Published in final edited form as:

Dev Psychol. 2018 February ; 54(2): 281–292. doi:10.1037/dev0000430.

Developmental Relations between Alcohol Expectancies and Social Norms in predicting Alcohol Onset

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Abstract

Expectations about alcohol's effects and perceptions of peers' behaviors and beliefs related to alcohol use are each shown to strongly influence the timing of drinking onset during adolescence. The present study builds on prior work by examining the conjoint effects of within-person changes in these social-cognitive factors on age of adolescent drinking onset. We related youths' alcohol status (i.e., alcohol-naïve, initiation during study, prior initiation) to increases in positive and negative alcohol expectancies (AOEs), as well as increases in perceived peer/close friend alcohol use and acceptance, during adolescence. We also investigated whether changes in AOEs and perceived social norms prospectively predicted alcohol onset in alcohol-naïve adolescents. Participants were 1,023 adolescents aged 12.2 years on average at enrollment ($SD=0.98$), 52% female, participating in an ongoing longitudinal survey on substance use and health behaviors. Positive AOEs, close friends' norms, and same-age peer norms increased linearly, whereas negative AOEs decreased linearly. Changes were attenuated for participants who remained alcohol-naïve and increased for participants who experienced initiation during the study. Furthermore, we found associations between individual changes in AOEs and perceived social norms. Finally, survival models revealed that onset of alcohol use was prospectively predicted by stronger initial positive AOEs, as well as increases in close friends' norms and decreases in negative AOEs over time. These findings emphasize co-development of AOEs and perceived social norms, coinciding with, and predictive of, onset of alcohol use, and point toward a unique role for within-individual changes in identifying youth at risk for early onset of alcohol use.

Keywords

alcohol; expectancies; onset; initiation; social norms; descriptive norms

Alcohol use typically onsets and escalates dramatically during adolescence (Johnston, 2013). In conjunction with increasing alcohol use, adolescence is a developmental period characterized by increased social interaction, greater emphasis on peer acceptance, and shifting expectations about the likely effects of alcohol use (Masten, Faden, Zucker, & Spear, 2009). Considerable research and theory suggests that impressions of peer alcohol-use behaviors and beliefs (i.e., social norms) and expectations for likely outcomes of drinking (i.e., expectancies) change significantly during this timeframe in ways that may

contribute to heavier drinking patterns (Brown, Creamer, & Stetson, 1987; Jester et al., 2015). However, associations between changes in these well-recognized influences on drinking and the conjoint influence of changes in peer norms and expectancies on alcohol-use initiation and escalation during the critical period of adolescence are largely unstudied. A promising approach to advancing theory and preventing increasing problem drinking during adolescence is to address the issue as a developmental process influenced by typical changes in alcohol-use behaviors and beliefs. In the present study of adolescents, we test developmentally informed hypotheses about the associations of adolescent alcohol use, expectancies, and social norms to deepen understanding of the multifaceted processes in early adolescence that lay the groundwork for later problem drinking.

Alcohol outcome expectancies (AOEs) are cognitive representations of an individual's learning about the likely consequences of alcohol consumption, both positive and negative (see Treloar, Pedersen, & McCarthy, 2016, for a review). Studies support a developmental interplay between alcohol use and expectancies, such that expectancies form prior to any direct alcohol use through social modeling (Lang & Stritzke, 1993; Zucker, Donovan, Masten, Mattson, & Moss, 2008) but also change over time with increasing drinking experience (Christiansen, Goldman, & Inn, 1982; Jester et al., 2015; Smith, Goldman, Greenbaum, & Christiansen, 1995). Studies examining differences in expectancies in different age groups (Schell, Martino, Ellickson, Collins, & McCaffrey, 2005) have shown that younger adolescents tend to hold more negative expectancies and fewer positive expectancies, compared to older adolescents. Studies investigating the development of expectancies within the individual over time find normative shifts in expectancies from predominately negative to positive during early adolescence (Dunn & Goldman, 1998, 2000; Miller, Smith, & Goldman, 1990). These shifts are important because positive expectancies, such as enhanced sociability, are associated with greater intentions to drink, earlier drinking onset, and increased drinking levels both cross-sectionally (Cameron, Stritzke, & Durkin, 2003; Christiansen et al., 1982), and prospectively (Christiansen, Smith, Roehling, & Goldman, 1989; Jester et al., 2015; Patrick, Wray-Lake, Finlay, & Maggs, 2010). Conversely, it has been shown that negative expectancies, such as the belief that consuming alcohol will make one feel sick, are associated with lower intentions to drink (Zamboanga, Ham, Van Tyne, & Pole, 2011) as well as relatively lower levels of alcohol use in social drinkers (Chen, Grube, & Madden, 1994; Lee, Greely, & Oei, 1999). Aside from age-related changes to AOE, changes to AOE have also been documented as a consequence of drinking (Jester et al., 2015). It remains important, however, to disambiguate changes to AOE as a consequence of drinking onset from changes to AOE as a consequence of aging.

