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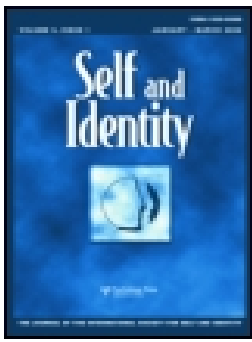
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Longitudinal links between identity and substance use in adolescence

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ABSTRACT

Identity development has been linked to substance use, but the directionality of this relationship remains unclear. We examined the longitudinal associations of educational and relational identity with substance use across three annual waves in 360 Dutch adolescents ($M_{\text{age}} = 13.7$ years). We found three latent profiles using the identity dimensions of commitment, exploration, and reconsideration as indicators. Using classification probabilities to determine participants' clusters at each time point, we distinguished stable, progressive, and regressive identity transition groups. No longitudinal associations were found between identity status transitions and substance use in either direction, but we did find significant cross-sectional correlations. Therefore, our findings do not support a directional process, but hint at a spectrum/continuity or common cause model.

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Identity development is considered a key developmental task in adolescence, and failure to construct a coherent identity is thought to be linked to maladjustment in adolescence and beyond (Erikson, 1950). Identity formation processes have also been linked to substance use in adolescence, with theoretical accounts of this association emphasizing the maladaptive nature of substance use, assuming that it is a result of abnormal identity structures (e.g., Erikson, 1950; Schwartz et al., 2011; Khantzian, 1987, 2003). However, the underlying causal processes and, directly following from that, the directionality remain unclear. In the present study, we examined the bidirectional associations between identity and substance use in adolescence longitudinally, using three waves of annual data.

The development of identity has frequently been studied using the identity status approach, in which statuses characterized by specific levels of commitment and exploration behavior are distinguished (e.g., Marcia, 1966), often using cluster analysis (Crocetti et al., 2008; Luyckx et al., 2008). Generally, five identity clusters have been differentiated: *achievement* (characterized by high commitment to an identity choice and exploration of alternatives, and low reconsideration of one's commitments), *foreclosure* or *early closure*

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(moderately high commitment, average exploration, and low reconsideration), *moratorium* (low commitment, average exploration, and high reconsideration), *searching moratorium* (high commitment, exploration, and reconsideration), and *diffusion* (low commitment, exploration, and reconsideration). Over time, adolescents are expected to move out of statuses characterized by high levels of exploration and into high-commitment statuses (i.e., progressive change; Crocetti et al., 2008). That is, adolescents are expected to move away from diffusion and via moratorium, searching moratorium, and foreclosure/early closure, move toward achievement (Meeus et al., 2010).

Previous work found that such transitions in identity statuses based on changes in commitment and exploration behavior are relatively infrequent, but transitions that have been observed are generally progressive (i.e., toward statuses defined by high commitment; Kroger et al., 2010). However, regressive changes (i.e., moving away from statuses defined by high commitment) are also relatively common during adolescence (e.g., Meeus et al., 2010). These insights highlight the importance of not only examining identity statuses but also changes between statuses (i.e., identity status transitions) through adolescence. In the present study, we examined both identity statuses and identity status transitions.

Importantly, adolescents need to figure out who they are in multiple domains of life (Erikson, 1950). However, identity processes do not necessarily develop at the same rate across different domains (Goossens, 2001). Previous research has suggested that the educational and interpersonal domain may be among the most salient for young people (Heaven et al., 2008). Educational identity encompasses the exploration of and commitment to different aspects of adolescents' educational experience (e.g., Becht et al., 2016), which includes but is not limited to values and requirements of school, participation in school, and what is being learned at school. On a more social level, educational identity also encompasses relationships with educational authority figures (e.g., teachers, mentors), and may be influenced by educational attitudes and stimulation by caregivers and siblings (e.g., Auerbach, 2007). Educational identity in adolescence may manifest itself for instance, in the process of choosing a specific curricular profile in secondary school.

In the interpersonal domain, adolescents have to explore and make choices regarding the nature of and values in their relationships with widely varying members of their social life such as friends, family members, class- and teammates, and teachers, and their own role and presentation within these relationships (Grotevant, 1987; Grotevant et al., 1982). In the present study, relational identity formation referred to the relationship with the best friend and plays a role in the selection, maintenance, and termination of friendships.

The development of a stable set of commitments to choices in various areas of life, such as friendships and education is considered a central developmental task of adolescence (Erikson, 1950). In accordance with the importance of identity, previous studies have consistently linked strong commitments to positive adolescent adjustment (Berzonsky, 2003; Luyckx et al., 2007; Van Doeselaar et al., 2016) and adolescent well-being (e.g., Meeus, 2011; Sandhu et al., 2012). For example, adolescents in the identity clusters achievement and foreclosure reported higher well-being than adolescents in moratorium or diffusion (Luyckx et al., 2005). Additionally, failure to establish a stable and meaningful identity by the end of adolescence may impede many of the psychosocial tasks of subsequent life

stages, such as engagement in intimate relationships (Erikson, 1950). Consistent with this notion, identity issues, such as the inability to commit to an identity, have been associated with a range of indicators of poor psychosocial adjustment. For example, less committed individuals are more likely to report increased levels of internalizing and externalizing symptoms, and are more likely to reside in poorly functioning families (Crocetti et al., 2009; Schwartz et al., 2005; Van Doeselaar et al., 2017). Moreover, identity diffusion has been linked to substance use (Arnett, 2005; Schwartz et al., 2011). However, these associations have not been scrutinized as frequently as the connection between identity and both internalizing and externalizing problems mentioned above.

Adolescent Substance Use

Drug surveillance data from large nationally representative surveys show that alcohol is the most prevalently used drug by youth of ages 12–18 (Johnston et al., 2019). Annual prevalence data on youth residing in the Netherlands show that by 13 years of age, 27% of adolescents reported to have tried alcohol at least once, and 9% indicated to have consumed alcohol in the past month (Stevens et al., 2018). At the same age, 4% of Dutch adolescents had smoked a cigarette and 2% had used marijuana at least once in their lives, which is considerably higher than the prevalence of other substances (e.g., 0.2% for MDMA). These numbers are similar to or somewhat lower than in other European countries (e.g., in the UK, 39% of 13 year-olds reports to have consumed alcohol at least once; Health and Social Care Information Centre, 2013).

