DECISION MAKING IN COLLEGE STUDENTS FROM

NON-ALCOHOLIC AND ALCOHOLIC FAMILIES

By

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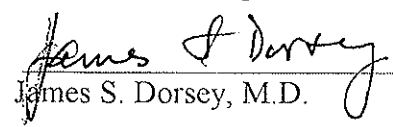
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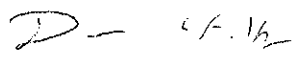James J. Gray, Ph.D.

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IN MEMORY OF

Timothy, who died too young, and

John, who endured.

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ABSTRACT

This observational study investigated whether poor performance on the Iowa Gambling

Task (IGT) occurs in college students with risk factors for alcohol dependence and/or

characteristics of various proposed types of alcohol use disorders. The recent alcohol use group

had earlier onset of alcohol problems, and more alcohol problems in the past year, impulsivity

and illicit drug use than the no recent alcohol group, but these groups did not differ on decision

making, psychopathy or family alcoholism history. Nearly all variables were significantly

correlated, as expected. No significant correlation was found of family alcoholism history with

any other variable, or of impulsivity with recent alcohol use. In the recent alcohol group, poor

decision making was not significantly correlated with impulsivity, while in the no recent alcohol

group, poor decision making was correlated with impulsivity and psychopathy, but not early

alcohol problems or past year alcohol problems. Psychopathy was correlated with past-year

alcohol problems among the full group and the recent alcohol use group but not among the no

recent alcohol group. Exploratory cluster analysis was conducted on the full data. In the two

cluster analysis, the cluster with the poorest decision making also had earlier onset of alcohol

problems, and more psychopathy, impulsivity, past-year alcohol problems, and recent alcohol

and drug use. In the three cluster solution, the group with most psychopathy had earliest alcohol

problems, most alcohol problems in the past year, and most impulsivity, alcohol use and drug

use, but had decision making near the mean. Neither the two or three cluster groups differed in

family alcoholism history. Similarities were discussed between patterns of variables in this

sample and proposed typologies of alcoholism.

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CHAPTER 1

INTRODUCTION

Alcohol use is common in the United States. Sixty-two percent of people surveyed in 2008 said they use alcohol (National Institute on Alcohol Abuse and Alcoholism (NIAAA), 2008). While most people who drink alcohol do not develop significant problems, for those who do, the personal and societal toll can be enormous. The emotional and physical suffering of people with alcohol use problems adversely affects their families, friends and coworkers as well. For example, data from 2006 through 2009 show that during the past year about 30.6 million people (13.2 percent of those 16 years or older) drove while under the influence of alcohol (National Survey on Drug Use and Health, 2010). In addition, the estimated economic cost to society of the use of alcohol in the United States during 1998 was $184,636,000,000, including such costs as lost wages, property destruction, medical problems, criminal justice services, and alcohol use disorder treatment (Harwood, 2000). Developing efficient and effective ways to prevent and treat problems with alcohol is thus a high priority for safety and health.

Among young people, alcohol use and problems related to it are wide-spread and can have serious consequences. During 2006 through 2009, drunk driving rates were higher for persons aged 16 to 25 (19.5 percent) than among those aged 26 or older (11.8 percent) (National Survey on Drug Use and Health, 2010). From 2002 through 2008, around 18% of full-time college students aged 18 to 22 were heavy drinkers of alcohol (Substance Abuse and Mental Health Services Administration, 2007). Over 40% of college students reported at least one binge-drinking episode (five or more drinks on one occasion) in the past two weeks, and college

drinking is associated with a variety of problems such as poor academic achievement, accidents, unsafe sex, physical and sexual assaults, and death (such as from accidents or alcohol poisoning) (National Institute on Alcohol Abuse and Alcoholism (NIAAA), 2008). In a epidemiological survey, the greatest proportion (more than 12%) of people with Alcohol Dependence (American Psychiatric Association, 2000), were 18 to 21 years old, while approximately 11% were 22 to 24 years old. Adolescents (12 to 17 years old) made up another 2 % of all alcohol dependent people (NIAAA, 2008). While some research suggests that young people identified in epidemiological surveys as alcohol dependent make a transition to milder or even no dependence from young adulthood to middle adulthood (Jackson, O'Neill, & Sher, 2006), other researchers suggest many young people may be misidentified as alcohol-dependent because of measurement error caused by their misinterpretations of diagnostic questions (Caetano & Babor, 2006). For example, Caetano and Babor (2006) point out that young people may misinterpret a natural increase in their ability to "hold your liquor" early in their drinking history, not realizing that this increase differs from tolerance (a criterion that can contribute to a diagnosis of alcohol dependence) which develops over many years of heavy drinking. Whether they drink in a problematic way in college or not, a minority of young people will go on to have alcohol problems later in life (Jackson, O'Neill, & Sher, 2006). One example is that urban American Indian youth who had a first experience of alcohol intoxication by age 14 drank more heavily in their later teen years and were more likely to develop a diagnosed alcohol use disorder early in life (Henry et al., 2011).

Decision-making deficits among people with alcohol problems have been noted by clinicians, researchers and the people themselves. Continuing to use substances despite negative consequences can contribute to a diagnosis of substance abuse or substance dependence in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (American Psychiatric

Association (APA), 2000). The website about the upcoming fifth edition (APA, 2011, 2012) lists proposed criteria for a new substance use disorder, which combines the previous abuse and dependence disorders. Two of the proposed criteria that can count towards this diagnosis are continued use despite persistent or recurrent interpersonal or social consequences and continued use despite knowledge of having a persistent or recurrent physical or psychological problem that is likely caused or exacerbated by the substance(s).

Poor decision-making has been frustrating to people with alcohol and other drug problems and those providing treatment for them. For people with substance use disorders, poor choices can lead to a downward spiral of heavy use, relapse after a period of abstinence, and a continuation or worsening of the social, legal, medical and other problems that can accompany addictions.

If a person is in withdrawal, using a substance that will discontinue discomfort makes some practical sense. Also, research on learning theories regarding addiction has found that what appears to be poor choice may be heavily influenced or controlled by learned behaviors such as conditioned place preferences (Walker & Ettenberg, 2007). This may explain people feeling drawn to bars even if they are consciously attempting not to drink. However, many poor choices by people with addictions seem to be just … poor choices. People who demonstrate adequate intelligence (for example by solving word problems correctly) may make choices about alcohol or drug use that can cost them their jobs, their relationships, their health or their freedom through incarceration. In one early study (Kelly, Scott, Prue, & Rychtarik, 1985), problem-solving training (D'Zurilla & Goldfried, 1971) increased the measured problem-solving skills of inpatient alcohol patients, but these patients nevertheless chose poor solutions in real life.

There is some evidence that there may be deficits in abstraction/problem-solving and possibly memory in people from alcoholic families even prior to developing alcohol problems themselves (Schaeffer, Parsons, & Yohman, 1984). Corral, Hologuin, & Cadaveira (1999) compared a battery of neuropsychological tests of attention, visuospatial abilities and frontal tasks (planning and self-regulation) in three groups of Spanish children aged 7-15 years: (a) children from non-alcoholic families; (b) children with an alcoholic father but no other first- or second-degree alcoholic relatives (termed "low density" family history for alcoholism); and (c) children from families with more than one close relative with alcoholism ("high density" family history of alcoholism). Their study showed that children with one alcoholic parent (in their study, the father) performed at similar levels to children with no alcoholism in the family on the attention and visuospatial tasks, but that children with alcoholism in other family members (i.e., in addition to the father) performed significantly worse on these tasks. Although Corral et al. (1999) did not find planning and self-regulation task differences among the three groups, their findings on other variables, such as academic achievement, suggest that there may be important differences in cognitive and neural characteristics between children from non-alcoholic, low density alcoholic, and high density alcoholic families.

Johnson and Rolf (1988) found no significant differences in verbal, performance or full-scale intelligence of non-economically disadvantaged children (age 6 -18) of recovering alcoholics and the children of non-alcoholics, yet the school performance of the children of alcoholics was poorer.