An equally rich body of literature shows that perceived social norms are some of the strongest predictors of substance use among adolescents, who are especially sensitive to social perceptions of their peers (D'Amico & McCarthy, 2006; Kelly et al., 2012; Trucco, Colder, & Wiczorek, 2011). Descriptive norms refer to perceptions of others' drinking behavior, such as how often they consume alcohol, while injunctive norms refer to perceptions of others' approval of alcohol use. Favorable injunctive and descriptive norms are both linked to increased individual alcohol use (Brooks-Russell, Simons-Morton, Haynie, Farhat, & Wang, 2014), and adolescent peer norms have been shown to be more alcohol-favorable among older adolescents than among younger adolescents (Brooks-

Russell et al., 2014). However, these studies report between-person age differences in perceived social norms, being in many cases cross-sectional (Beck & Treiman, 1996; Hildebrand et al., 2013). Prospective studies often predict changes in alcohol use using a single earlier assessment of perceived social norms (Mahlik et al., 2015; Eisenberg et al., 2014; Zehe et al., 2013). In one exception, Hong et al. (2013) demonstrated that the effect of both descriptive and injunctive peer norms on alcohol increased over time, across repeated assessments in 9th and 12th grade (approximately ages 15 – 18 years). Identifying finer-grained within-person changes in perceived social norms across adolescence, examining whether these changes vary along the spectrum of alcohol involvement or naiveté, and, further investigating how changes in perceived social norms may relate to changes in expectancies, are the next steps to understanding the developmental interplay of these social-cognitive factors and alcohol onset in youth.

Social cognitive theory (Bandura, 1986) highlights both environmental and cognitive influences on behavior. This theory suggest that both perceived norms and alcohol expectancies, which may be learned from the environment (either via personal experience or observation), represent personal, cognitive factors that may directly influence behavior. SCT also posits the notion of reciprocal determinism, which holds that individual behavior can influence cognitions (norms, expectancies) as much as it may be influenced by them. In other words, it appears likely that individual changes in AOE and perceived norms would travel together over time. If youth increasingly perceive that their peers are using and approving of alcohol, they may also increasingly perceive that alcohol comes with more benefits and fewer costs. Among college students, AOE and perceived social norms have been shown to uniquely predict alcohol use over time when controlling for the other (Wardell & Read, 2013). However, previous studies have not yet accounted for individual changes over time for AOE and social norms in tandem. Thus, there is a need for research that moves beyond testing predictors or outcomes of age-related change in these processes to modeling co-occurring processes of change at the within-person level.

The current study is intended to investigate the joint development of positive and negative alcohol outcome expectancies and perceived social norms in the prediction of onset of alcohol use in adolescents, arguably the developmental period during which these processes matter most. We evaluated the following hypotheses: 1) Differential change in the development of AOE and perceived social norms will be related to alcohol involvement prior to and during the study, such that increases in alcohol-positive expectancies and decreases in alcohol-negative expectancies, as well as increases in perceived peer/close friend alcohol use and acceptance, will be less pronounced in alcohol-naïve participants than in those who experience alcohol use onset. 2) We expect that changes in AOE and norms will be associated with each other, such that both stronger initial positive AOE, and greater increases in positive AOE over time, will be associated with higher initial levels of, and greater increases in, perceived social norms. For negative AOE, we expect weaker initial negative AOE, and greater decreases in negative AOE over time, will be associated with higher initial levels of, and greater increases in, perceived social norms. 3) In alcohol-naïve participants, we expect that initial levels of and changes in AOE and perceived social norms in early adolescence will each prospectively predict the hazard of onset of alcohol use. Specifically, we expect that higher initial levels of and greater increases in perceived social

norms as well as stronger initial levels of and greater increases in positive alcohol expectancies will predict greater odds of onset of alcohol use. Further, we expect that lower initial levels of and greater decreases in negative alcohol expectancies will predict higher hazard of onset of alcohol use.

Method

Participants

The study used data from adolescents in an ongoing prospective study of alcohol initiation and progression (see Jackson et al., 2014; Jackson, Colby, Barnett, & Abar, 2015). Early adolescents were recruited in five school cohorts from six schools in urban, suburban, and rural Rhode Island. The full parent study sample consisted of 1,023 6th, 7th, and 8th graders (33%; 32%; 35%, respectively; enrollment age 12.2 years on average (SD: 0.98), 52% female, 24% non-White, and 12% Hispanic. In all but two schools, in our sample contained fewer Caucasians than the school population from which it was drawn, and contained more Hispanic students in two of the schools. In terms of the students' socio-economic status, students receiving subsidized lunch were well represented in three of the five schools but underrepresented in the remaining two, suggesting that our sample is more racially diverse but less disadvantaged than the school populations from which the samples originated (Jackson et al., 2015; <http://infoworks.ride.ri.gov/>).

Procedure

Study information and consent forms were distributed to students by faculty as well as mailed to each student's home address based on the school roster; students were incentivized to return completed consent forms (regardless of whether parental consent was given). Thirty-eight percent of students returned a consent form (65% of which allowed for participation), and 88% of these individuals were enrolled into the study. Participants attended a two-hour in-person group orientation session that provided information about the study protocol and compensation and protections to ensure privacy, defined standard drink measurements, and collected student assent and detailed contact information. Participants also completed a 45-minute computerized baseline survey at this time (Wave 1).

Follow-up assessments were conducted using web-based surveys, which could be completed from any location. Participants completed five semi-annual surveys and a sixth survey one year later (three-year interval), followed by a series of quarterly surveys completed in high school (study design was modified at the point of re-funding by NIH). Data from the first five quarterly surveys are included in the present study, although quarterly data collection is ongoing. Thus, four years of data were used for data analysis but because follow-up surveys varied in timing across participants as a function of school cohort and grade at enrollment, survey data was re-coded based on age of participants at the time of assessment (See Analysis Strategy and Supplementary Materials). Students were compensated with a \$25 shopping mall gift card for the orientation session/baseline survey and a \$20 mall gift card for each follow-up survey completed.

