The influence of paternal and maternal drinking patterns within two-partner families on the initiation and development of adolescent drinking

Evelien Vermeulen-Smit a,⁎, Ina M. Koning b, Jacqueline E.E. Verdurmen a, Haske Van der Vorst c, Rutger C.M.E. Engels c, Wilma A.M. Vollebergh b

a Trimbos Institute (Netherlands Institute of Mental Health and Addiction), P.O. Box 725, 3500 AS Utrecht, The Netherlands
b Department of Interdisciplinary Social Science, University of Utrecht, P.O. Box 80140, 3508 TC, Utrecht, The Netherlands
c Behavioural Science Institute, Radboud University Nijmegen, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands

⁎ Corresponding author. Tel.: +31 302971100; fax: +31 302971111.
E-mail address: evermeulen@trimbos.nl (E. Vermeulen-Smit).

1 In the following overview of longitudinal studies we only refer to 'normative' levels of parental drinking (excluding alcoholism), as the association between parent alcoholism and adolescent drinking involves different mechanisms.

1. Introduction

1.1. Background

It is unclear to what extent parental drinking is a predictor of children's alcohol use. Longitudinal studies do not consistently confirm the mechanisms through which the influence of parental drinking on their offspring's alcohol use has been explained. The association between parental and adolescent drinking has been explained both directly by modeling (Bandura, 1977; Webb & Baer, 1995) and indirectly through parenting behavior (Latendresse et al., 2008). That is, children tend to imitate parental behavior (directly) when they watch their parents drink or when they drink together (Van der Vorst, Engels, & Burk, 2010; Zhang, Welte, & Wieczorek, 1999). In addition, the influence of parental drinking can be explained indirectly. That is, (heavy) drinking parents have been found to be more lenient towards their children's whereabouts in general (Latendresse et al., 2008) and their alcohol use in specific (Verdurmen, Smit, Van Dorsselaer, Monshouwer, & Schulten, 2008) which, in turn, are known predictors of adolescent drinking (Van der Vorst, Engels, Meeus, & Dekovic, 2006). Furthermore, genetic susceptibility plays a role in the relation between parent and offspring's drinking, and this becomes profoundly visible when it involves children of alcoholics (King et al., 2009). Although these explanations seem clear and several longitudinal studies have found parental drinking to predict children's alcohol use (Ary, Tildesley, Hops, & Andrews, 1993; Ellickson & Hays, 1991; Engels, Knibbe, De Vries, Drop, & Van Breukelen, 1999; Kandel & Andrews, 1987; Poelen, Scholte, Willemsen, Boomsma, & Engels, 2007; Seljamo et al., 2006; White, Johnson, & Buyske, 2000), other longitudinal studies did not find such an association between parental and adolescent drinking (Peterson, Hawkins, Abbott, & Catalano, 1994; Power, Stewart, Hughes, & Arbona, 2005; Reifman, Barnes, Dintcheff, Farrell, & Uhteg, 1998).

Different explanations for these contrasting findings have been suggested. First, they might be explained by varying measures used to operationalize parental drinking in particular studies. For example, adolescent drinking was not affected by parental household alcohol problems (Sieving, Maruyama, Williams, & Perry, 2000) but was
affected indeed by parental drinking frequency (Kandel & Andrews, 1987). Although a variety of measures, such as parental problem drinking (Latendresse et al., 2008; Sieving et al., 2000; Van der Zwaluw et al., 2008) and weekly and daily drinking (Poelen, Engels, Scholte, Boomsma, & Willemsen, 2009, Poelen et al., 2007) have been used, most scholars examined parental drinking by estimating the number of drinks a week (Otten, Van der Zwaluw, van der Vorst, & Engels, 2008; Peterson et al., 1994; White et al., 2000). Yet, the average number of drinks a week might conceal different drinking patterns, which may also differ in their impact on adolescent behavior. For example, an equal number of drinks (e.g. 10 drinks a week) might be consumed both by daily light drinkers (1–2 glasses daily) and by heavy episodic drinkers (e.g. 10 glasses each Saturday night). As no former studies tried to unravel these patterns, it is unclear which specific parental drinking patterns are most harmful.

Second, the role of parental gender is still inconclusive. A number of studies found especially paternal drinking to predict adolescent drinking (Poelen et al., 2009; Seljamo et al., 2006), whereas others emphasized the particular influence of maternal drinking (Otten et al., 2008; Poelen et al., 2007; Reiffman et al., 1998). A third category of studies suggests that the strongest influence is between same-sex dyads (father–son, mother–daughter; Wickrama, Conger, Wallace, & Elder, 1999). Less is known about the combined influence of paternal and maternal drinking patterns. The existing studies, comparing families with none, one or two drinking parents, report that adolescents are at particular risk when both parents drink (Green, Macintyre, West, & Ecb, 1991; Hung, Yen, & Wu, 2009). Hall, Hesselbrock, and Stabenau (1983) studied different combinations of paternal and maternal drinking patterns. Problem drinking fathers usually had wives who were not problem drinkers while problem drinking mothers often had husbands who were (Hall et al., 1983). However, combinations of paternal and maternal drinking patterns within a family have not been analyzed in relation to child drinking.

