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Misperception and Accurate Perception of Close Friend Substance Use in Early Adolescence: Developmental and Intervention Implications

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Abstract

Misperceptions of peer substance use (SU) are believed to be a robust correlate of adolescent SU, however, perceived peer SU is biased in the direction of an adolescent's own SU raising questions about the validity of perceived peer SU (social norms; Henry, Kobus, & Schoeny, 2011). In addition, social norm theories emphasize inaccurate perceptions of peer SU while other theories emphasize actual peer behavior and selection of friends as motivators of adolescent SU. Furthermore, no theories consider the role of accurate perceptions, suggesting the need to more carefully consider the co-evolution of perceived peer norms, actual peer behavior, and adolescent SU. To do this, we modeled the latent structure of accurate and inaccurate perceptions of peer SU while including an adolescent's own SU using latent class analysis (LCA) and tested the natural evolution of the classes using latent transition analysis (LTA). The design included three annual assessments of peer and perceptions of peer SU and six assessments of adolescent SU (N = 765; age = 10 - 13 at Wave 1; female = 53%). LCA findings largely replicated Henry et al. (2011), suggesting that misperceptions of peer SU were biased by an adolescent's own SU. We also found 3 distinct pathways to a high risk class that predicted high levels of later adolescent SU, two in which adolescent and perceived peer SU preceded peer SU (age=10-12 and 12-14) and another in which peer SU preceded adolescent SU and perceptions of peer SU (age=12-14). Implications for peer influence theories are discussed.

Keywords

adolescence; substance use; peer substance use; perceptions of peer substance use; social norms

Social context and peers are central to many etiological theories of adolescent SU (Authors, 2015; Leung, Toumbourou, & Hemphill, 2011; Osgood et al., 2013). Despite the robust association between peer and adolescent SU, there has been some debate as to the specific roles of perceived and actual peer SU. Some researchers posit that social norms, in particular, perceptions of peer SU, are as important or more important than actual peer SU to the initiation and escalation of SU (Hill, Emery, Harden, Mendle, & Turkheimer, 2008; Trucco, Colder, & Wieczorek, 2011). Perceived peer norms are thought to influence behavior because they communicate the acceptability and frequency of a wide range of

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behaviors (Collins & Steinberg, 2006; Salvy, Pedersen, Miles, Tucker, & D'Amico, 2014). Other researchers argue that peers provide positive reinforcement for SU behaviors as well as access to drugs (Dishion & Skaggs, 2000; Dishion, Spracklen, Andrews, & Patterson, 1996), suggesting the importance of actual peer behavior in the etiology of adolescent SU (Bauman & Ennett, 1996). Given that adolescence is a developmental period in which youth initiate SU, escalate SU, and place great importance on peer relationships (Brown, 2004), it is critical to understand characteristics of the social context involved in the early stages of SU to design effective preventions.

Perceived Peer SU and Actual Peer SU Behavior

To avoid confusion for the remainder of the paper, the terms perceived peer SU, actual peer SU, and adolescent SU will be used to refer to perceived descriptive norms, peer self-report of SU, and target adolescent self-report of SU, respectively. Despite large literatures linking perception of peer SU (Borsari & Carey, 2001; Perkins, 2002) and actual peer SU (Leung, Toumbourou, & Hemphill, 2011; Osgood et al., 2013) to adolescent SU, few studies consider perceived peer SU and actual peer SU together in early adolescence. This is a notable omission in the literature given that normative feedback interventions, which target correcting misperceptions about peer SU, have increasingly been utilized with middle school and non-college populations under the assumption that younger adolescents misperceive peer SU similar to college students (Elsey et al., 2015). Yet, research has not adequately documented whether early adolescents misperceive their peers' SU and hence whether normative feedback interventions are appropriate for this population.

Only one study, to our knowledge, has directly compared perceived peer SU to actual peer SU in early adolescence (Henry et al., 2011). Using a nationally representative sample, Henry et al. (2011) assessed adolescent perceptions of peers' SU and their peers' actual SU to determine whether adolescents misperceive their peers' SU. Evidence suggested that an adolescent's own initiation of SU largely biased perceptions of peer initiation of SU. That is, among early adolescents who misperceived their peers' SU, adolescents who were engaged in SU tended to overestimate peer initiation (Misperception+ [MP+]; see Figure 1 for a conceptual contingency table of the Henry et al. 2011 findings) while adolescents who did not use tended to underestimate peer initiation (Misperception- [MP-]; Henry et al., 2011). Furthermore, adolescents who accurately perceived peer initiation of SU also tended to have initiated (Accurate Perception-Users [AP-users]) and youth who accurately perceived peers not to have initiated SU tended not to be initiates (Accurate Perception-non-users [AP-non-users]). Findings replicated across alcohol, cigarette, and marijuana use and there was evidence of age differences such that misperception of peer use was far more common at younger (11-12 years old) than older ages (14-15 years old). These findings suggest several important characteristics of perceived peer SU and actual peer SU. First, there is heterogeneity in cross sectional profiles of adolescent SU, peer SU, and perceptions of peer SU. Second, it is important to consider their relative elevations to understand the early stages of SU. For example, high peer SU is evident in two patterns: (1) low perceived peer and low adolescent SU (MP-), and (2) high perceived peer and high adolescent SU (AP-users). Likewise, low peer SU is evident in two patterns: (1) low perceived peer and low adolescent SU (AP-non-users), and (2) high perceived peer and high adolescent SU (MP+). Although

far from a definitive test, this pattern suggests taxa (subpopulations) in the data (Waller & Meehl, 1998) or classes in which there are qualitative differences amongst the constructs (Collins & Lanza, 2010). Third, misperception profiles of peer SU were more likely in early adolescence, a point in development just prior to typical age of initiation of SU (Sung et al., 2004) when adolescents may be particularly vulnerable to the influence of the peer context (Steinberg, 2008).

Despite several strengths, Henry et al (2011) also had several limitations, which motivated the aims of the current study. First, perceived peer SU was asked with respect to “friends”. Misperception may be exaggerated when asking adolescents about the SU of more distal peers, such as “kids their own age” (see Baer, Stacy, & Larimer, 1991; Pape, 2012). This raises the question of whether perceived and actual SU of close friends would yield misperceived social norms in the direction of an adolescent's own initiation of SU.

Second, Henry et al. (2011) created observed groups based on cross tabulation of actual and perceived peer SU, and then tested whether adolescent SU predicted the observed groups. As such, the structure of accurate and inaccurate perceptions is assumed a priori and not tested explicitly. Latent Class Analysis (LCA) would provide a more rigorous test of classes or subpopulations and it would estimate measurement error. According to the findings of Henry et al. (2011) and their claim that perceptions of peer SU are largely biased by adolescent SU, then an LCA should reveal a four-cell structure similar to Figure 1. However, if some variance in perception of peer SU does not overlap with adolescent SU or actual peer SU, then perceptions of peer SU are not entirely explained by a bias (false consensus effect) and there would be additional cells in Figure 1 in which misperceptions occurred in the absence of adolescent SU.

Third, Henry et al. (2011) used a cross-sectional design, which cannot address questions concerning the direction of the effect between accurate/inaccurate perceptions of peer SU and adolescent SU. Social norm, social learning, and selection theories of early adolescent SU emphasize different directions for the effects of accurate/inaccurate perceptions of peer SU and adolescent SU. As discussed below, differences in these theories may suggest competing or complimentary hypotheses as to how youth would transition into and out of taxa or profiles characterizing perceived peer, actual peer, and adolescent SU.