Although the prevalence of substance use may not be different in the Netherlands from other European countries, it is important to acknowledge the tolerant climate surrounding use of some substances. Already since the 1970s, marijuana can be sold in designated shops to individuals 18 years old and over, without legal action being undertaken (although it is officially not legal). As such, there may be less stigma associated with the use of marijuana in the Netherlands than in other countries (Kilmer & Pacula, 2016). It is important to take into account this cultural aspect of substance use, as associations with normative development may be influenced by the climate around use.

In addition to alcohol, marijuana, and cigarettes, we examined the consumption of energy drinks as a lesser-known psychological risk factor. Energy drinks have become a common element of adolescent life, with over 68% of European adolescents reporting to have consumed at least one energy drink in the past twelve months, 21% consuming energy drinks two to five times a week, and 5% indicating consuming these drinks daily (Zucconi et al., 2013). The adverse physical effects of energy drinks are well documented (e.g., American Academy of Pediatrics Committee on Nutrition and Council on Sports Medicine and Fitness, 2011), with effects found on the development of cardiovascular and neurological systems. Moreover, there is increasing evidence for problems with caffeine dependence and withdrawal (Reissig et al., 2009). Although research on their psychological effects is lagging behind, preliminary evidence suggests consumption of energy drinks may also be tied to alcohol use (Arria et al., 2017; Miyake & Marmorstein, 2015), depression, and behavioral problems (Azagba et al., 2014). This is especially worrying given the large increase in energy drink consumption during the last few years (e.g., Zucconi et al., 2013). As the consumption of energy drinks is closely related to today's youth culture (Ludden & Wolfson, 2010), consumption of energy drinks may also be

intertwined with identity issues. Therefore, examining psychological effects of energy drink consumption alongside more traditionally studied forms of substance use in relation to identity represents an important extension to the existing literature.

Linking Identity and Substance Use

Past cross-sectional research often found associations between identity and substance use (e.g., Schwartz et al., 2011, 2008; Jones & Hartmann, 1988). For instance, Arnett (2005) found substance use to be associated with being in a moratorium or diffusion status. Substance use was lower in the foreclosure and achievement clusters. However, although a temporal order has often been assumed (i.e., identity issues were thought to *lead to* substance use), this proposition has rarely been tested.

Klimstra and Denissen (2017) recently proposed a framework to facilitate a better understanding of associations of identity and psychopathology. Applied to substance use, it may be that identity issues put adolescents at risk of substance use, following a “vulnerability” model. This is in line with Erikson’s (1950) description of adolescence as a period of vulnerability, in which existing identifications are relinquished, and new ones are explored and committed to. As such, adolescents may seek ways in which they can cope with the stressful and uncertain process of identity formation. Hence, some adolescents may use substances to manage stress from symptoms of psychological problems (i.e., self-medication hypothesis; Khantzian, 1987, 2003). Conversely, a strong identity may protect adolescents from substance use. For instance, recent research showed that having strong commitments predicted fewer experienced stressful life events (Van Doeselaar et al., 2017). Therefore, having a strong identity may also protect adolescents from life stress-associated substance use.

However, it is also possible – even whilst issues such as confusion about one’s identity (i.e., identity diffusion) may put adolescents at risk of substance use – that substance use leads to changes in identity. Substance use may impede successful navigation during adolescence and prevent adolescents from learning important skills, such as social or self-management skills, which are important in later life (e.g., for successful parenting; Bailey et al., 2013). Subsequently, these adolescents may be more likely to make poor choices in multiple life domains (e.g., educational, occupational, relational), which forces them into adult roles underprepared (i.e., developmental acceleration; Newcomb & Bentler, 1988). In the end, this interference with normative adult role socialization may impede the formation of a mature and well-adjusted identity. Substance use may also prevent adolescents from taking on these adult roles at all, leaving them in diffusion (i.e., developmental hiatus; Baumrind & Moselle, 1985; Newcomb & Bentler, 1988). However, past research has also found that alcohol and marijuana use both predict higher openness at a later time point (Klimstra et al., 2014). This may reflect that the use of these kind of substances can also be mere experimentation. Following from this, substance use may not only predict identity but also predict directionality in identity status transitions (i.e., regressive, progressive, or stability) across time.

The associations between the two become even more muddled as substance use may become part of an adolescent’s identity (e.g., “I am a marijuana user”). When this happens, it can have important implications for educational performance (Ellickson et al., 2004), because adolescents could feel that doing well at school does not fit with their identity as

a substance user. The resulting change in performance may in turn affect their educational identity (Pop et al., 2016), suggesting an indirect effect between substance use and educational identity where we may see a regressive identity status transition over time. Furthermore, identifying as a substance user may be especially vital for peer relationships when friends share this identity, as a shared identity may strengthen friendship ties (Fiske, 1992). Conversely, when friends do not use substances or even hold negative attitudes concerning substance use, this may result in lower identification with friends – and potentially the termination of these friendships. Therefore, in some cases a strong relational identity may be positively linked to substance use, with substance use predicting more progressive identity status change.

However, identity issues may not be linked to substance use alone, but also to the abstinence from substances. Abstinence, or developing principles/values that promote risk-aversion, is often seen as the best strategy to deal with risks that adolescents may face (e.g., Reyna & Mills, 2014), but there is some evidence that overly risk-averse adolescents may in fact show poorer psychosocial adjustment (e.g., Akse et al., 2007). This is consistent with Moffitt (1993, 2018), who suggested that, because antisocial behavior may be more socially accepted by peers during adolescence, abstaining completely from such behaviors potentially could be viewed as a sign of poor adjustment (Krueger et al., 1994; Mercer et al., 2016; Moffitt et al., 1996). In the context of adolescent substance use, research on abstinence has generated support both for (Shedler & Block, 1990; Siebenbruner et al., 2006) and against (Milich et al., 2000; Tucker et al., 2006) Moffitt's (1993) hypothesis regarding the role of minor delinquency as part of youth socialization. For instance, use of alcohol and marijuana has been linked to delayed psychosocial maturity in male juvenile offenders (Chassin et al., 2010). However, if substance use is indeed a form of exploration, individuals who abstain from this behavior may be expected to be worse off in terms of identity development in some life domains.

Adding to the complexity, the association between identity and substance use (and abstinence) likely depends on the specific life domain under study. On the one hand, substance use may be part of more general rebellious behavior, and may thus be expected to weaken commitment to domains that adolescents feel are not in line with this behavior, such as educational identity. On the other hand, in a life phase where substance use is increasingly socially accepted, substance use may actually lead to stronger commitment to friends (who use substances). With respect to substance abstinence, it may thus be expected that abstinence is related to poorer relational, but not educational identity. When examining linkages between identity formation and substance use, it is therefore important to distinguish between these different life domains.