Third, parental drinking might play differential roles at specific stages of adolescent drinking (Power et al., 2005). Reiffman et al. (1998) found maternal drinking to affect adolescent heavy drinking but not initiation. Other studies found the frequency of parental drinking to remain influential throughout adolescence (Poelen et al., 2007, 2009). Additional studies report parental drinking to affect initiation more than transition to regular or problem drinking (Power et al., 2005) and the impact to decline when adolescents grow older (Van der Zwaluw et al., 2008). Hence, the particular influence of parental drinking across different stages of adolescent alcohol use is still unclear.

Fourth, parental drinking is associated with parents' strictness towards their children's alcohol use (Peterson et al., 1994; Van der Vorst et al., 2006). Accordingly, the direct impact of parental drinking on adolescent alcohol use may decrease when parental rules about alcohol are taken into account (Van der Vorst et al., 2006). The same may apply to drinking of parents in the presence of the child. For example, Peterson et al. (1994) reported the significant influence of parental drinking frequency on adolescent drinking to disappear after controlling for parents' permissiveness concerning adolescent drinking. Hence, contrasting findings on the impact of parental drinking in particular studies may also be explained by the inclusion of confounders, such as parental rules about alcohol.

Last, the influence of parental drinking on adolescents may vary as specific groups might be more susceptible to parental drinking. That is, the impact of parental drinking may differ for boys and girls and across different socio-economic groups (Green et al., 1991; Wickrama et al., 1999).

1.2. The present study

This study is innovative in examining the impact of specific patterns of paternal and maternal drinking on the initiation and development of adolescent drinking over four years using a large sample (N = 2319) of parent–child dyads. First, we will identify specific paternal and maternal drinking patterns and examine the influence of detailed combinations of these drinking patterns on early drinking and the development of adolescent alcohol use. Second, we will investigate whether the influence of parental drinking patterns on adolescent drinking remains significant when controlling for parental rules about alcohol. Third, we will examine whether the influence of parental drinking patterns on adolescent drinking differs between 1) boys and girls and 2) low and high SES adolescents.

2. Method

2.1. Procedure

The data used in the current study are part of a longitudinal randomized controlled trial (RCT) called “Prevention of Alcohol Use in Students” (PAS: Koning et al., 2009). Current analyses were based on results from the four measurements, while controlling for the intervention conditions. A randomly selected sample of 80 secondary schools in the Netherlands was invited (by letter) to participate in the study. A total of 19 secondary schools from different regions in the Netherlands were willing to participate with a total of 3490 first year adolescents. The study included both the adolescents and one of their parents.

Data were collected in September/October 2006 (T1), 8 months later in May/June 2007 (T2), again in May/June 2008 (T3) and in May/June 2009 (T4). Adolescent data were collected in their classrooms through questionnaires, available on a secured web site. All questions needed to be answered, resulting in zero non-response on item-level. Research assistants were trained to administer the survey. Parental data were collected by written questionnaires that were sent to their home addresses in a school envelope along with a letter of consent. This letter gave parents the opportunity to refuse participation of their child (0.01% refusal). Parents could decide themselves whether the father or mother filled in the questionnaire. The questionnaire was followed by a written reminder three weeks later to parents who had not yet responded. Another two weeks later, non-responding parents were called by phone.

2.2. Participants

Nineteen schools, including 3490 adolescents were selected to participate in the study. Due to initial non-response (adolescents: N = 122, due to their parents’ refusal or their absence from school on the day the questionnaire was administered; parents: N = 643) and exclusion of single-parent families (N = 266, single parents were excluded as we were particularly interested in combinations of paternal and maternal drinking patterns) or parents with incomplete data (N = 140), 2319 parent–child dyads were eligible for analyses.

The adolescent sample had a mean age of 12.2 (SD = 0.5), including 52% boys, 51% in lower secondary vocational education (low education) and 49% in higher general secondary and pre-university education (high education). Most of the responding parents were female (80.2%). Two thirds of the mothers (72.7%) and fathers (63.5%) had low educational levels (only vocational training).

2.3. Attrition analyses

A total of 2196 adolescents (94.7%) at T2, 2055 adolescents (88.6%) at T3, and 2038 (87.9%) adolescents at T4 completed the follow-up assessments after 8, 20 and 32 months respectively. Attrition analyses on demographic variables and alcohol use indicated that responding adolescents were more likely to be younger, more often in lower education and drank a lower average number of alcohol beverages per week.
at baseline. No follow-up data from parent reports are used in the current study.

2.4. Measures

2.4.1. Parental alcohol use

Parental alcohol use at T1 was measured using a Quantity–Frequency Scale (Knibbe, Oostveen, & Van de Goor, 1991; Koning, Engels, Verdurmen, & Vollebergh, 2010; Monshouwer et al., 2008). Because the majority of the responding parents were mothers (80%), paternal alcohol use was generally reported by them. Cross-reports between partners have been found to be fairly reliable (correlation .65–.73) (Connors & Maisto, 2003). The alcohol use measures were adapted according to the gender of the responding parents. We used each of the quantity-frequency items separately to detect drinking patterns. This resulted in the following four items measured for mothers and fathers individually: (1) number of drinking days during the week (Monday to Thursday), (2) number of usual drinks on a weekday, (3) number of drinking days during the weekend (Friday to Sunday), and (4) number of usual drinks on a weekend day.

Drinking in the presence of the child was measured at T1 by asking the adolescent how often his/her parents drink alcohol in their presence (range: 1–5; 1 = never; 5 = very often) (Verdurmen et al., 2008).