Social Norm, Social Leaning, and Selection Theories

Following social norms theory, misperceptions of peer use are expected to precede use (or non-use). Adolescents who overestimate peer SU are expected to be more likely to initiate SU, whereas adolescents who underestimate peer SU would be unlikely to initiate SU, and may even select out of peer groups that engage in SU. This suggests that youth with a MP- profile should transition out of groups characterized by peer SU. However, another prediction would be that MP- youth are at risk of initiating and perceiving peer SU, consistent with “socialization” or “influence” effects (Osgood et al., 2013; Leung et al., 2011; Authors, 2015). Therefore, these theories predict opposite transitions for MP- youth. Furthermore, social norms theory suggests that the important factor in later adolescent initiation is the “overestimate” of peer SU, but this interpretation is confounded by the fact

that the “overestimates” are biased by the adolescent's own initiation of SU. That is, an alternative explanation is that youth who overestimate peer SU have already initiated and are just selecting friends because they are motivated to continue SU. Assessing transitions into and out of overestimates of peer SU (MP+) with and without adolescent SU would provide much needed clarity regarding the “overestimate” hypothesis.

Another limitation of social norms theory is that it does not consider how accurate perceptions of peer behavior may function in relation to adolescent SU. Social learning theory emphasizes positive reinforcement from peers for SU and other rebellious behavior (Dishion & Skaggs, 2000; Dishion, et al., 1996). Dishion and colleagues have found evidence for a process they termed “deviancy training” that starts with social reinforcement (laughing and reciprocated discussion) for SU behaviors (such as finishing a drink or taking a puff on a cigarette) and for recounting SU behavior verbally. Accumulation of these transactions over time results in the peer group becoming increasingly focused on SU (Dishion & Skaggs, 2000; Dishion, et al., 1996). From the perspective of “deviancy training,” youth at some point engage in SU together, which in turn may lead to accurate perceptions of close peers' initiation of SU. Theories that emphasize the importance of the peer context and actual peer SU would predict that transitions into an AP-users profile and stability in such a profile would predict increases in SU over time.

Although social learning theories make predictions concerning how youth are “influenced” once in a peer group, they do not make specific predictions as to how adolescents end up in the peer group in the first place. Social norms and selection theories offer slightly different views on this, suggesting that youth choose friends based on misperceptions (Authors, 2015; Cialdini & Trost, 1998) or based on common interests in SU (Burk, Van der Vorst, Kerr, & Stattin, 2012; Authors, 2015), respectively. Given that perceived peer, actual peer, and adolescent SU have never been included together in one model in early adolescence with a longitudinal design, to our knowledge the extant literature has not assessed the following theoretically interesting questions: Do inaccurate and accurate perceptions follow a particular developmental pattern such that misperception is more common earlier in adolescence with youth transitioning to accurate perception as SU initiation spreads through the cohort and becomes normative? Do social norm, social learning, and selection theories each receive support when subpopulations and transitions into and out of subpopulations are assessed? For those youth who initiate and end up in a peer group that has initiated, is subsequent stability in accurate perception of peer SU and adolescent SU synergistic to later levels of adolescent SU as social learning theories would suggest? These questions motivated the aims of the current study.

Summary and Hypotheses

The first aim (aim I) of the current project was to replicate Henry et al. (2011) using LCA to test for classes, close friends as the referent for perceptions of peer SU, and a close friend's self- reported SU. We hypothesized 4 classes at each wave and that class structure at all three waves would replicate Henry et al. (2011) in line with cells 1-4 in Figure 1. Although we expected class structure to be the same across waves, we expected the MP+ and MP- cells to be larger than AP-user cells at early waves given prior findings that misperception is

more common and more strongly related to adolescent SU at younger ages. Our data spanned the early stages of SU. As such, accurate and inaccurate perceptions reflect initiation of SU and not levels of use.

The second aim was to assess the direction of the effect between accurate/inaccurate perceptions and adolescent SU and whether misperception/accurate perception followed a specific developmental pattern using LTA. Our LTA is exploratory given limited research considering the three constructs together within a latent framework. Nonetheless, if the latent class structure implied in Henry et al. (2011) replicated with close friends as we hypothesized in aim I, certain transition patterns could address questions related to the direction of the effect between and actual peer, perceived peer, and adolescent SU as discussed above. For instance, transitions from the MP+ and MP– classes at one wave to the AP-users class at a later wave would test the effect of over and under estimation of peer initiation on actual peer initiation and adolescent initiation, respectively. In contrast, if the structure implied in Henry et al. (2011) did not replicate and there was unique variance in misperception above and beyond an adolescents own SU, there would be additional cells in Figure 1 such that some youth will perceive peer SU but not yet have initiated SU (MP+ with and without bias). If such a structure were to emerge, transitions from MP+ classes with and without adolescent SU to AP-users would reflect the effect of overestimation of peer SU with and without bias on later actual peer SU and adolescent SU and actual peer SU, respectively.

Our third aim was to test whether specific transition patterns across the waves differed on later adolescent SU (W4-W6). This allowed us to test specific theoretical questions concerning the direction of the effect between perceived peer, actual peer, and adolescent SU. Transition patterns in which adolescent SU preceded actual peer SU (what some researcher term “selection”) were compared to transitions in which actual peer SU preceded adolescent SU (what some researchers term “socialization”) to assess whether these different pathways to SU initiation are related to later *levels* of SU. Hypotheses were that there would be no difference between the classes. Transitions in which youth ended in the AP-users class by W3 were compared to transitions in which youth transitioned into MP+ classes but never transitioned to the AP-users class. This comparison assesses whether perceived peer, actual peer, and target SU operate synergistically when compared to MP+ (youth who have initiated and perceived their peers to have initiated but lack a peer context reinforcing use) and we predicted that youth who transitioned into the AP-users classes would have the highest levels of later SU. Finally, we compared each group of transitions described above and youth who transitioned into the MP-class to youth who remained in the AP-non-users class across waves. These comparisons assess the relative risk of different transitions through perceived peer, actual peer, and adolescent SU and hypotheses were that all transition patterns would be higher on later adolescent SU than youth who never transition into perceived peer, actual peer, or adolescent SU.

Method

Participants

Sample 1 included 378 families and Sample 2 included 387 families for a total of 765 families. Averaging across samples, adolescents were 10-13 years old (Mage = 11.3, SD = 0.76; 53% female) while peers were 8-15 (Mage = 11.5, SD = 1.15; 55% female) at the first assessment. Mean ages of targets at W1-W6 were 11.8 (SD = 0.79), 12.9 (SD = 0.79), 13.9 (SD = 0.79), 15.0 (SD = .77), 16.0 (SD = .79), and 17.0, respectively. The mean ages of peers (53% – 56% female) at W1-W3 were 11.5 (SD = 1.15), 12.4 (SD = 1.27), and 13.4 (SD = 1.18), respectively.

Recruitment—Two community samples were recruited using random-digit dialing (RDD) procedures of listed and unlisted telephone numbers. RDD was particularly well suited for recruitment considering 98.5% of households in the sampling frame (Erie County, NY) had a landline at the time of recruitment. To be eligible to participate adolescents had to be between the ages of 10-12 and 11-12 years old for Sample 1 and 2, respectively, and they could not have a language or physical disability that would impede their ability to understand and complete the assessment batteries. At W1-W3 for both samples, target adolescents provided the names of four close friends and one was recruited into the study (peers) to provide collateral reports of the target adolescent's peer environment. Peers were required to be within two years of age of the target adolescent and could not be a sibling. Moreover, targets were allowed to nominate different peers at each wave to allow for the fluid nature of adolescent peer relationships. A more detailed description of recruitment, demographics, and procedures can be found in Authors (2011) and Authors (2013), and in Authors (2015) for peers.