Bechara, Damasio, Damasio and Anderson (1994) developed a task to measure a subtle impairment in decision making in a person with brain injury in the ventromedial prefrontal cortex. This deficit involves choosing immediate gains while ignoring potential, often larger,

future losses. The authors were intrigued by a patient with ventromedial injury who was intelligent and able to voice appropriate solutions to problems, yet made poor choices for himself, such as not going to work. The authors described people with this type of brain injury as "seeming insensitive to the future" (Bechara et al., 1994, p 8). The measure they developed is the Iowa Gambling Task (IGT). The same decision-making deficit, measured by the IGT, has been found in other groups, including substance abusers. It is interesting that both ventromedial patients and persons with substance use disorders tend to have denial of their particular problem, which is usually obvious to others (Bechara, Dolan, Denburg, Hindes, Anderson and Nathan, 2001). Ventromedial patients often deny the cognitive problems related to their brain injury, and substance users often deny that their substance use is a problem.

The Iowa Gambling Task (IGT) requires participants to choose cards from four specially designed decks, until they are told to stop (generally after they have drawn 100 cards). The player is given a balance of $2000 (shown on screen during the computer version of the task). The player is told that all cards will provide a reward (i.e., some money will be added to their balance) but that some cards will also impose a penalty or punishment (some money will be taken from their balance). What the player is not told is that the A and B desks are "disadvantageous," because drawing them leads to a net loss over a number of cards, while drawing on the C & D decks is "advantageous" because it leads to a net gain. The most common net score for an individual completing the IGT is (total cards drawn from the advantageous [C & D] decks) minus (total cards drawn from the disadvantageous [A & B] decks), in brief [(C + D) − (A + B)] (Bechara et al., 1994).

Stout, Rodawalt and Siemers (2001) compared IGT performance of people with Huntington's disease, people with Parkinson's disease, and healthy controls. These researchers

found a difference in performance during the second half of the task (when most participants have figured out which cards are disadvantageous). The Huntington's participants chose more often from the disadvantageous decks during the second half of the task than did Parkinson's and healthy participants, who did not differ significantly from each other, just as the authors had predicted.

Women have performed more poorly than men on the IGT, and the IGT did not differentiate substance-using from non-substance-using women, while it did differentiate substance-using from non-substance-using men (Businelle, Apperson, Kendzor, Terlicki & Copeland, 2008). Women's performance rose to equal that of men when they contemplated moral dilemmas, activating areas of the brain that were not usually active when women performed the IGT under usual instructions (Overman, Graham, Redmond, Eubank, Boettcher, Samplawski, & Walsh, 2006).

Poor emotional decision making, measured as IGT performance, was associated with larger amounts of alcohol use in female college students who were low in inhibitory control (Patrick, Blair, & Maggs, 2008).

In a college sample, novelty seeking (NS), harm avoidance (HA), a composite score of NS and HA, and alcohol related problems, were correlated with total amount of alcohol consumed. IGT performance was not correlated to alcohol consumption. However, in the same study, novelty seeking was correlated both with IGT performance and also with alcohol-related problems (Skeel, Pilarski, Pytlak & Neudecker, 2008). For another behavioral measure of risk taking, the Balloon Analogue Risk Task (BART, Lejuez, Read, Kahler, Richards, Ramsey, Stuart, Strong, & Brown, 2002), the risk is clear, as opposed to the IGT, where the risk is ambiguous until the participant begins to have either a hunch or a conscious understanding of

how the task works. Skeel and colleagues (2008) recommend using behavioral tasks (such as the IGT or BART) and also self-report measures to screen for risk for excessive alcohol use.

There has been little IGT decision making research about young people who have not been diagnosed with a neurological, mental health or substance abuse disorder. In a study of binge-drinking college students from the summer before college until the end of their second year, those classified as heavy, frequent binge-drinkers showed impaired IGT performance, as compared to low, infrequent binge drinkers (Goudriaan, Grekin & Sher, 2007). The researchers gathered information on family alcohol history but did not report analysis using this variable. Among their sample of binge drinking students, 27% reported a multigenerational family alcohol history on either the maternal or paternal side, and 6% reported a multigenerational family alcohol history on both sides of the family. No relationship of impulsivity to IGT performance was found among Goudriaan and colleagues' (2007) sample of binge-drinking college students.

Lovallo, Yechiam, Sorocco, Vincent, and Collins (2006) studied non-alcohol-abusing males and females from families with and without a history of alcoholism. They found that males with a family history of alcoholism, but not females, were more attentive to financial gains than the other groups tested.

Children of alcoholics are not a homogeneous group. Finn, Sharkansky, Viken, et al. (1997) found three groups of people with positive family history of alcoholism. Their first type had little psychopathology in their family members, and moderate levels of alcoholism in the family. Their second type had high levels of violence, alcoholism and antisocial personality disorder in their family, while their third type had high levels of alcoholism and of several kinds of psychopathology (depression, mania and anxiety disorder). They also found that there was some similarity between characteristics of the parents and the offspring. Elementary school aged

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sons of fathers with alcoholism and antisocial personality disorder show lower IQs and poorer

academic performance than either sons of non-antisocial alcoholics or children of controls (Poon,

Ellis, Fitzgerald, & Zucker, 2000). The authors suggest that the offspring of antisocial alcoholics

might have "specific deficits in frontal lobe functioning" (Poon et al, 2000, p. 1025).

Finn, Sharkansky, Brandt, and Turcotte (2000) examined pathways from alcoholism in

the family to alcohol abuse by the offspring, by studying offspring of both alcoholics and non-

alcoholics. They found two major pathways. One led from alcoholism in the family to a

tendency to be socially deviant, which then led to alcohol abuse among the offspring. The second

pathway led from alcoholism in the family to a seeking for excitement and/or pleasure, which led

to increased drinking, which led to problems with alcohol.

A number of attempts have been made to identify and define types of alcoholics

(Cloninger, et al., 1987; Babor, Dolinsky, Hesselbrock, Hofmann, & Tennen, 1992; Bau, Spode,

Ponso, Elias, Gracia, Costa, & Hutz, 2001; Windle & Scheidt, 2004; Epstein, Labouvie,

McCrady, Jensen & Hayaki, 2002).

Using data on adopted-out children whose biological parents were known, Cloninger

et al. (1987) proposed two types, which he said can overlap, rather than be distinct types.

Cloninger's Type 1 is characterized by later onset of alcohol dependence (after 25 years old),

psychological dependence, guilt and fear about alcohol dependence (loss of control), and

personality traits of low novelty seeking, high harm avoidance and high reward dependence.

Type 2 is characterized by early onset (before 25 years old), frequent spontaneous alcohol-

seeking (inability to abstain), frequent fighting and arrests when drinking, and personality traits

of high novelty seeking, and low harm avoidance and low reward dependence (Cloninger, 1987).

Cloninger's types are not separate, but according to the author, can overlap. His table of which

characteristics occur in which type are not definite; for example, it shows that fighting and arrests while drinking are "infrequent" in Type 1 alcoholics and "frequent" in Type 2 alcoholics, rather than "present" or "absent." "These subgroups should not be considered discrete disease entities, because many alcohol abusers have some features of each type. Rather, the different alcohol-related syndromes are associated with the polar extremes of personality traits that vary continuously" (Cloninger, 1987, p. 411). These types were defined as having dimensionality, with individuals falling on continua of the various symptoms and traits, which is an important viewpoint taken in the development of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (American Psychiatric Association, 2011).

A proposed alcoholic typology developed through cluster analysis is Babor and colleagues' Type A/Type B (Babor et al., 1992). These researchers used cluster analysis involving 17 variables to produce their alcoholic types. They conducted the cluster analysis separately for their male and female participants, and proposed two types, which apply to both men and women. Type A is characterized by less severe dependence, fewer childhood risk factors, later onset, fewer physical and social consequences, less family and work distress, and less anxiety, less depression and less antisocial personality. Type B includes more childhood and family risk factors, more severe dependence, earlier onset, more serious consequences (even though the Type B cluster had fewer years of drinking on average than Type A), more use of drugs other than alcohol, and more co-occurring psychiatric disorders. Babor and colleagues' (1992) cluster analysis yielded the same two types for both male and female participants; the only differences were that male Type A and Type B participants differed on relief drinking, benzodiazepine use, depression and anxiety, while Type A and Type B females did not differ

significantly on these four variables. Like Cloninger (1987), Babor et al. (1992) described their types as overlapping.

Bau, C. H. D., Spode, A., Ponso, A. C., Elias, E. P., Gracia, C. E. D., Costa, F. T. & Hutz, M.H. (2001) found three subtypes. Their first group was characterized by lower severity and lower novelty seeking; their second group had earlier onset and high harm avoidance (which the authors related to anxiety); and their third group had a higher proportion of alcoholic relatives and more positive impact of life events (i.e., lower stress).

