Substance use outcomes in the Healthy School and Drugs program: Results from a latent growth curve approach

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Substance use outcomes in the Healthy School and Drugs program: Results from a latent growth curve approach ☆

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HIGHLIGHTS

- No effects of the HSD program on the development of substance use in adolescence.
- No beneficial effects were present for sex, education, and personality risk traits.
- The HSD program should not be delivered as it is currently implemented.

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ABSTRACT

Aim: To assess the effectiveness of the Healthy School and Drugs (HSD) program for secondary schools on the development of substance use among Dutch early adolescents and to explore whether boys, adolescents of lower educational backgrounds, or adolescents high on personality risk traits, would benefit more from the HSD program than others.
Design: Randomized clustered trial with two intervention conditions (i.e., lessons and integral) among a general population of adolescents in the Netherlands.
Participants: A total of 3784 students of 23 Dutch secondary schools.
Measurements: Structured digital questionnaires were administered pre-intervention and at 8, 20, and 32 months follow-ups. The outcome measure was the rate of change in substance use across follow-ups. Differential effectiveness of the HSD program was examined for sex, educational level, and personality traits.
Findings: Our results show no HSD intervention effects on the development of substance use. Sex, education level, and personality characteristics of the participants did not moderate the intervention effects.
Conclusion: The absence of effects of the Healthy School and Drugs program on the development of substance use indicates that the program should be renewed and redeveloped.

1. Introduction

'The Healthy School and Drugs (HSD)' program is a universal school-based prevention program aimed at preventing, postponing or reducing excessive substance use among early adolescents (Cuijpers, Jonkers, De Weerdt, & De Jong, 2002; Malmberg, Overbeek, Kleinjan, et al., 2010). Approximately 75% of all secondary schools in the Netherlands implement (parts of) the HSD program. However, an earlier study on the effectiveness of HSD revealed no effects of HSD on the incidence of substance use at 8, 20 and 32 months follow-ups (Malmberg et al., 2014). Although incidence-based approaches are commonly used when assessing the effectiveness in Randomized Controlled Trials (RCT's: Bodin & Strandberg, 2011; Foxcroft & Tsertsvadze, 2012; Koning, Van den Eijnden, Verdurmen, Engels, & Vollebergh, 2011; Koning et al., 2009; Skara & Sussman, 2003), it is important to note that when estimating the effect of a prevention program at each measurement wave separately, the dynamics in the development of the outcome variable over time are unknown (Duncan & Duncan, 1995; MacKinnon & Lockwood, 2003; Muthén & Curran, 1997; Taylor, Graham, Cumsille, & Hansen, 2000). With latent growth curve modeling it is possible to examine the HSD program effects while accounting for the developmental nature of substance use over time. In a latent growth curve model all information on the longitudinal course of the outcome variable is

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included in a single analysis, which makes it possible to determine individual variation in the development of use and to examine if an effect of the HSD program might be found on such changes over time (Duncan & Duncan, 1995).

In the current post-hoc analyses of the HSD prevention program effects, two intervention conditions are compared to the regular curriculum of Dutch secondary schools, using latent growth curve modeling. We expected that the HSD program would lead to a slower increase of substance use development. The relevant outcomes for alcohol were lifetime prevalence, overall alcohol use, and binge drinking. For tobacco use, we examined lifetime prevalence and overall tobacco use, and for marijuana use we examined lifetime prevalence. We expected that the increase of substance use behaviors over time would be less steep among adolescents in the intervention conditions, relative to adolescents in the control condition. Also, in line with findings of Koning et al. (2011, 2009) we expected that these effects would be more pronounced in the integral (i.e., consisting of information lessons, a parental meeting, regulation, and monitoring and counseling) than in the e-learning condition (i.e., in which the adolescents only received the information lessons).

We further explored whether certain theory-based subgroups would benefit more from the HSD intervention than others. Specific characteristics of study participants may moderate the relationship between the HSD program and substance use behaviors (Conrod, Castellanos, & Mackie, 2008; Conrod, Castellanos-Ryan, & Strang, 2010; Koning, 2011; Koning, Verdurmen, Engels, Van den Eijnden, & Vollebergh, 2012; Kreamer, Wilson, Fairburn, & Agras, 2002; Skara & Sussman, 2003). This kind of information is relevant for future redevelopments of the HSD program, because it can direct future implementation and content building. The risk moderation hypothesis suggests that prevention programs should be more effective in high-risk groups compared to lower risk groups. On the basis of previously reported moderators in the literature (Amaro, Blake, Schwartz, & Flinchbaugh, 2001; Conrod et al., 2008; Koning, 2011; Kuntsche, Knibbe, Gmel, & Engels, 2006; Verdurmen, Monshouwer, van Dorsselaer, Lokman, Vermeulen-Smit, & Vollebergh, 2012), we specifically examined participants' sex, educational level, and personality traits as possible moderators of HSD intervention effects.

