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Journal of Substance Use
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/ijsu20

Children's responses towards alcohol in virtual reality: associations between parental alcohol use, drinking selections and intentions to drink

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Published online: 17 Dec 2013.

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To cite this article: Haske van der Vorst, Kathrin Schuck, Rutger C. M. E. Engels & Roel C. J. Hermans (2014) Children's responses towards alcohol in virtual reality: associations between parental alcohol use, drinking selections and intentions to drink, Journal of Substance Use, 19:6, 429-435

To link to this article: http://dx.doi.org/10.3109/14659891.2013.852257

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Journal of Substance Use

http://informahealthcare.com/jsu
ISSN: 1465-9891 (print), 1475-9942 (electronic)

J Subst Use, 2014; 19(6): 429–435
© 2014 Informa UK Ltd. DOI: 10.3109/14659891.2013.852257

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ORIGINAL ARTICLE

Children's responses towards alcohol in virtual reality: associations between parental alcohol use, drinking selections and intentions to drink

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Abstract

To prevent harmful drinking, it is essential to understand factors that promote alcohol use at an early age. The aim of the present study was to examine the role of parental alcohol use in children's selection of alcoholic beverages in a virtual reality (VR) environment and their intentions to drink in the future. Participants were 7–13-year-old children ($N = 127$) who filled out questionnaires and participated in a VR computer game paradigm in which they were asked to select food and beverages for their parents and themselves. Children's selection of alcoholic beverages and their intentions to drink alcohol in the future were measured. Children who reported heavier parental drinking selected more alcoholic beverages for their parents and displayed greater intentions to drink alcohol. Children's responses in virtual reality explained incremental variance in children's intentions to drink. Implications and limitations are discussed.

Keywords

Alcohol, children, intentions to drink, parental drinking

History

Received 21 July 2013
Revised 18 September 2013
Accepted 18 September 2013
Published online 17 December 2013

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Introduction

It is well documented that attitudes, expectations and knowledge about alcohol use are formed years before adolescence, thus before the period when most children start to drink alcohol (Cameron et al., 2003; Dunn & Goldman, 1998; O'Connor et al., 2007). It has been suggested that young children's attitudes towards alcohol may develop as a result of observing parental drinking behaviour (Dalton et al., 2005; Noll et al., 1990; Pieters et al., 2010). This is in line with social learning theory (Bandura, 1977), which states that children learn through observing others' behaviour, attitudes, and outcomes of behaviour. According to social learning theory, children who are regularly exposed to their parents' drinking behaviour may develop more positive alcohol-related attitudes and more normative perceptions of alcohol use than children who are less exposed to their parents' drinking. These observations may, in turn, increase susceptibility to alcohol and drinking behaviour in adolescence. Indeed, parental alcohol consumption has been found to be associated with a better identification of alcohol by smell, use of alcohol during pretend play, and arousal association in response to alcohol in preschool and elementary schoolchildren (Dalton et al., 2005; Noll et al., 1990; Pieters et al., 2010), which suggests that children are sensitive to their parent's alcohol consumption and that parental alcohol consumption affects children's alcohol-related cognitions and behaviour already at a rather young age.

It is essential to understand factors that promote vulnerability to alcohol among children and adolescents in order to effectively prevent harmful drinking among youth, which constitutes a significant problem in most Western countries (Rehm et al., 2009). In elementary years, children usually have little experience with drinking alcohol (Donovan, 2007). However, elementary schoolchildren already display specific ideas about alcohol and intentions to drink alcohol in the future (Andrews et al., 2008; Dalton et al., 2005). Moreover, favourable alcohol-related cognitions and the intention to drink alcohol during elementary years have been shown to precede actual drinking behaviour in adolescence (Andrews et al., 2008; van der Vorst et al., 2013). Therefore, a vulnerability to alcohol, as measured by alcohol-related cognitions and the intention to use alcohol in the future, may constitute a relevant outcome, particularly in younger age groups, and an early predictor of drinking behaviour in the future.

Studying cognition and behaviour in young children poses a number of methodological difficulties. For instance, the cognitive abilities required for self-report measures, such as introspection and meta-cognition, are not yet fully developed in young children, which makes it difficult to assess their attitudes towards alcohol. Using a relatively new method that requires the use of cognitive efforts to a much

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lesser extent, however, may reduce this. An example of such a method may be virtual reality (VR). Recently, VR is starting to become more widely used, for example, to assess craving among smokers and drinkers (Baumann & Sayette, 2006; Bordnick et al., 2004; Cho et al., 2008). The assessment of children's responses towards alcohol in VR may therefore constitute a valuable contribution in the understanding of cognition and behaviour, particularly in young children.

