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PERSONALITY AND LEARNING PREDICTORS  
OF ADOLESCENT ALCOHOL CONSUMPTION TRAJECTORIES

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THESIS

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A thesis submitted in partial fulfillment of the  
requirements for the degree of Master of Science in the  
College of Arts and Sciences  
at the University of Kentucky

By

Sarah Jane Peterson

Lexington, Kentucky

Director: Dr. Gregory T. Smith, Professor of Psychology

Lexington, Kentucky

2017

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## ABSTRACT OF THESIS

### PERSONALITY AND LEARNING PREDICTORS OF ADOLESCENT ALCOHOL CONSUMPTION TRAJECTORIES

In a sample of 1897 youth studied across the last year of elementary school to the second year of high school, we (a) characterized different developmental trajectories of drinking frequency and drinking-related problems and (b) tested an a priori risk model that predicted variation in trajectory group membership. Analyses revealed five separate trajectories for both drinking frequency and drinking problems. Wave 1 scores on impulsogenic traits, expectancies for the reinforcing and stimulating effects of alcohol, and early pubertal onset differentiated among the trajectory groups, in some cases before the groups differed in drinking behavior. We also found substantial covariation between membership in high drinking frequency groups and membership in groups experiencing problems from alcohol consumption. The findings suggest that (a) youth vary considerably in the development of drinking behavior, and (b) trajectory groups can be distinguished by specific biological, personality, and learning risk factors.

**KEYWORDS:** Developmental Trajectories, Drinking, Impulsivity, Adolescence, Expectancies

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March 10, 2017

PERSONALITY AND LEARNING PREDICTORS  
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## Introduction

Alcohol consumption increases dramatically during the period of late elementary school to early high school, from rate estimates of 7-10% in late elementary school (Chung, Smith, Donovan, Windle, Faden, & Martin, 2012; Donovan, 2007; Gunn & Smith, 2010) to approximately 40-50% by the end of the first year of high school (Chung et al., 2012). Drinking during these periods is clinically significant both as a marker of other forms of concurrent dysfunction and as a predictor of future adjustment problems. Concurrently, for boys and girls ages 12-15, reports of having consumed alcohol one day (or more) during the preceding year have sensitivity of 1.0 and specificity of .94 (boys) and .95 (girls) in the concurrent prediction of any DSM IV alcohol use disorder symptom over that year (Chung et al., 2012). In addition, drinking concurrently relates to several other problem behaviors, such as early onset marijuana use, early sexual intercourse, and low value on academic achievement (Jessor, 1987). Prospectively, early consumption predicts diagnostic status and alcohol problems in later adolescence and adulthood (DeWit, Adlaf, Offord, & Ogborne, 2000; Grant & Dawson, 1997; Guttmanova et al., 2012). For these reasons, it is important to understand predictors of problematic drinking, beginning in early adolescence.

Historically, research focused on predicting increases in drinking with a single growth-trajectory (i.e. initial use and subsequent increases in drinking). Studies of this nature utilize a variable-centered approach, which describes the average characteristics and behavior of the sample in question and uses a regression approach to predict sample increases in drinking behavior over time. While research of this nature is parsimonious and helpful when examining average trends within a population, it does not address the

possibility that individuals or subgroups vary meaningfully in their patterns of use over the adolescent years.

More recent research suggests that adolescents follow different developmental trajectories in their drinking behavior. For example, some youth never begin drinking, others increase their consumption early in adolescence, others are abstinent until later adolescence, and others reduce their drinking over the adolescent years (e.g. Chassin, Pitts, & Prost, 2002; Tucker, Orlando & Ellickson, 2003; Windle, Mun, & Windle, 2005). This focus on variability among people, rather than using average variable scores across all people, is often described as a person-centered approach (Cicchetti & Rogosch, 2002). The establishment and characterization of alcohol use trajectories can be helpful in differentiating between developmentally normative drinking and drinking that is likely to become problematic.

While there is a large and growing body of research that provides evidence for varying developmental trajectories and their related outcomes (e.g. Hill, White, Chung, Hawkins, & Catalano, 2000; Oesterle, Hill, Hawkins, Guo, Catalano, & Abbott, 2004), less work has been done in the area of predicting what trajectories individuals are likely to follow. There has been some such predictive work (e.g. Chassin, Flora & King, 2004; Warner, White, & Johnson, 2007; Windle, et al., 2005). To date, that work has focused on environmental factors (i.e. peer drinking, family environment, stress, etc.) or behavioral correlates (i.e. externalizing symptomology, other drug usage, depression, anxiety, etc.). There is a need to extend predictive work to incorporate a range of possible influences on trajectory development.

Thus, the current study had two goals. First, we sought to confirm the existence and characterization of different developmental trajectories for drinking behavior and drinking related problems from early to late adolescence. Second, we tested a risk model for trajectory development specifying pubertal onset, high-risk personality traits, and learned expectancies for the effects of drinking as predictors of trajectory development. Each of these factors has proven important in accounting for the onset of consumption and high-risk consumption (Berg et al., 2015; Dick, Rose, Viken, & Kaprio, 2000; Peterson & Smith, in press; Smith & Cyders, 2016), so it is important to know whether their presence predicts subsequent development along different drinking trajectories.

### **Trajectories of Drinking Behavior**

A premise of this person-centered approach to alcohol use in adolescence is that the heterogeneity of alcohol use among people is critically important. On average, individuals begin drinking during adolescence, increasing their drinking into their twenties, and decrease when settling into adult roles (Bachman, O'Malley, & Schulenberg, 2014). However, there is wide variability in this average pattern, with some individuals establishing lifelong drinking patterns that differ in a potentially dangerous way from the norm. Differentiating patterns of adolescent drinking that are problematic from patterns that are relatively benign can aid in more targeted prevention and intervention efforts regarding future alcohol use and abuse (Flory, Lynam, Milich, Leukefeld, & Clayton, 2004; Sher, Gotham, & Watson, 2004). Over the past decade or so, several studies examining the characterization of drinking trajectories have emerged. More recently, research on drinking trajectories has moved towards correlates and

predictors of trajectory membership. We summarize the relevant literature regarding both characterization and prediction of membership in brief below.

One approach to understanding varying drinking trajectories is the identification of distinct, homogeneous groups within a sample whose drinking patterns differ over time. Often referred to as taxonomies, studies of this nature have been conducted for a variety of age groups. Research of this nature has focused substantially on trajectories of binge drinking and their correlates. Studies examining binge drinking trajectories from adolescence to emerging adulthood have found trajectory groups engaging in heavier patterns of drinking were at elevated risk for later substance abuse and/or dependence (Chassin et al., 2002), as well as other negative outcomes such as failing to graduate high school and higher rates of crime (Hill et al., 2000). Trajectories of drinking frequency have also been examined with similar results – membership in trajectory groups characterized by higher levels of alcohol consumption elevate risk for a variety of negative outcomes (Chassin et al., 2004; Colder, Campbell, Ruel, Richardson, & Flay, 2002; Oesterle et al., 2004; Tucker et al., 2003; Windle et al., 2005). Trajectories of drinking-related problems have been less examined, but one study indicates drinking problem trajectory membership can be predicted by age of onset, such that youth who begin drinking at younger ages belong to a trajectory group characterized by escalating problems (Warner et al., 2007).

Although it does appear that any amount of drinking places children and adolescents at a greater risk for substance abuse and/or dependence, as well as a variety of other undesirable outcomes, it also seems to be the case that individuals who begin drinking earlier and in heavier volumes suffer the worst consequences (Colder et al.,

2002; Oesterle et al., 2004; Tucker et al., 2003; Windle et al., 2005). Such negative outcomes include greater risk for not graduating from high school, high crime rates, and future alcohol and substance abuse and dependence. Thus, the effects of adolescent drinking depend, in part, on the developmental stage that it begins in, as well as the pattern it follows throughout development.