Reviews of earlier typologies described some that included two, three, four or five subtypes (Windle & Scheidt, 2004; Leggio, Kenna, Fenton, Bonenfant, & Swift, 2009). Windle and Scheidt's (2004) own typology included four subtypes, which they called Mild Course, Polydrug, Negative Affect and Chronic/ASP. Their Mild Course subtype had late onset, involved less alcohol consumption, fewer years of drinking, less impairment, fewer withdrawal symptoms, and fewer conduct problems when young. Those in the Polydrug subtype had the highest amount of benzodiazepine use and highest use of other drugs. Their Negative Affect subtype had the highest number of symptoms of major depression, generalized anxiety, and characterological problems. The Chronic/ASP subtype had the highest levels of antisocial behavior as adults, drank for more years, consumed the most alcohol, and had the most social consequences and greatest severity of dependence.

Studying alcoholics at a number of sites, in relation to four typologies (antisocial personality (ASP) vs. non-ASP, early vs. late onset, Type 1/Type 2, and Type A/Type B), Epstein, Labouvie, McCrady, Jensen, and Hayaki (2002) interpreted their data as suggesting "that no dichotomous typology is sufficient to describe an entire sample of alcoholic individuals" (p. 1051).

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The present study was observational, examining decision making in non-drinkers, social drinkers, and heavy drinkers, from families with and without a history of alcoholism, drawn from a young adult undergraduate university sample. Using college-age participants may have increased the chances of catching some participants before they begin drinking, or before drinking has become problematic, yielding more information about people who are at risk for alcohol use disorders, but not yet affected by years of heavy alcohol use. It is also hoped that asking the participants about their past and current alcohol use and other drug use increased the chances of distinguishing participants whose decision making problems could be inherited genetically and/or related to the environment in which they lived (such as learned cognitive distortions, messages about alcohol, possible family disruption, unstable living situation and/or violence) from decision making problems that may have been caused by the direct action of alcohol and/or other drugs on the participant's body (including of course the brain).

A clearer delineation of the presence or absence of decision making differences in the full range of both alcohol use and abuse, and family history of alcohol problems, could help illuminate the correlates of these patterns of decision making.

Including questions about the familial density of alcoholism allowed examination of gambling task performance by persons who have a history of alcohol problems in parent(s) or grandparent(s) as compared to those who do not. Corral and colleagues (1999) termed alcoholism only in a parent as low density family alcoholism, and termed alcoholism in first-degree relatives other than the parent (and/or in second-degree relatives) high density family alcoholism. Corral et al. (1999) viewed the risk of alcoholism in children of low density family alcoholism as environmental (learned) while considering the risk for high density family children

inherited. However, it is possible that people with a history of familial alcoholism may have heritable tendencies towards different decision making styles, which the present study explored.

Although different numbers of alcoholic types have been found by different research groups, most typologies suggested have included a type that involves psychopathic traits, or antisocial personality disorder, such as Cloninger's (1987) Type 2 and Babor et al.'s (1992) Type B, so psychopathy was included in the clustering variables..

If some people acquire decision making differences through the effects of their alcohol use, the best prevention and treatment strategies might differ from those for people who have the decision making deficit before (potentially) developing an alcohol problem. Knowing whether pre-existing decision making problems occur in children of alcoholic or non-alcoholic families would make it easier to identify which children and young adults to target with certain prevention strategies.

Understanding of the heritable risks for alcohol problems could be increased by looking for differences in decision making performance among young adults, then seeing how each type is associated with other risk factors and personality traits, rather than by pre-grouping people by known risk factors (such as family alcohol history).

Several studies failed to find a main effect relationship between psychopathy and poor performance on the IGT (Schmitt, Brinkley, & Newman, 1999; Lösel & Schmucker, 2004). However, in a young community sample, a diagnosis of Antisocial Personality Disorder, but not presence or absence of early-onset alcoholism, was associated with disadvantageous decision making on the IGT (Mazas, C. A., Finn, P. R. & Steinmetz, J. E., 2000). The antisocial participants showed some learning (i.e., made increasingly advantageous choices over the course of the task), and poorer decision making was associated with drinking more alcohol (but not with

drinking more frequently) and with lower IQ (Mazas, et al. 2000). In a study of currently

abstinent heroin addicts, those who were psychopathic performed worse on the IGT than the

non-psychopathic addicts (Vassileva, Petkova, Georgiev, Martin, Tersiyski, Raycheva, Velinov,

& Marinov, 2007).

Schuckit and Saunders (2006) suggested using latent class analysis or similar methods to

aid in selecting diagnostic items for substance use disorders in the fifth edition of the Diagnostic

and Statistical Manual of Mental Disorders (DSM-5, APA, 2011, 2012). Although Schuckit and

Saunders were addressing, among other things, differentiating substance dependence from abuse

and also "potential subsyndromal entities such as hazardous use," (p. 171), examining decision

making differences could help show whether they are characteristic of some type or types of

alcohol use disorders, whether they represent a continuous construct in alcohol abusers, or are

unrelated to different presentations of alcohol problems.

This study investigated whether the kind of deficit in decision-making discovered among

persons with a variety of neuropsychological illnesses and injury, including some substance

abusers (Gonzalez, Bechara & Martin, 2007; Bechara, Dolan, et al., 2001) might exist in young

people from alcoholic and/or non-alcoholic families, and whether this poor decision-making

tended to occur in those participants who had early onset of alcohol problems, use of drugs other

than alcohol and higher levels of psychopathy . The participants were undergraduate college

students at a Mid-Atlantic university, who volunteered in exchange for credits for a psychology

class (if applicable) and a chance to win a drawing for an i-Pod. The computerized version of the

Iowa Gambling Task (Bechara, Damasio, Damasio & Anderson, 1994) was administered to

measure decision making. Participants also filled out questionnaires with measures of

psychopathy, impulsivity, alcohol and other drug use during the preceding month, alcohol-

related problems during the past year, and family history of alcoholism, if any. Another questionnaire was adapted from the alcohol-related problems questionnaire (the Young Adult Alcohol Consequences Questionnaire (YAACQ), Read, Kahler, Strong and Colder, 2006), by changing the instruction to ask if the participant had ever experienced each of the YAACQ problems during or after drinking alcohol, and if so, what their age was when they first experienced each problem. The age of problematic use was operationalized as the age by which they had experienced three of those YAACQ problems. The recruitment materials did not ask for participants from alcoholic families or non-alcoholic families, as the size of the sample (N = 151 participants) was sufficient to provide participants from high-density and low-density alcoholic families, as well as families with no reported alcohol problems among the biological grandparents, biological parents or full-blood siblings.

Ways of measuring potentially risky drinking in college students include number of drinks per week, either that of a typical week or of the week in which the person drank the most ("peak week"); estimated blood alcohol levels after drinking; and frequency of binge drinking. Borsari, Neal, Collins and Carey (2001) found that quantity measures (such as weekly total drinks) were more strongly related to alcohol-related problems than were the blood alcohol or frequency of binge methods.

Although a few of the YAACQ questions parallel diagnostic criteria for alcohol abuse or dependence, the data collected for this study were not intended to result in an alcohol use diagnosis. Although some of this study's participants may have had true alcohol dependence, most probably did not. It is hoped that this study captured differences in decision making that represent a pre-alcoholic risk factor, rather than a product of years of heavy drinking. A clearer

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picture may emerge as to whether people at risk for different types of alcohol problem have the IGT decision making deficit before possibly developing alcohol abuse or dependence.

Hypotheses

The following hypotheses were tested:

1) If one of the clusters has poorer performance on the Iowa Gambling Task than the other(s), that cluster will also have greater family density of alcohol problems than the other group(s).

2) The cluster with the poorest performance on the Iowa Gambling Task will also have higher psychopathy scores than the other cluster(s).

3) The cluster with the poorest performance on the Iowa Gambling Task will also have earlier onset of problems with alcohol than the other cluster(s).

CHAPTER 2

METHOD

<u>Participants</u>

Participants were undergraduates recruited from a university population, aged 18 to 26. A total of 43 males completed the study, and of those, 36 males were included in the final analysis. A total of 122 females completed the study; of those, 115 females were included in the final analysis. If they were enrolled in a psychology class, they were offered extra credit towards their grade (if available). All participants were offered a chance to win a random drawing for an iPod.