The Current Study

In the present study, we investigated the association between identity formation and substance use. The present study adds to existing cross-sectional evidence linking identity and substance use by testing the direction and temporal order of the association. First, we examined to what extent the use of, or abstinence from substances was linked concurrently to identity clusters in a sample of Dutch adolescents, as derived from the three-dimension identity model (Crocetti et al., 2008). Specifically, we examined the association of identity status with alcohol, marijuana, and cigarette use, and more explorative, with

energy drinks consumption. Based on previous research on identity profiles using the same model (e.g., Luyckx et al., 2008; Meeus et al., 2010), we expected to find the five clusters of achievement, foreclosure/early closure, moratorium, searching moratorium, and diffusion. Given that commitment and reconsideration present a polarity between certainty and uncertainty (e.g., Schwartz et al., 2015), we also hypothesized a second, fallback model in which there would be one “average” class, one high commitment-low reconsideration class, and one low commitment-high reconsideration class. No expectations were held regarding the level of in-depth exploration in these last two clusters.

It was hypothesized that there would be higher representation of substance-using adolescents in clusters defined by low commitment (e.g., moratorium), in particular for educational identity (Hypothesis 1). Second, we investigated whether substance use predicted transitions between the identity clusters using data from three consecutive years. Because substance use was expected to serve a different function in the educational domain than in the relational domain, our hypotheses for this association were two-fold. We hypothesized that for educational identity, substance use would predict regressive change between identity clusters. That is, moving out of clusters characterized by high commitment (e.g., achievement) and into clusters characterized by high exploration (e.g., moratorium; hypothesis 2a). For relational identity, we expected substance use to predict progressive cluster change. In other words, moving out of clusters characterized by high exploration (e.g., moratorium) and into clusters characterized by high commitment (e.g., achievement; hypothesis 2b). Finally, we examined the extent to which routes of identity cluster transitions would be associated with substance use, as substance use may also be a form of coping with uncertainty brought on by the process of identity formation. It was expected that regressive cluster change of both educational and relational identity would be linked to increases in substance use (Hypothesis 3). We examined the effects of different substances by testing all hypotheses separately for the use of alcohol, marijuana, cigarettes, and energy drinks. The study’s hypotheses and methods were pre-registered at <https://osf.io/cf5z4/>. Please note that due to statistical and practical reasons, the final study deviates in several ways from our pre-registration. Table S1 of the Supplementary Material provides a complete overview of the deviations and the reasons for these deviations.¹

Method

Sample

We used data from the Study on Personality, Adjustment, Cognition, and Emotion II (SPACE-II). For this project, no specific sample size was aimed for, but instead as many potential participants as possible were approached and included. In the cross-sectional study, 949 Dutch adolescents filled out questionnaires, including information on identity and substance use. Adolescents were recruited at four different high schools from medium-sized cities (i.e., Tilburg, Rotterdam, Dordrecht, The Hague) in the south-west of the Netherlands and across various academic tracks. Of these schools, adolescents from three schools were followed longitudinally ($n = 360$, M_{age} at T1 = 13.7, $SD = 1.10$), in 2014, 2015, and 2016. Approximately half of these adolescents were female (49.7%). Of participants reporting their educational level, 9% were in the pre-vocational education track

(VMBO; preparatory track for jobs such as mechanic, beautician, call operator), 43% were in the pre-professional education track (HAVO; jobs such as accountant, social worker, IT engineer), and 48% were in the pre-academic education track (VWO; jobs such as lawyer, psychologist, veterinarian; see also Table 1). Comparing this to the distribution of the Dutch adolescent population at the time of data collection in 2014 (40%, 30%, and 30%, respectively; Central Bureau for Statistics, 2018), we see that individuals from VMBO were underrepresented and individuals from VWO overrepresented in our sample. This project was approved by the IRB of Tilburg University.

Measurement

Identity

To measure educational and relational identity we used the Utrecht-Management of Identity Commitments Scale (UMICS; Crocetti et al., 2008). The questionnaire consists of 13 items that tap into commitment, in-depth exploration, and reconsideration behavior, and are rated on a 5-point Likert scale, ranging from 1 (*Completely true*) to 5 (*Completely untrue*). To facilitate interpretation, the identity items were reversed so that high scores indicate high commitment, exploration, and reconsideration. Example items of the UMICS are “My school/best friend gives me certainty in life” (commitment), “I think a lot about my education/best friend” (in-depth exploration), and “I often think it would be better to try find a different education/best friend” (reconsideration). Past studies have found the UMICS to present acceptable reliability and validity (e.g., Crocetti et al., 2010; Meeus et al., 2010). In the current study, coefficient alphas across the three waves ranged between .71 (T1 reconsideration) and .91 (T3 commitment), and between .60 (T1

Table 1. Descriptive statistics of the sample ($N = 360$).

	Wave 1		Wave 2		Wave 3	
	<i>M</i> (<i>SD</i>)/ <i>N</i> (%)	Range	<i>M</i> (<i>SD</i>)/ <i>N</i> (%)	Range	<i>M</i> (<i>SD</i>)/ <i>N</i> (%)	Range
Age wave 1	13.7 (1.10)	11–18				
Sex (female)*	176 (49.7%)	–				
Educational level*						
VMBO	33 (9.3%)	–				
HAVO	152 (42.9%)	–				
VWO	169 (47.8%)	–				
Educational identity						
Commitment	3.37 (.85)	1–5	3.29 (.85)	1–5	3.06 (.89)	1–5
In-depth exploration	2.74 (.81)	1–5	2.59 (.80)	1–4.8	2.34 (.85)	1–5
Reconsideration	2.00 (1.03)	1–5	1.87 (1.05)	1–5	1.96 (.99)	1–5
Relational identity						
Commitment	3.69 (.95)	1–5	3.71 (.88)	1–5	3.61 (.91)	1–5
In-depth exploration	3.00 (.86)	1–5	3.08 (.84)	1–5	3.03 (.87)	1–5
Reconsideration	1.79 (.92)	1–5	1.56 (.83)	1–5	1.60 (.79)	1–4.3
Substance abstinence*						
Alcohol	59 (70.2%)	–	60 (56.1%)	–	–	–
Marijuana	344 (97.2%)	–	274 (91.6%)	–	96 (93.2%)	–
Cigarettes	319 (89.9%)	–	257 (86.5 %)	–	155 (88.1%)	–
Energy drinks	211 (59.9%)	–	200 (63.3%)	–	119 (68.0%)	–

Note. The numbers in the table represent the raw data statistics, before imputation.