Procedure

Procedures were similar for both samples and occurred concurrently. Three annual assessments were completed in university research offices. For target and peer families, consent (caregiver) and assent (adolescent) procedures were completed and then the adolescent and caregiver were taken to separate rooms to enhance confidentiality and privacy. Questions deemed “sensitive” (e.g., questions assessing SU) were entered into the computer by the adolescent to further increase confidentiality. At W4-W6 only adolescent SU was measured and adolescents entered responses through an audio Computer Assisted Self Interview (CASI).

Measures

Target and Peer Self-Reported SU—Items from the National Youth Survey (NYS) were used to assess substance use. Lifetime use (3 items: “Have you ever used alcohol/ cigarettes without your parents' permission?” “Have you ever used marijuana?”), past year frequency of use (“How many times in the past year have you used alcohol/cigarettes/ marijuana?”), and quantity of use (On the days you drink alcohol/smoke cigarettes, about how many drinks do you have/how many do you smoke?”) were assessed at W1-W3 for targets and peers (Elliott & Huizinga, 1983). For targets only, SU was also measured from W4-W6 with the same items from W1-W3. Self-reports of adolescent SU, such as the NYS,

have been shown to be valid when the adolescent perceives them to be anonymous and confidential (Winters et al., 1991). Rates of lifetime use for peers and targets from W1 to W3 can be found in Table 1. As expected given the age of our sample, rates of use were low at early waves. In fact, there was no target or peer marijuana use at W1 and rates of alcohol and cigarette use were very low at W1. Given low rates of use from W1-W3, peer SU and adolescent SU were kept dichotomous and reflected lifetime use (1) versus no use (0) for each substance. Table 1 also compares our rates of SU to several other large epidemiological and community samples in the literature. As expected, higher rates of target SU were observed between W4-W6 as youth aged. As such, quantity and frequency indices were used to model adolescent SU from W4-W6.

Perceived Peer SU—Target report of peer SU (close friend SU) was assessed using 3 items taken from Fergusson, Woodward, and Howard (1999). The instructions asked the adolescent to “Tell whether or not any of your three close friends have ever used alcohol/cigarettes/marijuana”. Responses were keyed as lifetime use (1) or no lifetime use (0). Rates of perceived peer SU can be found in Table 1.

Data Analysis

Peer and target adolescent self-reported and target's perceived peer alcohol, cigarette, and marijuana use were used as indicators in latent class analyses (LCA) at W1-W3. Given that there was no adolescent or peer marijuana use at W1 (see Table 1), there were seven indicators at W1 and nine indicators at W2 and W3 for the LCAs, respectively. Two through six class solutions were considered for each LCA and the Akaike, Bayesian, and sample size adjusted Bayesian Information Criteria (AIC, BIC, and ABIC, respectively; lower values reflect better fit) as well as entropy, *N* of classes, Lo-Mendell-Rubin test (LMR), and bootstrapped likelihood ratio test (BLRT) were all used to determine the number of classes to extract (Muthen, 2004; Lo, Mendell, & Rubin, 2001). Thresholds for indicators with extremely large or small probabilities of class membership were set to extreme values (+15 or -15) at each wave (Collins & Lanza, 2010). Once the number of classes to extract at each wave was determined, a latent transition analysis (LTA) was estimated across the three waves. Prior to estimating the LTA, we tested for measurement invariance using nested likelihood ratio tests (G^2; Collins & Lanza, 2010). Originally, gender and age were included as covariates in the LTA; however, gender did not predict class membership at any wave and was subsequently dropped. All LCA and LTA models were run in Mplus 7.2 (Muthén & Muthén, 1998–2012).

Different transition patterns through the latent classes were compared to each other on later adolescent SU by assigning youth to their most likely transition pattern and then comparing youth from different transition patterns on later adolescent SU using generalized linear modeling in SAS 9.4. First, dummy coded variables comparing each transition pattern to the class in which there was no perceived peer, actual peer, or adolescent use were created and entered into the model predicting W4-W6 frequency and quantity of SU in separate models. Three subsequent models were then run to compute additional specific contrasts using dummy coded variables. The first model tested the selection/socialization questions; the second model tested the joint effect of all three constructs versus MP+ only; and the third

model compared each combination of risky transition patterns to the class in which there was no adolescent, peer, or perceived peer use at any wave. From these estimates, Cohen's *d* and the 95% confidence interval were computed (small = Cohen's $d > 0.2$ but < 0.5; medium = $d > 0.5$ but < 0.8; large = $d > 0.8$).

Missing Data—Retention for target families was strong in the combined sample with an attrition rate of 3.9%, 6.5%, 6.7%, 8.1%, and 14.6% at W2-W6, respectively. Proportion of missing peer data was 8.3%, 13.9%, and 18.6% for W1-W3, respectively. Our LTA involved data from W1-W3. In prior papers, we compared participants with missing data at W2 or W3 with those who had complete data on demographic variables (socioeconomic status, age, parental marital status, minority status, and gender) and variety of W1 variables, including adolescent temperament, peer delinquency, puberty, psychopathology, parental SU, parental SU consequences, and parenting specific to SU (Authors, 2015). Here we extended these comparisons to include W1 peer closeness, target and peer alcohol and cigarette use, and perceived peer alcohol, cigarette, and marijuana use using chi-square and ANOVA. Targets with missing data were more likely to have initiated cigarette use in their lifetime (phi = .09) and were more likely to have peers who initiated cigarette in their lifetime (phi = .09). However, there were no differences on the other 29 variables. Targets with missing peer data were compared on the same variables listed above and results suggested that missingness was associated with lower SES, minority status, being from single-parent family, and with increased likelihood of cigarette use, actual peer cigarette use, and perceived peer cigarette use (all *p*s < 0.05). However, missingness was not related to the remaining 24 variables and effects were again small ($R^2 = .4\%$; phi range = .07 – .13). The small effects in the context of a large sample and low attrition rate suggests that missing data likely did not have a substantial impact on findings from LCA and LTA. As such, LCAs within wave were done excluding those with missing target data at W2 ($N = 737$) and W3 ($N = 715$) to simplify analyses. However, peer self-reported missing data within wave was handled using full information maximum likelihood (FIML) with robust standard errors and all LCA models met the assumption of Missing Completely at Random according to X^2 tests (X^2 range = 106.4 – 214.6, ps range: .58 – .97), suggesting that the additional missing peer data met the assumptions of FIML from W1-W3. FIML was also used to handle missing data on our repeated measures of perceived peer, actual peer, and adolescent SU for the full LTA. Results reported are primarily from the LTA and the full sample was used in all LTA related analyses ($N = 765$). Moreover, peer and adolescent cigarette use were included in the LTA, making FIML a good strategy for missing data (Shafer & Graham, 2002).

W4-W6 SU was the outcome in our transition pattern analysis and missingness at these waves was associated with lower SES, being from a single parent family, minority status, and several W1 variables, including initiation of cigarette use, peer cigarette use, and perceived peer use of three substances (all *p*s < 0.05), but the effects were again small ($R^2 = 0.9\%$; phi range = .09 - .13). The groups were not different on gender, age, target or peer alcohol use. Given the higher level of missing data at W6 and the small differences between those with missing data and those without missing data, we used multiple imputation and 25 imputed data sets in SAS 9.4 to account for missing data on our W4-W6 SU outcomes (Schafer & Graham, 2002).