One hundred and sixty four volunteers attended their appointments to participate in this study. A total of thirteen participants were eliminated from the analyses. Four participants were excluded because they were adopted, and therefore were not expected to be able to give information about the alcohol use of their biological families. Also, five participants were excluded from the data analysis because of missing data on measures of clustering and/or validation variables (in each case, one entire measure was not filled out or was otherwise missing). The data of three participants were excluded because of either Highly Atypical scores on both of the Inconsistent Responding scales of the PPI-R, or one Highly Atypical and one Atypical score. Further, one participant's data were excluded because of a very large number of corrections on the PPI-R answer sheet, combined with a very high PPI-R Virtuous Responding score (96th percentile) and one Highly Atypical Inconsistent Responding score.

Of the 151 participants whose data were used for the analyses, 115 were female and 36 were male.

The great majority of the participants self-identified as of White or Caucasian ethnicity. Because of the small numbers of participants who identified with one of the other ethnic groups, their data was not analyzed separately.

Experimenter

The experimenter was a female graduate student in a doctoral program in clinical psychology in a medium-sized Mid-Atlantic university.

Measures

Age, ethnicity, gender and adoptive status. A brief demographic questionnaire included questions on age, ethnicity and gender, and whether the participant was adopted. Since information about biological parents and other relatives of adopted volunteers may be unavailable, adopted persons are probably not able to report accurately on family history of alcoholism. Adopted volunteers completed testing and were given credit for attending but were excluded from the data analysis.

Family history of alcohol problems The population from which participants were recruited (college undergraduates, many of whom live far from their families, and many of whom are under the legal drinking age) raised ethical and practical considerations, because of which only the participants (probands) were questioned about both probands' and their families alcohol use patterns. This study was therefore based on family history data, rather than family study data (Hodgins & Shimp, 1995).

Participants completed The Family Tree Questionnaire (Mann, Sobell, L. C., Sobell, M. B. & Pavin, 1985). It gathers information on possible or definite alcohol problems in first degree relatives (parents and siblings) and second degree relatives (grandparents, aunts and uncles). It

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has good test-retest reliability with κ values from 0.78 to 0.94 (Hodgins & Shimp, 1995; Mann et al, 1985; Vogel-Sprott, Chipperfield, & Hart, 1985) and has demonstrated predictive validity (NIAAA, 2008).

The Family Tree Questionnaire only asks about biological parents and grandparents, and full-blood siblings, of the probands (i.e., no adopted or adoptive, half- or step-relatives of probands or of their parents are included), so that the information gathered about family alcohol use or abuse is pertinent to heritable risk factors. It does not attempt to ascertain a diagnosis, but rather to establish an alcohol problem in general, in the participant's knowledge or belief. For the purposes of this study, only information about alcohol problems in parents and grandparents was used, as siblings of college students may be so young that including them (probably as non-drinkers) in the calculation of family alcohol history may not give a true picture of the density of alcohol problems that might be in the family when they grew to adulthood.

Corbin, Vaughan and Fromme (2008) calculated family alcohol density by dividing the number of same-sex relatives who drank by the total number of same-sex relatives. However, their method of defining density may have been influenced by their interest in the effect of social influence of same-sex family members on the probands' drinking. The present study operationalized family alcohol density as the number of biological parents and grandparents of the probands who are identified by the participant as having a problem with alcohol, using the Family Tree Questionnaire. The possible range of answers was 0 to 6.

Participants' alcohol and other drug use. The Time Line Follow Back (TLFB) procedure (Sobell. L. & Sobell, M., 1995) was used to measure frequency and amount of alcohol and other drug use during the past 30 days. This measure allows identification of total amount consumed per week or month, and also allows calculation frequency of binge drinking. However, total

amount consumed will be used in this study, because of evidence that measures of amount of alcohol consumed per week were more strongly associated with alcohol-related problems than either estimates of blood alcohol level or frequency of binge drinking (Borsari et al., 2001).

Problems from alcohol use. The YAACQ (Young Adult Alcohol Consequences Questionnaire, Read, Kahler, Strong & Colder, 2006) was used to test for alcohol-related problems. The YAACQ was developed specifically for assessment of college students' drinking consequences, by including a wide variety of common consequences (such as memory loss and hangovers), most of which fall in the less-severe end of the range of alcohol related problems that college students commonly experience. The 48 questions refer to the past year and are answered yes/no. Examples of the YAAQC's alcohol related consequences are behaving rudely while drinking or needing an alcoholic drink upon awakening. Confirmatory factor analysis of the YAACQ showed that the eight factors all loaded on a single higher order factor. Concurrent validity was demonstrated by correlation with participants' scores on the Rutgers Alcohol Problem Index. The mean total score was 14.7 out of a possible 48 (SD 7.8). There were no significant gender differences on this measure (Read et al., 2006).

Age of problematic alcohol use. After they completed the YAACQ, participants were given a separate list of the YAACQ items and asked to indicate the age at which they first experienced any of the consequences they endorsed. For this study, age of problematic alcohol use was operationalized as the age by which they had experienced three or more of the 48 alcohol-related consequences on the YAACQ.

Impulsivity. Impulsivity was measured using the Barrett Impulsiveness Scale, revised form BIS-11 (Patton, Stanford, & Barratt, 1995). The BIS-11 are asks about such things as paying attention and planning thoroughly (reverse scored). Participants choose on a four-

response Likert-type scale (1, 2, 3, or 4), with 4 being the highest score. Internal consistency of the BIS-11 was within acceptable limits for all groups studied by Patton et al (1995) with Cronbach's alpha = .82 for undergraduates, .79 for substance-abuse patients, .83 for general psychiatric patients, and .80 for prison inmates. The two patient groups differed significantly from the undergraduates on BIS-11 scores, as expected (Patton, et al., 1995).

Psychopathy. Psychopathy was measured using the Psychopathic Personality Inventory™-Revised (PPI™-R, Lilienfeld & Widows, 2005). The PPI-R is a self-report, relatively brief questionnaire that has shown good construct and predictive validity, according to its publishers, Psychological Assessment Resources (Lilienfeld & Widows, 2005).

Decision-making. The computerized Iowa Gambling Task (Bechara, Damasio, Damasio, Lee, 1999; Bechara, Dolan, et al, 2001) was used to test decision-making. Instructions that accompany the computerized version of the test were used.

Verdejo-Garcia, Bechara, Recknor, and Perez-Garcia (2006) studied the ecological validity of the Iowa Gambling Task. They found that poorer performance on the IGT was be predicted by greater problems in several of the life areas measured by the Addiction Severity Index, which they interpreted as showing ecological validity. In a study of cocaine-dependent people in treatment, the split-half reliability of the IGT was computed using odd- versus even-numbered item grouping and correcting for the 50% reduction in observations that resulted. The resulting split-half reliabilities were $r = 0.80$ for total number of good decks chosen, and $r = 0.92$ for good decks chosen during the second half of the task (Montorosso, Ehrman, Napier, O'Brien, & Childress, 2001). Although these authors describe the full 100-choice IGT as less reliable than the last 50 choices of the IGT, they also recognize the observed differences in their split-half reliabilities are to be expected in a task which does not provide information on risks and possible

gains, such that earlier choices are largely by trial and error, while the learning over the length of the task shown by many participants would lead to greater similarity in the later choices, and thus greater split-half odd- versus even-numbered item reliability in the second half of the task. However, this study did not follow Montorosso et al.'s (2001) suggestion that only the scores of the second half of the IGT should be used. Ignoring the first half of the IGT removes some of the information on when (and, in some cases, possibly whether) the participant learned to choose the more advantageous decks.

C and D are the "advantageous decks." That means choosing mostly from decks C and D. will make a participant win money over the long run. A and B are the "disadvantageous" decks, meaning that choosing mostly from decks C and D. will make a participant lose money over the long run

A commonly used way of scoring the IGT is the formula s = (C + D) − (A + B), using *s* to indicate a given participant's score. Since (C + D) is the total number of advantageous choices, while (A + B) is the total number of disadvantageous choices, (C + D) − (A + B) indicates whether the person made more advantageous or disadvantageous choices. Equal numbers of good and bad choices yield a score of s = 0. More bad choices than good give a score s < 0, while more good choices than bad give s > 0 (Bechara, Dolan, et. al., 2001).

Other scoring methods have been used by some researchers. One common method uses the total money won or lost. Goudriaan, et al., (2007) measured IGT performance as number of cards drawn from advantageous decks during the first four blocks. Skeel, et al. (2008) counted the disadvantageous cards in each block instead. The present study used the ((C + D) − (A + B)) score, because the possible range of the resulting scores is from -100 (most disadvantageous) to +100 (the most advantageous); this means that disadvantageous (negative) and advantageous

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(positive) scores can be recognized easily and grasped more intuitively. Moreover, most recent studies have used $s = (C + D) – (A + B)$, and this study followed that practice to make it easier to compare this study's results to other recent studies.

