Identification and Prediction of Drinking Trajectories in Early and Mid-Adolescence

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The aim of this study was to identify subgroups of early and mid-adolescents with different drinking trajectories. In addition, we examined whether gender, parental, and peer factors predicted adolescents’ membership of these drinking trajectories. We used longitudinal data of 428 families (fathers, mothers, mid-adolescents, and their younger siblings). Latent Class Growth Analyses were performed to identify drinking trajectories. Four drinking trajectories emerged for early adolescents: abstainers, light drinkers, increasers, and heavy drinkers. For mid-adolescents, we identified a fifth group (stable drinkers) in addition to the four trajectories identified for early adolescents. Our results showed that being a boy, having a best friend or father who drinks heavily, and having parents who are permissive toward adolescents’ alcohol creates increased risk for both siblings to attend the more heavy drinking trajectories.

Adolescence is the age period in which alcohol consumption is typically initiated and sharply increases (e.g., Chassin, Pitts, & Prost, 2002; Duncan, Duncan, & Strycker, 2006). There are, however, substantial differences in the individual development of alcohol consumption (Jackson, Sher, & Schultenberg, 2005; Zucker, Fitzgerald, & Moses, 1995). Some adolescents merely experiment with alcohol, whereas others establish a stable drinking pattern or escalate their rates of use (e.g., Colder, Campbell, Ruel, Richardson, & Flay, 2002). Thus, the onset and rates of development in adolescents’ alcohol consumption are not homogenous. There appear to be subgroups that have different developmental trajectories (Jackson et al., 2005). Although developmental scholars have emphasized the importance of distinguishing drinking trajectories during adolescence (e.g., Guilamo-Ramos, Turrisi, Jaccard, Wood, & Gonzalez, 2004; Li, Duncan, & Hops, 2001; Power, Stewart, Hughes, & Arbona, 2005; Zucker et al., 1995), systematic investigations of early to mid-adolescence development of alcohol use have been lacking. Most past studies have focused on drinking trajectories in the transition from late adolescence to young or emerging adulthood (e.g., Bennett, McCrady, Johnson, & Padina, 1999; Casswell, Pledger, & Pratap, 2002; Schulenberg, O’Malley, Bachman, Wadsworth, &
whether parental and peer factors predict adolescents’ drinking in early and mid-adolescence. Furthermore, we examined whether parental and peer factors predict adolescents’ membership of these drinking trajectories.

To our knowledge, only a few studies actually examined normative drinking trajectories in early to mid-adolescence (Colder et al., 2002; Flory et al., 2004; Li, Barrera, Hops, & Fisher, 2002; Li et al., 2001). However, all of these studies are based on samples from the United States and do not provide insight into youth drinking trajectories in Europe. The drinking behaviors of European youth seem to differ from those of North American youth (Hibell et al., 2004). For instance, about 90% of the European youth reports life time alcohol use, compared to 75% of the American youth (Hibell et al., 2004; Johnston, O’Malley, Bachman, & Schulenberg, 2006).

Furthermore, somewhat surprisingly, two of these previous studies revealed only two distinct drinking trajectories for 11- to 15-year-olds: one group with high levels of alcohol use at baseline measurement and another with low levels of use at baseline measurement (Li et al., 2002; Li et al., 2001). It is important to note that these studies reported significant within-class variation among adolescents, suggesting interindividual heterogeneity within each trajectory, which implies more drinking trajectories. Colder et al. (2002) and Flory et al. (2004) showed this was indeed the case. They revealed respectively five and three drinking trajectories in their studies. However, Colder et al. did not distinguish a group of abstaining youth, despite past research consistently demonstrating a small group that does not start to drink at all (Flory et al., 2004; Poelen, Scholte, Engels, Boomsma, & Willemsen, 2005). On the other hand, Flory et al. were only able to detect two drinking trajectories in addition to the abstainers, which is again in contrast with the five trajectories reported by Colder et al. Thus, it still remains unclear how many drinking trajectories can be identified in early and mid-adolescence, in particular for European adolescents. Based on previous studies, we expected that there would be at least four drinking trajectories in early to mid-adolescence: one abstaining trajectory, one trajectory with relatively low levels of alcohol use, one trajectory with high levels of use, and one trajectory (rapidly) increasing the amount of alcohol use during the years.

It is important not only to determine which drinking trajectories exist in early and mid-adolescence but also to examine which factors predict a certain drinking trajectory. We think is especially important to determine the differences between those who use alcohol in adolescence and those who really abstain from drinking. Until now, it is unknown what individual and environmental factors are helpful in preventing youth from abstaining from alcohol. Such insights might be very relevant for prevention of adolescents’ alcohol use. In addition, it might be that adolescents of various drinking trajectories might need different approaches from prevention programs, because of the different risk across the trajectories. Thus, to understand diverse drinking trajectories one should consider the factors affecting adolescents’ alcohol use.

Social-environmental factors seem to play a substantial role in the initiation and escalation of alcohol use in young people. Research focusing on adolescents as a single group revealed that parents influence adolescents’ alcohol use by their own use (e.g., Duncan et al., 2006; Ellickson, Tucker, Klein, & McGuigan, 2001). Watching parents drink alcohol may lead to direct modeling or to the development of pro-alcohol norms in youth, especially when adolescents notice the advantages of alcohol consumption, such as having fun or relaxation (Duncan et al., 2006; Engels & Van Der Vorst, 2003; Van Der Vorst, Engels, Meeus, & Deković, 2006). However, it is still unclear how adolescents develop their drinking due to being exposed to parental alcohol use.