Trajectory research on adolescent drinking has proven enormously valuable. It now seems clear that different youth progress along different patterns of drinking development, and that the different patterns have different consequences for youth. Studies of this nature are useful for identifying which groups are at a heightened risk for negative outcomes. However, it is equally important to determine predictors of trajectory group membership in order to aid in early identification of high-risk children and target prevention efforts. As mentioned previously, where predictive work has been done, measurement of drinking has been done retrospectively (e.g. Derefinko, Charnigo, Peters, Adams, Milich, & Lynam, in press), or it has focused on environmental factors, such as peer drinking or family environment (e.g. Warner et al., 2007), or behavioral correlates, such as anxiety, depression, or externalizing symptomology (e.g. Chassin et al., 2002).

In research on the prediction of subsequent drinking behavior, without consideration of variation in trajectories, biological, personality, and psychosocial learning factors have each proven important in understanding adolescent drinking. Accordingly, it is important to evaluate each of these types of risk factors for their ability to predict development along different drinking trajectories.

## **Risk Factors for Drinking**

**Biological Risk: Pubertal Onset.** Any model concerning the period between elementary school and high school should consider pubertal onset. Early pubertal onset is typically defined as occurring before 75% of one's peers (Lynne-Landsman, Graber, & Andrews, 2010) and predicts early alcohol use and other addictive behaviors (Dick et al., 2000; Lanza & Collins, 2002; Tschann, Adler, Irwin, Millstein, Turner & Kegeles, 1994; Westling, Andrews, Hampson & Peterson, 2008). The influence of early puberty is presumed to reflect biological effects as well as social and contextual factors, and even parental psychopathology (Dick et al., 2000; Ellis, 2004; Ellis & Garber, 2000). Additionally, as noted above, early pubertal onset has been shown to predict membership in trajectories characterized by heavy adolescent drinking (Biehl, Natsuaki, & Ge, 2007).

There is also recent evidence that whenever the pubertal transition occurs, it is associated with subsequent increases in drinking behavior (Boyle, Riley, Crosby, & Smith, 2016). Boyle et al. (2016), using an eight-wave longitudinal design, evaluated prediction of drinking from pubertal onset whenever it occurred. They found that the pubertal transition was associated with a subsequent mean and slope increase in drinking behavior.

**Personality.** Several models exist to describe the role that personality plays in risk for addiction (Birkley & Smith, 2011; Sher & Trull, 1994; Sher, Trull, Bartholow, & Vieth, 1999; Wills, Sandy, Yaeger, Cleary & Shinar, 2001). Sher and Trull (1994) highlighted three dimensions of personality: neuroticism/emotionality, disinhibition/impulsivity, and sociability/extraversion as potentially related to problematic alcohol use. A model developed by Whiteside and Lynam (2001) and Cyders

and Smith (2007, 2008) includes traits related to each of those broad dimensions. Specifically, this model implicates five personality traits that increase the risk for impulsive behaviors, each of which can be placed along at least one of these dimensions (Whiteside & Lynam, 2001).

Two of the traits – positive and negative urgency – reflect a disposition to act impulsively when experiencing high levels of emotion. Positive urgency involves acting rashly when experiencing very positive emotions and similarly, negative urgency involves acting rashly when experiencing very negative emotions. Positive and negative urgency are highly correlated and can be thought of as facets of an overall urgency trait (Cyders & Smith, 2007). Both involve high neuroticism, low agreeableness, and low conscientiousness (Cyders & Smith, 2008). Thus, the two traits can be understood to reflect a contribution to risk involving both neuroticism and disinhibition.

Lack of planning represents the tendency to act without forethought and lack of perseverance represents a difficulty maintaining a focus on tasks; these two traits are facets of an overall low conscientiousness dimension (and thus reflect another form of disinhibition-based risk: Cyders & Smith, 2007). Finally, sensation seeking is the tendency to seek out novel, and thrilling stimulation and involves the extraversion domain of personality.

Each of these traits has been related to multiple forms of addictive behavior, including drinking. Urgency and its positive and negative variants predict subsequent drinking in both adolescents and adults (Cyders, Flory, Rainer, & Smith, 2009; Settles, Cyders, & Smith, 2010; Settles, Zapolski, & Smith, 2014). Sensation seeking consistently predicts increases in drinking frequency (Cyders et al., 2009). Low conscientiousness



predicts increased drinking in youth (Guller, Zapolski, & Smith, 2015). One study examined these impulsogenic traits as correlates of drinking frequency trajectories from 7<sup>th</sup> grade into college, using retrospective reports of youth drinking. Trajectory group membership was associated with the traits of urgency, lack of planning, and sensation seeking, with higher levels of these traits tending to be associated with heavier patterns of drinking (Derefinko et al., in press).

Another trait within the neuroticism domain of personality, negative affectivity, has been identified in relation to adolescent alcohol use (Sher & Trull, 1994). Negative affectivity, depression and anxiety predict subsequent drinking levels in youth (Caspi, Harrington, Milne, Amell, Theodore, & Moffitt, 1996; Hussong, Gould, & Hersh, 2008; King, Iacono, & McGue, 2004). It is also true that alcohol use predicts subsequent negative affect (Brook, Brook, Zhang, Cohen, & Whiteman, 2002), suggesting a reciprocal relationship. In addition, there is reason to believe negative affect anticipates drinking in European American youth, whereas drinking predicts subsequent negative affect in African American youth (Birkley, Zapolski, & Smith, 2015).

There is also considerable evidence that suggests positive affect is related to engagement in drinking. Although positive affect is valuable in many ways (Isen, Niedenthal, & Cantor, 1992; Phillips, MacLean, & Allen, 2002), strong positive affect can also (a) interfere with orientation toward the pursuit of one's long-term goals, (b) increase distractibility, (c) increase optimism about the positive outcomes of a situation (Dreisbach & Goschke, 2004), (d) lead to less discriminative use of information (Forgas, 1992), and (e) lead to poorer decision making (Slovic, Finucane, Peters, & MacGregor, 2004). Some individuals consume alcohol for celebratory purposes or to enhance an

already positive mood state (Del Boca, Darkes, Greenbaum, & Goldman, 2004; Kornefel, 2002). This drinking tends to be associated with negative outcomes such as driving while under the influence, unwanted sexual intercourse, increased physical violence, alcohol-related injuries and deaths, and involvement in other risky behaviors (Del Boca et al., 2004). There is also evidence that adolescents engage in risky behaviors when they are unusually happy, not just when they are distressed (Steinberg, 2004).

**Psychosocial learning: Expectancies for Reinforcement from Drinking.** There are multiple models that implicate learned expectancies in the addictive process. We utilize a model in which expectancies serve as markers of memory-based associative learning (Goldman, Darkes & DelBoca, 1999; Goldman, Reich & Darkes, 2006; Peterson & Smith, in press). They are a representation of what one has learned from the outcomes of behavioral choices and thus reflect anticipated reinforcement (Bolles, 1972; Tolman, 1932). Alcohol expectancies can form through modeling, as indicated in expectancy development prior to drinking experience (Miller, Smith & Goldman, 1990; Zucker, Kincaid, Fitzgerald, & Bingham, 1995), and are modified by drinking experience (Smith, Goldman, Greenbaum, & Christiansen, 1995a).

Prior research has found that expectancies for reinforcement from drinking predict the onset of, and increases in, drinking frequency, quantity, and drinking problems in adolescence (Goldberg, Halpern-Felsher, & Millstein, 2002; Ouellette, Gerrard, Gibbons, & Reis-Bergan, 1999; Settles et al., 2014; Smith et al., 1995a). Specifically, the expectancy that drinking facilitates social interaction has been shown to be particularly predictive (Settles et al., 2014; Smith et al., 1995a). To date there is one study that examines the predictive ability of expectancies on developmental trajectories of drinking,

but the sample utilized was a late-adolescent, emerging adulthood undergraduate sample (Greenbaum, Del Boca, Darkes, Wang, & Goldman, 2005).