Results

LCAs W1-W3

Fit indices for LCAs at W1-W3 can be found in Table 2. At W1, all fit indices suggested a four-class solution. AIC, BIC, and ABIC all increased when a 5th class was added and neither the BLRT nor LMR was significant suggesting the four class solution fit better than the five class solution. At W2, all fit indices except BIC suggested a five-class solution; however, the 5th class only contained 3.6% of the sample ($n = 25$). At W3, all fit indices suggested a five-class solution over a four-class solution and a six-class solution over a five-class solution; however, the 6th class only comprised 2.7% of the sample. These findings suggest that the most likely solution was a four-class solution at W1 and W2, and a five-class solution at W3.

LTA

Initial runs of the LTA which included all three waves and utilized the entire sample suggested that when a five class solution at W2 and/or a six class solution at W3 were estimated proportions of participants in the 5th class at W2 and 6th class at W3 were too small (less than 2%, respectively), again suggesting that a 4-4-5 class solution at W1-W2-W3 sufficiently modeled heterogeneity in response profiles without creating classes that were too small. As further support for the final model with the 4-4-5 class pattern at W1-W2-W3, respectively, AIC, BIC, and ABIC were smaller in the final model (pattern 4-4-5: AIC = 8362.99; BIC = 8766.77; ABIC = 8490.51; entropy = .88) when compared to (1) a model in which a fifth class was added at W2 and W3 (pattern 4-5-5: AIC = 8433.83; BIC = 8786.56; ABIC = 8545.23) and (2) a model in which a 6th class was added to W3 (pattern 4-5-6: AIC = 8505.71; BIC = 9730.98; ABIC = 8892.66). In the final model, we tested for partial measurement invariance (Collins & Lanza, 2010) by constraining all thresholds to be the same across the four classes that were consistent across all three waves and compared it to a model in which none of the thresholds were constrained. Freeing the thresholds improved model fit (G^2 [41, $N = 765$] = 123.85, $p < .01$). To determine which classes varied in measurement over time, we compared a series of sequential models using log-likelihood ratio tests. Constraining the thresholds for AP-non-users and MP- classes to be the same across waves did not result in a significant decrement to model fit G^2 [9, $N = 765$] = 6.20, $p = .72$ and G^2 [6, $N = 765$] = 7.23, $p = .30$, respectively). Constraining the MP+ alcohol (ALC) classes to be the same across waves resulted in a significant decrease to model fit (G^2 [11, $N = 765$] = 27.12, $p = .004$); however, constraining thresholds at just W2 and W3 did not result in a significant decrement to model fit (G^2 [7, $N = 765$] = 12.27, $p = .09$), while constraining W2 and W3 thresholds for AP-users resulted in significantly worse fit (G^2 [4, $N = 765$] = 14.43, $p = .006$). As such, in the final model, measurement invariance was observed for AP-non-users, the MP- classes, and for the MP+ ALC classes at W2 and W3, but not for the remaining classes.

Figure 2 contains model implied response probabilities plotted for each latent class at each wave for the final LTA and utilizes the full sample. Average latent class probabilities for most likely class membership were all high with 10 of 13 above .90 and the other three above .85. As can be seen from Figure 2, all three waves contained an AP-non-users class, a

MP- class in which targets did not use, and a MP+ ALC class in which target adolescents were engaged in alcohol use and misperceived (+) their peers' alcohol use. At W2 and W3, there was also an AP-users class in which response probabilities were high for all indicators at W2 and even higher at W3. At W1, there was no AP-users class as we had hypothesized but rather a 2nd MP+ SU class in which probability of an adolescents own SU was lower, perception of peer SU was high, but actual peer SU was lower for all substances. This pattern suggests an early user class in which misperception is *relatively* unbiased by an adolescent's own SU. At W3, the MP+ SU class had a higher probability of adolescent SU and lower probability of perceived peer SU than at W1. Although we predicted an AP-users class at W1 and did not predict separate ALC and SU MP+ classes at W1 and W3, LCAs generally supported hypotheses and replicated patterns in Henry et al. (2011) correcting for measurement error. The one exception was our finding that early in adolescence, there was a class of MP+ youth, most of whom had not yet initiated SU.

Given that lifetime SU variables were used to model target adolescent SU, once an adolescent entered a class in which there was adolescent SU, they were not allowed to transition back to classes in which there was no adolescent SU (AP-non-users and MP-). Transition probabilities from the final LTA model can be found in Table 3 with stabilities on the diagonal in bold. Given that the table represents predicted probabilities, odds ratios (ORs) can be obtained for specific comparisons by dividing the probabilities. As hypothesized, the probabilities suggested high stability from W1 to W2 and from W2 to W3 for AP-non-users and very high stability for AP-users from W2 to W3. In contrast, MP- and + youth had much smaller stabilities with MP- from W1 to W2 being the lowest. In fact, MP- youth were slightly more likely to transition into the AP-non-users class than the MP- class at W2 (OR = 1.08), suggesting that some MP- youth transitioned out of having a close friend peer who used. MP+ youth (both ALC and SU) were more likely to transition into the AP-users class than MP- youth from W1 to W2 (OR = 7.80); however, this changed from W2 to W3 such that MP- and + youth were near equally likely to transition into the AP-users class at W3 (OR = 1.17). Interestingly, W1 MP+ ALC and MP+ SU had similar odds of transitioning to AP-users at W2 (OR = 1.08) suggesting that misperception with and without bias had a similar sized effect on later adolescent and actual peer SU. There were small probabilities of transitioning from the MP- class to the MP+ ALC class from W1 to W2 and from W2 to W3. At W2 and W3 the odds were smaller than remaining stable in MP- (W2: OR = .42; W3: OR = .42). AP-non-users and MP+ ALC at W2 also had a small probability of transitioning to the MP+ ALC and MP+ SU classes at W3, respectively.

W4-W6 Target Adolescent SU

Youth were assigned to their most likely transition pattern across the latent class variables from W1-W3, total frequency and quantity of SU from W4-W6 was imputed across 25 data sets, and generalized linear models were run comparing youth from different transition patterns on total frequency and quantity of SU from W4-W6. Frequency of use for each substance was summed across W4-W6, respectively and then summed across substances to represent total frequency of SU from W4-W6 (M = 37.57; SD = 85.04; range = 0 – 281; skew = 2.34; kurtosis = 4.37). Quantity of use items measured average quantity of use per occasion (per frequency). As such, quantity of use was averaged for alcohol and cigarette

use across W4-W6, respectively and then summed across substances to represent total quantity of average SU per occasion (M = 1.75; SD = 2.78; range = 0 – 9.64; skew = 1.77; kurtosis = 2.64). Table 4 contains further descriptive statistics for W4-W6 quantity and frequency by the 16 transition patterns in panel A that comprised at least 1% of the sample.

A multivariate test across imputed data sets suggested that the transition pattern classes were different on total frequency (F[30, 60272] = 11.17, p < .0001) and quantity (F[30, 60272] = 31.93, p < .0001) of SU. As such, estimates of the effect of each transition pattern when compared to the class in which there was no adolescent, peer, or perceived peer SU and each planned contrast were used to calculate Cohen's d and the associated 95% confidence interval (CI; see Table 4). Planned comparisons indicated that trajectories in which actual peer SU preceded adolescent SU were not different from trajectories in which adolescent SU preceded actual peer SU. Transitioning into the AP-users class by W3 was associated with higher total frequency and quantity of later SU when compared to youth who transitioned into a MP+ class or remained stable in the MP+ classes. When compared to AP-non-users, youth whose SU preceded actual peer SU, youth with actual peer SU that preceded their own SU, youth who transitioned into a MP+ class or remained stable in the MP+ classes, and youth who transitioned into the AP-users class were all significantly higher on frequency and quantity of later SU; however, youth who remained in the MP- class were not different than AP-non-users.