Response rates for a given survey ranged from 92% to 79% with 992 respondents (97% of the full sample) contributing follow-up data within the 4-year follow-up interval. Those who failed to complete any follow-up survey were more likely to be male (odds ratio, OR = 2.65; $p < .05$) and Black (OR = 5.84; $p < .01$), but were not more or less likely to sip alcohol or consume a full drink, and did not differ by age. The Brown University Institutional Review Board approved all project procedures.

Measures

Alcohol Status and Onset—At each wave of the study, onset of full drink was assessed with the item, “Have you ever had a full drink of alcohol?”, not including consumption as part of a religious service. We created two variables: one, *alcohol status*, reflecting whether participants were (1) alcohol-naïve, (2) became alcohol-involved over the course of the study (i.e., the period of AOE and social norms assessment), or (3) had prior alcohol experience (consumed a full drink of alcohol prior to study enrollment). Additionally, we created an *alcohol onset* variable reflecting onset for each half-year increase in age. A value of 0 was used to signal no event, and a value of 1 was used to signal the occurrence of an onset event, while missing data indicated that no data was recorded or that onset had occurred at a previous time point (Singer & Willett, 2003).

Positive and Negative Alcohol Outcome Expectancies (AOEs)—At each wave of the study, we assessed positive (10 items; mean $\alpha = .91$ over 6 waves) and negative (13 items; mean $\alpha = .97$ over 6 waves) AOEs including affective, cognitive, and behavioral effects of alcohol use based on a scale adapted from Schell et al. (2005) to be more applicable or understandable to younger respondents. Items were preceded by the question: “How likely is it that the following things would happen to people your age if they had one or more drinks of alcohol?” Sample items are “have fun; feel relaxed” for positive expectancies and “get into fights; say things they wish they hadn’t said” for negative expectancies. Response options ranged from very unlikely (1) to very likely (4). We used mean scores on positive and negative items to calculate positive and negative AOE variables respectively.

Perceived Social Norms—At each wave of the study, both same-age peer norms and close friends’ norms were assessed.

Same-age peer norms: Descriptive norms were assessed with four items taken from a measure of perceived norms developed for college students by Wood and colleagues (2001) but adapted to reflect middle/high school age (e.g., 6th grade). School-year frequency was assessed by the question “How often do you think the typical [age]-year [gender] drinks alcohol?” (with appropriate age and gender custom programmed for each respondent) with scoring options ranging from “They don’t drink”, “1–5 times a year”, “6–11 times a year”, “About once a month”, “2–3 times a month”, “once or twice a week”, “3–4 times a week”, “Nearly every day”, “Every day”, to “Twice a day or more”. School-year quantity was assessed with an open-ended request for a whole number per occasion. School-year heavy episodic drinking was assessed by the question “In a typical month during the school year, how many times do you think that the typical [age]-year [gender] usually has three or more

drinks in a row?” and summer-time heavy episodic drinking was assessed with the question “In a typical month during the summer, how many times do you think that the typical [age]-year [gender] usually has three or more drinks in a row?”, with response options for “None”, “Once”, “Twice”, “Three to five times”, “Six to nine times”, and “Ten or more times”. We calculated the factor scores on a single factor based on these four items, invariant across time, to indicate scores on same-age peer norms, while using the sum of the four items for illustration on figures ($\alpha = .78$).

Close friends’ norms: The Peer Passive Social Influence questionnaire (Wood, Read, Mitchell, & Brand, 2004) was used to assess close friends’ norms, including two items assessing injunctive norms (“How do most of your close friends feel about kids your age drinking alcohol?”, “How do most of your close friends feel about kids your age getting drunk?”) and one item assessing descriptive norms (“When your close friends drink, how much on average does each person drink at a sitting?”). Response options ranged from strongly disapprove (1) to strongly approve (5) for injunctive norms, and included “They don’t drink”, “1 drink”, “2 drinks”, “3 drinks”, and “More than 3 drinks” for descriptive norms. We calculated the factor scores on a single factor based on these three items, invariant across time, to indicate scores on close friends’ norms although for illustration on figures, we calculated the mean of these three items to indicate scores on close friends’ norms ($\alpha = .79$).

Analysis Strategy

To address developmental change, our analytic models used age-distributed data ranging from ages 11.5 years to 18.5 years at half-year intervals. For example, age 11.5 is modeled as the first time point, age 12 as the second, age 12.5 as the third, and so on. For details on the transposition of data from wave to age, see Supplementary Materials. Data analysis for Hypotheses 1 and 2 used AOE and norms data from ages 11.5 – 16.5 years. Data analysis for Hypothesis 3 used AOE and norms data from ages 11.5 – 14.5 years, and alcohol onset data from ages 15.0 – 18.5 years.