An additional measure of parental drinking was examined to portray the observed latent classes. Parental problem drinking was measured at T1 with a short version of the problem drinking list (Cornel, Knibbe, Van Zutphen, & Drop, 1994). The scale consisted of six items asking whether the respondent e.g. “has tried to stop drinking” and “drank alcohol to forget my worries” in the past twelve months. Severity of problem drinking was reflected by the sum score. The respondent who filled in the questionnaire also answered the items for his/her partner. Cronbach’s alphas were .64 and .76 for mothers and fathers respectively.

2.4.2. Adolescents’ alcohol use

Adolescents’ alcohol use was measured at T1–T4 by using the same Quantity–Frequency Scale as described above for parental alcohol use. The Quantity–Frequency measure represented the average weekly alcohol use. Quantity–frequency was computed by calculating the products of the number of days and the number of glasses and then summing the two products for weekdays and weekend days. The quantity–frequency of one or more indicated that the respondent drinks at least one day a week, one glass of alcohol. For those who indicated no alcohol use last month, the quantity–frequency was adjusted to zero.

2.4.3. Rules about alcohol

Rules about alcohol measured the degree of rule-setting perceived by the adolescent at T1. This scale was developed by Van der Vorst, Engels, Meeus, Dekovic, and Van Leeuwe (2005). Items included “I am allowed to have one glass of alcohol when my parents are at home” and “I am allowed to drink alcohol at a party with my friends.” The scale consisted of the mean of ten items rated on a 5-point scale from 1 “never” to 5 “always” reversely scored, i.e. higher scores indicated more rule-setting behavior. Cronbach’s alpha was .90.

2.4.4. Educational level

In the Netherlands, from the first year of secondary school, when pupils are 12–13 years of age, the educational system is already highly differentiated. Depending on their teacher’s advice and the results of a test in the last year of primary education pupils enter different types of secondary education. Educational level was included as a dichotomous variable. Low education included: pre-vocational education and low general secondary education; higher education included: upper general secondary education and pre-university secondary education (Koning et al., 2009; Smit, Monshouwer, & Verdurmen, 2002). Educational level is a good proxy of adolescents’ own current level of SES (Rahkonen, Arber, & Labelma, 1995; Richter & Leppin, 2007). Furthermore, studying the potential differences of parental drinking on adolescent alcohol use across educational levels is recommended in the light of prevention efforts, since 1) effective family programs are targeting parents via schools (Koning et al., 2009; Mares et al., 2012); 2) family programs are differentially effective across educational levels (Verdurmen, Koning, & Vollebergh, under review) and 3) adolescent drinking is heavier at lower educational levels (Smit et al., 2002).

2.5. Strategy for analyses

2.5.1. Latent class analysis

Drinking patterns among parents were identified by applying latent class analysis (LCA) in Mplus 5.0 (Muthén & Muthén, 2007) to the list of four alcohol items (number of drinking days during the week; number of usual drinks on a weekend; number of drinking days during the weekend and number of usual drinks on a weekend day) for both mothers and fathers separately. LCA assumes that the association among the observed alcohol items is due to an underlying class structure. The goal of LCA is to identify the smallest number of latent classes that adequately describes the associations among the observed items. We started with the most parsimonious 1-class model and fitted successive models with increasing numbers of classes. Goodness-of-fit statistics were used to select the optimal model. We compared successive models by the Bayesian information criterion (BIC), the entropy and the Vuong Lo–Mendell–Rubin Likelihood Ratio Test (LMR-LRT). The model with the lowest BIC, the highest entropy and a significant LMR-LRT criterion, was considered to be the optimal model.

One-way ANOVA was carried out to examine whether parent and adolescent characteristics were significantly different between the classes. Bonferroni’s correction was used to adjust for multiple comparisons. Adolescents who are at higher risk for alcohol use are, among others, boys (Epstein, Botvin, & Diaz, 1998), the lower educational levels (Smit et al., 2002); 2) family programs are differentially effective across educational levels (Verdurmen, Koning, & Vollebergh, under review) and 3) adolescent drinking is heavier at lower educational levels (Smit et al., 2002).

2.5.2. Latent growth model

A latent growth curve (LGC) modeling approach was used to examine the development of adolescent weekly drinking over time and to investigate the influence of parental drinking patterns on the initiation and development of adolescent weekly drinking. First, different latent growth models (LGM) were estimated to examine which model described the growth of adolescent alcohol use over a four-year period (T1–T4) best. A two-factor latent growth model was used, including intercept and slope. The intercept represents information in the sample concerning the mean and variance of the adolescent alcohol level at T1. The second factor, the slope has the mean and variance of the total sample, and describes the individuals’ change of alcohol use over time. Slope parameters represent years 1, 2, 3 and 4 respectively. The residual variances of the outcome variables were estimated and allowed to be different across time. To examine whether the data are best described by linear or nonlinear growth, two models were tested. In the linear model, factor loadings for slope were fixed at values corresponding to a linear time scale (0, 1, 2.5 and 4). In the nonlinear model, constraints on linear growth were relaxed. For identification of the model, at least two factor loadings on the slope factor must be fixed to two different values (Meredith & Tisak, 1990). The first three factor loadings were fixed at 0, 1 and 2.5, whereas the fourth factor loading was allowed to be freely estimated.

