Measure	High reactors *M*	High reactors *SD*	Low reactors *M*	Low reactors *SD*
Vodka and orange juice*	111.7	100.9	43.0	37.4
Rye and ginger ale	79.2	77.2	64.7	64.4
Rum and coke*	93.1	90.1	42.0	36.9
Orange juice*	113.8	100.4	56.8	41.9
Water	43.9	55.7	61.9	58.9
Total alcohol*	283.5	255.3	149.7	103.9
Drinking occasions/week	3.9	2.6	3.0	2.5
Drinks/drinking occasion	4.6	2.9	4.1	2.3
Drinks/week*	15.6	15.3	8.4	4.6

*$p < .05$.

one-tailed *t*-tests, and nonalcoholic beverages were tested using two-tailed *t*-tests. There were no significant differences between the MGH and FH– groups. MGH and FH– subjects also did not differ in terms of self-reported drinking occasions per week, drinks per occasion, or drinks per week.

Reactivity Group Composition (MGH vs. FH–)

Chi-square analysis indicated that the total distribution of MGH and FH– subjects in the high and low reactivity groups deviated significantly from chance ($\chi^2 = 4.91$, $p < .027$). Although none of the individual cell chi-squares met significance, all the deviance in distribution was in accordance with the basic experimental hypothesis: There were more FH– and fewer MGH subjects in the low reactivity group and more MGH and fewer FH– subjects in the high reactivity group than predicted. Actual and expected distribution of subjects in these two groups, by risk, is shown in Table 3.

Table 3
Reactivity Group Composition by Risk

Risk group		Low reactivity	High reactivity
FH–	Actual	8	8
	Expected	5	11
	Chi square	1.3	.7
MGH	Actual	1	10
	Expected	4	7
	Chi square	1.9	1.0

Note.—Overall distribution significantly different than chance at $p < .05$.
MGH = multigenerational family history of alcoholism; FH– = family history negative.

DISCUSSION

The present study tested the hypothesis that men with increased cardiovascular reactivity to shock would drink more alcohol in a taste test situation and according to self-report than men without this increased reactivity. The results showed that high reactors indeed drank significantly more alcohol in total, more vodka and orange juice, and more rum and coke than did low reactors. In addition, high reactors consumed significantly more alcoholic drinks per week than low reactors, by their own self-report. The remaining hypothesis, that MGH subjects would consume more alcohol than FH – subjects, failed to receive support. This failure may indicate that cardiovascular reactivity is a better predictor of drinking than familial history of alcoholism, at least within subject groups preselected by family drinking history. It is important to note, in this regard, that MGH and FH – men in this study distributed within the high and low reactivity groups unevenly, with the MGH subjects represented more commonly in the high reactivity group and the FH – subjects more frequently in the low reactivity group. This means perhaps that family history actually predicts reactivity more accurately than it predicts alcohol consumption and that reactivity, in turn, is related more clearly to alcohol misuse. If such is generally the case, the confusion in the literature with respect to alcohol use among sons of alcoholics is understandable, especially among studies with a small sample size.

The findings of this study also demonstrate the importance of considering other factors in addition to familial history. Peterson and Pihl (1990) have presented a theoretical integration of the literature that concerns sons of male alcoholics (SOMAs), which outlines the potential interrelationship among factors commonly reported as typical of SOMAs, such as conduct-disorder, mild cognitive deficits, and abnormal psychophysiological response to certain classes of stimuli. Detailed consideration of the total clinical picture presented by subjects under experimental investigation with the findings of previous studies would heighten the likelihood of determining which individuals are truly at risk and, therefore, of understanding what factors underlie that risk.

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PSYCHOLOGICAL EFFECTS OF ORGANOPHOSPHATE PESTICIDES: A REVIEW AND CALL FOR RESEARCH BY PSYCHOLOGISTS

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Organophosphates are among the most commonly used and most toxic pesticides. They act directly on the nervous system by inhibiting the neurotransmitter acetylcholine. Organophosphates evoke a consistent pattern of physical symptoms. They also have acute psychological and behavioral effects, such as anxiety, depression, and cognitive impairments. Research suggests that moderate levels of acute poisoning may cause persistent problems. Long-term psychological effects of low-level exposure, however, have not been determined satisfactorily. Some research has documented cognitive and emotional deficits due to chronic exposure to organophosphates, but not all studies have found ill effects. To date, psychologists have played only a small role in studying the psychological effects of organophosphates, despite the substantial contribution their expertise could make.

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