*Percentage of those that filled out the item.

reconsideration) and .94 (T3 commitment) for the educational and relational domain, respectively.

Substance use

Substance use was assessed with a newly constructed measure which was similar to a measure used in previous longitudinal studies in the Netherlands (e.g., Keijsers et al., 2012; Nelemans et al., 2014) and based on questions from the ongoing longitudinal Peilstation study which examines substance use in secondary schools across the Netherlands every four years (Van Dorsselaer et al., 2016). This measure was used to assess the frequency of substance use based on a past 12-month period. Specifically, the measure contained separate items about 1) alcohol consumption, 2) marijuana use, 3) cigarette use, and 4) the consumption of energy drinks. Given the overall prevalence of use of alcohol, cigarettes, and energy drinks versus marijuana, we measured these substances on a different metric, in line with previous work on Dutch adolescents (e.g., Nelemans et al., 2016). For alcohol and energy drink consumption, response categories ranged from 1 (*Never drank alcohol/energy drinks*) to 6 (*Daily*). Marijuana use was rated on a 14-point scale, ranging from 1 (*Never used marijuana*) to 14 (*Used marijuana over 40 times in the past 12 months*). Cigarette use was measured on a scale from 1 (*Never smoked a cigarette*) to 9 (*Daily*). Due to an administrative error, frequency of alcohol use was not measured in the third wave. As such, we did not have information on alcohol use at this wave.

Statistical Analyses

Preliminary analyses

Of all participants in the longitudinal sample, 64.7% ($n = 233$) participated in two waves, and the remaining 35.3% ($n = 127$) participated in all three waves. Compared to participants with data at two waves, participants with data at three waves were significantly younger at T1. Moreover, participants with data at three waves scored higher on educational and relational exploration, and lower on educational and relational reconsideration at T1. There were no differences on any of the substance use variables (see Table S3 of the Supplementary Material for a detailed description of these analyses). Next, we examined patterns of missing values in our identity and substance use data by running Little's (1988) missing completely at random (MCAR) test in IBM SPSS version 25.0. The p -value of this test was .372, signaling that we would not have to reject the null hypothesis of data missing at random. Thus, imputation of missing data was justified, which was done using predictive mean matching (PMM; Little, 1988). PMM is a way of handling missing data in which an observed value is imputed for the missing value using a set of related indicators as predictors. PMM has been shown to perform quite well in preserving the underlying distribution of the data and the relationship within the dataset (e.g., Vink et al., 2014). In the presence of a binary variable, PMM has been found to be the optimal method for dealing with missing data (Peeters et al., 2015).

For the latent profile transition analyses (LPTAs), we used scores on the UMICS identity scales as indicators for the profiles. However, as the meaning of identity may have changed across the duration of the study, we first tested for measurement invariance across time for the indicators of our profiles: the scale scores of educational and relational

identity. We found evidence for strong invariance (i.e., equal factor loadings and intercepts; scalar invariance) for educational and relational identity, indicating that the results for identity could be meaningfully interpreted (see pp. 4–5 of the Supplementary Material for a detailed description of these analyses). Hence, they could be used as indicators for the latent profiles at the various measurement occasions.

Latent profile transition analyses

To examine whether substance use (i.e., alcohol, marijuana, cigarettes, and energy drinks) predicted identity cluster membership and the changes between clusters, we performed latent profile transition analyses (LPTAs). LPTAs are longitudinal extensions of latent profile analyses (LPA), a statistical technique that generates clusters based on empirically distinct patterns of responses across multiple variables and estimates probabilities of individuals belonging to, and transitioning between these clusters. With LPTA, we could then examine the probabilities of being classified in a cluster at the first wave (i.e., initial classification probabilities) and of moving from one specific cluster to another across waves (i.e., transition probabilities; Vermunt et al., 2008). We used LPTA because it allows for the empirical examination of the identity clusters present in the data based on a set of variables, takes uncertainty of membership into account, and – unlike cluster analysis techniques such as the two-step approach that is often used in identity research (e.g., Crocetti et al., 2008) – offers fit statistics (Vermunt & Magidson, 2002).

In the present study, we estimated clusters using observed scores on the subscales of identity (i.e., commitment, exploration, reconsideration). We expected to find five identity clusters for both educational and relational identity, based on previous research (see hypotheses). Variances were allowed to vary across clusters. The LPTA models were estimated in Latent Gold version 5.1.

These models were further expanded by introducing substance use as a covariate of the initial classification and transition to test our first and second hypotheses. More specifically, we investigated whether the probabilities of belonging or transitioning to a certain cluster differed for abstainers versus their substance-using peers. To do so, a dichotomized variable indicating abstinence versus substance use (0 = abstainer, 1 = user) was entered as a predictor in the LPTA. This allowed us to examine the extent to which substance use (versus abstinence) was related to cluster membership and predicted transitions between clusters across waves. Sex, age, and educational level were entered as control variables.

Three criteria were set to determine the best LPTA solution. First, each cluster needed to include more than 5% of the sample, as problems related to statistical power and interpretation may arise when we would examine the transitions between more uncommon types. Second, the Lo-Mendell-Rubin likelihood test (LMR-LRT; Lo et al., 2001) should be significant ($p < .05$), indicating that a model with k clusters fits the data better than a model with $k-1$ clusters. Last, the Bayesian information criterion (BIC; Schwarz, 1978) should be lower compared to solutions with fewer clusters. We used an alpha level of .01 to test the significance of our analyses, to control for multiple testing.

To test our third hypothesis that transition routes of identity clusters predict substance use, we assigned individuals to different higher-order identity transition groups, using their estimated posterior probability estimates. Specifically, we used the cluster to which they were the most probable to belong at each wave to create a (probable) identity

cluster trajectory for each person. We then combined these different trajectories into three broader cluster transition routes. We examined the association of a progressive, a regressive, and a stable route across T1-T3 with substance use at T3. For this purpose, we performed analyses of covariance (ANCOVA) for each of the substances (i.e., alcohol, marijuana, cigarettes, and energy drinks) and for both educational and relational identity, yielding six ANCOVAs in total. Sex, age, education level, and substance use at T2 were included as control variables.