### **Current Study**

The current study sought to confirm and characterize the presence of developmental drinking trajectories in a sample of youth beginning in the 5<sup>th</sup> grade and ending in the 10<sup>th</sup> grade. We examined trajectories of both drinking frequency and drinking problems. In addition to the identification and characterization of these developmental paths, we also sought to confirm a risk model that specifies certain predictors of membership in specific trajectories. Specifically, we tested whether each of four sets of predictors, measured in elementary school, anticipated trajectory group membership: (1) early pubertal onset; (2) impulsivity-related personality traits (i.e. urgency, low conscientiousness, sensation seeking); (3) positive and negative affectivity; and (4) learned expectancies for the reinforcing effects of drinking.

### **Method**

#### **Sample**

Participants are 1897 youth in 5<sup>th</sup> grade at the start of the study; they were drawn from urban, rural, and suburban backgrounds and represented 23 public schools in two school systems. The sample was equally divided between girls (49.9%) and boys. At wave 1, most participants were 11 years old (66.8%), 22.8 % were 10 years old; 10 % were 12 years old; and .2 % were either 9 or 13 years old. The ethnic breakdown of the sample was as follows: 60.9%, European American, 18.7% African American, 8.2 % Hispanic, 3% Asian American, and 8.8% other racial/ethnic groups.

## Measures

**Demographic and background questionnaire.** Participants were asked to circle their sex, write in their current age (in years), and indicate which label(s) best described their ethnic background.

**The Pubertal Development Scale (PDS;** Petersen et al., 1988). This scale consists of five questions for boys and five questions for girls. Sample questions are, for boys, “Do you have facial hair yet?” and, for girls, “Have you begun to have your period?” Individuals respond on a 4 point scale. Scores on the scale correlate highly with physician ratings and other forms of self-report ( $r$  values ranging from .61 to .67: Brooks-Gunn, Warren, Rosso, & Gargiulo, 1987; Coleman & Coleman, 2002). In the current study, internal consistency estimates of reliability within gender, within wave were  $\alpha = .97$  or higher.

**The UPPS-P Child Version** (Zapolski, Stairs, Settles, Combs, & Smith, 2010) measures the five traits of positive urgency, negative urgency, lack of planning, lack of perseverance, and sensation seeking. Item responses are on a four-point Likert-type scale, ranging from “not at all like me” to “very much like me.” Scale scores were calculated as the mean item response. At wave 1, the spring of 5<sup>th</sup> grade, coefficient alpha estimates of internal consistency for the five scales were: positive urgency, .89; negative urgency, .85; lack of planning, .77; lack of perseverance, .65; sensation seeking, .79. Reliability estimates were slightly higher in succeeding waves. ).

Positive and negative urgency are facets of an overall Urgency domain (Cyders & Smith, 2007). Therefore we ran preliminary analyses that indicated that all predictive effects were the same for the two facets, and the traits were highly correlated (wave 1  $r =$

.63), so we combined them and used overall urgency. Lack of planning and lack of perseverance are facets of an overall low Conscientiousness domain (Cyders & Smith, 2007). The two traits correlated  $r = .42$  at wave 1. Preliminary analyses showed that predictive effects sometimes differed between the two facets, so we analyzed them separately.

**The Positive and Negative Affect Schedule – Child Version (PANAS-C;** Laurent et al., 1999). This scale measures positive and negative affectivity in children. It was based on the adult PANAS (Watson, Clark, & Tellegen, 1988) and developed and validated for children in grades 4-8. Items were adapted to ask how one “generally” feels rather than how one feels “over the past few weeks.” We used both the negative affectivity and positive affectivity scales. There is impressive evidence for both scales’ reliability and validity (Laurent et al., 1999). For both scales, internal consistency estimate of reliability was  $\alpha = .90$  at wave 1 and slightly higher subsequent waves.

**Memory Model-Based Expectancy Questionnaire (MMBEQ: Dunn & Goldman, 1996)** provides an extensive assessment of alcohol expectancies in children. Based on past research (Settles et al., 2014; Smith et al., 1995a), we chose to study the expectancy that alcohol facilitates positive, social experience. The scale begins with the stem, “Drinking alcohol makes people \_\_\_\_.” Children then read items that complete the stem (e.g., “friendly,” “fun”) and then circle one of four responses: “never,” “sometimes,” “usually,” or “always.” Thus, items are scored on a Likert-type scale. Internal consistency reliability was estimated at  $\alpha = .82$  at wave 1, with higher estimates subsequent waves. This scale correlates with drinking cross-sectionally: Cruz & Dunn,

2003; Dunn & Goldman, 1996, 1998) and predicts drinking onset in youth: Settles et al., 2014).

We additionally chose to study the expectancy that alcohol consumption leads to wild and crazy behavior. The scale begins with the stem, “Drinking alcohol makes people \_\_\_\_\_.” Children then read items that complete the stem (e.g., “wild,” “loud”) and then circle one of four responses: “never,” “sometimes,” “usually,” or “always.” Thus, items are scored on a Likert-type scale;  $\alpha = .73$  at wave 1 and higher subsequent waves.

**Drinking Styles Questionnaire (DSQ: Smith, McCarthy, & Goldman, 1995b).**

This scale provides a number of measures of drinking behavior; we chose to measure self-reported drinking frequency because it is the best marker of concurrent alcohol-related problems, as noted above (Chung et al., 2012). Drinking frequency was measured at each wave, using a single item asking how often one drinks alcohol. A drink was defined as follows: “. . . a ‘drink’ is more than just a sip or a taste. (A sip or a taste is just a small amount or part of someone else’s drink or only a swallow or two. A drink would be more than that.)” Response choices are: 0 = “I have never had a drink of alcohol,” 1 = “I have only had 1, 2, 3, or 4 drinks of alcohol in my life,” 2 = “I only drink alcohol 3 or 4 times a year,” 3 = “I drink alcohol about once a month,” 4 = “I drink alcohol once or twice a week,” and 5 = “I drink alcohol almost daily.” This single item assessment has proven stable over time and there is good evidence for its construct validity (Guller et al., 2015; Gunn & Smith, 2010; Settles et al., 2014).

Additionally, we examined trajectories of drinking problems. Drinking problems were assessed with a true or false questionnaire comprised of several items regarding

negative drinking related outcomes. Example items include “I have passed out from drinking too much,” and “I have gotten into trouble with my parents for drinking alcohol.” Drinking problems scores were the total number of problems experienced.

### **Procedure**

Participants were recruited using a passive consent procedure. Parents of all potential participants received a letter, through the U.S. Mail, describing the study. Parents were asked to call a provided phone number or return an enclosed, stamped letter if they did not want their child to participate. In addition, youth had to assent to participate and sign an assent form at each wave. Out of 1,988 fifth graders in the participating schools, 1,897 participated in the study (95.4%). Reasons for not participating included (d) declination of consent by parents, (b) declination of assent by youth, and (c) youth language disabilities. Questionnaires were administered by study staff in the children’s classrooms or in a central location, such as the school cafeteria, during school hours. It was made clear to the students that their responses on the questionnaire were to be kept confidential and no one outside of the research team would see them. The research team introduced the federal certificate of confidentiality for the project and emphasized that they were legally bound to keep all responses confidential. After each participant signed the assent form, the researchers then passed out packets of questionnaires. The questionnaires took 60 minutes or less to complete. This procedure was approved by the University’s IRB and by the participating school systems. Children who left the school system were asked to continue to participate. Those who consented did so either by completing hard copies of questionnaires delivered through the mail or by completing the measures on a secure web site. They were paid \$30 for doing so.