Second, the relative influence of parental drinking patterns (dummy classes) on adolescents’ growth trajectories was estimated using path.
modeling. As multinomial regression requires a reference group, classes one to six were chosen as the reference group, successively. In this way all possible combinations of two classes were examined. All analyses were conducted in Mplus (5.0; Muthén & Muthén, 2007) using a maximum likelihood estimator (ML), the default in Mplus 5.0. Model fit was assessed using the Chi-square goodness of fit test, comparative fit index (CFI; Bentler, 1990) and root mean square error of approximation (RMSEA; Browne & Cudeck, 1993). Consequently, two different models were run, 1) a model which controlled only for demographic variables (age, gender and educational level) and 2) a model which additionally controlled for “rules about alcohol” to test the relative influence of parental drinking patterns on adolescent growth trajectories when controlling for parental rules about alcohol.

Third, we tested whether there were interaction effects between parental drinking patterns and gender and educational level on adolescent alcohol use (intercept and slope). All variables were centered or dichotomized before the interaction terms of gender and educational level were computed (Aiken & West, 1991).

As data are retrieved from a cluster randomized trial, design effects were estimated to decide on accounting for non-independence due to cluster sampling. As the design effect (based on possible cluster effects at the classroom level which is more conservative than at the school level), was lower than two, accounting for clustering was not imperative (Kish, 1965, Muthén & Satorra, 1995).

Complete parent–child dyads were selected in this study, without missing data on the independent variable, measured at baseline. No missing data appeared on confounders due to zero non-response on item-level for the adolescents. Missing data on the dependent variables were handled using full estimation maximum likelihood (Muthén & Muthén, 2007). Accordingly, all eligible parent–child dyads were used in the analyses (N = 2319).

3. Results

3.1. Latent class analysis of parental drinking patterns

Parental drinking patterns at T1 were identified using latent class analyses (LCA). The results of several criteria and measures to decide for the number of classes are given in Table 1. LCA identified a six-class solution to fit the data the best, according to LMR-LRT (six classes: p < .001, seven classes: p = .803). The average class probabilities were high (.91–.98), which indicated that the participants were properly classified to their latent class. The six parental drinking patterns that were identified by LCA are described in Table 2. Class 1 contained parents who drank 1–2 glasses 0–1 days a week (non/incidental drinkers). Parents in the second class drank 1–2 glasses 2–4 days a week (regular light drinkers). Class 3 consisted of families where mothers drank incidentally and fathers drank 2–3 glasses daily (mother incidental, father daily drinker). Class 4 contained families where both father and mother drank 2–3 glasses daily (both parents daily drinkers). Class 5 contained families where both parents tended to drinkheavy during weekends (class 6), adolescents drank significantly more at the age of 12 (T1) compared with adolescents whose parent(s) abstained or drank limited amounts regularly or daily (class 1 to 4). Moreover, adolescents with either a heavy drinking father (class 5) or two parents who tend to drink heavily during weekends (class 6) showed a stronger increase in drinking compared with adolescents having other parental drinking classes. Apart from classes 5 and 6, no direct associations were observed between parental drinking patterns on one hand and intercept or slope of adolescent drinking on the other.

Second, parental rules about alcohol was added to the model (Model 2; \( \chi^2 (28) = 106.5, p < .001; \text{CFI} = .95; \text{RMSEA} = .04 \)). Like model 1, significant associations were identified for membership in class 6 with the intercept of adolescent drinking, compared to classes 1 to 3 (\( \beta = .16, p < .05 \)). Also similar to model 1, class 5 was associated with the slope of adolescent drinking compared to classes 1 to 4 (\( \beta = .19, p < .05 \)). Class 6 was associated with the slope of adolescent drinking compared to classes 1 to 3 (\( \beta = .22, p < .05 \)), but not significantly compared with 3 to 6 (one or both parents daily or heavy drinkers) compared to classes 1 and 2 (nondrinkers or light drinkers). Membership in classes 5 (heavy drinking fathers) and 6 (heavy weekend drinking parents) was associated with significantly less parental rules about alcohol at T4 compared to other classes.

3.2. Latent growth model of adolescent drinking

3.2.1. Model fit

Two latent growth models (LGM) were estimated to examine which model described the intercept and slope of adolescent alcohol use over a four-year period (T1–T4) best. The linear growth model where time points for alcohol use were fixed, did not describe the growth trajectory for adolescent alcohol use over time very well (\( \chi^2 (5) = 112.3, p < .001; \text{CFI} = .90; \text{RMSEA} = .10 \)). As the non-linear model showed an acceptable fit (\( \chi^2 (5) = 48.5, p < .001; \text{CFI} = .96; \text{RMSEA} = .07 \)), this model was used for all further analyses. Unstandardized means (SE) for intercept and slope of adolescent drinking were .41 (.04) and .54 (.03) respectively.

3.2.2. Regression analyses

Table 4 shows the results of the regression models, all including six dummies of parental drinking patterns representing six classes of parental drinking. Successively, classes one to six were chosen as the reference group. As results above and below the diagonal corresponded, only results below the diagonal were reported.