Results suggest that transition patterns systematically differed on later adolescent SU such that youth who transitioned into the AP-users class by W3 were most at risk for higher levels of SU (large effects) followed by youth who transitioned into a MP+ class by W3 (small effects). Youth who remained in the AP-non-users class or transitioned into the MP- class by W3 generally had low levels of later SU that were not different from each other. Finally, when comparing AP-users to MP+ transition patterns small (frequency) to medium (quantity) sized effects were observed, suggesting that the combination of peer, adolescent, and perceived peer SU was synergistic to later levels of SU when compared to MP+ youth who did not have peers who initiated SU. Furthermore, there was evidence that entering the AP-user class by W2 resulted in the largest effects on later levels of SU (see transition pattern numbers 2, 7, 9, and 13 in panel A of Table 4) suggesting that stability in the joint effect (or chronicity of perceived peer, actual peer, and adolescent SU) had large effects on later levels of use in adolescence.

Validity analysis

Given that we observed partial measurement invariance, it is possible that differences in the latent structure across waves was not due to developmental processes but to changes in measurement. In addition, when sampling close friends we were unable to sample the entire close friend network. These methodological issues may raise questions concerning the validity of the latent classes. In prior work the validity of the classes at each wave was assessed by relating criterion variables, such as temperament, peer delinquency, peer closeness, pubertal development and demographics to the latent classes (Authors, 2015)[1].

[1]A copy of the poster that includes these results can be obtained from the first author upon request.

Youth in the AP-users class were older; higher in SES, peer delinquency, pubertal development, frustration, and surgency, a construct closely related to sensation seeking; and lower in effortful control and shyness when compared to AP-non-users. Moreover, these differences were consistent across W2 and W3 despite variance in measurement. MP+ ALC youth tended to be higher on age and peer delinquency than AP-non-users and MP- youth at W1 and W2 despite measurement variance, but generally lower on these factors than AP-users at W2. MP- youth were largely similar to AP-non-users, although they were lower than youth in MP+ classes and AP-users in peer closeness and lower than AP-non-users in affiliation. Moreover, AP-users tended to be higher than all other groups on peer closeness, frustration, and peer delinquency. Overall, these results provide support for the validity of the latent classes.

Discussion

Both perceptions of peer SU (social norms) and actual peer SU have been argued to be important proximal correlates of adolescent SU, yet only one study to our knowledge has considered these constructs together and the study was cross-sectional (Henry et al., 2011). The current study sought to address this gap by using LCA (cross-sectional) and LTA (longitudinal) to disentangle an adolescent's own SU, their perceptions of their peers' SU and their peers actual SU to more rigorously assess the validity of social norms and the influence of social norms and actual peer SU on adolescent SU. Additionally, the current study makes a contribution to the literature by adding to the limited body of work assessing transitions in and out of perceived social norms while considering SU of close friends.

Relationship between Peer, Perception of Peer, and Adolescent SU (Cross-Sectional)

The first goal of the current study was to extend the work of Henry et al. (2011) through modeling patterns of perceptions of peer SU (accurate and inaccurate) while simultaneously considering adolescent SU. Results generally supported the findings of Henry et al. (2011), especially at W2 and W3. Unlike Henry et al. (2011), however, we did not find support for an AP-user class at W1 and instead found an unbiased MP+ class at W1. Given that several factors differed in our design (structural equation modeling, close friend referent, and longitudinal design), these differences could be due to controlling for measurement error, only including close friends when assessing actual peer and perceived peer SU, or using a longitudinal design in which early adolescence is distinguished in time from middle adolescence. Despite differences, results support the overall conclusion that early in adolescence within wave reports of close friend descriptive norms are largely confounded by an adolescents own initiation status with a small class (6%) of youth whose misperceptions (+) were not biased by their own use.

At W3, there were two MP+ classes, one primarily engaged in alcohol use and another engaged in alcohol, cigarette, and marijuana use, and transitions to the latter class tended to come from the MP+ ALC class at W2. These patterns support a large literature that suggests that youth generally initiate alcohol prior to cigarettes and marijuana (e.g., Kandel, 1975) although these patterns are not believed to reflect causal relationships (Vanyukov et al., 2012). Results of our LCA demonstrate that while some adolescents accurately perceive

their peers' SU, others over-or underestimate peer SU. In addition, accurate perception is far more common than misperception throughout early adolescence. Moreover, comparison of our findings and those of Henry et al. (2011) suggests that over- and under estimation does *not* depend on whether close friends are the referent of perceived peer SU as Pape (2012) suggests, but does depend on age. Documenting that adolescents do not uniformly overestimate their peers' SU is important considering the body of work demonstrating that normative feedback interventions can have iatrogenic effects for individuals who underestimate levels of SU (Schultz et al., 2007).

Relationship between Peer, Perception of Peer, and Adolescent SU (Longitudinal)

Despite perceptions of peer SU being largely biased in the direction of an adolescents own use, patterns of biased misperception and accurate perception of peer SU were systematically related to later changes in SU behavior, perception of SU behavior, and actual peer behavior. Adolescents in the W1 MP+ ALC class were more likely to transition into the accurate perception user class at W2 and then remain in the AP-users class. Adolescents associate alcohol use with popular status and view adolescents who drink as gregarious and well-liked (Allen et al., 2005). Thus, adolescents who use alcohol as well as over perceive the alcohol use of their close friends may be highly motivated to seek out other peers who drink to obtain the positive social benefits associated with drinking. Then mutual positive reinforcement for SU behavior may be instrumental in creating a peer culture that revolves around risky behavior and SU. Although youth who under perceived their peers' SU were not at risk of transitioning to the AP-users class at W2, youth who over perceived their peers' SU but had not initiated SU were at risk. Moreover, MP+ ALC and SU were equally likely to transition into the AP-user class at W2 suggesting that whether misperceptions are biased by an adolescents own use or not, there were increased odds of transitioning to a class endorsing all three constructs. These patterns suggest three distinct pathways to the class at highest risk for later escalations in SU, two in which perceived peer SU precedes peer SU in late childhood (age: 10-12) and early adolescence (age: 12-14), and a third pathway in which peer SU precedes adolescent SU and perceptions of peer SU in early adolescence (age: 12-14). Of the first two pathways, one involved biased misperceptions consistent with a “selection” pathway, and one did not suggesting that the “overestimate” had an effect on initiation and selection of peers consistent with social norms theory. The third pathway in which peer SU preceded adolescent SU was consistent with a “socialization” or “influence” effect. As such, each pathway provides evidence consistent with selection theories, social norm theories, and social learning theories.

As hypothesized, youth who under perceived their peers SU were among the more dynamic at each wave. As discussed above, some youth ended up in the AP-users class consistent with a socialization effect; however, others remained stable or transitioned into the AP-non-user class suggesting that some youth selected out of having a close friend peer who had initiated SU consistent with social norms theory. AP-non-users and youth who over perceived their peers' alcohol use at W2 had small probabilities of transitioning to over perceiving their peers' alcohol use and over perceiving their peers' SU at W3, respectively. Taken together, these patterns suggest that youth generally start in a misperception class as well as an alcohol only class before entering a class in which peer SU, target SU, and

perception of peer SU are all likely, with a larger number of youth who over perceive their peers' SU transitioning into the AP-users class, the class most at risk for higher levels of later adolescent SU.