Participants completed the measures every 6 months from the spring of 5<sup>th</sup> grade (the last year of elementary school) through the spring of 8<sup>th</sup> grade (the end of middle school) and then twice more annually: in the spring of 9<sup>th</sup> grade and the spring of 10<sup>th</sup> grade.

**Data analytic method.** The primary analyses for this study were two trajectory analyses. We examined trajectories of the development of drinking frequency and drinking problems across the nine waves of the study. We applied finite mixture modeling (Nagin, 2005), using SAS Version 9.3 PROC TRAJ to model trajectories as a function of measurement wave. We used zero inflated poisson (ZIP) modeling because a large number of participant responses were zeros (reflecting no drinking). When using this method, one assumes that the target population can accurately be described as a mixture of distinct groups defined by their developmental trajectories. In brief, longitudinal data are used to identify the number of groups that best fits the data and to describe the shape of the trajectory for each group. One can then calculate the probability of each individual belonging to each of the trajectory groups that make up the model; individuals can then be assigned to the group to which the probability of their belonging is the highest.

Several fit indices are used to determine the optimal number of groups and the validity of the grouping result. The Bayesian Information Criterion (BIC) and the Akaike Information Criterion (AIC) become increasingly less negative with improvements in the fit of the group structure. Those statistics can be supplemented by additional statistics and guidelines for selecting the best trajectory solution. When the average probability of group membership is greater than .70 for each group (Nagin, 2005), the identified group



structure is thought to fit well. One also avoids group structures with extremely small group sizes, out of concern for the stability of the structure (Nagin, 2005).

Each analysis proceeded as follows. We first specified three groups and then tested a series of models in which we increased the number of groups and used the BIC, the AIC, the average probability of group membership, and the group sample size to evaluate model fit (Nagin, 2005).

Once we had determined trajectory group structure and assigned individuals to groups, analyses of variance (ANOVA) and planned contrasts were conducted to compare the groups on measures of pubertal onset, high risk personality traits, and alcohol expectancies. Results reported below compare trajectory groups on these measures at wave 1 (the start of the longitudinal period) to determine if trajectory group membership could be predicted at the start of the longitudinal period, in elementary school. In supplemental analyses presented in an appendix, using binary logistic regression, all predictors were entered together to determine which was most predictive of trajectory group membership.

## **Results**

**Participant retention.** Table 1 provides retention data for the study. Retention from one wave to the next ranged from 94.2% to 99.3%, for an overall retention rate of 74.3% over 9 waves. Youth who participated in these three waves of the study did not differ from those who participated in only one or two waves on any demographic, criterion, or trait variable. Therefore, we inferred that data were missing at random.

Table 1. Retention of Participants over the 9 Waves of Data Collection

	N at given wave (total # participated at each wave)	# new participants (first participated at given wave)	Percentage of full sample (Wave N/1906)	Percentage of previous wave (Wave N/Wave N – 1)
W1	1,843	1,843	96.7%	---
W2	1,806	63	94.8%	94.6%
W3	1,770	---	92.9%	99.3%
W4	1,667	---	87.5%	94.2%
W5	1,683	---	85.9%	98.3%
W6	1,563	---	82.0%	95.4%
W7	1,495	---	78.4%	95.6%
W8	1,428	---	74.9%	95.6%
W9	1, 416	---	74.3%	98.2%

W = wave. For example, W1 = wave 1. Wave 1: spring, 5<sup>th</sup> grade; Wave 2: fall, 6<sup>th</sup> grade; Wave 3: spring, 6<sup>th</sup> grade; Wave 4: fall, 7<sup>th</sup> grade; Wave 5: spring, 7<sup>th</sup> grade; Wave 6: fall, 8<sup>th</sup> grade; Wave 7: spring, 8<sup>th</sup> grade; Wave 8: spring, 9<sup>th</sup> grade; Wave 9: spring, 10<sup>th</sup> grade. A total of 63 youth were in the study but were absent from school during all testing days at wave 1, so began at wave 2.

Missing data were imputed using the expectation maximization (EM) procedure, which has been shown to produce more accurate estimates of population parameters than do other methods, such as deletion of missing cases or mean substitution (Enders, 2006). As a result, we were able to make full use of the entire sample of  $n = 1897$ .

**Descriptive data.** Table 2 presents drinking frequency and drinking problems endorsement over the nine waves of the study. While approximately 88% of our participants were non-drinkers at wave 1, only about 46% were non-drinkers by wave 9.

Table 2. Descriptive Statistics of Drinking Variables Across Waves

Drinking Frequency	T1	T2	T3	T4	T5	T6	T7	T8	T9
I have never had a drink.	87.9%	88.5%	85.6%	82.7%	78.3%	68.9%	68.5%	53.3%	45.8%
I have only had 1,2,3, or 4 drinks in my life.	10.4%	10.0%	12.1%	13.4%	16.2%	22.0%	21.7%	30.4%	30.0%
I only drink alcohol 3 or 4 times a year.	0.6%	1.1%	1.3%	2.4%	3.3%	5.1%	5.6%	8.8%	11.8%
I drink alcohol about once a month.	0.5%	0.2%	0.5%	0.7%	0.9%	2.3%	2.1%	4.1%	7.3%
I drink alcohol once or twice a week.	0.4%	0.1%	0.2%	0.5%	0.6%	1.2%	0.9%	2.0%	3.2%
I drink alcohol daily.	0.3%	0.2%	0.4%	0.3%	0.6%	0.6%	1.2%	1.5%	2.0%
Drinking Problems Sum Mean (SD)	.24 (1.14)	.18 (.91)	.31 (1.32)	.30 (1.19)	.55 (1.82)	.64 (1.70)	.67 (1.95)	1.30 (2.35)	1.79 (2.86)

Table 3 presents the means and standard deviations for urgency, sensation seeking, lack of planning, lack of perseverance, negative affect, positive affect, and alcohol expectancies at wave 1, as well as the percentages of males and youth who had pubertal onset at wave 1. By the end of 5<sup>th</sup> grade (wave 1), 443 youth (23.4%) had experienced pubertal onset. We considered pubertal onset by that time to be early, because 23.4% constitutes roughly the first quartile of our sample. Table 4 presents correlations among all study risk variables at wave 1.

Table 3. Descriptive Statistics of Risk Factors at Wave One of Data Collection

Wave 1 Variable	Mean	SD
Urgency	4.35	1.30
Sensation Seeking	2.62	.70
Lack of Planning	2.01	.55
Lack of Perseverance	2.04	.48
Negative Affect	2.11	.76
Positive Affect	3.73	.70
Positive Social Alcohol Expectancy	1.52	.37
Wild & Crazy Alcohol Expectancy	2.96	.49
	Percentages	
Males	50.8%	
Pubertal Onset	23.4%	

Table 4. Correlations between Risk Factors at Wave One of Data Collection

	1	2	3	4	5	6	7	8	9	10
1. Puberty	-									
2. Sex	.01	-								
3. Urgency	.13**	.00	-							
4. Sensation Seeking	.08**	.03	.33**	-						
5. Lack of Planning	.07**	.00	.37**	.14**	-					
6. Lack of Perseverance	-.02	.02	-.04	-.30**	.42**	-				
7. Negative Affect	.03	-.02	.40**	.01	.11**	.02	-			
8. Positive Affect	.01	-.03	-.07**	.20**	-.26**	-.37**	-.12**	-		
9. Positive Social Alcohol Expectancy	.12**	.03	.24**	.13**	.14**	.02	.11**	-.02	-	
10. Wild & Crazy Alcohol Expectancy	.10**	.01	.12**	.07**	-.01	-.08**	.08**	.11**	.14**	-

Note. \*\* =  $p < .01$

## **Subgroups of Adolescents: Different Developmental Trajectories**

We separately developed trajectory groups for drinking frequency and drinking problems. We used Nagin's (2005) procedure to determine (a) whether individual differences in trajectories of drinking frequency and drinking problems could be characterized in terms of subgroups and (b) what the number and shapes of the drinking frequency and drinking problem trajectory groups were. Using SAS Version 9.1 PROC TRAJ (zero inflated poisson (ZIP) modeling; Jones, Nagin, & Roeder, 2001), we conducted the analyses on nine waves to model the trajectories as a function of measurement wave. For the analyses, we first specified two groups and then tested a series of models in which we increased the number of groups and used the BIC, the AIC, the average probability of group membership, and the group sample size to evaluate model fit (Nagin, 2005). For each, we assigned participants to the group for which he or she had the highest probability of belonging.