1.1. Gender

There are differences between boys and girls in substance use behaviors (Verdurmen et al., 2012). For instance, boys tend to drink earlier, and more frequently and intense compared to girls. Also, there are sex differences in expectations toward substance use and risk factors for substance use (Amaro et al., 2001; Kuntsche et al., 2006; Petraitis, Flay, & Miller, 1995). Perceived peer pressure and dominant social norms with respect to substance use are especially relevant for girls, whereas expression of rebelliousness and achievement of peer status seem more relevant factors for boys' substance use (Amaro et al., 2001). In general, girls' risk factors for substance use concern more internalizing factors, like low self-esteem, and are more relevant for escalating trajectories of use (Chassin, Pitts, & Prost, 2002; Colder, Campbell, Ruel, Richardson, & Flay, 2002). In contrast, externalizing risk factors as low self-regulatory capacities are more important for boys, which are especially relevant for early onset of substance use (Chassin et al., 2002; Hill, White, Chung, Hawkins, & Catalano, 2000). Furthermore, girls are more likely to use substances as a way to cope with stress, while boys are more likely to use out of enhancement motives (Kuntsche et al., 2006; Petraitis et al., 1995). Based on this literature review we expected boys to benefit more from the HSD program, since they seem at highest risk for substance use in early adolescence.

1.2. Education level

There are differences in substance use behaviors between adolescents from lower and higher educational backgrounds (Salonna et al., 2008; Spijkerman, Van den Eijnden, & Huiberts, 2008; Verdurmen et al., 2012). Adolescents from lower educational levels use more alcohol, tobacco, and marijuana compared to adolescents from higher educational levels. Findings from a recently tested Dutch alcohol prevention program showed moderation effects of educational level on heavy weekly drinking, indicating that only lower educated adolescents profited from the intervention (Koning, 2011). Based on these findings, we expected higher program effectiveness on substance use outcomes for adolescents in lower educational tracks.

1.3. Personality traits

Among the many risk factors that can be identified, personality traits involving neurotic tendencies and deficits in behavioral inhibition are among the strongest predictors of substance use behaviors. Previous research showed that four specific traits are especially relevant for substance use development, namely anxiety sensitivity, hopelessness, sensation seeking, and impulsivity (Kotov, Gamez, Schmidt, & Watson, 2010; Krank et al., 2011; Malmberg, Overbeek, Monshouwer, et al., 2010; Malmberg et al., 2012; Sargent, Tanski, Stoolmiller, & Hanewinkel, 2010; Schmidt, Buckner, & Keough, 2007; Shin, Hong, & Jeon, 2012; Walther, Morgenstern, & Hanewinkel, 2012; Woicik, Stewart, Pihl, & Conrod, 2009). In general, higher levels of these personality traits are related to an increased risk for substance (mis)use behaviors. Also, prevention programs that are tailored to these personality traits show much promise in reducing substance use in adolescents (Conrod et al., 2008; Conrod et al., 2010). Therefore, we explored whether differential effects of the HSD program are present for the personality-based risk traits anxiety sensitivity, hopelessness, sensation seeking, and impulsivity.

2. Method

The design and procedure used in this study are in accordance with the study protocol (Malmberg, Overbeek, Kleinjan, et al., 2010). More detailed information on the procedure, randomization, power calculation, loss to follow-up, and the prevention program can be found in earlier reports (Malmberg, Overbeek, Kleinjan, et al., 2010; Malmberg et al., 2014).

2.1. Design and procedure

Of 123 eligible secondary schools that were invited, 23 schools including 3784 adolescents agreed to participate. An independent statistician randomly assigned these 23 schools to one of the three study conditions: (1) control condition, (2) e-learning condition, or (3) integral condition. The baseline data (T0) were collected among all first grade students between January and March 2009, before the intervention was carried out. The first follow-up (T1) was carried out after 8 months, the second (T2) after 20 months, and the third (T3) after 32 months. At all assessments, adolescents filled out a digital questionnaire during school hours in the presence of a teacher and a research assistant. Adolescents were informed that the data would be processed anonymously; respondent-specific codes were used to link the data from one time point to the next. Because adolescents did not know beforehand when the questionnaires would be administered, non-response can be ascribed to either illness or leaving school.