First, a model was run controlling for age, gender and education (Model 1; \( \chi^2 (26) = 92.2, p < .001; \text{CFI} = .95; \text{RMSEA} = .03 \)). An association was identified for membership in class 6 and the intercept of adolescent drinking, compared to classes 1 to 4 (\( \beta = -.27, p < .05 \)). Class 5 and class 6 were associated with the slope of adolescent drinking, compared to classes 1 to 4 (\( \beta = -.48, p < .001 \) and from \( -.22 \) to \( -.34, p < .05 \)). That is, within families where both parents tend to drink heavy during weekends (class 6), adolescents drank significantly more at the age of 12 (T1) compared with adolescents whose parent(s) abstained or drank limited amounts regularly or daily (class 1 to 4). Moreover, adolescents with either a heavy drinking father (class 5) or two parents who tend to drink heavily during weekends (class 6) showed a stronger increase in drinking compared with adolescents having other parental drinking classes.

Characteristics of each of the latent classes are presented in Table 3.
class 4 ($\beta = -0.16, p = .08$). Hence, when parental rules about alcohol were taken into account, the observed associations between parental heavy (episodic) drinking (class 5 and 6) and the intercept and slope of adolescent weekly drinking remained significant and consistent compared with less severe drinking patterns.

An association between “drinking in the presence of the child” and the intercept of adolescent drinking was observed ($\beta = 1.3$, $p < .001$), which disappeared when control for parents rules about alcohol ($\beta = .05, p > .05$) was applied. No significant associations were found between “drinking in the presence of the child” and the slope of adolescent drinking.

### 3.2.3. Interaction analyses

Interaction analyses were performed to observe whether parental drinking might influence adolescent early drinking (intercept) or drinking development (slope) differently in high-risk groups.

#### 3.2.3.1. Gender

First, to establish whether the relation between parental drinking and adolescent drinking differs across gender, interaction terms (Gender X Parental Drinking Classes) were added to the model (model 3: $X^2(38) = 120.1, p < .001; CFI = .95; RMSEA = .03$). Differences between boys and girls existed for the relationships between class 4 (compared with class 1; $\beta = -11.1, p < .05$), class 5 (compared with class 2 and class 4; $\beta$s are .22, $p < .05$) and class 6 (compared with class 1–5; $\beta$s ranging from -.18 to -.52 ($p < .05$)) and the intercept of adolescent drinking (Fig. 1). Fig. 1 shows that, at the age of 12 the influence of a heavy drinking father (class 5) is especially strong among girls, whereas the influence of both parents daily drinking (class 4) and heavy weekend drinking (class 6) affects boys more strongly. No significant interaction effects were found for the slope of adolescent drinking. Still, Fig. 1 reveals that boys in class 5 ‘catch up’ to boys in class 6 by the time they are 15, indicating that the father’s influence is also important to boys, but perhaps somewhat delayed. Though, for girls, the influence of the father’s heavy drinking (class 5) remains stronger throughout.

#### 3.2.3.2. Level of education

Second, interaction analyses were performed to establish whether the relation between parental drinking and adolescent drinking differs across educational levels (low versus high). The model revealed a good model fit (model 4: $X^2(38) = 113.3, p < .001; CFI = .96; RMSEA = .03$). Differences between educational levels existed for the relationships of class 6 (compared with class 2 ($\beta = -30, p < .05$)) and class 3 ($\beta = -25, p < .05$) and the intercept of adolescent drinking and for the relationship between class 4 (compared with class 1; $\beta = -13, p < .05$) and class 5 (compared with class 1 ($\beta = -36, p < .05$) and class 3 ($\beta = -23, p < .05$)) and the slope of adolescent drinking (Fig. 2). Separate analyses for educational levels revealed that the influence of parental heavy weekend drinking (class 6) more strongly affects 12 year olds attending lower education compared with their higher educated peers. Furthermore, membership in

### Table 2

<table>
<thead>
<tr>
<th>Groups</th>
<th>N (%)</th>
<th>1: Non/incidental</th>
<th>2: Regular light</th>
<th>3: MO incidental, FA daily</th>
<th>4: MO and FA daily</th>
<th>5: MO incidental; FA heavy</th>
<th>6: MO and FA heavy weekend drinkers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Week</td>
<td>Days*</td>
<td>Drinks</td>
<td>Days*</td>
<td>Drinks</td>
<td>Days*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mother</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>965 (42)</td>
<td>.05</td>
<td>.06</td>
<td>.53</td>
<td>.93</td>
<td>.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>494 (21)</td>
<td>1.56</td>
<td>1.43</td>
<td>1.78</td>
<td>2.19</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>432 (19)</td>
<td>1.28</td>
<td>1.80</td>
<td>2.63</td>
<td>2.53</td>
<td>3.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>51 (2)</td>
<td>.38</td>
<td>.42</td>
<td>.79</td>
<td>1.88</td>
<td>2.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34 (1)</td>
<td>1.03</td>
<td>2.53</td>
<td>1.38</td>
<td>8.28</td>
<td>1.22</td>
</tr>
</tbody>
</table>

Notes: MO = mother; FA = father.

* Number of drinking days during the week (Monday to Thursday).