The effect of parental alcohol use seems to decline when parenting practices are taken into account (Peterson, Hawkins, Abbott, & Catalano, 1994; Van Der Vorst, Engels, Meeus, Deković, & Van Leeuwe, 2005). The preventive impact of parenting, such as alcohol-specific parenting, on adolescents’ alcohol use has been shown in several studies (e.g., Barnes, Reifman, Farell, & Dintcheff, 2000; Jackson, Henriksen, & Dickinson, 1999; Van Der Vorst et al., 2006). Alcohol-specific parenting refers to steps taken by parents to manage or prevent adolescents’ drinking (e.g., setting rules about alcohol use or showing disapproval of drinking; Van Der Vorst et al., 2005). Setting strict rules about adolescents’ drinking seems to be one of the most effective alcohol-specific socialization practices of parents (Van Der Vorst et al., 2005; Yu, 2003). Thus, parents’ permissiveness or tolerance toward their children’s drinking leads to heavier consumption over time (Jackson et al., 1999; Li et al., 2001). But again, these results are mainly based on research investigating adolescents’ drinking as one homogeneous group and there are some indications that alcohol-specific parenting might be particularly relevant to a delay in the age of onset (Van Der Vorst et al., 2006).

Some scholars suggest that the influence of parents on adolescents’ drinking decreases during adolescence and is replaced by the influence of adolescents’ friends (Petraitis, Flay, & Miller, 1995; Steinberg & Silverberg, 1986). There is substantial empirical evidence that friends’ alcohol use affect the initiation and persistence of adolescents’ drinking (e.g., Bray, Adams, Getz, & McQueen, 2003; Curran, Stice, & Chassin, 1997; Duncan et al., 2006). Further, adolescents with a
majority of friends who are drinking will be more likely to drink heavily themselves (Griffin, Botvin, Epstein, Doyle, & Diaz, 2000), and most adolescents consume alcohol and get drunk in the presence of their friends in a pub or at a party (Mayer, Forster, Murray, & Wagenaar, 1998). As with parenting influences, most of these findings are based on studies measuring adolescents’ drinking at the general level and have not tested the influence of peers on specific alcohol use trajectories. Although it is generally accepted that both friends and parents play an important role in the development of adolescents’ alcohol use (Bogenschneider, Wu, Raffaelli, & Tsay, 1998), it is still unclear at which stages of adolescents’ drinking parents and friends have an impact. It is possible that parental and peer effects are differentially related to adolescents’ alcohol use within various trajectories (Power et al., 2005). It might be that parents are of influence in the initiation stage of alcohol use, before adolescents consume larger amounts of alcohol (Power et al., 2005; Van Der Vorst et al., 2006). That is, adolescents mostly start to drink at family gatherings in the home situation (Mayer et al., 1998; Warner & White, 2003). In addition, alcohol-specific parenting seems to lead to later initiation of drinking or smaller increase of use, whereas the effect declines when adolescents establish a drinking pattern (Van Der Vorst et al., 2006). Concerning friends, exposure to friends’ deviance predicts the increase of drinking for adolescents with initially low levels of alcohol use (Li et al., 2001). Likewise, it seems reasonable that heavy-drinking friends also have an impact on adolescents engaging in heavy drinking trajectories (Bot, Engels, Knibbe, & Meeus, 2005; Bray et al., 2003). Nevertheless, it remains unclear in which drinking trajectories peers and parental factors have the most influence. Therefore, our study takes both peer and parental factors into account in predicting a membership in a certain drinking trajectory. Further, gender of a person might be important as adult men are more at risk to engage in heavy (binge) drinking trajectories during late adolescence to young adulthood than women (e.g., Bennett et al., 1999). In our analyses, we also controlled for age as adolescents might have more opportunities to drink and it becomes more accepted as they grow older.

In summary, the current study aimed to identify different drinking trajectories in early and mid-adolescence including abstinence adolescents, using Latent Class Growth Analysis (LCGA; Nagin, 1999). Furthermore, we examined whether gender, age, parental drinking, best friends’ drinking, and parental alcohol-specific rules predict adolescents’ membership in one of the drinking trajectories to provide insight into what stage of drinking friends’ and parents are the most important. As mentioned before, we assumed that at least four drinking trajectories (abstainers, adolescents with low levels of alcohol use, adolescents who increase their use rapidly, and heavy drinkers) could be detected in early and mid-adolescence. We expected on the basis of previous research that being a boy, being older, and having a best friend who drinks predicts the membership of the heavy drinking trajectory or rapidly increasing trajectory, that strict alcohol-specific rules predict membership of the abstaining or drinking trajectory with low levels of alcohol use, and that parental drinking predicts drinking trajectories with low levels of alcohol use.

**METHOD**

Participants

Data for this study were collected as part of a broader longitudinal project, which examined socialization processes underlying various health behaviors in adolescence. We asked 20 municipalities in the Netherlands for the addresses of families with at least two children age 13 to 16 years. Of the approached families, 885 agreed to participate by returning the enclosed response form including the names of the participating family members, nonparticipating family members and the signature of one of the parents. This parent signed for all family members. These families were then contacted by telephone to establish whether they fulfilled all the inclusion criteria: the parents had to be married or living together, and the adolescents and their parents had to be biologically related. Families with twins or with family members who had mental or physical disabilities were excluded from the study. In addition, we also made a selection to achieve an equal division of educational level (i.e., one third special or low education, one third intermediate general education, one third highest level of secondary school in the Netherlands: preparatory college and university) and an equal division of sibling dyads (i.e., boy–boy, boy–girl, girl, boy, girl–girl). Finally, 428 families were selected on the basis of these criteria and participated at T1 in the fall of 2002. Of these, 416 families participated in the study 1 year later (at T2), and 404 did so 2 years later (at T3). Each family consisted of two parents and two adolescent children. Ninety-five percent of the participants were of Dutch origin. The mean age of the younger siblings was 13.36 (SD = .50, range = 13–15 years) and was 15.22 for the older siblings at T1 (SD = .60, range = 14–17 years). Fathers’ mean age was 46 (SD = 4.00) and mothers’ was 44 (SD = 3.57). Of the younger siblings, 47.7% were male, and of the older siblings 52.8% were male.