2.2. Participants

Twenty-three secondary schools, including 3784 first-grade students, were selected to participate (see Fig. 1). At T0, a total of 3542 first-grade students took part in the study; 229 adolescents (6.1%) were absent during data-collection and 13 participants (0.3%) were declined participation by their parents. The T0-sample ($N = 3542$) included 49.4% boys ($n = 1750$). Participants ranged in age from 11 to 15 years ($M = 13.01$, $SD = .49$). In total, 24.6% of these adolescents received pre-university education ($n = 871$), 18.9%

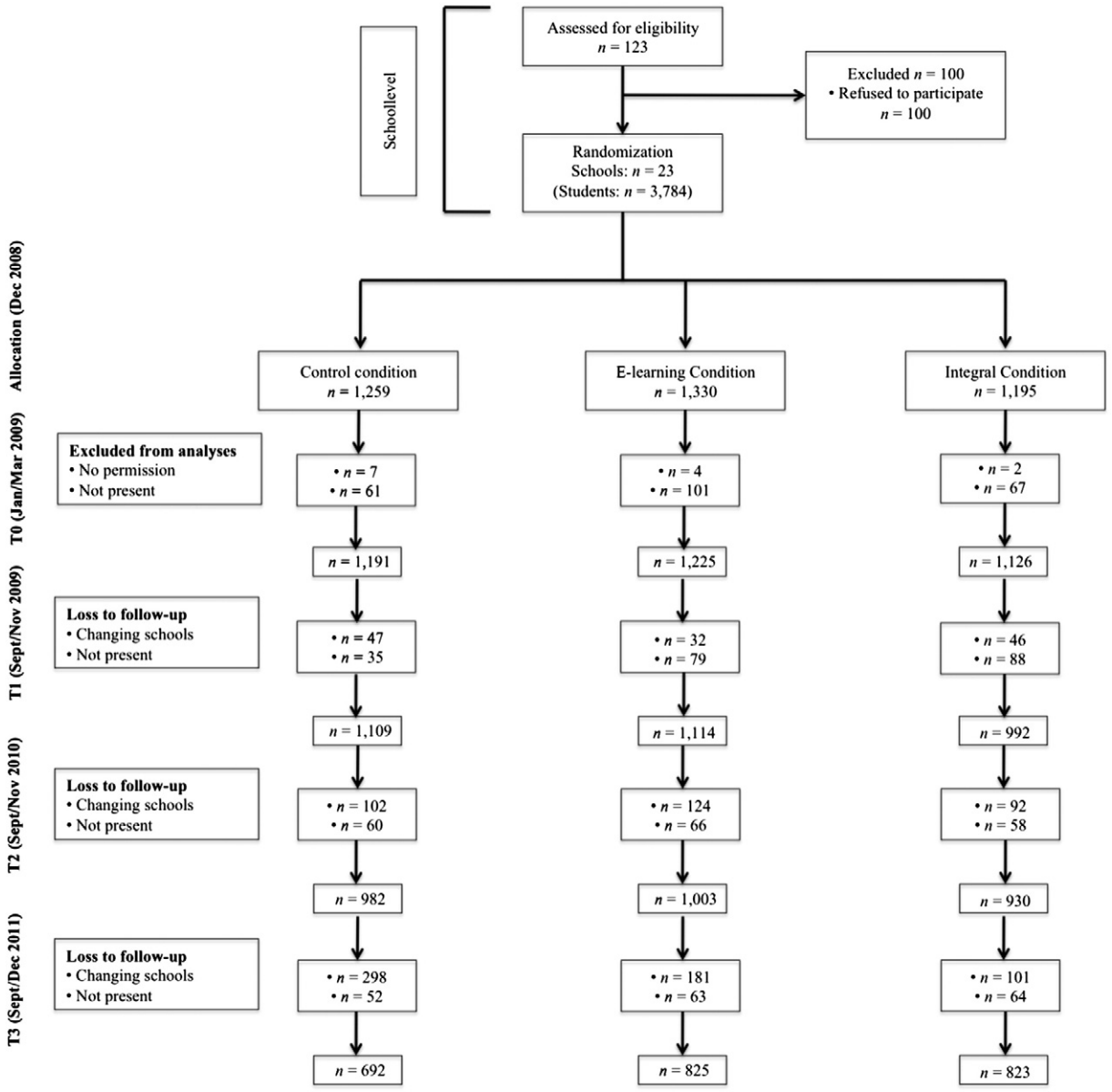

Fig. 1. Flow chart of participants through the trial. *Note*. Students who not participated in one follow-up could have participated in the next follow-up. Therefore, the final *n*'s cannot be calculated by subtracting the *n*'s of T1 and T2.

received higher general education ($n = 668$), 9.7% received a combination of pre-university education and higher general education ($n = 343$), 24.1% received lower general education ($n = 855$), and 22.7% received lower vocational education ($n = 805$). The majority of the participants were of Dutch descent (96%).