In a study comparing IGT performance of alcohol or stimulant dependent people with people with ventromedial cortical lesions and normal controls, all the ventromedial lesion participants had a total net IGT score $((C + D) – (A + B))$ of less that 10 (Bechara & Damasio, 2001). They therefore defined scores <10 as showing impaired performance (Bechara & Damasio, 2002). In the 2001 study, 63% of the substance dependent participants, and 37% of their normal controls, were impaired by this standard.

<center>Procedure</center>

When potential participants responded (by email or telephone) to the recruitment announcements, the experimenter replied asking whether they met the advertised study requirements (i.e., being an undergraduate student aged 18 through 26 years old). The experimenter also answered questions participants had about the study at that time. If the person qualified, and still wanted to participate, each participant was scheduled for an individual appointment. Adopted persons were not excluded at this point, but were later excluded from the analysis. Participants who did not appear or canceled their appointment were offered another appointment.

When a participant arrived, the experimenter went over the consent form and answered any questions the participant had. The experimenter and participant each signed two copies of the consent form, and one copy was given to the participant while the other was kept by the experimenter. The consent form used during the first year of data collection had been approved by the Department of Psychology Human Subjects Committee of the university from which

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volunteers were recruited. For the second year of data collection, the procedure for approval had been changed, and the consent form used was approved by the Institutional Review Board of that university.

The experimenter asked the participant to complete the study tasks. When the tasks were completed, the experimenter recorded the participant's course credit for participating. The experimenter also offered the participant a card to fill out to be entered in the drawing, if he or she wished to participate.

With rare exceptions (as when the computer was malfunctioning) participants first completed the computerized version of the IGT. (Three participants had to be asked to return at a later date to complete the IGT, and all three did so.) After the IGT, participants filled out paper and pencil versions of the Psychopathic Personality Inventory, Revised (Lilienfeld & Widows, 2005), the Barrett Impulsiveness Scale (Patton, et al., 1999), and two alcohol problem questionnaires, a) the YAACQ (Read, et al., 2006), covering problems experienced during or after drinking alcohol during the past year, and b) another copy of the YAACQ, which was modified to ask about earliest age of the included problems during or after drinking alcohol. The final set of questionnaires included the Timeline Follow-Back forms for number of drinks of alcohol and days of drug use during the past thirty days; the Family Tree Questionnaire (FTQ), a demographic questionnaire, and a brief questionnaire on days of nicotine and caffeine use during the preceding month.

The questionnaires and printouts from test software were identified only by code numbers assigned to each participant. The code key, answer sheets and other response materials were kept in a locked container to which only the experimenter has access. Cards for the drawing for an I-Pod were kept in a separate locked box.

Clustering Procedures

There were great differences in the scales and ranges of the variables used; for example, early alcohol problems were measured in years before age 21, with an actual range of 0 through 7, while the PPI-R scores had an actual range of 199 to 367 points. Therefore, the software was set to standardize the data to a mean of 0 and a range of -1 to 1 (Struyf & Rousseeuw, 1997).

A review of alcohol typologies (Windle & Scheidt, 2004) mentioned typologies that included between two and five subtypes. However, for the exploratory part of this study, the clustering procedure was conducted at $k = 2$ and $k = 3$.

Partitioning Around Medoids (PAM) cluster analyses were performed using R, a language and environment used for computing statistics and for graphics (**R** Development Core Team, 2008). The PAM clustering procedure was conducted on the full set of participants, using the clustering variables: a) decision making total scores, b) psychopathy scores, c) early alcohol problem scores, and d) number of full blood parents and grandparents with an alcohol problem.

Multivariate Analysis of Variance

For both clustering solutions, Multivariate Analysis of Variance (MANOVA) was conducted to check for separateness of each solution's groups. These MANOVAs were performed first on the clustering variables. Then, ANOVAs were conducted on each of the clustering variables to determine whether that variable differed significantly across the clusters of that clustering solution.

To test discriminate validity of the clustering solutions, MANOVAs were conducted on the validation variables of each solution's groups. The dependent variables for these MANOVAs were not used in the original analysis, but are known to be related to various alcoholic

typologies. These validation variables were a) impulsivity, b) alcohol problems experienced in the past year, c) total number of alcoholic drinks consumed in the past thirty days, and d) days of use of other drugs during the past thirty days.

CHAPTER 3

RESULTS

Descriptive Data

Table 1 shows descriptive data for the full set of participants, for those who reported no

alcohol use, and those who reported some alcohol use (in the past 30 days).

Table 1

Descriptive Data of Participants

Demographic	All[b]	Alcohol use[a]	
		No[c]	Yes[d]
Gender			
Female	115 (76.2%)	26 (76.5%)	89 (76.1%)
Male	36 (23.8%)	8 (23.5%)	28 (23.9)%
Ethnicity			
White/Caucasian	107 (70.9%)	20	87
Black/African/African American	6 (4.0%)	3	3
Asian/Asian American	11 (7.3%)	4	7
Hispanic (any racial description)	13 (8.6%)	3	10
Multiracial, Other and Unknown	14 (9.3%)	4	10

Note. Participants were 18 to 26 years old.
[a]Alcohol use refers to any alcohol consumption during the past 30 days. [b]$n = 151$. [c]$n = 34$. [d]$n =117$.

Clustering and Validation Variables

Descriptions of the variables analyzed in this study are shown in Table 2, with the full data shown first, then data for participants who reported no recent alcohol use, and finally for those reporting some recent alcohol use, and ANOVAs.

Table 2

Clustering and Validation Variables, All Participants, No Alcohol Participants and Yes Alcohol Participants

Variables	Alcohol use[a]			ANOVA results	
	All Mean s.d.	No Mean s.d.	Yes Mean s.d.	F value	Pr(>F)
Clustering variables					
Decision making	24.0	22.1	19.9	0.16	0.690 n.s.
	27.0	33.0	25.2		
Psychopathy	278.7	269.5	281.3	3.41	0.067 n.s.
	33.2	32.2	33.1		
Early alcohol problems	2.8	1.0	3.3	40.27	2.51e-09 ***
	2.1	1.7	1.9		
Family alcohol problems	1.0	1.3	0.9	3.41	0.066 n.s.
	1.1	1.1	1.0		
Validation variables					
Impulsivity	61.3	57.3	62.5	6.29	0.013 *
	10.8	9.5	10.8		
Alcohol problems past year	9.1	2.1	11.1	35.06	2.117e-08 ***
	8.7	4.6	8.6		
Alcohol use[a]	18.3	0	23.6	27.7	4.853e-07 ***
	25.0	0	26.1		
Drug use[b]	2.5	0	3.2	7.30	0.008 **
	6.3	0	7.0		
Other Variables					
Tobacco use[b]	2.2	0.0	2.8		
	6.2	0.2	7.0		
Caffeine use[b]	16.0	17.2	15.7		
	10.4	10.2	10.5		

Note. Tobacco use and Caffeine use were used in calculating correlations but not in clustering or validation of cluster solutions. s.d. = standard deviation. n.s. = not significant
[a] Alcohol use refers to the past 30 days. [b] Drug use, Tobacco use and Caffeine use are days of the past 30 days.
* *p* < .05. ** *p* < .01. *** *p* < .001

MANOVA was performed on the No and Yes alcohol groups using decision making, psychopathy, early alcohol use and family history of alcohol problems as the dependent variables. The results showed that the means of these major variables differed significantly, with approximate $F = 11.3$ and $Pr(>F) = 4.91e\text{-}08$.

Then, MANOVA was performed on the No Alcohol and Yes Alcohol groups using impulsivity, alcohol problems in the past year, alcoholic drinks in the past 30 days and days of drug use in the past thirty days as the dependent variables. The results showed that the means of these variables (which are sometimes associated with alcohol use disorders) differed significantly, with approximate $F = 10.5$ and $Pr(>F) = 1.659e\text{-}07$.

Correlations among the clustering and validation variables for the full data are shown in Table 3. Correlations among the clustering and validation variables for participants who reported no recent alcohol use are shown in Table 4. Correlations for participants who reported some recent alcohol use are shown in Table 5.