Results

Descriptive statistics of the demographic variables as well as the study variables (i.e., identity domains and substance use abstinence) are reported in [Table 1](#). As expected, abstinence was most common for marijuana use, followed by cigarette and then alcohol use, and lowest for energy drink consumption (97.2%, 89.9%, 70.2%, and 59.9% at T1, respectively). Zero-order correlations between the study variables are reported in [Table 2](#). Alcohol, marijuana, and cigarette use showed weak to moderate negative correlations with educational commitment, whereas energy drink use was not significantly correlated with educational commitment. Alcohol, marijuana, and cigarette use were negatively, but inconsistently, related to relational commitment with significant relations at some waves but not others. Energy drink consumption was not linked to relational commitment. Associations with educational and relational exploration were generally negative but small, and only reached significance for alcohol use and educational exploration at T1. Interestingly, only cigarette use and energy drink consumption were positively related to educational reconsideration, whereas all four substances were correlated with relational reconsideration, showing weak to moderate effect sizes. Correlations were generally strongest at T1 and decreased in size across waves. In addition to the main results discussed below, effects of the control variables are reported in [Table S4](#) of the [Supplementary Material](#).

Educational Identity

Models with up to six educational identity clusters were fitted to the data. Adding an additional cluster consistently led to lower BIC values. Moreover, all LMR-LRTs were significant ($p < .05$) and all six solutions had clusters containing over 5% of the sample. To make a decision as to the best fitting model, we plotted and inspected BIC values to determine the point at which the plotted line flattened out and BIC values no longer decreased considerably anymore (Vermunt, 1996). This technique is similar to the procedure of determining the best fitting model in Exploratory Factor Analysis based on a scree plot. In this case, the plotted line flattened out after a solution with three clusters and, as such, this solution was chosen as the best fitting solution (see [Figure 1a](#) for the clusters). In addition to the three-cluster solution, a five-cluster solution was fitted to compare the current study's results to those of previous studies (see [Table S5](#) and [Figure S1a](#) of the [Supplementary Material](#)). Although two clusters of this five-cluster solution did somewhat resemble the clusters of (early) closure (i.e., Profile 1) and achievement (i.e., Profile 2) found in previous research, the majority of the clusters did not resemble previously identified identity clusters.

Table 2. Zero-order correlations between the predictor variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Alcohol									
2. Marijuana									
T1	.37*								
T2	.24*								
T3	—								
3. Cigarettes									
T1	.28*	.35							
T2	.24*	.34*	.18*						
T3	—	.42*	.24*						
4. Energy drinks									
T1	.12	.07	.12						
T2	.26*	.04	.24*						
T3	—	.03	.12						
5. Educational commitment									
T1	-.33*	-.21*	-.30*	-.11*					
T2	-.06	-.16*	-.16*	-.07					
T3	—	-.17	-.13	.04					
6. Educational exploration									
T1	-.23*	-.10	-.10	-.06	.26*				
T2	-.07	-.10	-.04	-.01	.30*				
T3	—	-.13	-.10	-.04	.28*				
7. Educational reconsideration									
T1	.06	.06	.05	.15*	-.32*	.04			
T2	.06	.01	.12*	.24*	-.42*	.11*			
T3	—	.08	-.04	-.08	-.45*	.14			
8. Relational commitment									
T1	-.33*	-.10	-.16*	-.01	.24*	.18*	.01		
T2	.01	-.12*	-.14*	-.03	.26*	.18*	-.12*		
T3	—	.12	.10	.14	.26*	.16*	-.29*		
9. Relational exploration									
T1	-.20	-.01	.01	.05	.04	.38*	.05	.45*	
T2	.04	-.07	.01	.02	-.07	.33*	.10	.48*	
T3	—	<-.01	.14	.04	-.10	.37*	.15*	.41*	
10. Relational reconsideration									
T1	.22*	.10	.19*	<.01	-.14*	-.08	.20*	-.24*	-.02
T2	.22*	.11*	.17*	.14*	-.06	.16*	.32*	-.38*	-.06
T3	—	-.08	-.10	-.03	-.02	.26*	.34*	-.32*	.10

Note. For each correlation, the estimates are presented for wave 1, wave 2, and wave 3.
* correlation is significant at the .01 level.

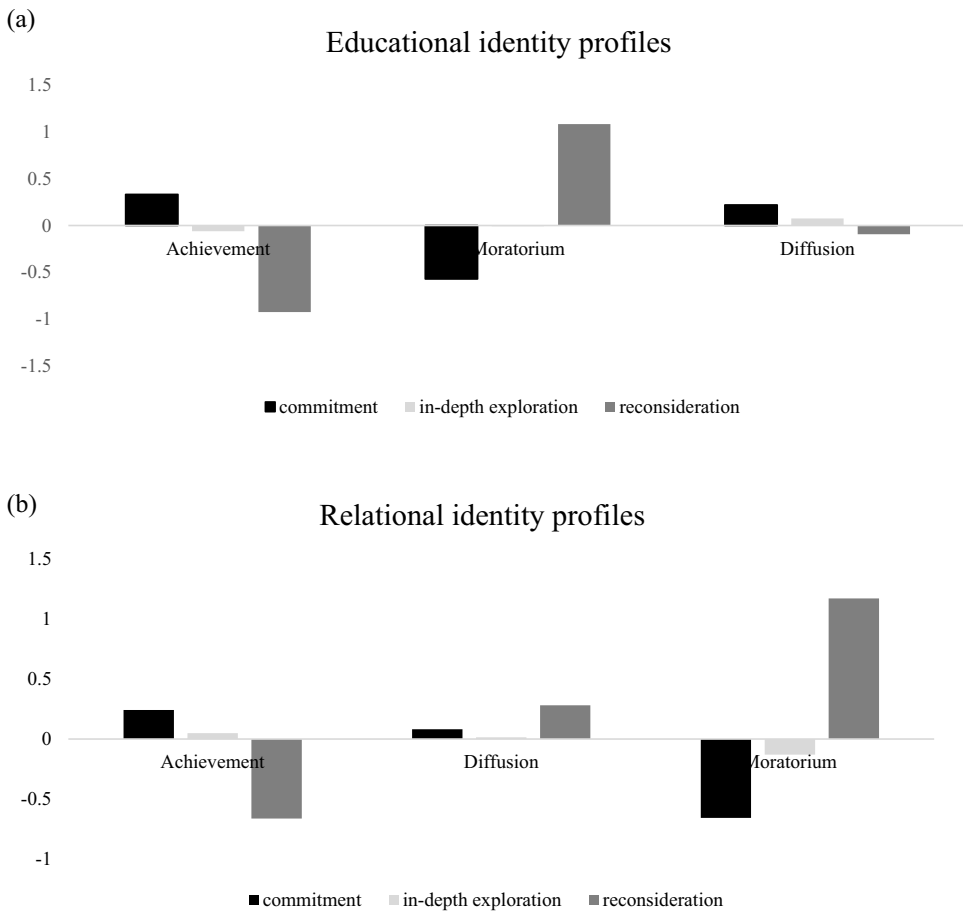


Figure 1. Identity profiles in final solutions for educational identity (1a) and relational identity (1b). *Note.* The scores in the figures represent deviation scores from the sample average.