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1The similarities in alcohol consumption of friends and adolescents could be due to either the influence of peers or to the selection of drinking friends (e.g., Bot, Engels, Knibbe, & Meeus, 2005).
Procedures

All four family members individually completed our extensive questionnaire at home in the presence of a trained interviewer. The questionnaire took about 2 hr to complete. The respondents were not allowed to discuss the questions or answers with each other. Each family received €30 after all four members had completed the questionnaire. At the end of the project, five checks of €1000 were raffled between the families who participated in all three waves of the study. In the current study, only data for families who participated at all three time points (n = 401) were used. The study was approved by the independent medical ethics committee METiGG in Utrecht, the Netherlands (research 6209).

Measures

Alcohol consumption. Each of the four family members was asked about the intensity of their alcohol consumption. Intensity of drinking was assessed by asking how many glasses of alcohol the respondents had drunk in the previous week during weekdays and during the weekend days in contexts at home and outside the home (Engels, Knibbe, & Drop, 1999; previously also used by, e.g., Bot et al., 2005; Van Der Vorst, Engels, Deković, Mees, & Vermulst, 2007). We focused on the last week, so recall bias, which often distorts reports on drinking (Sobell & Sobell, 1992), is minimized. The differentiation between drinking in the weekend days and weekend, as well as home and outside home, is also made to provide memory anchors to participants. Responses to these four questions were summed for each family member to obtain a personal indication of weekly alcohol consumption. This measurement revealed relative stability over time (Van Der Vorst, Engels, Deković, et al., 2007), has predictive validity in terms of prediction of drinking problems (Kuntsche, Van Der Vorst, & Engels, in press), and reveal differences in patterns and explanatory variables when differentiated to home and outside home drinking (Engels et al., 1999). We also asked the older and younger adolescents separately how many glasses their best friend had drunk the previous week at home and outside the home at T1. Responses to these two questions were summed to obtain an indication of weekly alcohol consumption of the best friend (see also Poelen, Engels, Van Der Vorst, Scholte, & Vermulst 2007).

Rules about alcohol. We used a 10-item scale to measure the degree to which parents permit their children to consume alcohol in various situations, such as “in the absence of parents at home” or “at a friends’ party” (Van Der Vorst et al., 2005). Thus, we asked each family member what rules the parents had set or what they had prohibited concerning alcohol. Respondents had to answer in what degree these rules were applicable at their homes. Response categories ranged from 1 (completely applicable) to 5 (not applicable at all). Higher scores indicated having stricter rules about alcohol consumption. We computed the rules about alcohol variable in SPSS on the basis of all the items of the scale (10). We used this variable for the multinomial logistic regression analyses. The internal consistency was high: .91 (older adolescents about parents T1). .92 (younger adolescents about parents T1).

Strategy of Analysis

To identify distinctive classes of developmental trajectories of alcohol use over time we applied LCGA (Nagin, 1999) using the software package MPLUS 4.2 (Muthén & Muthén, 1998–2006). This technique is a combination of latent growth analysis and latent class analysis, also known as mixture modeling. Using a Poisson regression model of alcohol use over the three equidistant time intervals, individual growth is captured with two latent variables: intercept and slope. A Poisson regression model assumes a linear relationship between the natural logarithm of the outcome variable (here: number of glasses of alcohol) and the time intervals. Intercepts and slopes are reported in terms of logarithmic values. Latent class analysis based on the individual intercepts and slopes was conducted to determine adolescents who share similar growth trajectories in alcohol use. In this way LCGA is a mixture modeling technique with a combined use of continuous latent variables (intercept and slope) and categorical latent variables (trajectory classes; Muthén, 2004).

We used several criteria to support the optimal number of trajectory classes. The first was the Bayesian Information Criterion (BIC; Schwarz, 1978). BIC is a measure of parsimony in model building (Schwartz, 1978), where lower BIC values indicate a better model fit. BIC values were calculated for models with increasing numbers of trajectory classes. The model with the lowest BIC value would be the most optimal one. A related measure with about the same properties as the BIC was Akaike’s Information Criterion Index (AIC; Everitt, 1998), in which lower values of the index are preferred for choosing a model. A next criterion was the classification quality of the model. Adolescents were classified into trajectory classes according to their posterior probability. Posterior probabilities express the degree to which adolescents belong to their trajectory class and are determined after the model (with a specific number of trajectory classes) is estimated (Nagin, 1999). High-posterior probabilities indicate that the model is well able to assign each adolescent to one particular class. Based on these posterior probabilities the entropy measure H is summarizing these posterior probabilities...
in one index. A high value (near 1) indicates a high level of classification quality (Everitt, 1998). Another criterion was the Lo-Mendell-Rubin Adjusted Likelihood Ratio Test (LMR-LRT) to test whether a model with a $k+1$ class solution is significantly better than a model with a $k$-class solution. If the entropy measure and the LMR-LRT are not clear in indicating the optimal number of classes, the final criterion will be the usefulness of the classes based on theoretical and/or practical considerations. A six-class solution with one class, for example, including only few adolescents with mean intercept and slope not strongly deviating from another class, could be a reason to decide for a five-class solution, if this is consistent with the theoretical expectations.

Because the number of glasses consumed in the past week measured alcohol use, the distribution of this variable was skewed with a long tail to the right and a high frequency of zeroes. The standard assumption of normal distributed variables in structural equation modeling was not fulfilled. A Poisson distribution as the underlying probability distribution for count data is widely accepted (Nagin, 1999) and is a built-in option in Mplus. In our sample we distinguished two kinds of zero counts. One kind of zeroes was the consequence of not drinking (abstainers) during the three time intervals and the other kind referred to adolescents who drank alcohol during at least one time interval but did not drink at one or two other time intervals. The first kind was denoted as structural zeroes, the second kind as random zeroes belonging to the Poisson process.

To examine how many trajectory classes with different drinking patterns can be distinguished, we conducted LCGA for increasing numbers of classes. Analyses were performed in a two-part model: The first part consisted of the trajectory class with structural zeroes (e.g., all counts are zero during the three time intervals) and the second part referred to the trajectory classes based on random zeroes (e.g., the counts have at least one value above zero during the three time intervals). This procedure is known as zero-inflated Poisson modeling (Lambert, 1992; Muthén, 2004; Roeder, Lynch, & Nagin, 1999).