Levels of SU Later in Adolescence

Mean differences between transition patterns across all three waves on later total adolescent SU (W4-W6) varied systematically by transition class and quantity and frequency indices. Youth most at risk for heavy SU later in adolescence were individuals who transitioned into the AP-users class. A peer group that supports and reinforces SU over time may be instrumental in establishing more habitual patterns of SU and a peer culture that revolves around SU. Overestimating SU in the absence of peers who actually initiated was associated with higher later SU than both AP-non-users and youth who under perceived peer SU, yet less than AP-users. These results suggest that while biased perceptions of social norms are associated with later SU behavior, lack of a peer context engaged in SU is associated with less overall SU than when adolescents had peers who initiated SU.

Youth least at risk for heavy SU later in adolescence were individuals who did not initiate SU in early adolescence and accurately perceived their peers not to have initiated. Moreover, youth who transitioned into under perceiving peer SU and remained stable in their under perception were also at low risk. These results suggest that having a peer who is engaged in SU does not guarantee the initiation or escalation of SU in early to middle adolescence. Understanding what factors prevent individuals from initiating SU despite having close friends who use may aid in the development of preventative interventions.

Limitations

Our sample spanned early to middle adolescence and our findings may not generalize to older ages when SU becomes more normative. That is, in later adolescence youth may have a more accurate picture of close friend SU as SU becomes more widely accepted. Unfortunately, we did not measure perceived peer or actual peer SU from W4-W6 and could not test LCAs or another LTA in later adolescence. Moreover, given the early stage of use in the current sample, we were only able to assess initiation vs. abstinence and not levels of use at the earlier waves. As such, further research is needed to determine whether youth who accurately perceived peer initiation also accurately perceive levels of SU (quantity and frequency).

While our measure of descriptive norms asked if an adolescent's three close friends had used alcohol/cigarette/tobacco in the past year, limited resources only allowed us to sample one close friend. By not recruiting all three of an adolescent's close friends, we may have missed SU among close friends or sampled the only close friend who was engaged in SU thus influencing whether an adolescent accurately or inaccurately perceived the SU of their close friends. Although we see no reason why this would led to systematic bias in the class structure, only sampling one peer likely resulted in increased measurement error in the latent classes which could attenuate effect size.

Most social learning theories on which socialization of SU behavior hypotheses are based hold that socialization happens on a time scale of days to months through positive

reinforcement and deviancy training, a process that is dynamic in the early stages of use (e.g., Dishion et al., 1996; Dishion & Skaggs, 2000). The development of perceived social norms may also be dynamic in the early stages of SU given the vast number of experiences that likely contribute to their development. Annual assessments may provide potentially crude approximations of close friend social processes and the development of social norms. Ecological momentary assessment may more closely model the dynamic peer processes at play in early adolescence.

There is a potential concern about the appropriateness of combining two samples for analysis. Although the complexity of our models prevented us from testing measurement invariance across samples, we added sample as a covariate to our final LTA and to our final transition pattern outcome analysis to test the robustness of our results. Sample significantly predicted three of 22 comparisons in the LTA, but these effects were small (ORs range = .68 -.82) and including sample as a covariate did not change the structure of the latent classes, the *n* in each class, nor the latent transition probabilities. Finally, sample did not predict W4-W6 quantity ($p > .10$; $d = .10$; 95% CI = -.04. - .24) or frequency ($p > .10$; $d = .04$; 95% CI = -.10. - .18) of SU. These results suggest that combining samples likely had little impact on findings.

Another limitation is that in the transition pattern outcome analysis in which different transition patterns were compared on later adolescent SU (W4-W6), we assigned youth to their most likely transition pattern. This approach did not allow estimation of measurement error.

Finally, interpreting our latent transition probabilities is complicated by partial measurement invariance and having a different number of indicators across assessments (Collins & Lanza, 2010; S. Lanza & L. Collins, personal communication, January 20th, 2016). Such differences may be a manifestation of a meaningful developmental process, and in our case, may reflect how SU unfolds over time in a young community sample. Despite these measurement issues, interpretation of the transition probabilities is aided by the observation that the pattern of response probabilities was similar across waves. Nonetheless, some caution is warranted when interpreting our transition analysis.

Implications for Theory and Intervention

Results suggested that perceived social norms for peer initiation of SU were strongly confounded by an adolescent's own SU in cross-sectional analyses. That is, youth who misperceived their peer's initiation of SU in the positive (+) and negative (-) direction tended to have used and not used substances, respectively. In addition, youth who accurately perceived their peers to have used or not used substances, tended to have initiated and not initiated, respectively, suggesting that descriptive social norms are often a reflection of the adolescent's own SU in cross-sectional analyses. An exception is that very early in adolescence some youth over perceived peer SU, but had not yet initiated. Longitudinal analyses suggested that these different patterns were associated with varying risk for later adolescent initiation of SU, actual peer initiation of SU, as well as later escalations in levels of adolescent SU. As such, we would contend that perceived SU and what social norms researchers call “socialization” is likely a mix of socialization (stability in AP-users) and

adolescents shaping their peer environment based on having already initiated SU (effects of MP+ classes on later AP-users). Moreover, studies using only descriptive social norms to assess peer SU also miss important variance unique to actual peer SU (MP-) that affects later social norms and adolescent SU (effect of MP- on later MP+ and AP-users, respectively). In contrast, studies using only actual peer SU to assess socialization likely underestimate effects by not including perceived peer SU as some youth appear to be unaware of their friends SU (MP-) and subsequently do not later have close friends who have initiated SU (effect of MP- on AP-non-users). Interestingly, whether peer initiation preceded target initiation or vice versa had no impact on later levels of adolescent SU, suggesting that the specific pathway ("selection" vs. "socialization") to the AP-users class did not matter to later levels of SU. High frequency of use as well as large average quantity per use were most likely when peer, perception of peer, and adolescent SU all had a high probability of endorsement and initiation occurred early in adolescence. In addition, overestimates of peer initiation of SU often occurred in the presence of adolescents who also initiated SU, raising questions about the mechanisms of "selection" effects. That is, if overestimated social norms mostly occur in the context of adolescent initiation and these same adolescents tend to transition to high risk classes later in time, it is unclear whether adolescent SU motivates friend selection due to common interests in SU or whether biased social cognitions motivate adolescents to seek out contexts in which SU is likely to gain social acceptance. Testing these competing hypotheses would be a good direction for further research.

Additionally, the current study points to the importance of social norms interventions targeting adolescents who perceive their peers to have initiated SU. Normative feedback interventions, which look to correct adolescent misperceptions of peer SU, have demonstrated strong effects on adolescents and college students (Lewis & Neighbors, 2006). However, researchers have noted that such intervention have not demonstrated consistent effects in reducing SU and have even demonstrated iatrogenic effects in some instances (Miller, Meier, Lombardi, & Leffingwell, 2015; Schultz et al., 2007). Arguments hold that inconsistent findings and iatrogenic effects may be the result of inclusion of individuals who either under perceive or don't perceive peer SU prior to normative feedback. Schultz et al. (2007) noted that social norms interventions influence behavior through motivating people to realign their behavior with the behavior of their peers. If adolescents under perceive (MP-) or don't perceive their peers to be using (AP-non-users), which when combined comprised 88% of our community sample at W1 and 67% by W3, then, according to social norms theory, adolescents may increase their drinking to align with the actual drinking practices of their peers. Furthermore, results from the current study found that rates of use were significantly higher in the MP+ classes and the AP-users classes compared to other classes; however, it is important to note that in early adolescence the size of these classes ranged from 12% at W1 to 33% at W3 suggesting that only a portion of adolescents would benefit from social norms interventions. The overall pattern of findings also suggests that in addition to correcting descriptive social norms, interventions may boost their effects by addressing actual peer SU and selection of friends who use substances.