For each of our hypotheses, we examined results from latent growth models (LGM, Bollen & Curran, 2006). LGMs model the trajectory of development of a process within an individual. The use of such models lies in being able to relate the individual change in a developmental process to relevant outcomes (Chassin, Sher, Hussong, & Curran, 2013). For our constructs, this process yields means and variances of expectancies and norms in terms of initial levels and change (increases/decreases). The means of linear slopes represent the estimated group-mean rate of change for every 6 months of time, whereas the latent factor score represents the individual deviation from that group mean. We compared unconditional model fit of LGMs representing either only the Intercept (model-estimated initial level at age 11.5 years), or Intercept and Slope (linear change over time), or Intercept, Slope, and Quadratic (exponential change over time) factors of change in AOE and perceived social norms. We determined fit of these models using omnibus fit statistics (Bollen & Curran, 2006). Additionally, we evaluated whether there was significant within-person variance in growth factors being represented by the latent factors.

To test whether differences in the development of AOE and perceived social norms were dependent on alcohol involvement prior to and during the study (Hypothesis 1), we modeled AOE and perceived social norms separately for each of the three *alcohol statuses* (*naïve*, *onsetter*, *prior drinker*), evaluating whether model fit was superior when assuming latent factors were identical between groups or when allowing latent factors to be freely estimated for each group. Given good model fit, we determined whether estimated slopes were significantly different across *alcohol status* by regressing two dummy coded variables on the estimated slopes. The reference group for the dummy code was altered to represent differences between each of the three *alcohol statuses*, thus permitting pairwise comparisons.

To test whether changes in AOE and norms were associated with each other (Hypothesis 2), we estimated a structural model representing four simultaneous growth processes represented by latent growth factors representing AOE (positive and negative) and social norms (peer and close friend), to examine whether between-person differences in these within-person growth factors were significantly associated with each other. We examined whether significant associations exist between the estimated slopes for AOE and perceived social norms, controlling for the autoregressive correlation between intercepts and their corresponding slopes within each growth process. For interpretation, it is important to understand that individual estimated scores on the slope factors indicate between-person differences relative to the estimated sample mean of within-person growth over time.

To test whether initial levels of, and changes in, perceived social norms and AOE were associated with the hazard of onset of alcohol use (Hypothesis 3), we estimated growth factors representing AOE and perceived social norms during ages 11.5 to 14.5 years. We selected participants who were alcohol-naïve up to and including this early range, to ensure that individual changes over time were purely predictors of, and not the consequence of, alcohol use onset. Using these factors as predictors, we predicted *alcohol onset* using discrete-time survival modeling (Singer & Willett, 2003). Using this approach, we consider the occurrence of a single non-repeatable event (here: *alcohol onset*) based on information from a range of time points (range: data from ages 15 to 18.5 years). In this analysis, the hazard of event occurrence, given that the event did not occur at the previous time point, is estimated based on the observed ages of onset or censoring. To ensure the assumption of proportional hazards was met, we examined relations between the outcome and growth factors. This involves creating a product term of time $\times$ predictor, and including this product term in multivariate prediction of the outcome. If the product term is significant, the assumption of proportional hazards is violated. Equally, we investigated whether growth factors interacted with gender.

Results

Demographics

Table 1 contains descriptive statistics on demographic variables, alcohol initiation and attrition over the course of the study. Indications of alcohol onset (based on having consumed a full drink of alcohol) increased from 7.7% at Time 1 to 45.7% at Time 7 (across 4 years).

Hypothesis 1: Changes in Norms and AOE based on Alcohol Status

The associations with *alcohol status* were evaluated by comparing individual growth factor structures for each *alcohol status* group to the other respective *alcohol status* groups. Table 2 contains results and fit statistics from overall unconditional growth models for AOE and perceived social norms. Figures 1 and 2 show means, standard deviations and superimposed latent trends for change in AOE and perceived social norms, respectively. As Table 2 shows, there was superior model fit for models representing intercept and slope, relative to an intercept-only model, for both positive and negative AOE. Models of AOE including a quadratic component did not converge for positive AOE, and did not capture significant variance for negative AOE. Therefore, we determined that LGMs including an intercept and slope represent the optimal model for positive and negative AOE. For perceived social norms, unconditional fit statistics indicated superior fit of a model including a quadratic component for changes in both close friends' norms and same-age peer norms, but with low or non-significant individual variance attributed to these quadratic components. Based on these results and interpretability of findings between *alcohol status* groups, we examined factor mean changes of intercept and slope factors.

Table 3 contains growth factor estimates (means and variances) based on *alcohol status*. Fit statistics in Table 3 show that freely estimating means for latent factors representing intercept and slope produced superior model fit (a $>.01$ increase in CFI) for AOE and perceived social norms. Based on prediction by *alcohol statuses*, the estimated slopes for the naïve group are significantly attenuated compared to the onsetter group for all outcomes (See Figures 1 and 2). These attenuations may be interpreted as modifications to the estimated rate of change per 6 months based on group membership. Specifically, relative to alcohol-naïve participants, those youth who started drinking during the study reported greater increases in positive AOE, $B = 0.16$, 95% CI [0.02, 0.29], $p = .018$, greater decreases in negative AOE, $B = -0.04$, 95% CI [-0.06, 0.02], $p < .001$, greater increases in same-age peer norms, $B = 0.45$, 95% CI [0.25, 0.65], $p < .001$, and greater increases in close friends' norms, $B = 0.43$, 95% CI [0.33, 0.53], $p < .001$, over time. Further, those youth who drank prior to the study reported greater decreases in negative AOE over time, relative to the alcohol-naïve participants, $B = -0.17$, 95% CI [-0.32, -0.03], $p = .02$. Finally, the estimated slope for the onsetter group is significantly steeper compared to the prior use group in models representing positive AOE and close friends' norms. Specifically, relative to those youth whose drinking onset during the study, those youth who drank prior to the study reported attenuated increases in positive AOE, $B = -0.27$, 95% CI [-0.43, -0.11], $p = .001$, as well as attenuated increases in close friends' norms, $B = -0.36$, 95% CI [-0.48, -0.23], $p < .001$. However, differences between prior users and onsetters may reflect the fact that the prior use group had a much higher intercept, suggesting a ceiling effect for increases over time.