After we identified the trajectory class membership for each sibling within LCGA in Mplus, we inputted the class memberships in a SPSS-data file. Next, we performed Multinomial Logistic Regression Analysis in SPSS to predict trajectory class membership by gender, intensity of drinking of best friend, intensity of drinking of mother, intensity of drinking of father, and parental alcohol-specific rules.

RESULTS

Descriptive Statistics

Fathers drank 12.74 ($SD = 10.29$) glasses of alcohol in the week prior to T1, compared with 5.90 glasses a week consumed by mothers ($SD = 6.12$), $t(401) = -14.45$, $p < .001$. The best friends of the older adolescents drank on average 4.72 glasses of alcohol ($SD = 7.71$) at T1, and the best friends of the younger siblings consumed on average 1.52 glasses ($SD = 2.86$), $t(400) = 8.01$, $p < .001$. Finally, the adolescents reported their parents were more permissive about drinking toward the older adolescents than towards the younger ones, $t(401) = 4.87$, $p < .001$.

Drinking Trajectories

To examine how many trajectory classes with different drinking patterns can be distinguished, we conducted LCGA for increasing numbers of classes. Analyses were

<table>
<thead>
<tr>
<th>No. of Classes</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adolescents</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIC</td>
<td>7731</td>
<td>5819</td>
<td>5269</td>
<td>5090</td>
<td>4986</td>
</tr>
<tr>
<td>AIC</td>
<td>7707</td>
<td>5783</td>
<td>5221</td>
<td>5030</td>
<td>4915</td>
</tr>
<tr>
<td>H</td>
<td>.84</td>
<td>.87</td>
<td>.84</td>
<td>.77</td>
<td>.77</td>
</tr>
<tr>
<td>LMR-LRT Statistic</td>
<td>99.88</td>
<td>91.35</td>
<td>93.00</td>
<td>93.10</td>
<td>44.64</td>
</tr>
<tr>
<td>LMR-LRT p Value</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.087</td>
</tr>
<tr>
<td><strong>Older Adolescents</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIC</td>
<td>11602</td>
<td>8363</td>
<td>7611</td>
<td>7437</td>
<td>7312</td>
</tr>
<tr>
<td>AIC</td>
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<td>8327</td>
<td>7563</td>
<td>7377</td>
<td>7240</td>
</tr>
<tr>
<td>H</td>
<td>.95</td>
<td>.94</td>
<td>.91</td>
<td>.86</td>
<td>.86</td>
</tr>
<tr>
<td>LMR-LRT Statistic</td>
<td>66.57</td>
<td>66.49</td>
<td>67.21</td>
<td>67.97</td>
<td>61.51</td>
</tr>
<tr>
<td>LMR-LRT p Value</td>
<td>.002</td>
<td>.052</td>
<td>.000</td>
<td>.000</td>
<td>.240</td>
</tr>
</tbody>
</table>

Note: BIC = Bayesian Information Criterion; AIC = Akaike’s Information Criterion; H = entropy measure; LMR-LRT = Lo-Mendell-Rubin Likelihood-Ratio-Test.

2A correlation table including all model variables is available from the first author.
performed on 401 cases with no missing values on the variables. The results of the several criteria and measures to decide for the number of classes are given in Table 1. For the early adolescents the BIC and AIC are decreasing for increasing the number of classes. However, the drop of BIC and AIC are considerable from two to three classes and from three to four classes. The drop in BIC and AIC are relatively low from four to five classes and from five to six classes. Using these two criteria, a four-class solution would be the most optimal. The \( p \) value of the LMR-LRT statistic (.087) suggests that a six-class solution was not significantly better than a five-class solution and this result should be an indication that a five-class solution was preferable. The entropy measure for a four-class and a five-class solution is .84, indicating that the quality of classification were equal for both solutions.

To decide for a four-class or five-class solution we inspected both solutions. Three classes in the four-class solution were almost identical with three classes in the five-class solution. The fourth class in the four-class solution was a small class with 15 participants (intercept = 2.92 and slope = .42). In the five-class solution we found a very small class of 5 participants (intercept = 3.31 and slope = .49) and a small class with 16 participants (intercept = 2.58 and slope = .33). Because a class with 5 participants was very low and the intercepts and slopes of the two classes in the five-class solution were not much deviating from the small class in the four-class solution, we decided to adopt a four-class solution.

For the mid-adolescents the considerable drops of the BIC and AIC were from Class 2 to Class 3 and from Class 3 to Class 4, suggesting a four-class solution. The \( p \) value of the LMR-LRT statistic (.240) suggests that a five-class solution is preferable above a six-class solution. To decide for a four-class or a five-class solution we compared both models. The five-class solution showed one extra class above the four found in the four-class solution (this four-class solution was comparable with the solution of the young adolescents). For this reason we decided for a five-class solution in this age group.

The class sensitivity (the average class-membership probability) after classifying the adolescents was high for the four-class solution of the early adolescents with posterior probability levels between .87 and .99. It was also high for the five-class solution of the mid-adolescents with posterior probability levels between .85 and .97. These high values of posterior probabilities indicated that the adolescents were well classified to a particular class. The estimated alcohol consumption at the three waves for each of the four trajectory classes of the early adolescents in Figure 1 and for the five trajectory classes of the mid-adolescents are depicted in Figure 2.

**Early adolescents.** Class 1 contained adolescents who abstained from drinking at all three time points (Abstainers: Intercept = .00, Slope = .00), with 28.7% of the early adolescents (n = 115; boys = 53%, girls = 47%) being classified to this class. Adolescents in the second class hardly drank alcohol during this period (Light drinkers: Intercept = .61, \( z = 3.57, p < .001 \); Slope = .34, \( z = 2.99, p < .001 \)). This class contained 178 (44.4%; boys = 38%, girls = 62%) adolescents. Early adolescents belonging to the third class (23.2% of the early adolescents, n = 93; boys = 54%, girls = 46%) strongly increased their drinking over time (Increasers: Intercept = 1.33, \( z = 6.52, p < .001 \); Slope = .67, \( z = 6.66, p < .001 \)). Finally, the fourth class consisted of early adolescents who were already heavy drinkers at T1 and strongly increased their drinking over the next years (Heavy drinkers: Intercept = 2.92, \( z = 13.36, p < .001 \); Slope = .42, \( z = 3.09, p < .01 \)). This class had the lowest proportion of early adolescents, namely, 3.74% (n = 15; boys = 80%, girls = 20%).