The three clusters of the best-fitting solution (with sex, age, and education level included, $LL = -2477.75.90$, $BIC = 5249.81$) were labeled *achievement* (i.e., high on commitment, average on in-depth exploration, and low on reconsideration; 35.1%), *moratorium* (i.e., low on commitment, moderately high on in-depth exploration, and high on reconsideration; 32.8%), and *diffusion* (i.e., moderately high commitment, moderately low in-depth exploration and reconsideration; 32.1%). Across waves, there was an increase and then a decrease in the proportion of adolescents who were in *achievement* (i.e., T1 33.8%, T2 38.4%, T3 33.9%). There was stability and then an increase in adolescents who were in *moratorium* (i.e., T1 31.8%, T2 29.1%, T3 36.2%), and a decrease in the proportion of the sample classified in *diffusion* (i.e., T1 34.4%, T2 32.4%, T3 29.9%).

Substance use vs. abstinence

To test hypotheses 1 and 2a, a model with three clusters was fitted, including the control variables (i.e., age, sex, education level) and the dichotomous substance use versus abstinence variables ($LL = -2437.21$, $BIC = 5451.26$). Use versus abstinence of alcohol,

marijuana, cigarettes, and energy drinks was not significantly related to identity transitions (Wald $\chi^2 = 7.61, p = .270$, Wald $\chi^2 = 8.78, p = .190$, Wald $\chi^2 = 6.99, p = .320$, and Wald $\chi^2 = 13.05, p = .042$, respectively).

Identity transition groups predicting substance use

Next, to test hypothesis 3, we discuss the effects of identity on substance use. To examine these effects, we determined the most likely cluster at each wave for all individuals using the posterior probabilities estimated in the LPTA. Then, we divided the sample based on membership to one of the three identity transition groups. Specifically, we distinguished a *stable* route (i.e., those who were in the same identity cluster at T1 and T3), a *progressive* route (i.e., those who experienced positive identity cluster change from T1 to T3; moving from diffusion to achievement, or from moratorium to diffusion or achievement), and a *regressive* route (i.e., those who experienced negative identity cluster change from T1 to T3; moving from diffusion to moratorium, or from achievement to diffusion or moratorium). Identity transition group membership, in addition to sex and age as control variables, was then entered into an ANCOVA to explain substance use. This ANCOVA showed that educational identity transition group membership did not significantly predict marijuana use, $F(2, 92) = 0.38, p = .682$, cigarette use, $F(2, 164) = 1.64, p = .198$, or energy drink consumption, $F(2, 163) = 1.87, p = .158$ at T3. The effect of identity transition group membership could not be calculated for alcohol use at T3, as there were no data available on alcohol consumption at this time point. To obtain greater insight into this relation, we ran a post-hoc analysis on alcohol use at T2, using the educational identity routes across T1 and T2 as predictor. Educational identity route significantly predicted alcohol use at T2 ($F(2, 100) = 1.48, p = .001$). Examining the paired comparisons showed that adolescents with a stable versus a regressive route were more likely to abstain from alcohol at T2 (mean difference of $-.49, p < .001$).

Relational Identity

Also for relational identity, we tested models with up to six identity clusters. BIC values were lower for solutions with up to six clusters. Each LMR-LRT was significant, indicating that each solution had a significantly better fit than a model with one less profile. However, solutions with four or more clusters had groups consisting of $<5\%$ of the sample. As such, a solution with three clusters was selected for further analyses (see [Figure 1b](#) for the clusters). Additionally, we estimated a five-cluster solution to compare the clusters of the present study to those of previous studies on identity (see Table S5 and Figure S1b of the Supplementary Material). Consistent with the findings for educational identity, these clusters only very loosely resembled those found in previous work.

The clusters of the best-fitting solution (with control variables included, LL = -1938.90 , BIC = 4172.10) were named *achievement* (i.e., high on commitment, average on in-depth exploration, and low on reconsideration; 50.5%), *moratorium* (i.e., low on commitment, moderately low on in-depth exploration, and high on reconsideration; 21.9%), and *diffusion* (i.e., moderately high on commitment and in-depth exploration, moderately low on reconsideration; 27.6%). Across waves, there was an increase and then a decrease in *achievement* (i.e., T1 44.1%, T2 56.6%, T3 52.8%), a decrease and then an increase in

prevalence in *moratorium* (i.e., T1 19.5%, T2 16.0%, T3 20.5%), and a decrease in *diffusion* (i.e., T1 36.4%, T2 27.4%, T3 26.7%).

Substance use vs. abstinence

A model with three clusters including the control variables and the substance use versus abstinence variables was fitted to the data (LL = -1900.15, BIC = 4377.15) to test hypotheses 1 and 2b. Alcohol (Wald $\chi^2 = 12.61$, $p = .050$), marijuana (Wald $\chi^2 = 9.74$, $p = .140$), cigarette (Wald $\chi^2 = 11.13$, $p = .084$), and energy drinks use (Wald $\chi^2 = 13.66$, $p = .034$) were all not significantly related to identity transitions.