Hypothesis 2: Associations between Changes in AOE and Norms

We modeled a simultaneous growth process model using AOE and perceived social norms data, and examined the estimated between-person relations between within-person growth factors from each process, using participants who were alcohol-naïve at baseline. Figure 3 displays significant estimated pathways from each of the possible relations between

intercept and slope of AOE_s and perceived social norms. The final model fit the data fairly well (CFI: 0.88, RMSEA: 0.039). Freely estimating all covariances between slopes significantly improved the model (no associations between slopes: $\chi^2(102, N = 1005) = 2085.5$, associations between slopes: $\chi^2(108, N = 1005) = 1913.0$; DF: 6, $p < .001$).

As shown in Figure 3, of the six estimated relations between slopes, four were significant (range of standardized effects: .31 – .52). Greater increases in positive AOE_s were associated at the between-person level with attenuated decreases in negative AOE_s, greater increases in close friends' norms, and greater increases in same-age peer norms. Additionally, there was a significant relation between the slope of close friends' norms and same-age peer norms, indicating that greater increases in close friends' norms were associated with greater increases in same-age peer norms. Two associations were not significant (slope of negative AOE_s and slope of same-age peer norms: $\beta = .06$, $p = .32$, 95% CI [–0.06, 0.17]; slope of negative AOE_s and slope of close friends' norms: $\beta = -.10$, $p = .13$, 95% CI [–0.23, 0.03]).

Hypothesis 3: Predicting Onset using Development of AOE_s and Norms

We conducted discrete-time survival regression with the outcome *alcohol onset* regressed on the latent factor scores representing intercept and slope of positive and negative AOE_s, as well as the perceived social norms over time, covarying for gender. Table 4 presents the hazard ratios for each of the growth factors as well as the model fit for the model with Intercept factors and the model with Slope factors added. These ratios modify onset such that for each SD increase in the (standardized) predictor, the odds of onset at each time point are increased by a factor equal to the estimated hazard ratio, given that onset did not occur at the previous time point. We also examined the assumption of proportional hazards for this regression. Using an adjusted threshold of $\alpha = .01$ given 16 separate tests of significance for interactions, none of these estimated interactions were significant. This indicates that the assumption of proportional hazards was satisfied¹.

Results show that among alcohol-naïve participants, the hazard of subsequent onset was increased by higher initial positive AOE_s (HR: 1.29, $p = .01$), higher initial close friends' norms (HR: 1.31, $p = .02$), steeper decreases in negative AOE_s (HR: 0.85, $p = .04$), steeper increases in close friends' norms (HR: 1.17, $p = .40$), and steeper increases in same-age peer norms (HR: 1.23, $p = .01$) while the relation to steeper increases in positive AOE_s was non-significant (HR: 1.02, $p = .80$). Of the examined interactions with gender, none reached significance, indicating that gender did not moderate the relation between the growth factor predictors and the outcome.

Discussion

In the present investigation, we prospectively assessed the inter-relations among AOE_s, perceived social norms, and drinking over four years in a large sample of boys and girls

¹At $\alpha = .05$, two of the tests of time variance were significant: time reduced the effect of change in positive AOE_s over time ($p = .036$), and time reduced the effect of initial differences in peer norms ($p = .020$). Neither main effect significantly predicted hazard (change in positive AOE_s: HR = 1.02, $p = .80$; initial peer norms: HR = .96, $p = .62$).

during early adolescence—a period of development marked by rapid social and cognitive change and both indirect and direct exposure to alcohol and other substance use. The relation between alcohol cognitions and onset has been demonstrated previously at several points during adolescence. The unique contribution of the current study is to examine whether within-person changes in alcohol cognitions, rather than/in addition to those cognitions measured at a static point in time, in fact contribute to onset as well. Extending prior work, the structure of our data and chosen analytic approach allowed us the opportunity to examine whether rate of change in the alcohol cognitions, rather than static levels of those cognitions, may place adolescents at acute risk for early onset of alcohol use. This differs from previous studies in that a person's development of alcohol cognitions, possibly due to external contextual influences (e.g. peer influence, media alcohol exposure), may directly influence the growth of such cognitions, which then puts the adolescent at acute risk of early onset of alcohol use. Standard between-subject approaches do not directly model this growth, and may thus overlook the developmental trajectories of relevant antecedents of onset. Our study is the first to characterize changes in AOE and norms across early adolescence in the context of *alcohol status*, to relate these changes to each other, and to simultaneously evaluate their importance for predicting the subsequent onset of alcohol use. Additionally, we distinguish between initial differences versus within-individual changes in AOE and perceived social norms both in the context of, and in the prediction of, alcohol use. Broadly, study hypotheses were supported as follows: (1) two well-known influences on youths' drinking—AOE and perceived social norms—changed as a function of experience with alcohol (*alcohol status*); (2) changes in AOE and perceived social norms were related to each other; (3) these changes predicted onset of alcohol use (*alcohol onset*).