**Mid-adolescents.** Similar to the classification of the drinking of the early adolescents, Class 1 of the mid-adolescents contained adolescents who were abstaining
from drinking at all three points (Abstainers: Intercept = .00, Slope = .00). This class contained 42 mid-adolescents (10.5%; boys = 45%, girls = 55%). The adolescents of Class 2 drank small amounts of alcohol during this period (Light drinkers: Intercept = .56, z = 1.64, ns; Slope = .48, z = 2.54, p < .05), of which 42.3% (n = 162; boys = 40%, girls = 60%) were classified for this trajectory. Adolescents in the third class strongly increased their drinking during the three time points (Increasers: Intercept = 1.85, z = 9.41, p < .001; Slope = .53, z = 4.53, p < .001) and contained 97 mid-adolescents (24.2%; boys = 68%, girls = 32%). The fourth class consisted of mid-adolescents who were already heavy drinkers at T1 and strongly increased their drinking over the next years (Heavy drinkers: Intercept = 3.03, z = 28.26, p < .001; Slope = .32, z = 4.84, p < .001). This class contained 9.7% of the mid-adolescents (n = 37; boys = 84%, girls = 16%). Finally, a class of stable drinkers was estimated, containing 16.5% of the mid-adolescents (Stable drinkers: n = 63; boys = 54%, girls = 46%; Intercept = 2.27, z = 8.20, p < .000; Slope = -.169, z = -1.38, ns).

The Predictors of Trajectory Classes
Multinomial logistic regression analyses were conducted for early and mid-adolescents to examine to which degree gender, intensity of drinking of best friend, intensity of drinking of mother, intensity of drinking of father, alcohol-specific rules, and age were predictors of the membership of a specific trajectory class. Multinomial logistic regression requires a reference group and therefore we started with abstainers (Class 1) as the reference group, followed by light drinkers (Class 2), increasers (Class 3), and heavy drinkers (Class 4; only for the mid-adolescents). In this way all possible combinations of two classes were examined. The results in terms of odd ratios are reported in Table 2.

In preliminary analyses, we also controlled for parents’ and adolescents’ education. Because the education of all the family members was not significantly associated with any of the classes for both adolescents, we omitted these variables from further analyses.

TABLE 2
Multinomial Logistic Regressions: Odds Ratio Estimates

<table>
<thead>
<tr>
<th>Younger Adolescents</th>
<th>Older Adolescents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abstainers</strong></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>.68**</td>
</tr>
<tr>
<td>Intensity BF</td>
<td>1.04</td>
</tr>
<tr>
<td>Intensity M</td>
<td>1.04</td>
</tr>
<tr>
<td>Intensity F</td>
<td>1.02</td>
</tr>
<tr>
<td>Rules</td>
<td>.75</td>
</tr>
<tr>
<td>Age</td>
<td>.82</td>
</tr>
<tr>
<td><strong>Light Drinkers</strong></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>.46**</td>
</tr>
<tr>
<td>Intensity BF</td>
<td>1.02</td>
</tr>
<tr>
<td>Intensity M</td>
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<tr>
<td>Intensity F</td>
<td>1.01</td>
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<tr>
<td>Rules</td>
<td>.71*</td>
</tr>
<tr>
<td>Age</td>
<td>1.83*</td>
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<td><strong>Increasers</strong></td>
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</tr>
<tr>
<td>Gender</td>
<td>.15*</td>
</tr>
<tr>
<td>Intensity BF</td>
<td>1.03</td>
</tr>
<tr>
<td>Intensity M</td>
<td>1.05</td>
</tr>
<tr>
<td>Intensity F</td>
<td>1.04</td>
</tr>
<tr>
<td>Rules</td>
<td>.34**</td>
</tr>
<tr>
<td>Age</td>
<td>2.59</td>
</tr>
<tr>
<td><strong>Heavy Drinkers</strong></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>4.02**</td>
</tr>
<tr>
<td>Intensity BF</td>
<td>.93**</td>
</tr>
<tr>
<td>Intensity M</td>
<td>.96</td>
</tr>
<tr>
<td>Intensity F</td>
<td>1.03</td>
</tr>
<tr>
<td>Rules</td>
<td>1.35</td>
</tr>
<tr>
<td>Age</td>
<td>2.37*</td>
</tr>
</tbody>
</table>

Note: The drinkers in the left column are the reference classes. BF = Best Friend; F = Father; M = Mother; *p < .05, **p < .01, ***p < .001.
Early adolescents. In general, early adolescent boys were more likely to be classified in the heavy drinking classes (increasers or heavy drinkers) and girls more in the abstaining or light drinking classes. However, early adolescent boys were also more likely than girls to be an abstainer compared to a light drinker. For the early adolescents we found only significant differences of best friends’ drinking between the abstaining early adolescents and the increasers and heavy drinkers. Increasers or heavy drinkers were more likely to have heavy drinking best friends than abstainers. Furthermore, for the early adolescents we did not find any significant associations of the alcohol consumption of the mother. Fathers of the heavy drinking early adolescents were more likely to consume alcohol than mothers of the light drinking group. Concerning alcohol consumption of the father, the fathers of the increasers, heavy drinkers, and stable drinkers were more likely to drink alcohol than the fathers of the abstainers. All other findings concerning paternal alcohol use were not significant. Finally, the parents of the abstaining early adolescents were stricter about their child’s drinking than the parents of the mid-adolescents from all other classes. Also, parents from the light drinkers were more likely to be strict about alcohol compared to the parents of the increasers, heavy drinkers and stable drinkers. Thus, the findings with regard to alcohol-specific rules indicate that parents with children who drink rather heavily were more likely to be permissive than parents whose adolescent children hardly or entirely not use alcohol. Finally, only one odd ratio for age was significant for age: Stable drinkers were more likely to be older than heavy drinkers.