The largest correlations among variables for all three groups (all participants, no alcohol participants and some alcohol participants) were between early alcohol problems and past year alcohol problems For all participants, the correlation was .71, accounting for 50.4% of the variance in these two variables. For the no alcohol participants, the correlation was .66, accounting for 43.6% of the variance. It is interesting both that this holds true for the no alcohol participants, and that the means, and many of the values, of these variables were non-zero. Many of the participants who reported no alcohol use in the past month did report early alcohol use and/or non-zero alcohol problems in the past year. For the some alcohol participants, the correlation between early alcohol problems and past year alcohol problems was .64, accounting for 41.0% of the variance.

Table 3

Correlations of Variables for All Participants

Variables	Psychopathy	Early alcohol problems	Family alcohol problems	Impulsivity	Alcohol problems	Alcohol use[a]	Drug use[b]
Decision making	-0.30 ***	-0.16 *	0.00 n.s.	-0.20 **	-0.24 **	-0.20 **	-0.20 **
Psychopathy	--	0.32 ***	0.00 n.s.	0.57 ***	0.34 ***	0.23 **	0.25 ***
Early alcohol problems		--	0.00 n.s.	0.29 ***	0.71 ***	0.45 ***	0.35 ***
Family alcohol problems			--	-0.09 n.s.	0.04 n.s.	-0.03 n.s.	-0.11 n.s.
Impulsivity				--	0.30 ***	0.13 n.s.	0.25 ***
Alcohol problems[c]					--	0.63 ***	0.32 ***
Alcohol use[a]						--	0.37 ***

Note. Directional significance was used. n.s. = not significant.
[a]Alcohol use refers to the past 30 days. [b]Drug use is in days of the past 30 days. [c]Alcohol problems are in the past year.
* $p < .05$. ** $p < .01$. *** $p < .00$

For both the full group of participants and the some alcohol group, the next largest correlations between variables are between past year alcohol problems and recent (past month) alcohol use. (Recall that no correlations could be calculated for these two variables in the no alcohol group, because all recent alcohol use scores equaled 0.) For the full group, the correlation was .63, accounting for 39.7% of the variance in these two variables. For the some alcohol group, the correlation was .57, accounting for 32.5% of the variance.

Table 4

Correlations of Variables for Participants Reporting No Recent Alcohol Use

Variables	Psychopathy	Early alcohol problems	Family alcohol problems	Impulsivity	Alcohol problems[a]
Decision making	-0.31 *	-0.13 n.s.	0.10 n.s.	-0.33 *	-0.03 n.s.
Psychopathy	--	0.32 *	-0.09 n.s	0.53 ***	0.17 n.s.
Early alcohol problems		--	0.18 n.s.	0.23 n.s.	0.66 ***
Family alcohol problems			--	-0.13 n.s	0.02 n.s.
Impulsivity				--	0.18 n.s.

Note. Correlations were not calculated for alcohol or drug use, as all scores for these two variables equaled 0 among the no recent alcohol use participants. Directional significance was used**. n.s.** = not significant. s.d. = standard deviation.
[a]Alcohol problems are in the past year.
* $p < .05$. ** $p < .01$. *** $p < .001$

The third largest correlation for both the full group and the some alcohol group (and the second largest for the no alcohol group) was between psychopathy and impulsivity. For the full

group, it was .57 (accounting for 32.5% of the variance) for the no alcohol group it was .53 (28.1% of variance) and for the some alcohol group, it was .56 (31.4% of the variance).

The fourth largest correlation for the full group and the some alcohol group was between early alcohol problems and recent alcohol use. (Again, no correlations could be calculated for these two variables in the no alcohol group, because all recent alcohol use scores equaled 0.) For the full group the correlation was .45 (20.2% of variance) and for the some alcohol group the correlation was .36 (13.0% of the variance).

The means of clustering variables of the $k = 2$ clusters, and the ANOVA results for each variable, are shown in Table 6. The same information for the validation variables of the $k = 2$ clusters are shown in Table 7.

Cluster membership was the categorical independent variable y for a MANOVA performed on the $k = 2$ clusters, using the clustering variables (decision making, psychopathy, early alcohol use and family history of alcohol problems) as the dependent variables. The results showed that the clusters differed significantly, with approximate $F = 58.67$, Pr $(>F) < 2.2e\text{-}16$. This indicates that the means of the clustering variables of these clusters differ at a level beyond $p = 0.001$. This result supports separateness of the $k = 2$ clusters.

To test the discriminant validity of the $k = 2$ clusters, another MANOVA was performed using cluster as the independent variable and impulsivity, alcohol problems in the past year, number of alcoholic drinks in the past month, and days of drug use in the past month as the dependent variables. The results showed that the clusters differed significantly, with approximate $F = 16.85$, Pr $(>F) = 2.236e\text{-}11$. This result supports discriminant validity of the $k = 2$ clusters.

Table 5

Correlations of Variables for Participants Reporting Some Recent Alcohol Use

Variables	Psychopathy	Early alcohol problems	Family alcohol problems	Impulsivity	Alcohol problems[a]	Alcohol use[b]	Drug use[c]
Decision making	-0.29 ***	-0.18 *	-0.05 n.s.	-0.15 n.s.	-0.31 ***	-0.25 **	-0.25 **
Psychopathy	--	0.27 **	-0.05 n.s.	0.56 ***	0.33 ***	0.22 **	0.26 ***
Early alcohol problems		--	0.00 n.s.	0.22 **	0.64 ***	0.36 ***	0.29 ***
Family alcohol problems			--	-0.04 n.s.	0.13 n.s.	-0.04 n.s.	-0.09 n.s.
Impulsivity				--	0.25 ***	0.06 n.s.	0.24 **
Alcohol problems[c]					--	0.57 ***	0.27 ***
Alcohol use[a]						--	0.31 ***

Note. $n = 117$. Directional significance was used. n.s. = not significant.
[a]Alcohol problems are in the past year. [b]Alcohol use refers to the past 30 days. [c]Drug use is in days of the past 30 days.
* $p < .05$. ** $p < .01$. *** $p < .001$

Table 6

Clustering Variables of k = 2 Clusters, Means and ANOVA Results

	Cluster 1[a]	Cluster 2[b]	ANOVA	
Clustering variables	Mean s.d.	Mean s.d.	F value	Pr(>F)
Decision making	0.0 24.5	30.2 22.3	57.2	3.7e-12 ***
Psychopathy	306.5 24.8	265.3 28.1	76.9	3.7e-15 ***
Early alcohol problems	4.5 1.6	2.0 1.8	69.0	5.5e-14 ***
Family alcohol problems	0.94 1.11	0.99 1.03	0.1	0.77 n.s.

Note. n.**s.** = not significant. s.d. = standard deviation.
[a]$n = 49$. [b]$n = 102$.
* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 7

Validation Variables of k = 2 Clusters, Means and ANOVA Results

	Cluster 1[a]	Cluster 2[b]	ANOVA	
Validation variables	Mean s.d.	Mean s.d.	F value	Pr(>F)
Impulsivity	66.7 10.7	58.7 9.9	20.3	1.3e-05 ***
Alcohol problems[c]	15.3 9.4	6.1 6.5	49.2	7.7e-11 ***
Alcohol use[d]	30.8 35.2	12.3 15.0	20.7	1.1e-05 ***
Drug use[e]	5.6 9.0	1.0 3.7	19.3	2.1e-05 ***

Note. n.s. = not significant. s.d. = standard deviation.
[a]$n = 49$. [b]$n = 102$. [c]Alcohol problems are in the past year. [d]Alcohol use refers to the past 30 days.
[e]Drug use is in days of the past 30 days.
* $p < .05$; ** $p < .01$; *** $p < .001$.

The means of clustering variables of the $k = 3$ clusters, and the ANOVA results for each variable, are shown in Table 8. The same information for the validation variables of the $k = 3$ clusters is shown in Table 9.

Table 8

Clustering Variables of k = 3 Clusters, Means and ANOVA Results

Clustering variables	Cluster 1[a] Mean s.d.	Cluster 2[b] Mean s.d.	Cluster 3[c] Mean s.d.	ANOVA F value	Pr(>F)
Decision making	24.4 25.8	7.0 24.2	39.7 19.3	4.7	0.0324 *
Psychopathy	311.4 20.8	272.4 23.3	248.5 25.2	155.3	< 2.2e-16 ***
Early alcohol problems	4.1 1.5	3.0 1.8	0.6 1.2	90.1	< 2.2e-16 ***
Family alcohol problems	0.96 1.02	0.97 1.10	1.00 1.03	0.0	0.8573 n.s.