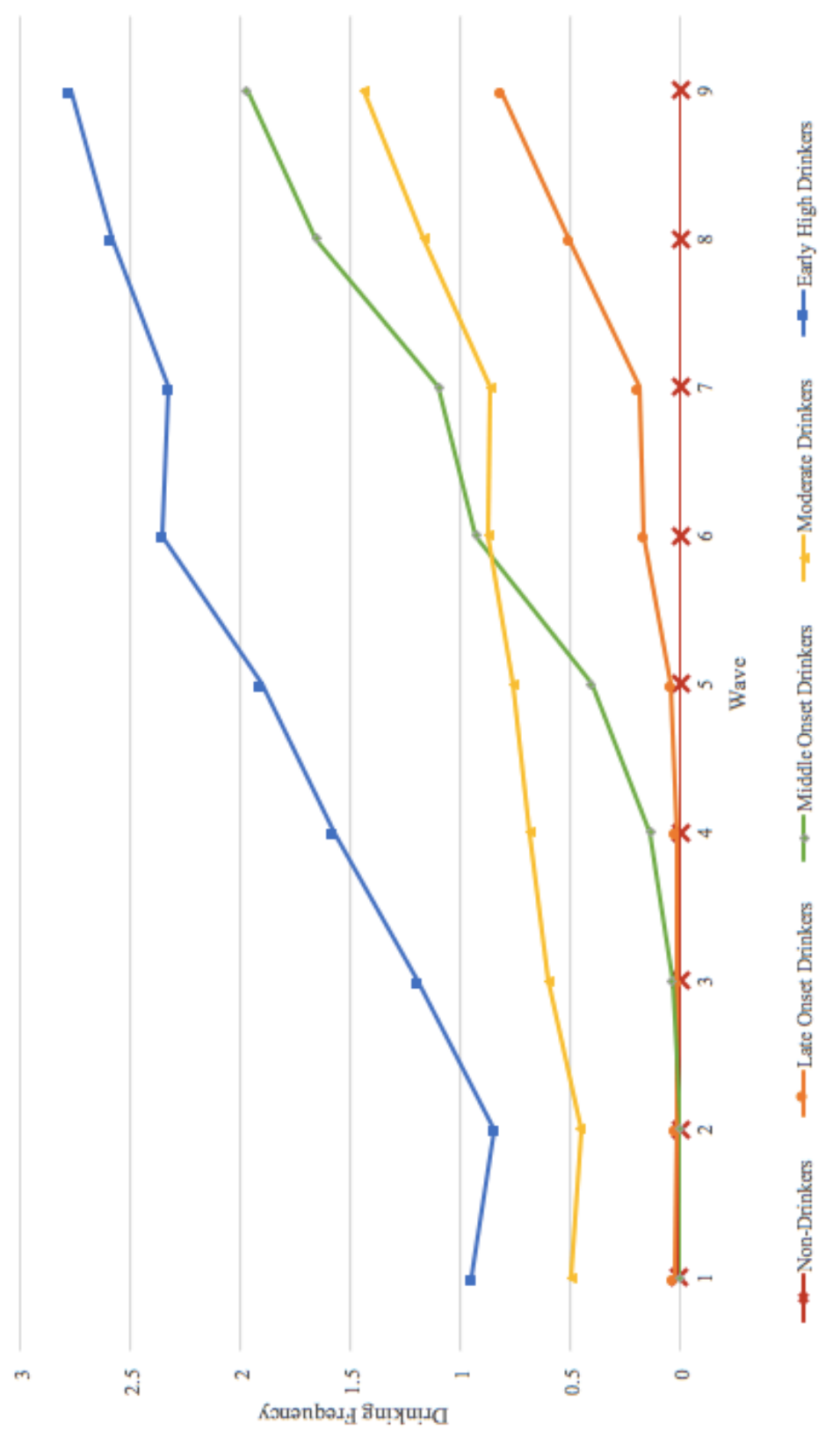
**Drinking Frequency Trajectories: Selection of Trajectory Models.** For this analysis, BIC and AIC values became progressively less negative from the three-group solution to the five-group solution. The six-group solutions produced BIC and AIC values that were less negative, but they included groups with very small samples sizes and did not involve groups with substantively different trajectories from those apparent in the five-group solutions. We therefore adopted five-group trajectory solutions for drinking frequency. The five-group solution had average group membership probabilities from .72 to .89. Thus, there was clear, straightforward assignment of individuals to trajectory groups.

**Drinking Problems Trajectories: Selection of Trajectory Models.** For this analysis, BIC and AIC values became progressively less negative from the three-group solution to the five-group solution. The six-group solutions produced BIC and AIC values that were less negative, but they included groups with very small samples sizes and did not involve groups with substantively different trajectories from those apparent in the five-group solutions. We therefore again adopted five-group trajectory solutions for drinking problems. The five-group solution had average group membership probabilities from .90 to .97. Thus, there was clear, straightforward assignment of individuals to trajectory groups.

**Drinking Frequency Trajectories.** As shown in Figure 1, 436 (23.0%) of the 1897 youth reported essentially no drinking at each of the nine data collections from 5<sup>th</sup> grade through 10<sup>th</sup> grade (non-drinkers group). A group of 817 youth (43.1%) reported no drinking through the first five waves of data collection, then reported increased drinking beginning in the sixth wave, which corresponds to the fall of eighth grade (late onset drinkers). The pattern of increase followed a combination of a significant linear trend ( $t(1) = 10.51, p < .001$ ), a significant quadratic trend ( $t(1) = 4.43, p < .001$ ), and a significant cubic trend ( $t(1) = -3.84, p < .001$ ). A group of 201 youth (10.6%) reported no drinking through the first three waves of data collection, then reported an increase in drinking beginning in the fourth wave, which corresponds to fall of seventh grade (middle onset drinkers). The pattern of increase followed a combination of a significant linear trend ( $t(1) = 4.53, p < .001$ ) and a significant quadratic trend ( $t(1) = -1.99, p = .047$ ). A fourth group of 327 (12.2%) youth reported moderate drinking throughout the nine waves of data, with a slight, but steady increase (moderate drinkers). The pattern of

increase followed a significant linear trend ( $t(1) = 4.05, p < .001$ ). The final group was the smallest group, consisting of 116 youth (6.1%) who consistently endorsed relatively high levels of drinking behavior, which steadily increased over the nine waves of data collection (early high drinking group). The pattern of increase followed a combination of a significant linear trend ( $t(1) = 7.07, p < .001$ ) and a significant quadratic trend ( $t(1) = -2.52, p = .01$ ).