2.3. Loss to follow-up

Of the total of 3784 randomized participants, 3542 (93.6%) completed the baseline assessment (T0). In total, 3215 participants of the T0-sample (90.8% of 3542) participated in the program and completed the follow-up assessment after 8 months. The response rate for the 20-months follow-up was 82.3% ($n = 2915$ out of $n = 3542$). Just before the 32-months follow-up (T3), one school from the control condition and one school from the e-learning condition dropped out of the study due to practical considerations. Since adolescents were included based on their school's participation, all students of these schools were lost to follow up. A total of 2340 adolescents of the remaining 21 schools participated at T3 (response rate out of $n = 3542 = 66.1\%$). We conducted logistic regression analyses with loss to follow-up as DV to examine attrition effects at T3 for sex, ages, educational level, ethnicity, and condition (we excluded schools that withdrew from the effectiveness trial, as student attrition was a consequence of school attrition). Adolescents lost to follow-up were less likely to be in pre-university education and more likely to be in higher general education or a combination of pre-university education and higher general education (OR = 1.13, 95% CI [1.07, 1.20], $p < .0001$) compared to adolescents who completed the 32-month follow-up assessment. Nagelkerke R^2 for the regression model was .015. No differences in loss to follow-up were found for the demographics sex, age, and ethnicity. Furthermore, no differences in loss to follow-up were present between the three conditions.

2.4. Intervention

The primary goal of both the intervention conditions was to prevent (or postpone) the onset of alcohol, tobacco and marijuana use. The e-learning condition only targeted the education part of the HSD

program, in which adolescents are educated on alcohol, tobacco and marijuana use. The integral condition targeted the whole multi-component structure of the HSD program.

2.4.1. E-learning condition

The participants in this condition received an e-learning module about alcohol (four lessons) between April and July 2009, tobacco (three lessons) between April and July 2010, and marijuana (three lessons) between April and July 2011. The lessons are based on the Attitude–Social Influence–Self-Efficacy (ASE) model (Brug, Schaalma, Kok, Meertens, & Van der Molen, 2000; De Vries, Backbier, Kok, & Dijkstra, 1995; De Vries, Dijkstra, & Kuhlman, 1988). The ASE components are embedded in the modules in that the lessons are focused on increasing knowledge about substances, aim to tutor adolescents about risks concerning substance use, and preparing adolescents for coping with group pressure by training their refusal skills (i.e., increasing self-efficacy). The lessons consist of small films, animations, and several types of interactive tasks. Also, adolescents are able to discuss relevant topics or to exchange their opinions through chatrooms and forums. The lessons are designed to gradually increase adolescents' skills in responsibly dealing with substances. For more details on the e-learning modules and their theoretical basis see (Malmberg, Overbeek, Kleinjan, et al., 2010).

2.4.2. Integral condition

As well as the digital e-learning modules, the participants in the integral condition received three additional intervention components (i.e., parental participation, regulation, and monitoring and counseling). The parental participation component consists of a plenary parental meeting for the parents of participating students and was planned in the first year of the intervention at school in collaboration with the regional institutions for treatment and care of drug addiction (ITCD) or the Municipal Health Services (MHS). During this meeting, information was provided on the HSD program and substance use. Specifically, characteristics and risks of substance use, opinions on substance use, and education in the home setting with respect to substance use were discussed. The regulation component concerned the school standard and subsequent rules regarding substance use behaviors of students and school personnel, and was planned in the second year. Examples of rules regarding substance use concern alcohol use at school parties or if and where adolescents are allowed to smoke at school. If a school in the integral condition lacked such regulation, one was created in cooperation with the ITCD or MHS. Finally, the monitoring and counseling component consisted of a training session for school personnel on signaling and guiding problematic substance use among individual adolescents, which was also scheduled in the second year and provided by the ITCD or MHS. During this training session, practical information was provided on how to recognize problematic use in adolescents and on how to efficiently support these adolescents in and outside the school setting. For more details on the integral components see (Malmberg, Overbeek, Kleinjan, et al., 2010).

2.4.3. Control condition

The schools in the control condition agreed not to start any substance-related interventions in our target group throughout the study period. Because many schools in the Netherlands have employed basic initiatives to decrease or prevent substance use, they were allowed to continue their 'business as usual' activities.

2.5. Outcome measures

2.5.1. Alcohol use

Alcohol use was measured with three variables, namely lifetime prevalence, overall use, and prevalence of binge drinking. Lifetime prevalence was measured by asking: "Have you ever drunk a glass of alcohol?" Adolescents answered with yes (=1) or no (=0). Overall use was based on lifetime and past month prevalence of alcohol use (Engels, Knibbe, & Drop, 1999). Adolescents were assigned to one of the following categories: 1 = 'I have no alcohol experience', 2 = 'I drank alcohol, but not in the past month', 3 = 'I drank alcohol once or twice in the past month', 4 = 'I drank alcohol once or twice per week in the past month', and 5 = 'I drank alcohol more than twice per week in the past month.' Finally, binge drinking was measured by asking adolescents how many times they had five or more alcoholic beverages on one occasion in the past four weeks. Adolescents answered on a 7-point scale: 1 = 'never' to 7 = '9 times or more.' Because of the skewed distribution we recoded this variable into a 4-point scale, with 1 = 'never', 2 = 'once', 3 = 'twice', and 4 = '3 times or more.'