Note. n.s. = not significant. s.d. = standard deviation.
[a]$n = 47$. [b]$n = 67$. [c]$n = 37$.
* $p < .05$; ** $p < .01$; *** $p < .001$.

A MANOVA was performed on the $k = 3$ clusters using cluster as the independent variable and decision making, psychopathy, early alcohol use and family history of alcohol problems as the dependent variables. The results showed that the clusters differed significantly, with approximate F = 78.83, Pr (>F) < 2.2e-16. This indicates that the means of the clustering variables of these clusters differ significantly, at a level beyond $p = 0.001$. This result supports separateness of the $k = 3$ clusters.

Table 9

Validation Variables of k = 3 Clusters, Means and ANOVA Results

Validation variables	Cluster 1[a] Mean s.d.	Cluster 2[b] Mean s.d.	Cluster 3[c] Mean s.d.	ANOVA F value	Pr(>F)
Impulsivity	69.2 10.1	60.1 9.3	53.6 7.3	62.1	6.2e-13 ***
Alcohol problems[c]	13.9 8.3	9.6 8.5	1.9 3.4	51.9	2.74e-11 ***
Alcohol use[d]	25.5 25.0	19.9 28.5	6.2 9.5	12.8	0.0005 ***
Drug use[e]	4.4 7.5	2.5 6.6	0.0 0.2	10.8	0.0012 **

Note. n.s. = not significant. s.d. = standard deviation.
[a]$n = 47$. [b]$n = 67$. [c]$n = 37$. [d]Alcohol problems are in the past year. [e]Alcohol use refers to the past 30 days. [f]Drug use is in days of the past 30 days.
* $p < .05$; ** $p < .01$; *** $p < .001$.

To test the discriminant validity of the $k = 3$ clusters, a MANOVA was performed using cluster as the independent variable and impulsivity, alcohol problems in the past year, number of alcoholic drinks in the past month, and days of drug use in the past month as the dependent variables.   The results showed that the clusters differed significantly, with approximate $F = 27.25$, Pr $(>F) < 2.2e$-16. This indicates that the clustering variables of these clusters differ significantly, at a level beyond $p = 0.001$. This result supports separateness of the $k = 3$ clusters.

CHAPTER 4

DISCUSSION

This study of college undergraduates (including many who drink alcohol and some who do not drink) from non-alcoholic and alcoholic families demonstrated some relationships among variables that are considered risk factors for or characteristics of alcohol problems. Some of these relationships are similar to some found by earlier researchers studying people with alcohol use disorders (Cloninger, et al., 1987; Babor et al., 1992; Bau C. H. D., Spode, A., Ponso, A. C., Elias, E. P., Gracia, C. E. D., Costa, F. T. & Hutz, M.H., 2001).

This study, unlike the many past studies about alcoholism typology, looked at both drinking and non-drinking young adults, who may or may not have a family history of alcoholism, and who may or may not have or ever develop a problem with alcohol. Although the study did not include questions about extent of life-time alcohol use, or reasons for abstaining from alcohol, several participants volunteered the information that they had never had any alcohol, and a few added that this was for religious reasons.

The full data correlations showed that all variables were significantly correlated except for the following: family history of alcohol problems and caffeine use were not significantly correlated with any other variable; and impulsivity had a non-significant correlation with recent alcohol use. The main variable of interest, decision making, was significantly correlated with all other variables except family alcohol history among the full set of participants. (The correlation was negative; however, for all other variables higher scores meant more severity, while for decision making, higher scores meant better performance, so poor scores on the IGT tended to

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occur with more severe scores on the other variables.) The no alcohol group had significantly higher (i.e., better) decision making scores than the some alcohol group. Also, among the no alcohol group, decision making was significantly correlated with psychopathy and impulsivity, but not family alcohol history or past year alcohol problems. In the some alcohol group, impulsivity was not significantly correlated with decision making. The other variables (except family history) were significantly correlated with decision-making in the some alcohol group.

For those participants who reported no alcohol use during the past 30 days, poor decision making was significantly correlated with psychopathy and impulsivity; psychopathy was also significantly correlated with early alcohol problems and impulsivity, and early alcohol problems were also correlated with alcohol problems during the past year. It was noted that the mean family history of alcohol problems was higher among those who reported no alcohol use during the past 30 days than among those who reported some recent alcohol use: however this difference was not significant.

The four largest correlations among variables for all three groups were very similar. The variables producing these largest correlations were identical for the full set of participants and the some alcohol group, namely early alcohol problems, past year alcohol problems and recent alcohol use. For all three groups, the highest correlation was between early alcohol problems and past year alcohol problems. It is interesting that this is true for the no alcohol participants, reflecting the fact that many who reported no recent alcohol use had positive scores for both early and past year alcohol problems.

ANOVA tests on the clustering variables of the $k = 2$ clusters show that the means of decision making, psychopathy, and early alcohol problems differed significantly between the two clusters. In Cluster 1, decision making was worse, psychopathy was higher, and alcohol

problems occurred at a younger age than in Cluster 2, supporting two of this study's hypotheses. There was not a significant difference in family history of alcohol problems between the two clusters; this finding failed to support to the other hypothesis.

Also, ANOVA tests on the validation variables of the $k = 2$ clusters show that the means of impulsivity, past-year alcohol problems, past-month alcohol intake and past-month days of drug use differed significantly among the three clusters. This supports the suggestion that these variables differ in these clusters as they tend to do in the alcohol typologies that the clusters resemble in their clustering characteristics. Specifically, these variables in Cluster 1 resemble Cloninger's Type 2 (1987)

MANOVA performed on the $k = 3$ clusters gave results showing that the means of the dependent variables differed significantly. This result supports the separateness of the clusters. The cluster means for the decision making and family history of alcohol problems variables differed significantly at the level of p< .0001, while the differences of psychopathy and early alcohol problems were not significant. When a MANOVA was performed with cluster as the independent variable and the validation variables (impulsivity, alcohol problems during the past year, and past-month alcohol and drug use) as the dependent variables, the result was not significant (F ≈ 1.089, p = 0.3791).

These clusters $k = 3$ are a little harder to interpret. Cluster 1 of the $k = 3$ clusters has early onset of alcohol problems and the highest psychopathy or Antisocial Personality Disorder diagnosis, as well as most past year alcohol problems, most impulsivity, and most use of both alcohol and other drugs, while decision making scores are around the mean.. Cluster 3 has high (good) decision making scores, low psychopathy, later onset of alcohol problems, low impulsivity, fewer past year alcohol problems, and low use of alcohol and other drugs. These

participants may be at low risk for alcohol problems, or may be at risk for problems similar to Cloninger et al.(1987)'s Type 1 or Babor's Type B (which is characterized by late onset and fewer psychiatric symptoms). Cluster 2 had the worst decision making, but all other variables were close to the mean of the sample. This group may include people who would be among the "normal" people who do poorly on the IGT without detected neurological problems (Bechara & Damasio, 2001).

Since some alcohol abusers (including young alcoholics and some older alcoholics) do not show significant differences from normal controls on the IGT (Gonzalez, Bechara and Martin, 2007; Mazas, Finn and Steinmetz, 2000), it is possible that deficits found among college age participants may be related to variables other than the effects of frequent and heavy alcohol use.

It was noted that decision making (IGT) is significantly correlated with all of the variables except family history of alcohol problems. In addition, family history of alcohol problems is not significantly correlated with any of the variables in the full data. All other variables are significantly correlated except impulsivity and number of alcoholic drinks during the past 30 days. Correlation among these variables is expected as they were chosen for study because research has shown that they frequently occur together in people with alcohol problems and people from families with a history of alcohol problems.

The finding of poor decision making in clusters that resemble previously studied heritable alcoholism types suggests that a trait of poor decision making may be genetically linked to the heritable alcoholism, or could be a behavior learned in families that include people with alcohol problems. This suggests avenues for future research. If this decision making tendency is genetically linked to heritable alcoholism, it may be mediated by related neural mechanisms. If

so, pharmacological or neurobehavioral treatments might be found to alleviate poor decision making, and might be useful in prevention or treatment of alcohol problems. On the other hand, if it is found to be more strongly linked to learned behaviors, prevention and treatment efforts aimed at cognitive behavioral or skills building approaches might be found more helpful in prevention and treatment efforts.