Overall, age-related changes in expectancies in the current sample of relatively inexperienced, alcohol-naïve adolescents are consistent with patterns observed in earlier prospective studies (Brown et al., 1987) showing that increases in positive AOE and decreases in negative AOE occur over the course of early adolescence. Findings also are consistent with most (Dunn & Goldman, 1998, 200; Miller et al., 1990), though not all (Donovan, Molina & Kelly, 2009), studies of change in AOE at the within-level, over time. Although Donovan et al. did not find changes in negative AOE after the age of 12, their study examined AOE that were shared with parents, where our study did not specifically target mutual beliefs. Our study also demonstrated linear within-person increases in perceived social norms over this crucial developmental period. Virtually no studies to date have examined change in perceived social norms over time in early adolescence, with most studies examining initial group level differences and their relation to alcohol use (Eisenberg, Toumbourou, Catalano, & Hemphill, 2014; Hildebrand et al., 2013; Voogt, Larsen, Poelen, Kleinjan, & Engels, 2013). Of note, our results are consistent with one study which showed increases in descriptive norms from 10th to 11th grade; approximately age 16–17 years (Brooks-Russell et al., 2014).

Importantly, we extend the aforementioned studies by showing that linear changes in AOE and perceived social norms occur differently between those who are alcohol-naïve, those who experience alcohol onset, and those who have previously consumed alcohol – that is, we consider cognitive and social processes in the context of one's drinking experience. By doing this, we disambiguate growth in social cognitions based on age from growth in social

cognitions based on alcohol experience. Consistent with Hypothesis 1, the rate of change in both AOE and norms was slowest for participants who remained alcohol-naïve throughout the study and fastest for participants who experienced onset of alcohol use during the course of the study. Further, change was attenuated for those already involved with alcohol at the start of the survey, as compared to those who experienced onset during the course of the study. While changes in AOE over time with increasing drinking experience are well-documented (Christiansen et al., 1982; Jester et al., 2015; Smith et al., 1995), we move beyond prior findings by detailing changes leading up to or as a consequence of alcohol onset. This was the first study to look at within-person changes over time in perceived social norms among adolescents as a function of alcohol experience, as earlier studies in the context of alcohol use have been limited to single-time (baseline) observations of perceived social norms (de Visser et al., 2014; Wood et al., 2004). It is clear that associations between social processes and drinking must be considered in a developmental framework.

Furthermore, results from Hypothesis 2 show that among participants who were alcohol-naïve at baseline, changes in AOE and perceived social norms travel together. While previous work has shown that AOE and peer norms are associated (Scheier & Botvin, 1997; Wood et al., 2004; Zamboanga, Ham, Van Tyne, & Pole, 2011), no previous work had examined between-person associations between within-person changes over time in the two constructs. First, in our investigation, we found that between individuals, within-individual increases in positive AOE are associated with attenuated within-individual decreases in negative AOE. That is, while an adolescent may grow in his/her expectations for positive outcomes from alcohol use, he/she may not simultaneously lessen his/her expectations of negative outcomes from alcohol use. Rather, growth in positive expectations is associated with maintenance of negative expectations, perhaps due to greater experience with both the positive and negative effects of alcohol. Second, changes in perceived social norms favoring alcohol were related to increasing positive AOE and decreasing negative AOE. In other words, as an adolescent grows in positive expectations about the effects of alcohol, their perceptions that peers are drinking/approving of drinking become stronger. In contrast, as an adolescent's expectations for negative drinking outcomes diminish over time, their perceptions that peers are drinking/approving of drinking become stronger. These findings suggest that potentially, intervention on either component may affect social beliefs regarding both norms and AOE.

Based on results from Hypothesis 3, both initial level and within-person changes over time in cognitions significantly predicted whether an adolescent subsequently consumed a full drink of alcohol. First, consistent with prior work, starting with higher levels of positive AOE increased risk for later onset. Prior work had shown that initial differences in positive AOE were prospectively predictive of increases in alcohol use among drinkers (Christiansen et al., 1989). Notably, however, our latent growth approach provides evidence that a latent initial level informed by multiple preceding assessments of positive AOE similarly predicts initiation. Hence, the initial level predictors were not subject to measurement error that might result from having a single earlier assessment (for instance, measurement error from time-specific influences like summer holidays, or beginning of school year; Simons-Morton 2004). Likewise, initial differences in social AOE had been shown to be prospectively predictive of onset of alcohol use (Killen et al., 1996; Simons-

Morton, 2004), although similarly based on earlier baseline assessments. We replicate and extend this finding by showing that this relationship holds over longer periods of time from ages 15 to 18.5 years, and that individual differences in the rate of change of negative AOE's can predict onset over and above the initial group-level differences in AOE's. In terms of changes over time, smaller declines in negative AOE's over time uniquely increased risk for later onset. Additionally, increases in alcohol use were likewise associated with increases in positive AOE's in turn, suggesting a reciprocal relation between alcohol use and positive AOE's (Sher, Wood, Wood, & Raskin, 1996; Smith & Goldman, 1994; Smith et al., 1995).