Mid-adolescents. In general, mid-adolescent boys were more likely to be classified in the heavy drinking classes (increasers and heavy drinkers) and girls in the light drinking class. Mid-adolescents with heavy drinking friends were more likely to have a drinking pattern with higher levels of alcohol use. This indicates that mid-adolescents with heavy alcohol use are more likely to have a heavy drinking best friend at T1. In addition, only one odds ratio was significant with regard to the alcohol consumption of the mother. Mothers of the increasers group had a higher probability to drink more alcohol than mothers of the light drinkers group. Concerning alcohol consumption of the father, the fathers of the increasers, heavy drinkers, and stable drinkers were more likely to drink alcohol than the fathers of the abstainers. All other findings concerning paternal alcohol use were not significant. Finally, the parents of the abstaining mid-adolescents were stricter about their child’s drinking than the parents of the mid-adolescents from all other classes. Also, parents from the light drinkers were more likely to be strict about alcohol compared to the parents of the increasers, heavy drinkers and stable drinkers. Thus, the findings with regard to alcohol-specific rules indicate that parents with children who drink rather heavily were more likely to be permissive than parents whose adolescent children hardly or entirely not use alcohol. Finally, only one odd ratio for age was significant for age: Stable drinkers were more likely to be older than heavy drinkers.

The Influence of the Intercept and Slope of Alcohol-Specific Rules on the Trajectory Classes of Drinking

The results of the previous multinomial logistic regressions showed that setting alcohol-specific rules is a strong precursor of the drinking classes of both early and mid-adolescents. On the basis of these findings, however, it is still unclear whether the start value of alcohol-specific rules (at baseline) or the change (or stability) of the rule-setting differentiates the drinking trajectories.

TABLE 3
Multinomial Logistic Regressions with the Intercept and Slope of the Rules Variable: Odds Ratio Estimate

<table>
<thead>
<tr>
<th>Younger Adolescents</th>
<th>Older Adolescents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Light Drinkers</strong></td>
<td><strong>Heavy Drinkers</strong></td>
</tr>
<tr>
<td><strong>Increasers</strong></td>
<td><strong>Heavy Drinkers</strong></td>
</tr>
<tr>
<td><strong>Stables Drinkers</strong></td>
<td></td>
</tr>
<tr>
<td>Abstainers</td>
<td></td>
</tr>
<tr>
<td>Intercept Rules</td>
<td>0.50**</td>
</tr>
<tr>
<td>Slope Rules</td>
<td>0.15***</td>
</tr>
<tr>
<td>Light Drinkers</td>
<td></td>
</tr>
<tr>
<td>Intercept Rules</td>
<td>0.51**</td>
</tr>
<tr>
<td>Slope Rules</td>
<td>0.21**</td>
</tr>
<tr>
<td>Increasers</td>
<td></td>
</tr>
<tr>
<td>Intercept Rules</td>
<td>0.31*</td>
</tr>
<tr>
<td>Slope Rules</td>
<td>4.67</td>
</tr>
<tr>
<td>Heavy Drinkers</td>
<td></td>
</tr>
<tr>
<td>Intercept Rules</td>
<td>2.40</td>
</tr>
<tr>
<td>Slope Rules</td>
<td>3.28</td>
</tr>
</tbody>
</table>

Note: The drinkers in the left column are the reference classes. *p < .05. **p < .01. ***p < .001.

4We also conducted multinomial logistic regressions with alcohol-specific rules based on the reports of the fathers and those of the mothers. The results based on parental reports were similar to those with the perspectives of the adolescents.
Therefore, we conducted latent growth curve analyses on alcohol-specific rules measured at three waves. We calculated individual intercepts and slopes with respect to alcohol-specific rules. Scores on parental rule-setting at T1, T2 and T3 were the input for Latent Growth Curve Analysis using MPLUS 4.2 (Muthén & Muthén, 1998–2006). Next, we conducted the same multinomial logistic regressions on the trajectories, including also the previous variables gender, age, intensity of drinking of best friend, intensity of drinking of mother and father, and the individual intercepts and slopes of alcohol-specific rules (Table 3). We discuss only the results of the intercept and slope on the classes. All other outcomes were comparable to the previous reported outcomes.

**Early adolescents.** Concerning the intercept of alcohol-specific rules, we found that parents of adolescents who abstain from drinking were more likely to have strict rules concerning their child’s drinking at baseline measurement compared to parents of drinking adolescents. The slope of the abstaining class differed also significantly with the slopes of the other classes with the exception of the heavy drinkers. This implies that parents of abstaining early adolescents were less likely to become permissive toward their child’s drinking than the parents of the light drinkers or increasers. The intercept of parental rules of the light drinkers was significantly different from the intercepts of the increasers and heavy drinkers. The parents of light drinkers were more likely to be strict about alcohol use than the parents of the increasers or heavy drinkers at baseline measurement. The slope of the light drinkers was only significantly different compared to the slope of the increasers. The parents of the increasers were more likely to become more permissive over time than the parents of the light drinkers. Finally, the intercept of alcohol-specific rules of the increasers, but not the slope, differed significantly from the intercept of the heavy drinkers. Parents of the increasers were stricter about their child’s drinking than parents of the heavy drinkers at T1.

**Mid-adolescents.** The intercept of alcohol-specific rules in the abstaining mid-adolescents class differed from the intercepts of all other classes. In addition, the slope of parental rules of the abstaining class differed only significantly from the slope of the light drinkers, which indicates that the parents of the light drinkers were more likely to become permissive towards their child’s drinking than parents of the abstainers. Parents of light drinkers were more likely to be strict about alcohol than parents of heavy drinkers. The slope of rules of light drinkers was not significantly different from the slopes of the increasers, heavy drinkers, and stable drinkers. Finally, the intercept of the increasers was significantly different from the intercept of the heavy drinkers, whereas all other intercepts and the slopes of the three heavy drinking classes (increasers, heavy drinkers, stable drinkers) were not significantly different from each other. To summarize, parents of adolescents who drink heavily were more likely to be permissive than parents of adolescents who abstained or drank a little at baseline. This holds for parents of youth in early and mid-adolescence. The way parents change their rules over the years was of less importance in the drinking of mid-adolescents. However, for early adolescents, parents of abstainers were less likely to become permissive towards drinking than the parents of the light drinkers or increasers.