Figure 1. Drinking Frequency Trajectory Groups





**Drinking Problem Trajectories.** As shown in Figure 2, 981 (51.7%) of the 1897 youth reported essentially no drinking related problems at each of the nine data collections from 5<sup>th</sup> grade through 10<sup>th</sup> grade (no problems group). A group of 530 youth (27.9%) reported no drinking problems through the first seven waves of data collection, with an increase in the eighth and ninth waves, corresponding to the springs of 9<sup>th</sup> and 10<sup>th</sup> grade (low late-onset problems group). The rate of linear increase was statistically significant,  $t(1) = 13.22, p < .001$  and there was a significant quadratic trend ( $t(1) = 5.84, p < .001$ ). A group of 147 youth (7.8%) also reported increasing levels of drinking problems beginning in the last two waves of data collection, however the increase in problems was more extreme (high late-onset problems). The pattern of increase followed a combination of a significant linear trend ( $t(1) = 14.30, p < .001$ ), a significant quadratic trend ( $t(1) = 11.25, p < .001$ ), and a significant cubic trend ( $t(1) = -9.98, p < .001$ ). A fourth group of 107 (5.6%) youth reported moderate levels of drinking problems across the nine waves of data collection (moderate problems group). This group's pattern involved a significant linear decrease ( $t(1) = -4.40, p < .001$ ), a significant quadratic trend ( $t(1) = 6.01, p < .001$ ), and a significant cubic trend ( $t(1) = 5.17, p < .001$ ). The final group consisted of 132 youth (6.9%) who endorsed no drinking related problems across the first two waves of the study and then relatively rapid increases in drinking problems beginning in the third wave which corresponds to the spring of 6<sup>th</sup> grade (early onset problems group). The pattern of increase followed a combination of a significant linear trend ( $t(1) = 13.20, p < .001$ ), a significant quadratic trend ( $t(1) = -12.24, p < .001$ ), and a significant cubic trend ( $t(1) = 5.47, p < .001$ ).

Figure 2. Drinking Problems Trajectory Groups



## Covariation between Drinking Frequency and Drinking Problems Trajectory Group Membership

There was a high degree of covariation in membership of drinking frequency and drinking problems trajectory groups (Table 5). 28.3% of youth reported no drinking and no drinking problems. Of those who reported no drinking, 95% also reported no problems. Of those who reported no problems, 53% reported no drinking. Of those in the early high drinking group, 83% were in either the moderate or early onset problems trajectory groups. Of those in the early onset problems trajectory group, 95% were in either the middle onset, moderate, or early high drinking trajectory groups.

Table 5. Cross-Classification between Drinking Frequency Trajectory Groups and Drinking Problem Trajectory Groups: Frequencies of Membership

	No Problems	Late-onset Low Problems	Late-onset High Problems	Moderate Problems	Early-onset Problems	Total
Non-drinkers	538 (28.4%)	21 (1.1%)	3 (0.2%)	1 (0.1%)	3 (0.2%)	566
Late Onset Drinkers	394 (20.8%)	277 (24.6%)	54 (2.8%)	5 (0.3%)	4 (0.2%)	734
Middle Onset Drinkers	29 (1.5%)	75 (4.0%)	44 (2.3%)	1 (0.1%)	29 (1.5%)	178
Moderate Drinkers	49 (2.6%)	125 (6.6%)	33 (1.7%)	63 (3.3%)	42 (2.2%)	312
Early High Drinkers	4 (0.2%)	9 (0.5%)	5 (0.3%)	35 (1.8%)	54 (2.8%)	107
Total	1014	507	139	105	132	1897

### **Differences Among the Trajectory Groups on Risk Factors**

Using ANOVA and planned contrasts, we next tested whether trajectory groups differed from each other on the risk factors we described above at the spring of 5<sup>th</sup> grade assessment, i.e., at the start of the trajectory period. This was carried out for drinking frequency and drinking problems trajectory groups separately. Results are presented in Table 6.

Table 6. Wave One Contrasts

Drinking Frequency Contrasts (t)						
	Contrast 1 (Non-Drinkers v. Early High)	Contrast 2 (Non-Drinkers v. Late onset)	Contrast 3 (Non-Drinkers v. Middle onset)	Contrast 4 (Non-Drinkers v. Moderate Drinkers)	Contrast 5 (Late Onset v. Middle Onset)	Contrast 6 (Moderate v. Early High Drinkers)
Urgency	-8.53**	-3.51**	-5.25**	-9.36**	-3.05**	-2.13*
Sensation Seeking	-7.46**	-2.61**	-4.07**	-6.29**	-2.44*	-3.06**
Lack of Planning	-7.11**	-5.15**	-4.46**	-10.0**	-1.13	-.37
Lack of Perseverance	-2.02*	-.93	.14	-4.93**	.77	1.21
Positive Social Expectancy	-7.22**	-2.37*	-3.14**	-7.07**	-1.65	-2.34*
Wild & Crazy Expectancy	-4.60**	-2.15*	-1.72	-1.40	-.33	-3.44**
Positive Affect	-.64	.03	.28	3.91**	.27	-3.06**
Negative Affect	-2.08*	-.47	-.67	-1.76	-.38	-.85
Puberty ( $\chi^2$ )	51.24**	18.83**	8.50**	35.03**	.01	5.82*
Sex ( $\chi^2$ )	.02	.38	7.29**	1.17	5.61*	.69
Drinking Problems Contrasts (t)						
	Contrast 1 (No Problems v. Early Onset Problems)	Contrast 2 (No Problems v. Late Onset Problems)	Contrast 3 (No Problems v. High Late-Onset Problems)	Contrast 4 (No Problems v. Moderate Problems)	Contrast 5 (Low Late-Onset v. High Late-Onset Problems)	Contrast 6 (Moderate Problems v. Early Onset Problems)
Urgency	-7.25**	-8.22**	-4.03**	-10.60**	.87	3.20**
Sensation Seeking	-3.81**	-3.62**	-4.57**	-4.34**	-2.26*	.70
Lack of Planning	-6.63**	-5.82**	-3.20**	-8.20**	.28	1.74
Lack of Perseverance	-4.13**	-3.07**	-1.54	-3.39**	.29	-.27
Positive Social Expectancy	-4.98**	-4.97**	-3.28**	-9.90**	-.28	4.24**
Wild & Crazy Expectancy	-3.46**	-2.24*	-1.87	-2.45*	-.50	-.53
Positive Affect	1.28	2.45*	.11	2.14*	-1.28	-.77
Negative Affect	-1.34	-2.63**	-.68	-4.12**	.85	2.29*
Puberty ( $\chi^2$ )	17.18**	12.52**	6.81**	41.58**	.13	3.23
Sex ( $\chi^2$ )	.11	.30	.00	.98	.06	.29

Note. \* =  $p < .05$ , \*\* =  $p < .01$

## **Drinking Frequency**

*Non-drinkers v. drinking groups.* First we conducted a planned contrast comparing the non-drinker trajectory group to the average of all drinking trajectory groups. Youth who did not engage in any drinking behavior over the five-year time period exhibited significantly lower levels of lack of planning, sensation seeking, urgency; lower endorsement of the expectancy that alcohol facilitates positive social experiences; and were less likely to have experienced early puberty (Table 6).

We next made a series of comparisons between those in the non-drinking group and members of other, specific trajectory groups: (1) compared to the non-drinking group, the early high drinking group were more likely to lack perseverance and to experience negative affect, and more strongly endorsed the expectancy that drinking alcohol leads to wild and crazy behavior. (2) Youth in the late onset drinking trajectory group more strongly endorsed the wild and crazy alcohol expectancy. (3) Moderate drinkers tended to experience less positive affect and tended to lack perseverance, when compared to the non-drinking trajectory group.

*Middle onset v. Late onset groups.* As shown in Figure 1, youth in these groups are nearly identical through wave 3 (spring of 6<sup>th</sup> grade). We therefore examined if risk factors at wave 1 (spring of 5<sup>th</sup> grade) could differentiate the two groups before either began to drink. Youth in the middle onset group had higher levels of sensation seeking and urgency than youth in the late onset group. There were no significant differences between these groups on any other risk factors.