Results regarding Hypothesis 3 strengthened the case that relevant individual changes occur prior to the onset of alcohol use. With respect to norms, starting with higher levels of close friends' norms (but not more general peer norms) increased risk for later onset. This is in line with earlier findings (Voogt et al., 2013) showing initial differences in proximal groups' norms (close friends' norms) were more important predictors of heavy drinking than initial differences in more distal groups' norms. It bears consideration that initial differences in peer norms may reflect the adolescent's perceptions of proximal groups' alcohol use that do not necessarily accurately correspond to levels of peer drinking per se. These peer norm responses may be functionally and theoretically distinct from prediction by the rate of change of such peer norms that may reflect increasing levels of familiarity with alcohol's effects, either from vicarious exposure or direct contact. Further, we demonstrate that individual differences in rate of change of social norms is also uniquely predictive of onset of alcohol use. However, it was individual differences in the rate of increase in distal groups' norms (but not close friend norms) that were also uniquely predictive of onset. This may reflect a tendency of adolescents to perceive their age cohorts as increasingly alcohol-initiated, which may not necessarily be reflected in their appraisal of their close friends' drinking.

Strengths and Limitations

Limitations of the present study include the following. Our measure of alcohol use was based on a single self-report item; although self-reported measures of alcohol consumption have been shown to be valid in adolescents (Donovan, 2004; Smith et al., 1995), and particularly so with web-based data collection (Turner et al., 1998), there is still potential for self-report bias. While other assessment methods (e.g., parent report) would add to the richness of our data, other investigations have shown that underestimation of child alcohol use is common and severe (Jones et al., 2017), and it's unclear how such discrepancies would be resolved in this study. Also related to measurement, although we distinguished between norms held by general peers versus close friends, the scale assessing close friends' norms included both descriptive and injunctive norms, where the scale assessing peer norms assessed only descriptive norms. This may limit interpretability of the differential influence of these two types of social referents. Added to this, previous work has shown that the genders of social referents form important contexts, where same-gender referents produce a greater impact of normative information (Borsari & Carey, 2003; Lewis & Neighbors, 2006; Walters & Neighbors, 2005); unfortunately we did not have information about the gender of the close friends. Our knowledge of the relation between changes in social norms and onset

would be enhanced by replicating our findings using gender-specific normative referents both in same-age peer norms and close friends' norms.

Representativeness of our sample also presents a limitation. The study sample was drawn from a subset of middle schools in a single geographic region and thus is not representative of the United States as a whole. Relatedly, in predicting onset of alcohol use, we selected a subsample for whom onset of alcohol use occurred after age 14.5 years. This was necessitated by our aim to predict onset of alcohol use based on preceding change in AOE and norms. Given that early onset of alcohol use is especially risky, our results on onset of alcohol use may not describe those at greatest risk for future harmful consequences.

Finally, it is important to note that the analytical approach selected (latent growth curve modeling) precluded investigation of mediational effects, since estimated individual intercepts and slopes are not assessed with strict temporal precedence relative to each other. Instead, growth curves are estimated based on all available information at all time points with the intercept here representing the model-estimated initial value at the start of the growth curve. While it may have potentially been informative to investigate to what extent changes in one process occur based on influences from another process (e.g. does the increase in positive AOE mediate the effect of the initial value of perceived peer norms), such a model would have been misleading in the present study (see Preacher, 2015, for further discussion on mediation in the context of growth modeling). Instead, we focused here on the contribution of investigating individual differences in within-person developmental trajectories of relevant social-cognitive predictors of adolescent alcohol use.

Conclusions

The current study offers key contributions to the literature on adolescent development of AOE and social influences of particular relevance to the onset of alcohol use. Both AOE and perceived social norms are shown to change rapidly over the course of the current study, and are shown to be highly relevant in the context of alcohol use. These findings may inform efforts to modify the link of adolescent AOE, peer norms, and close friendships to alcohol use, in that it is shown that while onset of alcohol use is linked to rapid change in social context, this context also changes prior to the onset of alcohol use. A primary clinical implication of these findings is that it may be most useful to implement preventive interventions targeting AOE and peer norms prior to the onset of alcohol use, in order to delay or thwart such onset. Additionally, given that norms and expectancies travel together, targeting one in the context of intervention may be expected to have an impact on the other; however, this remains to be tested. Future studies may reinforce our conclusions by replicating our findings on changes in trajectories of AOE and perceived social norms, and by confirming the prospective link to the onset of alcohol use. Furthermore, it remains important to tie changes in AOE and social predictors to both the quantity and frequency of alcohol use in recent-to-onset adolescents.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This study was supported by grants R01 AA016838 (PI: Jackson), K02 AA13938 (PI: Jackson), K01AA022938 (PI: Merrill), K23AA024808 (PI: Treloar), and T32 AA007459 (PI: Monti).

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Figure 1.

Figures 1a and 1b. Means and latent trend lines per alcohol status for positive and negative alcohol expectancies from ages 11.5 to 16.5. Note: Bars refer to overall mean scores on items from positive and negative expectancy scales. Lines represent the means and slopes estimated by latent growth factors. ^{ab}Alcohol Statuses with identical letters in superscript do not have significantly different slopes from each other.

Figure 2.

Figures 2a and 2b. Means and latent trend lines per alcohol status for close friends' norms and same-age peer norms. Note: Bars refer to overall mean scores on items from close friends' norms and peer norms scales. Lines represent the means and slopes estimated by latent growth factors. ^{ab}Alcohol statuses with identical letters in superscript do not have significantly different slopes from each other.

Figure 3.