2.5.2. Tobacco use

Tobacco use was measured with two variables, namely lifetime prevalence and overall use. Tobacco use was assessed by a single item on a 9-point scale ranging from 1 = 'I never smoked, not even a puff' to 9 = 'I smoke at least once a day' (De Leeuw, Engels, Vermulst, & Scholte, 2008; Kremers, Mudde, & De Vries, 2001). To tap lifetime prevalence of smoking, adolescents who responded in the categories 2 to 9 were categorized as tried smoking before (=1), and the adolescents who responded in category 1 were categorized as never tried smoking (=0) (Kremers, 2002). To gain more insight into frequency of use, we recoded the original variable into a 5-point scale of overall use (cf. De Leeuw et al., 2008). The new categories were: 1 = 'I have never smoked, not even one puff', 2 = 'I tried smoking, I do not smoke anymore', 3 = 'I stopped smoking, after smoking at least once a month', 4 = 'I smoke occasionally, but not every day', and 5 = 'I smoke at least once a day.'

2.5.3. Marijuana use

We assessed adolescents' marijuana use in terms of lifetime prevalence. Lifetime prevalence was assessed trough a single item: 'Have you ever used marijuana?' (Monshouwer, Smit, De Graaf, Van Os, & Vollebergh, 2005). Adolescents could answer with yes (=1) or no (=0).

2.5.4. Personality traits

The personality traits were measured at T0 with the Dutch translation of the Substance Use Risk Profile Scale (SURPS: Malmberg, Overbeek, Monshouwer, et al., 2010; Woicik et al., 2009). Factor structure, internal consistency and test–retest reliability, as well as construct, convergent, and discriminant validity of this instrument were shown to be good (Krank et al., 2011; Malmberg, Overbeek, Monshouwer, et al., 2010; Woicik et al., 2009). The SURPS distinguishes four personality traits, namely anxiety sensitivity (i.e., the fear of physical arousal), hopelessness (i.e., negative thinking), sensation seeking (i.e., the urge for trying out new things), and impulsivity (i.e., difficulty in controlling behavioral responses). Each trait was assessed using five to seven items that could be answered on a 4-point scale, ranging from 1 = 'strongly disagree' to 4 = 'strongly agree.' Example items are: 'It's frightening to feel dizzy or faint' for anxiety sensitivity, 'I feel that I'm a failure' for hopelessness, 'I like doing things that frighten me a little' for sensation seeking, and 'I usually act without stopping to think' for impulsivity. Cronbach's alphas at T0 were .69, .85, .68, and .67 for anxiety sensitivity, hopelessness, sensation seeking, and impulsivity, respectively. These reliability estimates converge with previous research (Jaffee & D'Zurilla, 2009) and are satisfactory for short scales (Loewenthal, 1996).

2.6. Strategy of analyses

We used Latent growth curve modeling (LGCM) in Mplus 6.1 (Muthén & Muthén, 1998–2010) to estimate the role of HSD program on individual levels of substance use at baseline (i.e., intercept) and changes in substance use over time (i.e., slope; Duncan, Duncan, &

Strycker, 2006). In LGCM adolescents are allowed to differ on their starting level of substance use and the rate of change in substance use over time. Therefore, LGCM is a good way to investigate individual variation in the development of substance use behaviors and to examine if the intervention condition might relate to such changes over time. We estimated separate models for all substance use variables. In order to reliably test individual growth over time, we only included adolescents with at least two reports on the outcome variable in our analyses. Because the substance use variables in the models are ordinal, the parameters in the model were estimated with probit regression using the Weighted Least Square with Mean- and Variance-adjusted chi-square test statistic (WLSMV) estimator. To deal with missing data all available pairwise information in the data is used (Asparouhov & Muthén, 2010). The chi-square and the p-value, the Comparative Fit Index (CFI: with a cut-off value of .95), and the Root Mean Square Error of Approximation (RMSEA: with a cut-off value of .06) were used to assess the goodness of fit of the model (Hu & Bentler, 1999).