*Moderate v early high groups.* Individuals in both of these groups exhibit drinking behavior by wave 1 (spring of 5<sup>th</sup> grade) and steady increases in drinking

frequency throughout the five-year period, with individuals in the early high group consistently reporting more drinking (Figure 1). We examined if risk factors measured at wave 1 could differentiate between the two groups. The two groups differed in all three categories of risk factors. Interestingly, the early-high drinking trajectory group, in addition to reporting higher levels of sensation seeking and urgency, also reported experiencing higher levels of positive affect. With respect to psychosocial learning, the early-high drinking group had higher endorsement of the expectancy that alcohol facilitates a positive social experience and the expectancy that alcohol results in wild and crazy behavior. This group was also more likely to have experienced early pubertal onset.

### **Drinking Problems**

*No problems v. all other groups.* The no problems trajectory group was compared to the average of all other drinking problems trajectory groups. Youth who did not endorse any problems related to drinking alcohol over the five-year time period exhibited significantly lower levels of lack of planning, sensation seeking, urgency, and lower endorsement of the expectancy that alcohol facilitates positive social experiences (Table 6). Additionally, youth in the no problems trajectory were less likely than youth in all other trajectory groups to have undergone early puberty (Table 6).

We next conducted a series of comparisons between the no-problem group and other, specific trajectory groups. (1) Youth in the early onset problems group were more likely to lack perseverance and to endorse the expectancy that drinking alcohol leads to wild and crazy behavior. (2) Youth in the low late-onset onset problems trajectory group were more likely to lack perseverance, more strongly endorsed the wild and crazy alcohol expectancy, had higher levels of negative affect, and lower levels of positive affect. (3)

Similarly, youth in the moderate problems group tended to lack perseverance, more strongly endorsed the wild and crazy alcohol expectancy, had higher levels of negative affect, and lower levels of positive affect.

***Low late onset v high late onset problems groups.*** As shown in Figure 2, youth in these groups are nearly identical through wave 7 (spring of 8<sup>th</sup> grade) with the high late-onset group experiencing a dramatic increase in alcohol problems through waves 8 and 9 relative to the low late-onset group. We therefore examined if risk factors at wave 1 (spring of 5<sup>th</sup> grade) could differentiate the two groups before either began to endorse problems related to drinking alcohol. One significant contrast emerged. Youth in the high late-onset group had higher levels of sensation seeking than youth in the low late-onset group.

***Moderate problems v early onset problems.*** Individuals in these two groups endorsed the highest number of alcohol problems on average throughout the five-year period (Figure 2). We therefore examined if risk factors measured at wave 1 could differentiate between the two groups. Those in the early onset problems group were at elevated risk compared to those in the moderate problems group on three dimensions: higher levels of both negative affect and urgency, and more likely to endorse the expectancy that alcohol facilitates a positive social experience.



### **Incremental Validity of Risk Factors**

In addition to planned contrasts between trajectory groups on risk factors, we entered all predictors into a binary logistic regression model to identify which risk factors predicted trajectory group membership above and beyond others. This was done separately for drinking frequency and drinking problems trajectory groups. Results are presented below in Table 7.

Table 7. Incremental Validity of Predictors of Trajectory Group Membership

Drinking Frequency						
	Contrast 1 (Non-Drinkers v. Early High)	Contrast 2 (Non-Drinkers v. High-school onset)	Contrast 3 (Non-Drinkers v. Middle-school onset)	Contrast 4 (Non-Drinkers v. Moderate Drinkers)	Contrast 5 (High-school Onset v. Middle-school Onset)	Contrast 6 (Moderate v. Early High Drinkers)
Urgency	1.43**	1.07	1.27**	1.39**	1.19*	1.03
Sensation Seeking	2.52**	1.10	1.32	1.71**	1.24	1.60*
Lack of Planning	1.92*	1.74**	1.79**	1.95**	1.02	.90
Lack of Perseverance	1.91*	1.02	.94	2.04**	.92	1.30
Positive Social Expectancy	2.73**	1.20	1.54	2.27**	1.37	1.28
Wild & Crazy Expectancy	1.62	1.23	1.08	1.08	.98	1.86*
Positive Affect	.98	1.05	.99	.82	.93	1.52*
Negative Affect	.80	.94	.85	.82	.92	1.12
Puberty	3.63**	1.77**	1.78*	2.26**	.89	1.63*
Sex	.99	.94	.64*	1.06	.65*	.79
Drinking Problems						
	Contrast 1 (No Problems v. Early Onset Problems)	Contrast 2 (No Problems v. Low Late-Onset Problems)	Contrast 3 (No Problems v. High Late-Onset Problems)	Contrast 4 (No Problems v. Moderate Problems)	Contrast 5 (Low Late-Onset High Late-Onset Problems)	Contrast 6 (Moderate Problems v. Early Onset Problems)
Urgency	1.50**	1.35**	1.20*	.59**	.89	.86
Sensation Seeking	1.50*	1.20*	1.73**	.20	1.50*	.95
Lack of Planning	1.41	1.18	1.11	.59*	.95	.84
Lack of Perseverance	2.52**	1.57**	1.75*	.59*	1.24	1.14
Positive Social Expectancy	2.13**	1.61**	1.69*	1.48**	1.06	.40**
Wild & Crazy Expectancy	1.59*	1.20	1.29	.09	1.10	1.49
Positive Affect	1.05	.90	1.02	-.08	1.13	1.00
Negative Affect	.82	.95	.92	.08	.96	.79
Puberty	1.84**	1.48**	1.58*	.95**	1.10	.75
Sex	.99	.92	.95	.12	1.00	.90

Note. \* =  $p < .05$ , \*\* =  $p < .01$

## **Drinking Frequency**

*Non-drinkers v. drinking groups.* Compared to the non-drinking group, members of the early high drinking group were more likely to report higher levels of urgency, sensation seeking, lack of planning and lack of perseverance; more strongly endorse the expectancy that drinking alcohol leads to wild and crazy behavior; and to have experienced early pubertal onset. Youth in the late onset drinking trajectory group were higher in lack of planning and were also more likely to have experienced early pubertal onset when compared to non-drinkers. Middle onset drinkers were more likely to report higher levels of urgency and lack of planning, and to have experienced early pubertal onset than non-drinkers. Finally, moderate drinkers tended to report higher levels of urgency, sensation seeking, lack of planning, lack of perseverance; to more strongly endorse the expectancy that alcohol consumption facilitates positive social experiences; and to have experienced early pubertal onset, when compared to the non-drinking trajectory group.

*Middle onset v. Late onset groups.* As shown in Figure 1, youth in these groups are nearly identical through wave 3 (spring of 6th grade), so we tested whether risk factors measured at wave 1 (spring of 5th grade) could differentiate the two groups before either began to drink. Youth in the middle onset group had higher levels of urgency than youth in the late onset group. There were no significant differences between these groups on any other risk factors.

*Moderate v early high groups.* Individuals in both of these groups exhibit drinking behavior by wave 1 (spring of 5th grade) and steady increases in drinking frequency throughout the five-year period, with individuals in the early high group

consistently reporting more drinking (Figure 1). We examined if risk factors measured at wave 1 could differentiate between the two groups. The early-high drinking trajectory group reported higher levels of sensation seeking and positive affect. With respect to psychosocial learning, the early-high drinking group had higher endorsement of the expectancy that alcohol consumption results in wild and crazy behavior. This group was also more likely to have experienced early pubertal onset.

### **Drinking Problems**

*No problems v. all other groups.* When compared to youth endorsing no problems related to alcohol consumption, youth in the early onset problems group were higher on urgency, sensation seeking, and lack of perseverance; more likely to endorse the expectancy that alcohol consumption facilitates positive social experiences and the expectancy that alcohol consumption leads to wild and crazy behavior; and to have experienced early pubertal onset. Youth in the low late-onset problems trajectory group were more likely to lack perseverance, more strongly endorsed the positive social alcohol expectancy, and had higher levels of urgency and sensation seeking. Youth in the moderate problems group tended to lack perseverance and planning, more strongly endorsed the positive social alcohol expectancy, had higher levels of urgency, and were more likely to have experienced early pubertal onset.