Relations between growth models of positive and negative expectancies (AOEs) and perceived social norms. Note: Lines represent significant point estimates for associations (double arrowhead; displayed as straight lines for simplicity) and regressions (single arrowhead) between the estimated intercepts and slopes for positive and negative expectancies, close friends', and peer norms over time. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 1

Descriptive statistics of age, gender, race/ethnicity, alcohol initiation and attrition

	Enrollment	Enrollment + 4 years
Age (M years, SD)	12.2 (0.98)	16.2 (0.95)
Gender (% female)	47.8	44.6
Race (% non-white)	17.0	16.4
Ethnicity (% Hispanic)	12.1	11.3
Ever consumed full drink (% yes)	7.7	45.7
Attrition (% completes)	100	78.9

Note. None of the changes in ratios of gender, race or ethnicity as a consequence of attrition were significant.

Table 2

Model fit and variances for unconditional growth models of alcohol expectancies and social norms

Outcome	Solution	AIC	SRMR	CFI	RMSEA	Variance i	Variance s	Variance q
Positive expectancies	Intercept-only	10935.65	0.172	0.843	0.065	.271***		
	add Slope	10802.18	0.151	0.937	0.043	.336***	.004***	
	add Quadratic ¹	10747.87	0.084	0.976	0.027	.182***	.015	<.001
Negative expectancies	Intercept-only	11282.27	0.108	0.934	0.041	.306***		
	add Slope	11230.96	0.081	0.973	0.027	.402***	.005***	
	add Quadratic	11207.54	0.063	0.993	0.015	.387***	.031**	<.001
Close friends' norms	Intercept-only	11835.54	0.213	0.788	0.096	.319***		
	add Slope	11603.33	0.142	0.889	0.071	.300***	.010***	
	add Quadratic	11508.86	0.088	0.931	0.058	.137***	.027***	<.001*
Same-age peer norms	Intercept-only	15587.24	0.218	0.721	0.128	.665***		
	add Slope	15126.56	0.124	0.867	0.091	.511***	.027***	
	add Quadratic	15047.02	0.103	0.894	0.084	.313***	.036***	<.001

Note. Model fit statistics for different growth processes representing alcohol expectancies at ages 11.5–16.5 years. SRMR: Standardized Root Mean Square Residual. CFI: Comparative Fit Index. AIC: Akaike's Information Criterion. RMSEA: Root Mean Square Error of Approximation. Variances of 'i', 's', and 'q' refer to the standardized variances of intercept, slope, and quadratic factors, respectively.

¹Model did not properly identify.

* p < .05.

** p < .01

*** p < .001.

Table 3

Growth factor estimates for overall models and models based on alcohol status

	Onset ^a	Mean		Variances		CFI ^b
		Intercept	Slope	Intercept	Slope	
Positive expectancies	All	2.365**	0.045**	0.359**	0.006**	-
	Naïve	2.323**	0.039**	0.359**	0.006**	.016
	Onset	2.379**	0.060**	0.269**	0.008**	.016
	Prior use	2.687**	0.005	0.045	0.002	.016
Negative expectancies	All	3.272**	-0.027**	0.428**	0.004	-
	Naïve	3.262**	-0.012	0.430**	0.004	.017
	Onset	3.339**	-0.056**	0.225**	0.006*	.017
	Prior use	3.264**	-0.059*	0.251	0.006	.017
Close friends' norms	All	0.211**	0.076**	0.135**	0.005**	-
	Naïve	0.201**	0.059**	0.136**	0.005**	.219
	Onset	0.273**	0.167**	0.537**	0.015**	.219
	Prior use	1.384**	0.026	1.137*	0.033*	.219
Same-age peer norms	All	1.227**	0.290**	1.518**	0.046*	-
	Naïve	1.269**	0.259**	1.513**	0.044*	.018
	Onset	0.887**	0.478**	2.771**	0.087*	.018
	Prior use	2.985**	0.262**	5.496	0.000 [†]	.018

Note. Means and variances calculated based on indicators at ages 11.5–16.5 years. Slope means represent the estimated mean rate of change per 6 months.

^a Onset status differentiates between full sample (N = 1,023; All), those alcohol-naïve throughout the study (n = 713; Naïve), those who onset during the study (n = 214; Onset), and those who drank prior to the study (n = 78; Prior use).

^b Comparative Fit Index. A > .01 increase in CFI indicates superior model fit (Cheung & Rensvold, 2002; Dimitrov, 2010) for models freely estimating factor means per *alcohol status*.

Results of discrete-time survival regression of alcohol onset (age 15–18.5) on growth factors of alcohol outcome expectancies and perceived social norms

Table 4

		Full Drink		
		HR	p	95% CI
Step 1	Gender	0.641	<.001	0.493 0.835
Step 2	Intercept positive expectancies	1.293	<.001	1.116 1.498
	Intercept negative expectancies	0.945	.456	0.815 1.096
	Intercept close friends' norms	1.311	<.001	1.155 1.488
	Intercept same-age peer norms	1.064	.367	0.930 1.216
χ^2 (4, N = 753) = 33.11, p < .001				
Step 3	Slope positive expectancies	1.023	.796	0.863 1.212
	Slope negative expectancies	0.848	.037	0.726 0.99
	Slope close friends' norms	1.169	.040	1.007 1.357
	Slope same-age peer norms	1.226	.008	1.055 1.424
χ^2 (4, N = 753) = 19.22, p < .001				

Note. Gender is coded male=1. HR = Hazard Ratio. All predictors other than gender were standardized.