First, we estimated the initial developmental models based on the four time points (T0–T3) without any predictors or control variables. All outcome variables are ordered categorical or binary. In Mplus, the response scale of each outcome variable is replaced by a normally distributed latent response variable with threshold values based on the percentages of the response categories. The linear probit growth model has an initial status (intercept) factor and a change (slope) factor. The model implies across-time differences in the individual values of the latent response variable due to the slope factor (Muthén & Asparouhov, 2002). The mean of the intercept growth factor is fixed at zero while the mean of the slope growth factor and the variances of the intercept and slope growth factors are estimated as default (Muthén & Muthén, 1998–2010, p. 207). An estimation problem occurred while estimating the slope of marijuana use with the WLSMV estimator. Therefore, we used the ML estimator (i.e., the parameters in the model were estimated with logit regression) for the marijuana models only. In contrast to the probit models, fit measures cannot be calculated in logit models.

Second, we tested if the intervention condition predicted the initial level of substance use (i.e., intercept) and/or the rate of change (i.e., slope) in substance use. We controlled for sex, age, education, and ethnicity in these analyses. For more detailed information we refer to Malmberg et al. (2014). Third, we examined interaction effects between the intervention conditions on the one hand and sex, education, and the four SURPS personality traits on the other. To avoid multicollinearity, the personality variables were centered before computing interaction terms. We controlled for sex, age, education, and ethnicity if they were not part of the interaction model. Although we systematically tested interaction effects on the intercept and the slope, we only interpreted significant interactions on the slope because we were solely interested in development and not baseline differences. To avoid chance capitalization because of multiple comparisons, we applied a Bonferroni correction for 6 outcome measures (.05/6); alpha was considered significant when it fell below .008 (Bland & Altman, 1995).

3. Results

3.1. Descriptive statistics

The percentages of alcohol, tobacco, and marijuana use at each wave are presented per condition in Table 1. As can be seen from Table 1, adolescents increase in their alcohol, tobacco, and marijuana use over time.

3.2. Basic growth models

First, we tested the initial developmental model (i.e., no predictors) for all substance use behaviors separately. All the probit models showed a good fit to the data (see Table 2). The slope was significant for alcohol, tobacco, and marijuana use, indicating that levels of alcohol, tobacco, and marijuana use increased significantly over time. We also tested the quadratic trends of the models; besides overall alcohol use, none of the models showed a significant quadratic trend. We performed a WLSMV chi-square difference test for overall alcohol use and including the quadratic trend significantly worsened the model fit ($\chi^2(4) = 39.39$, $p < .0001$). Therefore, we only included the intercept and the slope in our following models. Fig. 2 shows the rate of change over time for overall alcohol use, separately for the three study conditions.

Table 1
Percentages of substance use at all measurements (T0–T3) separately for conditions.

		Percentages (%)											
		T0			T1			T2			T3		
		Control	E-learning	Integral	Control	E-learning	Integral	Control	E-learning	Integral	Control	E-learning	Integral
Alcohol													
Lifetime	Yes	25.4	28.4	32.2	34.5	38.6	38.8	49.6	58.1	57.7	74.9	78.8	74.8
Overall use	1.	74.6	71.6	67.8	65.5	61.4	61.2	50.4	41.9	42.3	25.1	21.2	25.2
	2.	15.5	18.1	18.0	19.1	21.9	21.2	24.0	26.8	27.4	22.2	19.2	22.8
	3.	7.1	7.5	9.7	10.3	11.1	12.7	18.0	20.3	18.1	35.0	34.9	30.9
	4.	1.8	2.0	3.3	3.0	3.3	3.5	5.5	7.3	8.1	13.4	18.8	15.9
	5.	1.1	0.8	1.3	2.1	2.3	1.4	2.1	3.8	4.1	4.3	5.8	5.2
Binge	1.	94.1	93.1	90.5	91.0	89.4	88.5	80.1	73.7	74.2	62.9	53.8	60.7
	2.	2.0	3.1	3.6	3.6	4.6	4.9	10.0	11.8	10.0	15.8	12.2	13.6
	3.	1.4	1.9	2.9	1.8	2.0	2.4	3.2	6.0	6.1	9.4	12.3	11.1
	4.	2.5	1.9	3.0	3.6	4.0	4.2	6.8	8.5	9.6	11.9	21.7	14.5
Tobacco													
Lifetime	Yes	17.3	22.6	26.1	25.5	30.7	33.9	32.2	39.1	42.2	39.6	48.4	49.6
Overall use	1.	82.7	77.4	73.9	74.5	69.3	66.1	67.8	60.9	57.8	60.4	51.6	50.4
	2.	12.6	16.0	17.1	16.2	17.3	19.0	14.5	19.0	17.7	17.8	20.3	17.5
	3.	0.8	2.3	3.1	1.9	1.9	2.8	3.3	4.5	5.9	4.6	4.0	4.5
	4.	2.1	2.3	3.7	4.5	6.5	7.3	9.4	7.7	9.2	9.4	11.8	14.2
	5.	1.8	2.0	2.2	2.9	5.0	4.8	5.0	7.8	9.3	7.9	12.3	13.4
Marijuana													
Lifetime	Yes	1.3	2.4	2.8	5.2	6.1	7.0	9.4	12.2	12.8	15.7	18.2	20.0