# Table 3

<table>
<thead>
<tr>
<th>N (%)</th>
<th>Total</th>
<th>1: Non/incidental</th>
<th>2: Regular light</th>
<th>3: MO incidental, FA daily</th>
<th>4: MO and FA daily</th>
<th>5: MO incidental; FA heavy</th>
<th>6: Both heavy weekend drinkers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2319</td>
<td>965 (42)</td>
<td>494 (21)</td>
<td>343 (15)</td>
<td>432 (19)</td>
<td>51 (2)</td>
</tr>
</tbody>
</table>

### Adolescent characteristics

- Gender (% boys): 52.2, 53.2, 52.6, 52.5, 49.1, 49.0, 61.8
- Mean age: 12.2, 12.2, 12.1, 12.1, 12.1, 12.1, 12.1
- Education (%): 51.4, 56.1, 40.2, 51.3, 40.0, 64.7, 67.6
- Adolescent weekly drinking (T1)**: 3.9, 3.6, 3.3, 3.9, 3.9
- Adolescent weekly drinking (T4)**: .4, .4, .3, .3, .3
- Parent characteristics:
  - Weekly drinking mother (T1)**: 4.7, 1.1, 6.1, 1.2, 1.2, 12.6, 3.1, 15.9
  - Weekly drinking father (T1)**: 9.1, 3.1, 6.2, 15.4, 16.2, 34.0, 19.9
  - Problem drinking mother (T1)**: .4, .1, .6, .2, 1.0, .4 .1, 1.3
  - Problem drinking father (T1)**: .7, .3, .6, 1.0, 1.1, 2.0, 1.4
  - Drinking in presence of child (T1)**: 2.3, 2.3, 2.9, 3.2, 3.6, 3.3, 3.1
  - Parental rules about alcohol (T1)**: 4.6, 4.6, 4.5, 4.5
  - Parental rules about alcohol (T4)**: 4.2, 4.2, 4.2, 4.2

Notes: Means compared by ANOVAs using Bonferroni’s correction to adjust for multiple comparisons. MO = mother; FA = father. Means that do not share superscripts (1, 2, 3, 4, 5) are significantly different ($p < .05$).

* Average number of glasses a week.

** Severity of problem drinking is reflected by the aggregated score of 6 items (range: 0–6).

* Means of drinking in the presence of the child, measured on a 5-point scale ranging from never (1) to very often (5).

* Strictness of parental rules is measured by the mean score of 10 items (range: 1–5).
4. Discussion

This study is the first to investigate the combined influence of particular paternal and maternal drinking patterns on early drinking and the development of adolescent drinking over four years using a large sample of parent-child dyads. In general, two parental drinking patterns constituted a particular risk for adolescent drinking. That is, 1) adolescents from families with an incidentally drinking mother and a heavy drinking father were at higher risk for a stronger increase in drinking throughout adolescence, and 2) adolescents from families with two heavy episodic drinking parents were at higher risk of both early drinking and for a stronger increase in drinking. Thus, parental heavy (episodic) drinking, and not so much the frequency of drinking, seems to be the most harmful to their offspring.

When controlled for parental rules about alcohol and for the impact of several background factors (e.g., adolescent age, gender and educational level), these findings remained significant and consistent.

class 4 (both parents daily drinkers) and class 5 (father heavy drinker) was associated with a stronger increase in drinking among adolescents attending low education compared to high education. Consequently, when parents were in classes 4, 5 and 6 (drinking both daily or heavily) alcohol consumption among adolescents in lower educational levels was 1.5 to 2 times higher compared with that of their higher educated peers (Fig. 2).

Fig. 1. The relationship between parental drinking patterns and adolescent weekly drinking moderated by adolescent gender (unstandardized effects). Note: c1 = non/incidental drinkers; c2 = regular light drinkers; c3 = mother incidental, father daily drinker; c4 = both parents daily drinkers; c5 = mother incidental, father heavy drinker; c6 = both parents heavy weekend drinkers.

Fig. 2. The relationship between parental drinking patterns and adolescent weekly drinking moderated by adolescent education (unstandardized effects). Note: c1 = non/incidental drinkers; c2 = regular light drinkers; c3 = mother incidental, father daily drinker; c4 = both parents daily drinkers; c5 = mother incidental, father heavy drinker; c6 = both parents heavy weekend drinkers.

Table 4
Regression analysis of background variables and parental drinking patterns on the intercept and slope of adolescent weekly drinking (standardized estimates (β))