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		Actual Peer SU			
		No	Yes		
Perceived Peer SU	Yes	Misperception +	Accurate Perception-Users	Yes	**Adolescent Own SU**
	No	Accurate Perception-Non-users	Misperception -	No	

Figure 1.

Conceptual Contingency Table of Cross-sectional Profiles of Actual Peer SU, Perceived Peer SU, and an Adolescent own SU.

Note. + and - = misperception in the direction of an adolescents own use with + meaning over-estimation and – meaning underestimation. The table is consistent with Henry et al., (2011) and as such we hypothesized a priori that class structure at all 3 waves would replicate this pattern.

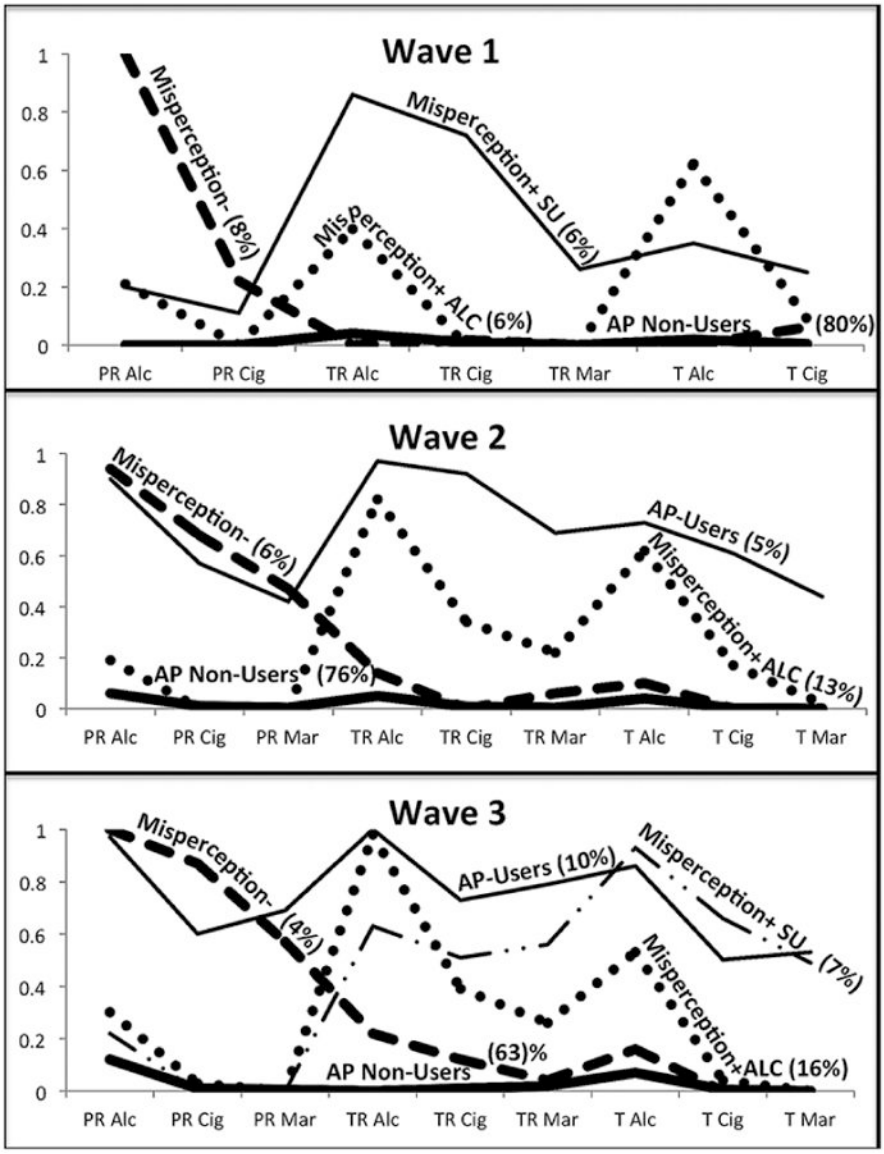

Figure 2.

Latent Class Analysis Results by Wave.

Note. PR = peer self-reported use, TR = target reported peer use, T = target's own use, Alc =alcohol, Cig = cigarette, Mar = Marijuana, SU = substance use, AP = accurate perception, + and – reflect the direction of misperception. Values on the y-axis reflect the probability of observing SU or perceived peer SU for each latent class. Percentages in parentheses reflect the proportion of sample in each class. There was no target or peer self reported marijuana use at W1 and hence these variables were not included in the analysis at W1 and can therefore be assumed to have a probability of 0 for all classes.

Table 1
Rates of Substance Use and Perceived Peer Substance Use by Wave

	Wave 1	Wave 2	Wave 3
P Alcohol	10% (70)	17% (112)	28% (174)
P Tobacco	4% (25)	8% (51)	11% (69)
P Marijuana	0% (0)	5% (34)	10% (61)
T Alcohol	6% (43)	16% (114)	29% (208)
T Tobacco	3% (22)	6% (43)	11% (47)
T Marijuana	0% (0)	3% (19)	9% (63)
TR P Alcohol	10% (79)	21% (153)	31% (225)
TR P Tobacco	5% (40)	10% (74)	18% (132)
TR P Marijuana	2% (12)	7% (55)	18% (127)
***M* T Age**	**11.8**	**12.9**	**13.9**
***M* P Age**	**11.5**	**12.4**	**13.4**
MTF alcohol	NA	NA	33-36%
MTF Tobacco	NA	NA	18-21%
MTF Marijuana	NA	NA	15-16%
NYDDS alcohol	NA	NA	40%
NYDDS Tobacco	NA	NA	16%
NYDDS Marijuana	NA	NA	7%
King et al, 2004 Alcohol	2%	NA	30%
King et al, 2004 Tobacco	7%	NA	32%
King et al, 2004 Marijuana	.2%	NA	10%

Note. P = Peer, T = Target, TR = Target Report, MTF = Monitoring the Future (Johnston et al., 2014), NYDDS = New York State Youth Development Survey (New York State Office Alcoholism and Substance Abuse Services, 2009). In the top portion of the table, percentages represent proportion of youth who endorsed initiation or perception of peer initiation of alcohol, cigarette, and marijuana use form W1-W3 in the current sample. The number in parentheses is the *N* who endorsed initiation or perception of peer initiation. In the bottom portion of the table, ranges for MTF reflect use for 8th graders in the 2009-2011 cohorts, both of which correspond to our sample at W3 and NYDDS was another 8th grade sample collected in the same state as the current sample. Note that MTF does not include “use without parents permission” as we did for alcohol use. Moreover, NYDDS did not include “without parents permission” like MTF, but NYDDS also excluded “more than a few sips.” These differences in wording are likely one explanation for the differences in alcohol use across the 3 samples. Although King et al., 2004 is a cohort from the 1990's (*N* = 1402) their assessment of all substances was similar to ours and provided a comparison for our early waves. Henry et al., 2011 reported rates of SU across a wider age range (Teen Survey [*N* = 163, age = 11-15]: 26% alcohol, 26% cigarette, 9% marijuana; Add Health [*N* = 397, age = 12-14]: 27% alcohol, 16% cigarette, 2% marijuana).