Note. Overall use alcohol; 1 = I have no alcohol experience, 2 = I drank alcohol, but not in the past month, 3 = I drank alcohol once or twice in the past month, 4 = I drank alcohol once or twice per week in the past month, 5 = I drank alcohol more than twice per week in the past month. Binge; 1 = Never, 2 = Once, 3 = Twice, 4 = 3 times or more. Overall use tobacco; 1 = I have never smoked, not even one puff, 2 = I tried smoking, I do not smoke anymore, 3 = I stopped smoking, after smoking at least once a month, 4 = I smoke occasionally, but not every day, 5 = I smoke at least once a day.

Table 2
Rate of change (slope) in adolescents' substance use.

	S	Var (I)	Var(S)	χ^2(df)	χ^2 *p*-value	CFI	RMSEA
1. Lifetime alcohol	.340***	.806***	.052***	14.01(2)	.001	.998	.042
2. Overall use alcohol	.401***	.745***	.059***	108.23(11)	<.0001	.987	.051
3. Binge drinking	.438***	.705***	.058***	29.65(8)	<.0001	.990	.028
4. Lifetime tobacco	.223***	.981***	.074***	2.95(2)	.229	1.000	.012
5. Overall use tobacco	.225***	.912***	.074***	48.26(11)	<.0001	.998	.032
6. Lifetime marijuana	.904***	6.872***	.742**	–	–	–	–

Note. The regression coefficients for marijuana use are based on logit regression. All other coefficients are based on probit regression.
S: Slope; Var (I): Variance of the intercept; Var (S): Variance of the slope.
** $p < .01$.
*** $p < .001$.

3.3. Predicting substance use increases by condition

Study condition was included as a predictor of substance use development in the model. Table 3 shows that, after controlling for sex, education level, ethnicity and age, condition was neither related to the intercepts nor the slopes in all substance use behaviors. These results indicate that the initial level of substance use and the increases in substance use across follow-ups did not differ between the intervention conditions and the control condition.

3.4. Interaction effects

Finally, we examined if sex, education or adolescents' personality traits moderated the relationship between the intervention condition and the initial level of substance use (i.e., intercept) or the rate of change (i.e., slope) in substance use (see Table 3). We only found two interactions on the intercepts (i.e., moderation of sex on binge drinking and moderation of education on lifetime alcohol use) and did not find any interaction on the slopes of substance use.

4. Discussion

Previously, no HSD program effects were found when looking at the incidence of substance use at three follow-up time points separately (Malmberg et al., 2014). However, by taking the dynamics of substance use development over time into account, we did not find any program effects of the HSD prevention program either. An increase in prevalence and intensity rates of substance use was expected (Verdurmen et al., 2012), but exposure to the HSD program was expected to lead to a slower increase in substance use behaviors. Because the developmental trajectory of substance use is related to substance-related problems (Poelen, Scholte, Engels, Boomsma, & Willemsen, 2005; Spaeth, Weichold, Silbereisen, & Wiesner, 2011), slowing down the normative increase in substance use seems an important prevention strategy and one of the goals of the HSD prevention program. So far, most evaluations

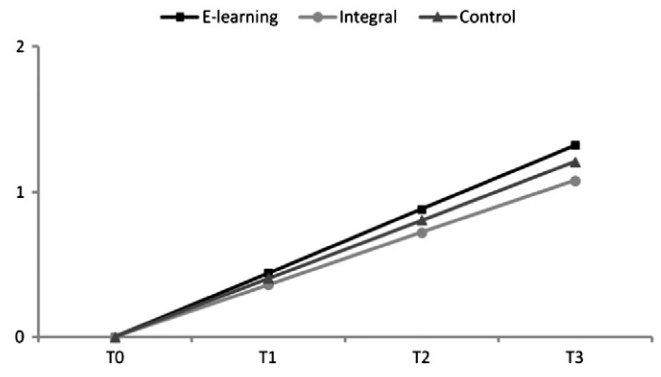

Fig. 2. Rate of change over time for overall alcohol use, separately for the three study conditions.

on substance use prevention programs merely focus on overall program effects on certain time points (Bodin & Strandberg, 2011; Botvin & Griffin, 2004; Cuijpers, 2002; Cuijpers et al., 2002; Faggiano et al., 2008; Foxcroft & Tsertsvadze, 2012; Koning et al., 2009; Koutakis, Stattin, & Kerr, 2008; Nation et al., 2003; Skara & Sussman, 2003; Thomas & Perera, 2008; West & O'Neal, 2004; Winters, Fawkes, Fahnhorst, Botzet, & August, 2007). Only a few studies evaluated the effects on substance use development (e.g., Conrod et al., 2008; Mason, Kosterman, Hawkins, Haggerty, & Spoth, 2003; Spoth, Redmond, Shin, & Azevedo, 2004; Taylor et al., 2000) or combined both approaches (e.g., Spaeth et al., 2011), which is required to draw firm and accurate conclusions. Combining both approaches provides a far more complete picture of the intervention effects and by doing so for the HSD program we must now stress that there are neither point-prevalence nor developmental effects.