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regular light drinkers (class 2)</th>
<th>Mother incidental, father daily drinker (class 3)</th>
<th>Both parents daily drinkers (class 4)</th>
<th>Mother incidental, father heavy drinker (class 5)</th>
<th>Both parents heavy weekend drinkers (class 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>Slope</td>
<td>Intercept Slope</td>
<td>Intercept Slope</td>
<td>Intercept Slope</td>
<td>Intercept Slope</td>
</tr>
<tr>
<td>Model 1</td>
<td>Gender</td>
<td>.07**</td>
<td>.09**</td>
<td>-.02</td>
<td>-.08</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.10**</td>
<td>.09**</td>
<td>-.06</td>
<td>-.08</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>.11***</td>
<td>.07*</td>
<td>-.06</td>
<td>-.08</td>
</tr>
<tr>
<td></td>
<td>Class 1</td>
<td>.02</td>
<td>.01</td>
<td>-.01</td>
<td>-.04</td>
</tr>
<tr>
<td></td>
<td>Class 2</td>
<td>.01</td>
<td>.01</td>
<td>-.01</td>
<td>-.04</td>
</tr>
<tr>
<td></td>
<td>Class 3</td>
<td></td>
<td></td>
<td>-.04</td>
<td>-.04</td>
</tr>
<tr>
<td></td>
<td>Class 4</td>
<td></td>
<td></td>
<td>-.04</td>
<td>-.33***</td>
</tr>
<tr>
<td></td>
<td>Class 5</td>
<td></td>
<td></td>
<td>-.04</td>
<td>-.33***</td>
</tr>
<tr>
<td>R²</td>
<td></td>
<td>.05***</td>
<td>.07***</td>
<td>-.003</td>
<td>.008</td>
</tr>
<tr>
<td>Model 2</td>
<td>Parental rules</td>
<td>-.52***</td>
<td>-.29***</td>
<td>-.03</td>
<td>.01</td>
</tr>
<tr>
<td></td>
<td>Class 1</td>
<td>.05</td>
<td>.03</td>
<td>-.05</td>
<td>.07</td>
</tr>
<tr>
<td></td>
<td>Class 2</td>
<td>.004</td>
<td>-.01</td>
<td>-.04</td>
<td>-.07</td>
</tr>
<tr>
<td></td>
<td>Class 3</td>
<td></td>
<td></td>
<td>-.04</td>
<td>-.03</td>
</tr>
<tr>
<td></td>
<td>Class 4</td>
<td></td>
<td></td>
<td>-.04</td>
<td>-.05</td>
</tr>
<tr>
<td></td>
<td>Class 5</td>
<td></td>
<td></td>
<td>-.04</td>
<td>-.05</td>
</tr>
<tr>
<td>R²</td>
<td></td>
<td>.31***</td>
<td>.15***</td>
<td>.009</td>
<td>-.29***</td>
</tr>
</tbody>
</table>
In addition, known risk groups of adolescent drinking (e.g., boys and lower SES adolescents) are affected more strongly by specific parental drinking patterns, such as daily and heavy drinking.

Notably, in general only two out of six parental drinking patterns were related to the initiation or development of adolescent drinking. This finding underlines the importance of studying specific patterns of parental drinking. That is, parents who drink 30 glasses throughout the week (6–9 glasses per day) (class 5) or 10–15 glasses during weekends (6–10 glasses per day) (class 6) constitute a higher risk for adolescent drinking compared with parents who drink 10–15 glasses throughout the week (2–3 glasses per day) (class 4). Our findings seem to contrast the results of Poelen et al. (2007, 2009) who found parental weekly drinking to predict offspring’s drinking. However, Poelen et al. (2009) (peculiarly) found adolescent drinking to be predicted longitudinally by fathers who drink a few times a week but not by fathers’ daily drinking. This unexpected finding might be explained by the fact that they studied only the frequency and not the intensity of parental drinking.

In line with previous studies investigating heavy parental drinking patterns such as the intensity of weekly drinking and problem drinking (Otten et al., 2008; Seljamo et al., 2006; Van der Zwaluw et al., 2008), we observed that parents who regularly drink (moderately) do not expose their children to the same risk as parents who drink heavily (either regularly or solely during weekends). In short, in particular father’s heavy drinking and parental heavy episodic drinking seem to harm adolescents, placing them at a greater risk for increased drinking during adolescence.

No significant associations with adolescent drinking were observed for “drinking in the presence of the child”, when controlled for parents rules about alcohol. Possibly, apart from the aforementioned mechanisms, underlying drinking expectancies or drinking motives may explain why adolescent alcohol use is predicted by heavy parental drinking but not by other drinking patterns. For example, heavy drinking parents may drink to enhance a positive mood or to cope with stress (Cooper, Russell, Skinner, & Windle, 1992; Engels, Wiers, Lemmers, & Overbeek, 2005) whereas daily (moderate) drinking parents might drink for different reasons. Possibly, parental drinking motives and expectancies may predict adolescent drinking.

Furthermore, heavy parental drinking was found to predict not only early drinking but also a stronger increase in adolescent drinking among 12–15 year olds. This is in contrast with theoretical models reporting parental drinking to affect early drinking more than the transition to regular or problem drinking (Simons, Conger, & Whitebeck, 1988). Parental modeling, for example, is suggested to play a stronger role at a younger age because most adolescents start to drink with the family at home (Van der Vorst et al., 2010). However, apart from parental modeling, the persistent role of parental drinking throughout adolescence may be explained by additional mechanisms. Rose and Dick (2005) report environmental factors, like parental modeling, to greatly influence the initiation of drinking, while genetic influences become of increasing importance once drinking has been initiated. Hence, parental modeling and genetic factors might explain the observed impact of parental heavy drinking on both early drinking and development of adolescent drinking.

After controlling for some socio-demographics, such as gender, age and educational level, and parental rules about alcohol, the observed associations between parental heavy drinking and adolescent initiation and development of drinking remained significant and consistent. This finding is in contrast with the finding of Peterson et al. (1994) but in line with those of other studies (Latendresse et al., 2008; Van der Zwaluw et al., 2008) showing that parental drinking directly affects their offspring’s alcohol use.

Moderation analyses revealed the influence of parental drinking to differ across groups of adolescents. With respect to gender, positive as well as negative interactions were observed with the intercept of adolescent drinking. That is, 12 year old girls are affected more strongly by their fathers’ heavy drinking, while same-age boys are more influenced by fathers’ and mothers’ heavy episodic drinking (Fig. 1). These findings are in contrast with that of Wickrama et al. (1999) who found transmission of parental health behaviors, including extensive drinking, to be strongest along the same gender lines, but are in line with that of Andrews, Hops, and Duncan (1997) in showing that the impact of father’s drinking in early adolescence is stronger for girls. Possibly, boys may relate to weekend drinking at an earlier age than girls, as drinking among men is still more normative, whereas they may not relate to their fathers heavy drinking at the age of 12.