The present study investigated the role of parental alcohol use in children's responses towards alcohol in a VR environment and their intentions to drink alcohol in the future. The VR game that was used in this study presents a three-dimensional graphic environment on a flat-screen monitor (no real-world occlusion), within which the child can navigate. This environment provides the child with a sense of being in an existing world due to the use of realistic images, high-quality sound, and user interaction (Blascovich et al., 2002). It was hypothesized that heavier parental alcohol use is associated with more normative perceptions of alcohol use at home, as measured by a greater selection of alcoholic beverages and higher intentions to drink alcohol in the future among children. To evaluate whether paternal drinking and maternal drinking equally affect children's alcohol-related cognitions and responses, we examined the effects of paternal and maternal drinking separately.

Methods

Participants and procedure

Study participants were 127 children (7–13 years) from a primary school located in a rural area in the Netherlands. Of the sample, 55.9% of the children were girls. The average age was 10.0 years ($SD = 1.57$). The vast majority of the children were of Dutch origin (93.6%) and lived with both parents at home (90.6%). Before the start of the study, parents of all children in grade 4–8 received written information about the school's participation in the study as well as information about the procedure and aim of the study. These grades were chosen because all children had to be able to read and fill in the questionnaires. Parents were informed that participation in the study was voluntary, and they received a form to refuse the study participation of their child (''passive consent''). Parents of four children (3.1%) refused study participation.

During school hours, all children completed the VR-assessment, which is a VR 3D computer game for laptop in Vizard (WorldViz LLC, Santa Barbara, CA) in the presence of a researcher or a trained research assistant. The VR-assessment took place in a separate classroom to minimize distraction by other children or teachers. Depending on the child's age, the VR-assessment took approximately 30–45 min. Two weeks after completion of the VR-assessment, all children filled in a questionnaire in the classroom in the presence of a trained research assistant. Children in grade 4–6 received additional help with the questionnaire (i.e. the assistant read out loud each question and the possible answer categories). Children were encouraged to ask for help at any point during the VR-assessment and during the completion of the questionnaire.

Measures

Selection of beverages

Children's drinking selections were assessed as the number of alcoholic beverages that they selected for their father, their mother, and themselves.

During the VR-assessment, children could move around in the game by simultaneously using the arrows on the keyboard (left hand) and the mouse (right hand). Before the start of the game, each child was told that he/she would enter a virtual home (living room connected to a kitchen) and was asked to pretend that it was his/her home. By means of a cover story, the child was told that it was Saturday night and that the family would spend the evening watching television together in the living room. While the parents were still upstairs, the child was asked to select food and drinks for both parents and for himself/herself from the kitchen for the whole evening.

Children completed the selection of food and beverages first for their father, then for their mother, and then for themselves. During completion of the task, the child had to open all cabinets and the refrigerator before a selection could be made. In the cabinets and the refrigerator, a variety of food and drinks (non-alcoholic and alcoholic) were presented (see Figure 1). With regard to the alcoholic drinks, participants could either select a bottle of beer (33 cl) and/or a glass of wine (24 cl). We chose to specifically focus on beer and wine, because these are the most frequently consumed alcohol drinks by Dutch adults (Dutch Institute for Alcohol Policy, 2011).

To make sure that each child recognized the available products, all products were named once by the researcher. A child could click on the product of his/her choice to store it for selection (i.e. product disappears). Children could pick as many products and beverages as they thought their parents would like to eat and drink (the maximum number of alcoholic beverages available was seven).

Child selections of food and beverages were measured twice. First, the number of alcoholic beverages selected was assessed after the child had opened all cabinets and the refrigerator and said he/she was finished with gathering food and drinks for a person. Then, the researcher presented to the child an overview on the screen of all products the child had selected. The researcher then asked the child whether he/she wanted to add or remove a product. After confirmation, the selected products appeared on the table in the living room in front of the TV. This was the second assessment of the number of alcoholic beverages selected. The number of alcoholic beverages selected at the first and the second measurement correlated highly ($r_{\text{father}} = 0.97$, $r_{\text{mother}} = 0.99$, $r_{\text{child}} = 1.00$), indicating that children were confident about their selection of beverages. The number of alcoholic beverages selected at the first measurement was used as the outcome variable. For the aims of the present study, only beverage selections were evaluated.