Although some participants showed low IGT scores and also early problems with alcohol and/or a high level of current problems with alcohol, this study does not allow us to determine whether poor IGT decision making existed before the problems from alcohol or other drugs, or might have been caused by participants drinking frequently enough and/or heavily enough to cause difficulties at an early age or at present. Participants who are already drinking or using other drugs regularly and/or heavily may have acquired decision-making problems, and may or may not also have inherited a proposed tendency for decision-making problems.

Because the participants in this study were overwhelmingly female, the full data set is not representative of undergraduates in general, and cannot be generalized to that population. Further, in some studies, males and females have been found and have been hypothesized to differ on age of onset and severity of alcohol use symptoms.

As referred to earlier, men tend to score better on the IGT than women. However, in this study, women's mean IGT scores were higher than those of the men. It is not clear why that is so. The men in the norming samples of the PPI-R also had higher scores than the women (Lilienfeld & Widows 2005). This study's women's scores on the PPI-R were also unexpectedly higher than the men's scores. Magnusson, Goransson, & Heilig (2010) found that women who met criteria for Type II alcoholism (Cloninger et al, 1981) had elevated levels of trait aggression compared to non-alcoholic and Type I alcoholic women. Magnusson and colleagues view verbal,

indirect and social aggression by women as antisocial activities. Perhaps this sample contained larger than average numbers of women with Type II traits (for example, they might have been attracted by the subject of the study), resulting in high mean psychopathy scores among the female participants. If this is true, the female results of this study may not generalize well to the female undergraduate population in the United States. On the other hand, they may be more generalizable to the population of women with alcohol problems.

All clusters have family alcohol problems close to the mean, and the no alcohol and some alcohol groups did not differ significantly on family alcohol history. Magnusson et al. (2010), found that women with alcohol dependence who met criteria for Type II had high density of alcoholic relatives, high aggression (which they counted as antisocial behavior) and high impulsivity.

Another way of looking at the similarities between the patterns of variables shown in this study's clusters and those seen in alcoholic typologies is that this study's patterns reflect groupings of behaviors, personality traits, genetic inheritance and family environment that most or all of college students fall into. These patterns are also seen in people who later develop alcohol problems and presumably also in people who don't develop alcohol problems, since most people in the United States do not develop alcohol use disorders.

Whether the measures used in this study are tapping nascent versions of similar constructs in persons with alcohol use disorders could be another direction for future research. Exploring whether the Iowa Gambling Task's type of decision making deficit is genetically connected to some of the other traits it clustered with would be fruitful in finding effective prevention and treatment techniques, possibly targeting working memory deficits (Bechara & Martin, 2004).

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This study's data do not provide enough information to determine whether the participants who had high scores on risk factors had these before they begin to have severe enough problems with alcohol to qualify for a substance use disorder diagnosis. The YAACQ includes questions that cover some of the symptoms used for substance abuse diagnoses, but most are less severe (i.e. hangovers, saying or doing something embarrassing while drunk). It cannot be assumed that college students who have a given level of a variable tested will have the same levels if they develop an alcohol problem, so one cannot make direct predictions, for example, from low psychopathy in this sample to low psychopathy after an addiction has developed.

Although decision making measured by the IGT is not the same concept as delay discounting, there are similarities in their implications. There is preliminary evidence of heritability of delay discounting (Anokhin et al., 2011), which is a concept drawn from behavioral theory. So it may be that delay discounting would be a more helpful variable to investigate than Iowa Gambling Task scores in research on genetic risks for alcohol use disorders.

It would not be unusual for most of the variables in this study to be significantly correlated in a sample of people with alcohol problems. However, these significant correlations were found in a sample of college age people, who have levels of alcohol use ranged from none to frequent and heavy, and few to many problems caused by alcohol. This suggests that there may be pre-existing patterns of these variables in young people, most of whom have not yet developed an alcohol problem, and probably will never develop and alcohol problem.

APPENDIX A

CONSENT FORM – LATEST REVISION

American University
Department of Psychology
4400 Massachusetts Avenue, NW
Washington DC 20016-8062

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE OF STUDY: Decision making, personality characteristics, alcohol and other drug use, and family alcohol use.

PRINCIPAL INVESTIGATOR: Heather Whitney Price, M.S., M.A.
FACULTY ADVISOR: James J. Gray, Ph.D.

INTRODUCTION:

We would like to invite you to be part of a research study at American University.
You are being asked to participate because you are between the ages of 18 and 26.
This form gives you information about the study. We will answer any questions you have about the study and this consent form. You will be given a copy of this form to keep for your records.

PURPOSE OF STUDY

The purpose of this study is to examine undergraduates' decision making, some aspects of their personality, their alcohol and other drug use, and (in general terms) their families' use of alcohol.

PROCEDURES

If you agree to participate you will be asked to sign this consent form, and you will be given a copy for yourself. You will make one visit to the laboratory, which will last approximately 1 to 1½ hours. During the visit, you will complete a task (something like a simple game) on a computer. You will then fill out some questionnaires.

You are required to abstain from alcohol and other drugs (except prescribed and over the counter medications, taken as prescribed or as recommended on the package) on the day of your visit.

POTENTIAL RISKS/DISCOMFORT

There are no known physical risks associated with filling out the questionnaires or completing the computer task. Psychological risks, if any, are expected to be mild, such as mild embarrassment or nervousness about answering some of the questions. If you wish to discuss any such feelings, American University offers counseling at the Counseling Center. You can make an appointment there by calling (202) 885-3500.

CONFIDENTIALITY

Every effort will be made to keep all data collected from you completely confidential. A numeric code will be used in place of your name on all questionnaires. Your questionnaires will be stored in a locked location, and your signed consent form will be stored in a separate locked location.

POTENTIAL BENEFITS

There are no direct benefits to you for participating in this study. This study may help us learn more about decisions made by people who use or abuse alcohol, family patterns of alcohol use, and some aspects of personality and behavior that sometimes are seen in people who develop alcohol problems.

ALTERNATIVES TO PARTICIPATION

Participation in this study is entirely voluntary. If you decide to participate, you can change your mind and drop out of the study at any time. You will receive the extra credit for a psychology course (if available to you) and will be entered in the lottery for the iPod (see next paragraph) even if you stop participating in the study before it is completed.

COMPENSATION

Students who are taking a psychology course that offers extra credit towards their grade will receive 1½ research credits. You will also be enrolled in a lottery for an iPod, if you chose to write your name and email address and/or phone number on a card for the drawing. This card will be kept totally separate from your consent form and from your questionnaires. You will receive this compensation even if you stop participating before the study is finished. The odds of winning the iPod are about 1 in 145.

QUESTIONS ABOUT THE STUDY

If you have questions or concerns during the time of your participation in this study, or after its completion or you would like to receive a copy of the final aggregate results of this study, please contact:

Heather Whitney Price, M.S., M.A.   James J. Gray, Ph.D.
Department of Psychology   Department of Psychology
American University   American University
hw2659a@student.american.edu   Telephone: (212)885-1716
                                jgray@american.edu

QUESTIONS ABOUT YOUR RIGHTS AS A RESEARCH SUBJECT

You can contact either of the following about your rights as a research subject:

Dr. David Haaga   Matt Zembrzuski
Chair, Institutional Review Board   IRB Coordinator
American University   American University
(202)885-1718   (202)885-3447
dhaaga@american.edu   irb@american.edu

I consent to participate in this study and understand that I have the right to withdraw from this study at any time.

_____   _____
Signature of participant   **Date**

_____
Printed name of participant

_____   _____
Signature of experimenter   **Date**

_____
Printed name of experimenter

APPENDIX B

DEMOGRAPHIC QUESTIONNAIRE

1) Please check the box that corresponds to your age:

☐ 18 years old   ☐ 21 years old   ☐ 24 years old
☐ 19 years old   ☐ 22 years old   ☐ 25 years old
☐ 20 years old   ☐ 23 years old   ☐ 26 years old

2) What race do you consider yourself to be?

☐ American Indian or Alaska Native
☐ Asian
☐ Black or African-American
☐ Native Hawaiian or Other Pacific Islander
☐ White, non-Hispanic
☐ Other:_____

3) Do you consider yourself to be Hispanic/Latino?

☐ No
☐ Yes

4) What is your gender?

☐ Female
☐ Male

5) Are you adopted?

☐ No
☐ Yes

6) During the past 30 days, how many days have you used any of the following items?
   (If you are not sure, please make your best guess.)

Tobacco   _____ days
  (Cigarettes, cigars, pipe tobacco, chewing tobacco, etc.)
Caffeine   _____ days
  (Coffee, tea, caffeinated sodas, power drinks, etc.)

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