Identity transition groups predicting substance use

As for educational identity, to test the effect of relational identity on substance use we divided the sample based on most likely membership (i.e., posterior probabilities) to one of three transition groups (Hypothesis 3). We distinguished stable (i.e., same identity cluster at T1 and T3), progressive (i.e., positive cluster change from T1 to T3), and regressive (i.e., negative identity cluster change from T1 to T3) routes. Entering group membership as a predictor of substance use in an ANCOVA, we found that relational identity transition membership was not significantly related to T3 marijuana use, $F(2, 92) = 0.45$, $p = .641$, cigarette use, $F(2, 164) = 0.07$, $p = .929$, or energy drink consumption, $F(2, 163) = 1.70$, $p = .185$. We could not estimate the effect of relational identity transition membership on T3 alcohol use due to a lack of data. To obtain greater insight into the relation between relational identity transition membership and alcohol use at T2, we ran a post-hoc analysis with alcohol use at T2 and identity transition route across T1 and T2. Similar to the findings for educational identity, results indicated that identity transition membership predicted alcohol use at T2 ($F(2, 100) = 5.43$, $p = .006$). Examining the paired comparisons, however, showed that none of the identity route comparisons represented significant differences. It should be noted that the Tukey test used for these comparisons is known to be conservative (e.g., Howell, 2010). This possibly explains why the overall significant effect does not translate to any significant differences in the specific comparisons.

Discussion

In the present study, we examined to what extent adolescent substance use (i.e., alcohol, marijuana, cigarettes, and energy drinks) was related to the development of educational and relational identity in adolescence. Previous research only focused on the cross-sectional links between identity and substance use (e.g., Arnett, 2005), and did not sufficiently take into account the possibility of identity domain-specific effects (Goossens, 2001). The present findings corroborated earlier findings on cross-sectional associations but did not support the existence of longitudinal associations between adolescent substance use and identity development. Before discussing these findings in detail, we turn to the issue of the three-cluster model for identity found in the present study.

Identity Clusters

Three identity clusters, *diffusion*, *achievement*, and *moratorium*, were consistently identified across both identity domains. Furthermore, we found consistent overall developmental patterns. Specifically, we saw a decrease in the proportion of adolescents that were in *diffusion*, which suggests that adolescents became more engaged in thinking about and exploring their identity over time. This is in line with the idea that adolescence is the period in which youth first start to consider who they are (Erikson, 1968). The proportion of adolescents in *achievement* increased and then slightly decreased, whereas the proportion in *moratorium* decreased and then slightly increased over time, which is in line with what has been called the maturity dip in mid-adolescence (Denissen et al., 2013).

The clusters from the present study are similar to those obtained in previous studies (e.g., Klimstra et al., 2011; Crocetti et al., 2008). Like in past research, we found a high commitment cluster (*achievement*), a high reconsideration cluster (*moratorium*), and a cluster that was defined by average levels of identity commitment, exploration, and reconsideration (*diffusion*). As such, this latter cluster may not be diffused in the classic sense, as individuals in this cluster actually scored around the sample average on all three identity features. However, we failed to replicate all five identity clusters. Even if we would have opted for five-cluster solutions, five-cluster solutions drawn from our sample did not resemble the five typical clusters of *achievement*, *diffusion*, *foreclosure*, *moratorium*, and *searching moratorium* (see Table S5 and Figure S1 of the Supplementary Material). Post-hoc analyses using traditional cluster analysis (e.g., using a two-step procedure; Crocetti et al., 2008) on the five-profile clusters from the our data suggested that our divergent findings may be due to using LPAs rather than traditional cluster analyses, as these clusters were different from our three- and five-cluster LPA solutions, and quite similar to clusters found in previous research (see Table S6 and Figure S2 of the Supplementary Material). Simulations (e.g., Magidson & Vermunt, 2002) have shown that LPAs are superior to other clustering techniques, which is why we recommend the use of LPAs in large samples. In contrast to traditional cluster analyses, LPTA is based on empirical data patterns, takes uncertainty of membership into account, and provides fit statistics that can help gauge model efficiency when deciding between solutions with k versus $k + 1$ classes (Vermunt & Magidson, 2002). In addition, LPTA is a model-based clustering technique. As such, LPTA, but not traditional forms of cluster analysis, estimates a statistical model for the population from which the sample is drawn, making it more likely to be generalizable to the larger population. It is possible that results from studies using LPA will converge better with our findings than results from studies using cluster analysis. Moreover, it is worthwhile to note that while previous research using cluster analysis has often used the same labels for their clusters, their contents sometimes differed markedly.

Another factor that may have contributed to the differences in findings is the age of the participants. At the first assessment wave, participants were on average 14 years old, with some as young as 13, whereas previous research often employed somewhat older adolescent samples (e.g., 16.5 years-old on average; Klimstra et al., 2011). Identity is expected to develop with age; thus, the age of assessment should be related to the identity status adolescents are in (Meeus et al., 2010). Similarly, transitions from one identity status to another may be expected to be partly determined by age (e.g., Kroger

et al., 2010). For instance, although older adolescents are expected to move into achievement, this transition may be less likely for younger adolescents. However, the fact that other research using samples more similar to ours in terms of age also found the typical five-cluster solution (e.g., Crocetti et al., 2008; Meeus et al., 2010) seems to suggest that factors other than age are important in understanding the difference in cluster structure between previous work and the present study. Further research should examine the issue of invariance of the cluster structure for identity more thoroughly.

Identity and Substance Use

The overall pattern of cross-sectional correlations between the identity subscales and substance use replicated findings from previous work on identity and substance use (e.g., Arnett, 2005; Schwartz et al., 2011, 2008; Jones & Hartmann, 1988). That is, in line with earlier cross-sectional work, we found negative links of use of alcohol, marijuana, cigarettes, and energy drinks with identity commitment in both domains. Substance use also was positively related to more reconsideration of identity commitments. This shows that use of substances may indeed be related to poorer adolescent adjustment.

However, we found little support for longitudinal relations between identity statuses and substance use, thus rejecting our hypotheses, which were pre-registered on the Open Science Framework website before we inspected and analyzed the data. Specifically, substance use was not a predictor of having an identity status characterized by low commitment (Hypothesis 1). Substance use also did not predict regressive status change in educational identity (Hypothesis 2a), or progressive status change in relational identity (Hypothesis 2b). Finally, we found some support that regressive identity status change predicted a greater likelihood of using substances (Hypothesis 3). Specifically, adolescents who experienced regressive change had a greater likelihood of using alcohol at a later time point, compared to adolescents who remained in the same identity status. No differences in substance use were found between specific pairs of transition routes for relational identity. However, these findings should be interpreted with some caution. As there were no data on alcohol use available at T3, we could only exploratively test the predictive effect of identity status change from T1 to T2 on alcohol consumption at T2. As such, more research is needed to replicate this finding across more waves.