Children's previous alcohol use

One item was used to ask children whether they had ever drunk alcohol (e.g. beer, wine, champagne, ''alcoholpops'' (i.e. beverages containing distilled alcohol and fruit juice or

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Figure 1. Depiction of the kitchen in VR.

other flavourings)). Answer categories were the following: (1) ''No, never,'' (2) ''Yes, one sip,'', (3) ''Yes, several sips,'' (4) ''Yes, one glass,'' and (5) ''Yes, several glasses''. Answers were recoded into three answer categories (never, less than a glass, one glass or more).

Children's intention to drink alcohol

Three items were used to ask children whether they intended to drink (1) beer, (2) wine, or (3) ''alcohol pops'' in the future. Answer categories were the following: (1) ''No,'' (2) ''Maybe,'' (3) ''Yes.'' Answers were recoded into a dichotomous score (no versus maybe/yes). Intention to drink was computed as the sumscore of these three variables.

Availability of alcohol at home

To assess availability of alcohol at home, children were asked: ''Do your parents have beer or wine at home?'' Answer categories were the following: (1) ''No,'' (2) ''Sometimes,'' (3) ''Often,''

Perceived parental alcohol use

To assess perceived alcohol use of father and mothers, children were asked: ''Did your father drink beer or wine last week?'' and ''Did your mother drink beer or wine last week?'' Answer categories were the following: (1) ''No.'' (2) ''Once,'' (3) ''A couple of times,'' (4) ''Every day''.

Strategy for analysis

Means, standard deviations, and frequency distributions are displayed to describe the study sample. Correlations between study variables are presented. Linear hierarchical regression analyses were conducted to evaluate whether study variables (i.e. age, gender, previous use of alcohol, parental drinking, availability of alcohol at home) predict children's drinking selections in VR. Additionally, a linear hierarchical regression analysis was conducted to examine whether children's drinking intentions can be predicted by self-reported study variables (i.e. age, gender, previous alcohol use, parental drinking) and children's behavioural responses in VR (i.e. children's drinking selection in VR).

Results

Descriptive statistics

Descriptive statistics are displayed in Table 1. A total of 123 children (96.8%) reported the availability of beer or wine at home. Twenty-six children (21%) reported that they drank at least one glass of alcohol during their lives. Boys were more likely to have tried alcohol than girls ($\chi^2 = 8.09$, $p < 0.05$). With regard to the selection of beverages,

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Table 1. Descriptive statistics of study variables.

	N	%
Perceived paternal alcohol use during last week		
None	25	19.7
Once	46	36.2
More than once	53	41.7
Perceived maternal alcohol use during last week		
None	58	45.7
Once	53	41.7
More than once	14	11.0
Availability of beer and wine at home		
Never	2	1.6
Sometimes	69	54.3
Often	54	42.5
Previous alcohol use		
Never	39	31.0
Less than one glass	61	48.0
More than one glass	26	21.0
Number of alcoholic beverages intended to drink in the future (beer, wine, alcohol pops)		
0	5	3.9
1	15	11.8
2	48	37.8
3	58	45.7

Number of alcoholic beverages selected for father in VR (*M*; *SD*)=1.00 (0.95).
Number of alcoholic beverages selected for mother in VR (*M*; *SD*)=0.54 (0.70).

Table 2. Pearson correlations between study variables.

Variables	1	2	3	4	5	6
1 Paternal alcohol use	–					
2 Maternal alcohol use	0.43***	–				
3 Child alcohol use	0.16	0.19*	–			
4 Availability of alcohol	0.36***	0.25**	0.26*	–		
5 Intention to drink	0.36***	0.40***	0.26**	0.18*	–	
6 Selection for father in VR	0.23*	0.12	0.24**	0.18*	0.13	–
7 Selection for mother in VR	0.02	0.22*	0.16	0.13	0.30***	0.20*

*$p<0.05$, **$p<0.01$, ***$p<0.001$.

86 children (68%) selected at least one alcoholic beverage for their father ($M=1.00$, $SD=0.95$, range 0–4) and 56 children (44%) selected at least one alcoholic beverage for their mother ($M=0.54$, $SD=0.70$, range 0–3). No significant difference was found between boys and girls in the number of alcoholic beverages selected for father or mother. Younger children (i.e. 7–9 year old) selected more alcoholic beverages for their father, but not for their mother, than older children (i.e. 10–13 year old) ($\beta=-0.20$, $p=0.03$). Six children (5%) selected alcoholic beverages for themselves ($M=0.15$, $SD=0.84$, range 0–7). Finally, 121 children (96%) indicated that they had the intention to drink beer, wine, or alcohol pops in the future. No differences in intention were found between boys and girls ($p>0.05$).