*Low late onset v high late onset problems groups.* As shown in Figure 2, youth in these groups are nearly identical through wave 7 (spring of 8th grade) with the high late-onset group experiencing a dramatic increase in alcohol problems through waves 8 and 9 relative to the low late-onset group. We therefore examined if risk factors at wave 1 (spring of 5th grade) could differentiate the two groups before either began to endorse

problems related to drinking alcohol. One predictor was significant above others. Youth in the high late-onset group had higher levels of sensation seeking than youth in the low late-onset group.

*Moderate problems v early onset problems.* Individuals in these two groups endorsed the highest number of alcohol problems on average throughout the five-year period (Figure 2). We therefore examined if risk factors measured at wave 1 could differentiate between the two groups. Those in the moderate problems group were more likely to endorse the positive social alcohol expectancy.

### **Discussion**

This work is an important expansion of prior research into developmental drinking trajectories utilizing a sample of youth spanning the ages of 11 to 16. This study builds upon the work of others in the establishment and characterization of development trajectories of drinking behavior (Chassin et al., 2002; Derefinko et al., in press; Hill et al., 2000). We focused on trajectories of drinking frequency as it serves as a marker of concurrent and future dysfunction (Chung et al., 2012; DeWit et al., 2000; Grant & Dawson, 1997; Guttmanova et al., 2012; Jessor, 1987). We also examined trajectories of drinking-related problems to determine patterns in the emergence and severity of consequences related to alcohol consumption. We identified five developmental trajectory pathways for drinking frequency and five for problems related to the consumption of alcohol. These are similar to the trajectories established and characterized by others for samples of different ages or for trajectories of binge drinking (Chassin et al., 2002; Hill et al., 2000; Derefinko et al., in press; Warner, White & Johnson, 2007). Importantly, these findings indicate that there exists considerable variability among youth

in their engagement in drinking and the development of drinking-related problems. An implication of these findings is that early adolescent and youth risk research utilizing non-trajectory analytic methods (i.e. regression, structural equation modeling, etc.) is perhaps better understood as research into general trends of the sample that collapse across meaningful variability among children.

Perhaps the most striking findings of the current study were that, for both drinking frequency and drinking problems trajectory groups, risk factors measured in elementary school could differentiate between trajectory groups before drinking behavior or drinking-related problems were present. Specifically, urgency, sensation seeking, lack of planning, endorsement of the expectancy that alcohol facilitates positive social experiences, and early pubertal onset all differentiated between youth who subsequently did, or did not, begin drinking and experiencing drinking problems over time.

Each of these risk factors can be helpful in the identification of youth who are at risk of developing problematic drinking habits; however, urgency and sensation seeking seem critically important in distinguishing between drinking that is more normative and drinking that is problematic. Youth in the middle onset and early high drinking groups saw relatively considerable increases in their drinking frequency over the course of the study, likely reflecting a level of drinking that is non-normative. These groups can be differentiated from other groups whose drinking behavior is more normative (i.e. late onset or nondrinkers) by their a priori levels of urgency and sensation seeking. Other groups that reflect perhaps a more normative style of drinking (i.e., late onset drinkers), can be distinguished by other risk factors such as lack of planning. Similar patterns can be seen for trajectories of drinking-related problems. Therefore, it seems that prevention

and intervention efforts focused on reducing problematic, non-normative drinking should target tendencies to act rashly when highly emotional and seek out thrilling stimuli.

For groups that had already begun drinking by the fifth grade assessment, interesting patterns emerged in the risk factors differentiating these groups. Youth in the early-high drinking group, as compared to youth in the moderate drinking group, were higher on sensation seeking, positive affect, and endorsement of the expectancy that alcohol consumption leads to wild and crazy behavior and facilitates positive social interactions. This suggests a potential characterization of youth in the early high group as “partiers,” who engage in a high amount of drinking because it is seen as an exciting, celebratory activity. Both groups seem to experience the higher levels of problems related to drinking than groups that did not engage in alcohol consumption until later in the data collection.

Also of note is the covariation between drinking frequency and drinking problems trajectory groups. On the whole, individuals in trajectory groups characterized by moderate or increasing problems were also engaging in the most drinking or increased drinking over time, and vice versa. Thus, higher levels of drinking frequency in youth appear to be accompanied by a higher number of problems related to alcohol consumption, making drinking at higher levels seemingly more maladaptive and dysfunctional.

These findings suggest several areas for intervention and prevention efforts. Trajectory analysis and comparison on risk factors has not only shown that youth progress along different pathways of alcohol consumption, but has allowed us to differentiate between youth at varying levels of risk for non-normative and potentially

problematic pathways of drinking. Screening youth on risk factors related to impulsivity, early pubertal onset, and learned expectancies about the reinforcing effects of alcohol can give insight into more targeted and cost-effective prevention and intervention efforts.

The findings of this study should be viewed in the context of the study's limitations. First, we did not model variability among youth who are members of the same trajectory group. Second, though there were relatively low attrition rates, we cannot know whether the results would have differed with even higher retention. Third, all risk-factor and drinking behavior reporting was assessed by questionnaire and was not supplemented by interview data. Fourth, we did not assess the context of the drinking behavior.

In sum, the present findings provide clear support for different developmental trajectories of alcohol consumption and drinking-related problems in youth as they transition from late elementary school through middle school and into high school. Membership in trajectory groups was predictable from impulsogenic personality traits and psychosocial learning characteristics of youth when they were in 5<sup>th</sup> grade, as well as early pubertal onset. These findings can help inform researchers and clinicians about the different ways in which youth engage in the consumption of alcohol and the different problems they come to face, which may inform theories of etiology as well as intervention efforts.



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## VITA

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## **PUBLICATIONS**

Riley, E.N., **Peterson, S.J.**, & Smith, G.T. (in press). Towards a developmentally integrative model of personality change: A focus on three potential mechanisms. Invited chapter in N. Columbus (Ed.), *Advances in Psychological Research*. Volume 115.

**Peterson, S. J.** & Smith, G. T. (in press). Application of the expectancy concept to substance use. Invited chapter in S. A. Brown and R. A. Zucker (Eds.), *Oxford Handbook of Adolescent Substance Abuse*.

Davis, H. A., **Peterson, S. J.**, & Smith, G. T. (in press). Assessment. Invited chapter in A. E. Wenzel (Ed.), *The Sage Encyclopedia of Abnormal and Clinical Psychology*. Sage Publications, Thousand Oaks, CA.

**Peterson, S. J.**, Van Tongeren, D. R., Womack, S. D., Hook, J. N., Davis, D. E., & Griffin, B. J. (2017). The benefits of self-forgiveness on mental health: Evidence from correlational and experimental research. *The Journal of Positive Psychology*, *12*(2), 159-168.

### CONFERENCE POSTER PRESENTATIONS

**Peterson, S. J.** & Smith, G. T. (accepted for 2017, June). *On the validity of negative urgency*. A poster presented at the annual meeting of the Research Society on Alcoholism, Denver, CO.

**Peterson, S. J.** & Smith, G. T. (accepted for 2017, June). *Elementary school youth characteristics predict developmental trajectories of drinking behavior*. A poster presented at the annual meeting of the Research Society on Alcoholism, Denver, CO.

**Peterson, S. J.** & Smith, G. T. (2016, June). *Personality and learning transact to predict early onset drinking behavior*. A poster presented at the annual meeting of the Research Society on Alcoholism, New Orleans, LA.

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