Our findings suggest that while identity statuses may be related to substance use at the same time point, status membership does not predict substance use or vice versa. That is, the two may co-occur, but are not causally related. As such, our findings do not support the framing of identity structures as a catalyst for substance use in existing theory (e.g., Erikson, 1950; Schwartz et al., 2011; Khantzian, 1987, 2003). Instead of the “vulnerability” model (in which identity puts adolescents at risk of substance use) and the “scar” model (in which substance use impedes adolescents identity development) that we initially considered, another theoretical framework may provide a better explanation for the association between substance use and identity (Klimstra & Denissen, 2017). Specifically, the present findings could be explained by a spectrum/continuity model, in which identity and substance use might be extremities of the same underlying construct, or a common cause model. While the former seems unlikely, in the latter case, both identity issues and substance use may, for instance, be predicted by stressful experiences (Anthis, 2002; Low et al., 2012), personality pathology (Bogaerts et al., 2020), or lack of

autonomy (Ryan et al., 2006). However, several issues need to be considered before we can apply these explanations.

First, it is possible that the findings of the current study are specific to the Dutch context, due to the tolerant climate regarding substance use. The lower stigma attached to substance use may have affected our findings, such that more positive effects, and less harmful effects may be expected when substance use is not stigmatized (Hathaway et al., 2011). As a result, positive and negative effects may have canceled each other out in this case. Second, and related, adolescent identity development takes place in many different areas of life (Erikson, 1950) and does not happen uniformly across these domains (Goossens, 2001). In the present study, we examined identity in the educational and relational domain because they are thought to be most salient for youth (Heaven et al., 2008). However, identity also develops in other domains of adolescents' lives (e.g., political, occupational), and it is likely that the links with substance use may differ for these different life domains. Finally, we did not examine identity content. Although the questionnaire method for measuring identity used in the present study provides some insight in whether or not adolescents, for instance, felt committed to their school or best friend, it says little about the aspects of their school or friendship to which they feel committed. Understanding the content of adolescent identity may be important for understanding the association between identity and substance use (Klimstra & Denissen, 2017). For some adolescents, a highly committed relational identity may mean being committed to a deviant peer, and as such may be a positive predictor of substance use. The UMICS questionnaire does not tap into identity content and, therefore, is unable to tap into the content adolescents commit to, explore, and reconsider. As such, identity behaviors to positive and negative aspects of school and best friend may have evened out each other, thus resulting in an overall null effect.

Limitations

Our findings should be interpreted while taking into account some limitations of the present study. First, because no data were available on alcohol use at T3, we could only test the predictive effect of identity status change on alcohol exploratively for the first two waves. However, more longitudinal research is needed to examine this relation in detail. Furthermore, in the present study, we focused only on three identity transition routes (i.e., stable, progressive, regressive), but in the presence of larger samples, it may also be important to examine non-linear transitions between identity statuses and their relations to substance use. Relatedly, in the present study, we only tested for linear effects of substance use, but we cannot exclude the possibility of non-linear relations between identity and substance use. For instance, it may be that substance use only becomes maladaptive at high, but not at moderate, frequencies of use. Another interesting avenue for future research may be the examination of transitions in substance use and their predictive effects on identity. That is, large-sample studies could examine whether changes in substance use behaviors impact identity development. It may also be important to examine polysubstance use, as a marker for maladjustment. Where use of individual substances may, in part, depend on the situation (e.g., alcohol at a party, energy drinks for studying), use of many different types of substances may reflect broader vulnerability or problem behavior. Moreover, in addition to examining multiple

substances at once, it may also be interesting to examine the combinations, alignment and mis-alignment, of identity in different domains. For instance, some adolescents may not commit to their education, but have a strong commitment to a (future) occupation that requires them to achieve high grades (e.g., Crocetti et al., 2012). Substance use may be particularly likely in such cases where there is a misalignment between domains, as this may be expected to result in confusion and discomfort.

In addition, our sample was biased toward higher educational tracks. In the past, both substance use (Cox et al., 2007) and identity (Klimstra et al., 2010) have been related to educational level, with those in higher educational tracks generally reporting lower substance use and a more mature identity. As such, our results may not generalize to all Dutch adolescents, and may in fact only apply to adolescents in higher educational tracks. In addition, we found that attrition was also related to educational and relational identity. Specifically, we found that adolescents who completed three waves reported higher exploration and lower reconsideration at T1. This suggests that adolescents who were better adjusted in terms of their identity were more likely to remain in the study. It is important that future research examines these processes in a sample that better represents the general population of Dutch youth.

Next, caution should be taken when interpreting the results from our study due to several potential measurement issues. Self-report was used to tap into both identity processes and substance use, possibly introducing shared-method bias (Podsakoff et al., 2012). Moreover, it is possible that the positive link between substance use and identity in adolescence may in part be explained by social desirability. Although adolescents were instructed to complete the questionnaire anonymously, the questionnaire was filled out in a classroom setting. Therefore, we cannot rule out the possibility that if adolescents believed substance use to be desirable among their peers, they may have over-reported on their substance use. However, comparing reported substance use in our adolescent sample (25% alcohol and 5% marijuana) to that reported in the general population (27% and 2%; Stevens et al., 2018), this does not seem to be the case. Moreover, like any other study, we cannot be sure to have excluded all third variables that may explain the relation between identity and substance use. It could be that other variables (e.g., stressful experiences, personality pathology, lack of autonomy) influence both identity development and substance use.

Finally, substance use also depends on contextual factors. Adolescents may differ in their substance use depending on the neighborhood, school context, or peer group, because substance use may be more or less socially accepted in these contexts (e.g., Ridenour et al., 2009; Stone et al., 2012). For instance, in peer groups where high status peers display more substance use, youths may perceive substance use as more acceptable, or even as a way to gain status within the group (Dishion et al., 1995). In contrast, for some peer groups (e.g., religious groups) abstinence may be more normative, and may even be part of the group's and the individual's identity. It is important for future research to also take these proximal contextual effects into account.

Conclusion

The current study shows that while the use of substances in adolescence is cross-sectionally related to less adaptive identity behaviors, it is not longitudinally associated

with the classification in and transitions between identity statuses. This suggests that other factors may explain both identity development and substance use.

Note

1. As one of the deviations reported in Table S1, the manuscript only reports findings on identity with the dichotomous use-abstinence variables, and not with the original continuous variables. However, descriptive statistics of the continuous substance use variables for all waves are reported in Table S2 of the Supplementary Material.

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No potential conflict of interest was reported by the authors.

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