Correlations between study variables

Correlations between study variables are presented in Table 2. The number of alcoholic beverages children selected for their fathers in VR was positively associated with child reports of paternal alcohol use ($r=0.23$, $p<0.05$) and previous alcohol use of the child ($r=0.24$, $p<0.01$). Also, the number of alcoholic beverages selected for the father was positively associated with the number of alcoholic beverages selected for the mother ($r=0.20$, $p<0.05$). The number of alcoholic beverages children selected for mothers was associated with child reports of maternal alcohol use ($r=0.22$, $p<0.05$) and with children's intentions to drink ($r=0.30$, $p<0.001$). Children's intentions to drink alcohol in the future were associated with paternal drinking ($r=0.36$, $p<0.001$), maternal drinking ($r=0.40$, $p<0.001$), previous alcohol use of the child ($r=0.26$, $p<0.05$), and the availability of alcohol at home ($r=0.18$, $p<0.05$).

Regression analyses

Children's selection of alcoholic beverages for father

In the first step, child age ($\beta=-0.25$, $p<0.05$) and previous alcohol use of the child ($\beta=0.19$, $p<0.05$) predicted a significant amount of variance in the number of alcoholic beverages selected for the father during the VR-assessment ($R^2=0.12$, $p<0.001$). The inclusion of paternal alcohol use in the model added a significant amount of explained variance to the prediction of the outcome ($R^2=0.16$, $R^2_{change}=0.04$, *sig.* $F_{change}=0.02$). In this model, the number of selected alcoholic beverages for the father was explained by child age ($\beta=-0.25$, $p<0.01$) and paternal alcohol use ($\beta=0.20$, $p<0.05$), while the effect of previous alcohol use of the child became non-significant ($\beta=0.16$, $p=0.08$). Specifically, younger age and higher reported paternal drinking behaviour predicted the selection of a higher number of alcoholic beverages for the father in VR. The addition of maternal alcohol use or availability of alcohol at home did not increase the amount of explained variance in the model (see Table 3).

Children's selection of alcoholic beverages for mother

In the prediction of the number of alcoholic beverages selected for the mother in VR, none of the child variables (i.e. gender, age, previous alcohol use of the child) was significant. Only child reports of maternal alcohol use predicted a significant amount of variance in the number of alcoholic beverages selected for the mother during the VR-assessment ($R^2=0.06$, $p<0.05$; $\beta=-0.20$, $p<0.05$). Specifically, higher reported maternal drinking behaviour predicted the selection of a higher number of alcoholic beverages for the mother in VR. The addition of paternal alcohol use or availability of alcohol at home did not increase the amount of explained variance in the model (see Table 3).

Child's intention to drink alcohol

In the first step of the prediction of the child's intention to drink alcohol, age, gender, and previous alcohol use of the child predicted a significant amount of variance ($R^2=0.09$, $p<0.05$). However, only previous alcohol use of the child was statistically associated with the child's intention to drink alcohol ($\beta=0.32$, $p<0.001$), while the effects of age and gender were not significant. Specifically, more previous alcohol use predicted the intention to drink alcohol in the future in children. In the second step, paternal alcohol use and

Table 3. Results of hierarchical regression analyses predicting the number of alcoholic beverages selected for father and mother in virtual reality.

	Number of alcoholic beverages selected for father in VR					Number of alcoholic beverages selected for mother in VR			
Predictors	*B*	*SE*	Beta	*p*	Predictors	*B*	*SE*	Beta	*p*
Step 1					Step 1				
Gender	−0.26	0.17	−0.14	0.13	Gender	−0.06	0.13	−0.05	0.64
Age	−0.15	0.05	−0.25	0.01	Age	−0.03	0.04	−0.07	0.46
Previous alcohol use	0.24	0.12	0.19	0.04	Previous alcohol use	0.10	0.09	0.11	0.25
R^2	0.35				R^2	0.15			
Step 2					Step 2				
Paternal alcohol use	0.24	0.10	0.20	0.02	Maternal alcohol use	0.21	0.09	0.20	0.03
R^2	0.41				R^2	0.25			
Step 3					Step 3				
Maternal alcohol use	0.04	0.13	0.03	0.79	Paternal alcohol use	−0.09	0.09	−0.10	0.32
R^2	0.41				R^2	0.26			

Table 4. Results of hierarchical regression analyses predicting children's intention to drink alcohol.