Table 2

Model Fit for LCAs from W1-W3

	# C	AIC	BIC	ABIC	Entropy	LMR	BLRT	% in class
W1	2	1926.27	1991.25	1946.79	0.89	476.44	485.41	7, 93
	3	1900.32	1993.12	1929.60	0.77	637.89	649.89	14, 9, 77
	4	**1887.95**	**1985.42**	**1918.73**	**0.90**	**737.04**	**750.92**	**5, 4, 8, 83**
	5	1892.87	2027.47	1935.378	0.90	10.88+	11.08+	4, 8, .5, 4, 83
W2	2	3229.06	3311.98	3254.82	0.89	1165.6	1183.3	14, 86
	3	3100.80	3215.97	3136.59	0.90	151.38	153.92	4, 13, 83
	4	**3003.57**	**3155.60**	**3050.81**	**0.88**	**115.91**	**117.66**	**4, 5, 11, 79**
	5	2982.16	3161.82	3037.98	0.88	122.09	124.14	3, 4, 5, 14, 74
W3	2	4265.84	4348.27	4291.11	0.88	1164.1	1183.7	31, 69
	3	4111.77	4235.41	4149.67	0.87	184.47	187.27	11, 21, 68
	4	4013.90	4165.01	4060.23	0.88	252.91	257.18	5, 10, 23, 63
	5	**3980.25**	**4158.84**	**4035.00**	**0.90**	**83.87**	**85.46**	**4, 7, 10, 15, 62**
	6	3950.51	4152.00	4012.28	0.91	61.01	62.19	3, 5, 7, 8, 15, 63

Note. W = Wave, C = class, AIC = Akaike Information Criteria, BIC = Bayesian Information Criteria, ABIC = sample size Adjusted Bayesian Information Criteria, LMR = Lo-Mendell-Rubin test, BLRT = bootstrapped likelihood ratio test. All LMR and BLRT values are significant unless labeled +, in which case, $p > .05$. Lower AIC, BIC, and ABIC values, and higher entropy indicate better fit.

Table 3

Latent Transition Probabilities

			Wave 2		
Wave 1	**1. AP/NU**	**2. MP -**	**3. MP+A**	**-**	**4. AP/U**
1. AP/NU	**0.84**	0.06	0.09	-	0.01
2. MP -	0.41	**0.38**	0.16	-	0.05
3. MP+A	0.00	0.00	**0.61**	-	0.39
4. MP+S	0.00	0.00	0.65	-	0.36
			Wave 3		
Wave 2	1. AP/NU	2. MP-	3. MP+A	4. MP+S	5. AP/U
1. AP/NU	**0.74**	0.03	0.19	0.02	0.02
2. MP-	0.05	**0.48**	0.20	0.03	0.24
3. MP+A	0.00	0.00	**0.57**	0.15	0.28
4. AP/U	0.00	0.00	0.05	0.06	**0.89**

Note. AP = accurate perception, NU = non-user, U = user, MP = misperception, + = overestimation consistent with adolescents' own initiation of SU and - = under estimation consistent with the adolescents' own non-use.

Table 4

Transition Patterns from LTA: Descriptive Statistics and Cohen's d for all Comparisons Calculated across 25 Multiple Imputations

Panel A: Transition Pattern Descriptive Statistics

LC W1➔	LC W2➔	LC W3	*N*	%	*M* freq	*M* quan	*d freq*	*d 95 % CI*	*d quan*	*d 95 % CI*	Tran #
AP/NU	AP/NU	MP-	8	1.04	51.80	1.23	0.43	-0.27 - 1.13	0.35	-0.35 - 1.05	1
MP-	AP/U	AP/U	8	1.04	242.91	4.66	2.21	1.49 - 2.93	2.55	1.83 - 3.27	2
MP-	MP-	MP-	9	1.18	43.62	1.23	0.25	-0.41 - 0.91	0.36	-0.29 - 1.02	3
AP/NU	MP-	AP/U	10	1.30	258.05	5.30	2.11	1.47 - 2.75	2.72	2.06 - 3.37	4
AP/NU	MP+A	MP+S	11	1.44	237.31	4.51	2.08	1.46 - 2.69	2.32	1.70 - 2.94	5
AP/NU	AP/NU	AP/U	14	1.83	213.68	3.50	1.84	1.29 - 2.38	1.81	1.27 - 2.36	6
MP+A	AP/U	AP/U	14	1.83	263.58	6.35	2.17	1.62 - 2.72	3.57	2.98 - 4.15	7
AP/NU	MP+A	AP/U	15	1.96	106.03	3.48	0.89	0.37 - 1.41	1.82	1.29 - 2.35	8
AP/NU	AP/U	AP/U	15	1.96	498.56	5.08	12.02	11.06 - 12.99	2.73	2.18 - 3.27	9
AP/NU	MP-	MP-	17	2.22	22.19	0.98	0.02	-0.47 - 0.50	0.19	-0.29 - 0.68	10
MP+A	MP+A	MP+A	17	2.22	207.38	2.55	1.37	0.87 - 1.86	1.15	0.66 - 1.65	11
MP-	AP/NU	AP/NU	21	2.74	34.07	1.03	0.14	-0.29 - 0.58	0.22	-0.21 - 0.66	12
MP+S	AP/U	AP/U	29	3.80	190.99	4.04	1.50	1.11 - 1.89	2.04	1.64 - 2.44	13
AP/NU	MP+A	MP+A	42	5.49	67.27	2.58	0.47	0.15 - 0.79	1.14	0.82 - 1.47	14
AP/NU	AP/NU	MP+A	90	11.76	67.56	2.04	0.44	0.21 - 0.67	0.77	0.54 - 1.002	15
AP/NU	AP/NU	AP/NU	400	52.29	20.43	0.69	-	-	-	-	16

Panel B: Transition Pattern Mean Comparisons

Tran # V Tran #	N_1	N_2	M_1	M_2	*d* freq	*d 95% CI*	*d* quan	*d 95% CI*	
7+8+12 V 2+4	58	18	186.54	251.32	-0.21	-0.74 - 0.32	-0.16	-0.69 - 0.37	-
2+4+6+7+8+12 V 5+10+13+14	90	160	203.72	94.01	0.42	0.16 - 0.68	0.64	0.37 - 0.90	-
7+8+12 V 15	58	400	186.54	20.43	1.22	0.93 - 1.50	1.96	1.66 - 2.27	-
2+4 V 15	18	400	251.32	20.43	1.87	1.38 - 2.36	2.32	1.82 - 2.82	-
5+10+13+14 V 15	160	400	94.01	20.43	0.48	0.29 - 0.66	0.82	0.63 - 1.00	-
1+3+9 V 15	34	400	34.83	20.43	0.14	-0.21 - 0.49	0.24	-0.10 - .60	-
2+4+6+7+8+12 V 15	90	400	203.72	20.43	1.16	0.92 - 1.40	1.76	1.51 - 2.02	-

Note. In Panel B all Cohen *ds* significant unless marked by non-significant^{ns}; W = *wave,* LC = latent class, ➔ reflects that the W1 to W2 to W3 columns in Panel A reflect classes of transitions across the 3 waves, Tran = transition pattern, AP = accurate perception, NU = non-user, U = user, MP = misperception, + = overestimation consistent with adolescents' own initiation of SU and - = under estimation consistent with the adolescents' own non-use, freq = frequency, quan = quantity. In Panel A, class name-class name-class name under LC (W1-W2-W3) refers to latent classes at each wave. For Panel B, Tran # reflects the transition patterns that were combined and then compared (V) For instance, the first one, 7+8+12 means that Transition Pattern numbers 7, 8, and 12 from the last column in panel A were combined and then compared to Transition patterns 2 and 4.

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