Although the literature is still inconclusive, more insight into the transmission of parental drinking to their offspring’s early alcohol use may be of particular importance as the age of first alcohol use predicts alcohol problems later in life (DeWitt, Adlaf, Offord, & Ogborne, 2000). Therefore, studying the effect of parental drinking patterns on boys’ and girls’ alcohol use in early adolescence is recommended.

Differences between educational levels are more profound. When both parents drank daily, heavy episodically or when fathers drank heavily (classes 4, 5 and 6), adolescent weekly alcohol consumption for those in lower educational levels was 1.5 to 2 times higher at the age of 15 compared with that of their higher educated peers (Fig. 2). These findings are in line with those of Spijkerman, Van Den Eijnden, and Huiberts (2008) who found adolescents from low SES families with heavy drinking parents to be at particular risk for excessive alcohol use. Possibly, adolescents in low SES groups are more sensitive to parental modeling effects, compared with their better-off peers (Spijkerman et al., 2008), resulting in earlier and heavier drinking.

Despite the strengths of this study, some limitations need to be mentioned. First, parental drinking, parental rules about alcohol and the intercept of adolescent drinking were measured at the same time, thus outcomes related to the intercept of drinking should be interpreted as cross-sectional associations. Accordingly, conclusions about the causal- ity can only be drawn for the outcomes on the slope of adolescent drinking.

Second, the data of this study are retrieved from a RCT, testing the effectiveness of a parent and student intervention, offered separately and jointly, in postponing adolescent drinking. As (only) the combined intervention was effective in postponing adolescent drinking (Koning et al., 2009, 2011) it could be argued that the relationship between parental drinking patterns and adolescent alcohol use may differ for the dyads that received the combined intervention. Post-hoc analyses revealed a significant difference for the combined intervention in the influence of class 5 on the slope of adolescent drinking (p < .01). The fathers’ heavy drinking impacts the slope of adolescent drinking for the non-effective and control conditions (class 5 compared with classes 1–4; βs ranging from −.33 to −.49; p < .001), whereas this was not observed for the combined intervention (βs ranging from 0.6 to .15 (p > .05)). Thus, the observed relation between the fathers’ heavy drinking (class 5) and the slope of adolescent drinking may disappear due to the intervention. Consequently, findings were observed, not because but, despite of the intervention. All other findings did not differ across intervention conditions. Accordingly, the impact of parental heavy episodic drinking (class 6) on the intercept and slope of adolescent drinking did not differ across RCT conditions.

Third, apart from parental drinking, peer drinking is also an important predictor of adolescent alcohol use which was not included in the current analyses (Scholte, Poelen, Willemsen, Boomsmma, & Engels, 2008). Combining peer and parent drinking in a single model is suggested to get a better understanding of the development of adolescent alcohol use (Reifman et al., 1998).

Fourth, parental drinking in our study population seems lower compared to other studies investigating same-aged Dutch adults (of whom approximately 10 percent are heavy drinkers; Van Laar, Cruts, Van Ooijen-Houben, Meijer, & Brunt, 2010). Possibly, parental non-response in the study is higher among heavy drinkers. Our study population (two-parent families) may give an additional explanation, as heavy drinking is lower in two-parent families compared to adults
without children (Van Dijk, Toet, & Verdurnen, 2004) and single parents (Weitoff, Hjern, Haglund, & Rosén, 2003). To identify combinations of paternal and maternal drinking patterns, single-parent families were excluded from analyses. As both parental drinking and parenting behavior in single parents differ from this sample (Pettersson, Lindén-Boström, & Eriksson, 2009; Weitoff et al., 2003), the conclusions might differ as well. In sum, as heavy drinking parents are probably underrepresented in this study of two-parent families, replication of these analyses among single parents is suggested.

In conclusion, parental heavy (episodic) drinking, and not so much the frequency of drinking, predicts earlier drinking and a stronger increase in drinking among 12–15 year olds. These findings remained consistent and significant when controlled for demographics and parental strictness towards adolescent drinking. Interaction analyses revealed that, adolescents in lower education may be particularly susceptible to parental heavy drinking. Parents and professionals must be aware that parental heavy drinking may increase underage drinking in their offspring, especially among adolescents with lower SES, resulting in earlier and heavier drinking among this high-risk group.

Role of funding sources
This study was funded by grant number 6220-0021 and grant number 50-50130-98-099 from the Dutch Health Care Research Organization (Z.O.N.-M.W.). These funds had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication.

Contributors
Jacqueline Verdurnen, Wilma Vollebergh and Rutger Engels designed the PAS study. Evelien Vermeulen-Smit, Ina Koning and Jacqueline Verdurmen developed the research question and the study methods. Ina Koning carried out the data collection for the study. Evelien Vermeulen-Smit and Ina Koning conducted the statistical analyses. Ina Koning wrote the first draft of the method section. Evelien Vermeulen-Smit wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interests
All authors declare that they have no conflicts of interest.

Acknowledgments
We thank all the participating schools, parents, and students. Many thanks go to Quinten Raaijmakers and William Burk for their assistance with data analysis. We thank two anonymous reviewers whose comments helped improve the manuscript.

References