	Children's intention to drink alcohol			
Predictors	*B*	*SE*	Beta	*p*
Step 1				
Gender	0.13	0.15	0.08	0.39
Age	0.04	0.05	0.08	0.39
Previous alcohol use	0.20	0.06	0.33	<0.001
R^2	0.32			
Step 2				
Paternal alcohol use	0.25	0.10	0.24	0.01
Maternal alcohol use	0.28	0.11	0.23	0.01
R^2	0.50			
Step 3				
Drinking selection for father in VR	0.06	0.08	0.07	0.41
Drinking selection for mother in VR	0.27	0.10	0.23	0.01
R^2	0.56			

maternal alcohol use added a significant amount of explained variance to the model ($R^2 = 0.23$, $R^2_{change} = 0.17$, *sig.* $F_{change} < 0.001$). In this model, previous alcohol use of the child ($\beta = -0.27$, $p < 0.01$), paternal alcohol use ($\beta = -0.22$, $p < 0.05$), and maternal alcohol use ($\beta = 0.27$, $p < 0.01$) were associated with intention to drink alcohol in children. In the third step, the number of alcoholic beverages selected for fathers and mothers was added to the model. The inclusion of both variables added a significant amount of explained variance to the model ($R^2 = 0.32$, $R^2_{change} = 0.06$, *sig.* $F_{change} < 0.01$). In this model, previous alcohol use of the child ($\beta = -0.24$, $p < 0.01$), paternal alcohol use ($\beta = -0.22$, $p < 0.05$), maternal alcohol use ($\beta = 0.24$, $p < 0.01$), and number of alcoholic beverages selected for mother in VR ($\beta = 0.24$, $p < 0.01$) were associated with intention to drink alcohol in children. The number of alcoholic beverages selected for father in VR was not significant (see Table 4).

Discussion

The present study evaluated associations among parental alcohol use, children's selection of alcoholic beverages, and intentions to drink alcohol by using a VR computer game paradigm.

Our results indicated that children's selection of drinks was predicted by their previous alcohol use as well as parental alcohol use. That is, children selected a higher number of alcoholic beverages in VR if they had consumed more alcohol in the past and if the parent, for whom the beverages were selected, had consumed more alcohol during the past week. These findings are in line with the social learning theory (Bandura, 1977). According to this theory, children develop normative perceptions based on the behaviour they observe in their social environment. These perceptions subsequently affect children's cognitions and behaviour. As hypothesized, the child's selection of drinks was indeed associated with perceived parental drinking behaviour, suggesting that parental alcohol consumption may affect children's alcohol-related perceptions and responses towards alcohol already at a rather young age. Previous studies have shown associations between parental drinking and children's substance-related cognitions (e.g. implicit and explicit attitudes, normative perceptions, benefit perceptions, risk perceptions) (Andrews et al., 2010; Pieters et al., 2010; van der Vorst et al., 2013). Alternatively, children's selections may also reflect cognitive biases or biased responses towards alcohol-related stimuli such as attentional biases or behavioural response tendencies (e.g. approach-avoidance tendencies). Previous studies indicate that children of alcohol-dependent parents display an attentional bias for alcohol-related stimuli (Zetteler et al., 2006). Whether children's selections of alcoholic beverages in VR reflect cognitive characteristics, cognitive biases, or behavioural response tendencies need to be evaluated in future research.

In addition to the association between parental alcohol use and children's selection of alcoholic beverages, paternal and maternal alcohol uses were also associated with children's intention to drink alcohol in the future. That is, children who perceived that their fathers and mothers had consumed more alcohol during the past week intended to drink a greater variety of alcoholic beverages in the future. Both paternal drinking and maternal drinking contributed to children's intentions do drink. Again, these findings are in line with social learning theory, which predicts that intentions and behaviour develop from normative perceptions and behavioural observations within the social environment. Interestingly, children's drinking selections for their mothers

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in virtual reality explained incremental variance in children's drinking intentions, over and above the effects of paternal and maternal alcohol consumption. That is, children who selected more alcoholic beverages for their mothers in VR intended to drink a greater variety of alcoholic beverages in the future (after parental drinking behaviour was taken into account). While paternal and maternal drinking seem to equally affect intentions to drink in children, children's drinking selections in VR may additionally tap into perceived social norms at home. In young children, mothers may have more influence on perceived social norms than fathers, which may in turn influence children's intentions to drink. The finding indicates that the assessment of responses in VR may constitute a valuable measure which may explain additional variance in behaviour, above and beyond traditional self-report measures. Indirect measures, such as the assessment of responses in VR, may be particularly valuable in subgroups in which meta-cognition and introspection is less feasible (e.g. young children). While responses in VR demonstrate overlap with self-report measures, they may additionally tap into different constructs (i.e. cognitive biases or behavioural response tendencies instead of pure meta-cognition).