**DISCUSSION**

This study tested the heterogeneity in the development of drinking in early and mid-adolescence. Further, we tested whether gender, age, parental drinking, best friends’ drinking, and alcohol-specific rules predicted adolescents’ membership of a specific drinking trajectory. To our knowledge, the current study is the first European study assessing the development of the quantity of alcohol use over time during early and mid-adolescence. For the early adolescents (13-year-olds at baseline measurement), we found four different drinking trajectories as we initially expected: abstainers, light drinkers, adolescents who strongly increased their drinking over time (increasers), and adolescents who initially consumed alcohol heavily but also strongly increased their drinking within 2 years (heavy drinkers). For mid-adolescents, we identified a fifth trajectory (stable drinkers) in addition to the four trajectories identified for early adolescents. These adolescents drank approximately six glasses of alcohol per week at all three measurements, which gave the impression that they already established a stable drinking pattern. Further, our results showed that being a boy, having a best friend or father who drinks heavily, and having parents who are permissive towards adolescents’ alcohol creates increased risk for both age groups to be part of a heavy drinking trajectory.

In accordance with Flory et al. (2004), our results showed that there is a group of adolescents that abstain from drinking. The light drinkers, increasers and heavy drinkers corresponded with trajectories found by Colder et al. (2002; light drinkers, escalators, and heavy drinkers), although these authors divided escalators and heavy drinkers trajectories also by frequency, resulting in four trajectories. Thus, it seems there are, at least for quantity of drinking, four drinking trajectories to be detected in (early) adolescence. Our findings, as
problems (e.g., Fergusson, Lynskey, & Horwood, 1994). This age period. Unfortunately, because of the data did not provide the information whether the stable drinking trajectories of the early and mid-adolescents was three times as big as the group of heavy drinkers. These results suggest that perhaps even more drinking trajectories could be identified if adolescents would be followed during the entire period of adolescence. Unfortunately, because of the two separate samples, it was not possible to detect trajectories from 13 to 17 years with our data. In addition, the outcomes indicated that the early adolescents drank rather similar amounts of alcohol as the mid-adolescents, although a comparison between the drinking trajectories of the early and mid-adolescents was statistically not possible. Nevertheless, it suggests that birth order may play a role in the development of adolescents’ alcohol use. It seems that younger siblings are more at risk to develop higher levels of alcohol consumption after initiation. One reason could be that the older sibling influences the younger siblings’ alcohol use by being a role model or by offering alcohol to their younger brother or sister. Previous research showed that this is indeed the case, although older siblings’ influence on the younger ones is marginal (Epstein, Botvin, Baker, & Diaz, 1999; Van Der Vorst, Engels, Meeus, Deković, & Van Leeuwe, 2007). On the other hand, it might be that the older sibling already introduced youth drinking in the family, which could have created a more liberal family climate toward youth drinking as a consequence. Previous research also provides some support for this assumption. Specifically, when the younger siblings reach the age of the older ones at the first measurement (15 years), the parents of drinking as well as nondrinking adolescents appear to be less strict towards the drinking of these 15-year-old adolescents than toward the older adolescents at that age (Van Der Vorst et al., 2007). However, the effects of alcohol-specific rules on adolescents’ alcohol use are the same for older and younger siblings (Van Der Vorst et al., 2006).

Predictors of Drinking Trajectories

Previous studies indicated parents can lower adolescents’ alcohol use by being strict about alcohol (Jackson et al., 1999; Van Der Vorst et al., 2006). Our study extended these previous findings by clearly showing that parents of adolescents who abstain from drinking or hardly drink at baseline were more likely to set stricter rules about alcohol than parents of adolescent children with more heavy drinking patterns (increasers and heavy drinkers). This indicates that parents can postpone the increase in alcohol use by being strict from childhood on and by keeping these strict house rules about drinking. We found these results for both early and mid-adolescents, which underscores the consistency of this outcome. Thus, it seems that alcohol-specific parenting is mainly of influence in the stages before regular alcohol use. In addition, the way parents change their rule-setting over time was only of influence for the early adolescents. Parents of 13-year-old abstainers were less likely to become permissive towards their child’s drinking than the parents of 13-year-old light drinkers or increasers. That we found an association of the slope of alcohol-specific rules (a general decrease in rule-setting) for early adolescents, but not for the older ones, might be caused by birth order. Parents seem to become more liberal toward secondborns in early adolescence than toward first-borns, probably as a consequence of the drinking behavior of the firstborns (Van Der Vorst et al., 2007).

Further, fathers of mid-adolescent light drinkers, increasers, and stable drinkers were more likely to consume alcohol than fathers of abstainers, an outcome that has been found by others before (e.g., Zhang, Welte, & Wieczorek, 1999). Also, fathers could have a preventive effect before adolescents’ start to use alcohol by not drinking in their children’s presence. For the
early adolescents, we only found a significant difference between the abstainers and heavy drinkers. This difference between older and younger siblings seems remarkable, as paternal alcohol consumption was the same for both siblings. An explanation could be that the older siblings have a clearer perception of the actual drinking of their fathers compared to their younger brothers or sisters, because they seem to drink more often with their fathers than with their younger siblings do. As a consequence, the older adolescents might have more opportunity to imitate their fathers’ drinking. That adolescents have a tendency to directly imitate parental drinking has been shown by several studies (e.g., Ellickson et al., 2001; Quigley & Collins, 1999).

In contrast, we found few significant results for the alcohol consumption of mothers on the different drinking trajectories of early and mid-adolescents. That especially paternal drinking is of importance in the development of adolescents’ alcohol use, and not maternal drinking, is in accordance with the results of others (e.g., Zhang et al., 1999). Does this mean that children are influenced not by the drinking of their mothers but only by their fathers? We assume that this is not the case. For instance, it might be that the paternal alcohol use is more salient in families than maternal alcohol use. Perhaps mothers drink less in the presence of their children or drink less with their children. Mothers consume, in general, less alcohol and less often than fathers (Van Der Vorst et al., 2005). To fully understand the role of maternal alcohol use in adolescents’ alcohol development, it would be helpful to compare the effects of maternal alcohol use in single families with two-parent families. It should also be stressed that our findings underscore the importance of measuring paternal and maternal alcohol consumption separately, instead of parental alcohol use as many studies have done before (e.g., Engels & Van Der Vorst, 2005).

Both alcohol consumption of the father and the alcohol use of the best friend play a role in adolescents’ drinking. The alcohol consumption of the best friend was particularly associated with the heavy drinkers compared to the other trajectories, which is in accordance with results from the study of Tucker et al. (2003) on binge drinking trajectories but has not been shown by studies on normative drinking trajectories. In our study, best friends’ drinking differentiates between all trajectories with the heavy-drinking trajectory in the group of the mid-adolescents and differentiates the abstainers from the increasers and heavy drinkers of the younger ones. Unfortunately, we could not find out whether these results were due to influence or selection processes (Bot et al., 2005; Poelen et al., 2007). The best friends of the increasers, stable drinkers, and heavy drinkers were more likely to consume alcohol than the best friends of the light drinkers of the mid-adolescents. That we did not find differences between abstainers and the other trajectories for the older adolescents, but found this for the light drinkers compared to the other trajectories, suggests that the drinking of the best friend becomes important after initiation of drinking. This would be consistent with the contention that most adolescents start to drink at home in a family gathering and not in the presence of a friend (Warner & White, 2003). Alcohol consumption in mid- and late adolescence is also more concentrated at pubs, bars, discos, and parties where adolescents hang out with friends (Bot et al., 2005). Thus, friends might become more involved in the development of the drinking behavior later in adolescence than parents. On the other hand, parents seem to have the highest influence in the initiation stages of youth alcohol use by being strict about alcohol and fathers by not drinking in the presence of their children. However, future research is needed to confirm this interpretation.

Finally, our results with regard to gender correspond with the findings of Bennett et al. (1999). Adolescent boys are more at risk to engage in heavy drinking than adolescent girls. Girls were more likely to be classified in a light drinking trajectory or to abstain from alcohol. Age, on the other hand, was generally not associated with our drinking trajectories for both early and mid-adolescents. We only found that age differentiated light drinkers from increasers and heavy drinkers in early adolescence, and heavy drinkers from stable drinkers in mid-adolescence. This might be because of the small age differences in both samples.

Limitations

Despite the clear findings and the strengths of the study, such as its relatively large sample size and the full-family data, the current study is limited by some factors. First, our findings might not reflect the situation in countries with other drinking cultures (Hibell et al., 2004). Second, some of the drinking classes were rather small, especially the heavy drinkers. This could have affected our results in the sense that we perhaps did not find significant associations for some of the predictors of certain classes, resulting in Type II errors. It might be that with larger classes some results would become significant. Another consequence of the small trajectories was that it prevented us from examining the individual

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5 In our study the older siblings drank significantly more often with their fathers than the younger siblings, \( t_{T_1}(420) = 4.28, p < .001; t_{T_2}(416) = 3.11, p < .01; t_{T_3}(42) = 2.51, p < .05 \).

6 In our study, both siblings drank significantly more often with their fathers than with their mothers, \( t_{T_1}(420) = 3.27, p < .01; t_{T_2}(419) = 2.10, p < .05; t_{T_3}(420) = 3.33, p < .01; t_{T_4}(422) = 2.85, p < .01; t_{T_5}(424) = 3.00, p < .05; t_{T_6}(416) = 3.11, p < .05 \).
intercepts and slopes of the other predictors (e.g., best friends’ drinking) and from testing other predictors. Therefore, we also did not add siblings’ alcohol use in our analyses. Furthermore, because information about best friend drinking was given by the adolescent, this could have led to shared measurement variance. Finally, using self-reports might not have give an accurate estimation of “real-life” drinking because of social desirability or because adolescents simply could not recall precisely what they had been drinking. However, according to a review of Brener, Billy, and Grady (2003), certain factors increase the validity of self-reports, for example, short recall period, specific and simple questions, and providing the respondent privacy during completion of the questionnaire. We met these criteria in our study.

Implications for Research, Policy, and Practice
Taking these limitations into account, our findings reveal substantial evidence that there is heterogeneity in the development of early and mid-adolescents’ alcohol consumption. This underscores the importance of focusing on drinking trajectories in research on adolescents’ drinking instead of on studying adolescents as a single, homogeneous group. That is, our findings show not only that some factors are more important for certain trajectories, such as best friends’ drinking for heavy drinkers, but also that the influence of factors can differ by age periods, for instance the change in the influence of parental setting of alcohol-specific rules.

Further, these results can be meaningful for alcohol prevention programs. Alcohol prevention programs should not focus on adolescents as a single group, but should provide programs for specific groups. Increasers and the heavy drinkers might be of particular risk for later alcohol related problems (Fergusson et al., 1994). Therefore, treatment programs should particularly target adolescents in these trajectories. It also seems that increasers and heavy drinkers could benefit from programs designed to help them resist peer pressure, whereas for abstainers and light drinkers parental involvement in the treatment appears more important. On the basis of our findings, prevention programs should enhance parents’ awareness of their power to delay the age of onset and the increase of drinking by providing and keeping strict rules about adolescents’ drinking. Currently, a prevention program on alcohol-specific rule setting is being conducted, and the preliminary results of the Dutch program are promising (Vollebergh, Verdurmen, Schulten, & Engels, 2005), as well as a Swedish version of the program (Koutakis & Stattin, 2004).

A correlation table including all model variables is available from the first author.

REFERENCES