In children, intentions to drink may be regarded as precursor of future behaviour. Research indicates that favourable alcohol-related cognitions and the intention to drink alcohol precede actual drinking behaviour among youth (Andrews et al., 2008; Olds et al., 2005; van der Vorst et al., 2013). To prevent harmful drinking in adolescence, it is essential to understand factors that promote susceptibility to drinking in youth. Future research needs to evaluate whether perceived parental alcohol use, responses towards alcohol in virtual reality, and intentions to drink during elementary years indeed predict actual drinking in adolescence using a longitudinal design. In addition, these studies might also include relevant covariates such as parental attitudes towards alcohol (e.g. encouraging or prohibiting children's alcohol consumption), because this might give more information on how the relation between parental drinking and child perceptions of alcohol use may be affected by other variables (cf. Mares et al., 2012).

Several limitations should be acknowledged. The first limitation pertains to the cross-sectional design of the study. The present study does not allow interferences about temporal precedence or causality between study variables. While it is intuitive to assume that parental drinking predicts children's drinking selections for their parents in virtual reality, a third variable (e.g. a cognitive susceptibility to alcohol) may also underlie both the report of parental drinking and children's selections. For example, children who display a cognitive vulnerability to alcohol may be more likely to notice and report alcohol consumption in their social environment and they may be more likely to display more normative perceptions about alcohol, thereby selecting more alcoholic beverages for their parents in the VR-assessment.

Second, the assessment of responses in VR constitutes a rather new methodology. Up to this point, psychometric properties and varying forms of validity of this methodology in this particular sample are not well evaluated. For example, although it is assumed that participants' responses in VR reflect their normative perceptions of alcohol use, this was not specifically measured. Therefore, it remains unclear whether children's beverage selection reflects what they perceive to be normally consumed by their parents or whether this reflects what they personally think should be consumed. Responses in virtual reality may reflect cognitive characteristics (e.g. normative perceptions or favourable alcohol-related attitudes), cognitive biases, or behavioural response tendencies in children. For a comprehensive understanding of children's responses in virtual reality, more information is needed, particularly regarding correspondence between VR-responses and other measures, such as self-reports or computer-assisted tasks (e.g. computer tasks measuring attentional biases or approach-avoidance tendencies) regarding attitudes towards alcohol or alcohol-related norms.

Third, although the use of a specific scenario, in which children were asked to pretend that it was Saturday night, might have made the study more realistic, this scenario might also have affected the children's selection of drinks. For example, it might have been difficult for children to anticipate on the total number of drinks consumed during the whole night and therefore they might have under-or overestimated their parents' consumption. Given that we were not specifically interested in children's estimations of their parents' actual alcohol consumption, but rather in children's perceptions or cognitions regarding parental alcohol consumption at home, the anticipated amount of alcohol as selected by children for the evening constitutes a relevant outcome.

To summarize, in elementary schoolchildren, perceived parental alcohol use was associated with the number of alcoholic beverages selected for parents in a VR-assessment. Moreover, previous alcohol use and parents' alcohol use predicted children's intention to drink alcohol in the future. Interestingly, children's selection of beverages in VR-predicted incremental variance in children's drinking intention, over and above self-report measures of parental alcohol use, indicating that VR-assessments may constitute a valuable research tool, particularly in certain subgroups (e.g. younger children) or domains in which introspection and meta-cognition is less feasible. Practical implications of this study encompass enhanced attention to preadolescence in alcohol prevention efforts. Knowledge regarding predisposing factors in childhood may help in the early identification of vulnerable groups and selective prevention of harmful drinking among youth.

Acknowledgements

The authors would like to thank Jeroen Derks for the development of the VR-game and Josine Verhoeven for helping with the collection of the data. Furthermore, the authors would like to thank the employees and students of B.S. De Zjwiek, Roggel, the Netherlands for their participation in the study.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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