We also did not find beneficial effects of the HSD prevention program for boys, adolescents from lower educational tracks or adolescents high on anxiety sensitivity, hopelessness, sensation seeking, and impulsivity. There are inconclusive indications in the literature that certain groups benefit more from prevention efforts than others. Differences in program content might explain these contradicting findings. There are, for instance, programs that show beneficial effects for boys (Vigla-Taglianti et al., 2009), while others show comparable effects for both boys and girls (Jones et al., 2005; Koutakis et al., 2008; Kulis, Nieri, Yabiku, Stromwall, & Marsiglia, 2007; Trudeau, Spoth, Lillehoj, Redmond, & Wickrama, 2003). Some researchers impose that it is important to integrate and address group-specific pathways to substance use in (theories behind) prevention programs in order for beneficial effects to occur (Amaro et al., 2001; Conrod et al., 2008). A promising example in which group-specific needs are incorporated in a prevention program, concerns the personality-targeted interventions of Conrod et al. (2008, 2010). The lack of differential effects on personality might be explained by the fact that the HSD program has not integrated such specific personality-based elements in its current content. Also, the lack of findings on sex and education level seems to indicate that the HSD program insufficiently reflected the needs of these specific sub-groups.

Although the intervention schools were asked to implement the prevention activities according to the study protocol, the prevention activities were implemented by different prevention workers, different teachers, and in different school cultures. It is important to note that Dutch schools mainly implement prevention programs on a voluntary basis. The corresponding prevention activities are incorporated as extra curriculum activities in already stacked school programs, making it likely for schools and teachers to experience the HSD prevention activities as time-consuming and intense. It seems likely that schools, teachers and professionals involved in the implementation might very well adjusted (parts of) the program due to personal interests, time pressure or organizational issues (Durlak & DuPre, 2008; Dusenbury, Brannigan, Falco, & Hansen, 2003). The yearly evaluations with the participating schools substantiate this thought and suggest that there was variation in the way the program was administrated within the

Table 3
Initial level (intercept) and rate of change (slope) in adolescents' substance use on condition and moderators.

	E-learning		Integral					
	Intercept	Slope	Intercept	Slope				
	B (*p*-value)	B (*p*-value)	B (*p*-value)	B (*p*-value)	χ^2(df)	χ^2 *p*-value	CFI	RMSEA
Condition as predictor								
1. Lifetime alcohol	−.055 (.341)	.033 (.236)	.045 (.440)	−.030 (.278)	34.99 (14)	.001	.996	.021
2. Overall use alcohol	−.056 (.244)	.026 (.136)	.033 (.494)	−.019 (.277)	57.99 (23)	<.0001	.994	.021
3. Binge drinking	−.158 (.081)	.072 (.350)	.064 (.469)	−.108 (.273)	28.52 (20)	.098	.995	.011
4. Lifetime tobacco	−.010 (.865)	.005 (.842)	.099 (.102)	−.015 (.527)	18.18 (14)	.199	1.000	.009
5. Overall use tobacco	−.013 (.816)	.001 (.959)	.082 (.143)	−.009 (.703)	35.88 (23)	.042	.999	.013
6. Lifetime marijuana	−.023 (.944)	.097 (.517)	.191 (.548)	.086 (.558)	–	–	–	–
Sex as moderator								
1. Lifetime alcohol	.056 (.607)	−.010 (.847)	.056 (.617)	.008 (.881)	25.35 (18)	.116	.998	.011
2. Overall use alcohol	.069 (.446)	−.021 (.494)	.113 (.221)	−.034 (.286)	48.87 (27)	.006	.995	.016
3. Binge drinking	.316 (.080)	.023 (.919)	.479 (.007)	.049 (.872)	33.98 (24)	.085	.993	.011
4. Lifetime tobacco	.138 (.210)	−.008 (.877)	.009 (.935)	.020 (.643)	34.92 (18)	.010	.999	.017
5. Overall use tobacco	.177 (.088)	−.017 (.698)	.062 (.553)	−.001 (.976)	51.14 (27)	.003	.998	.016
6. Lifetime marijuana	.995 (.139)	−.089 (.770)	1.580 (.018)	−.374 (.214)	–	–	–	–
Education as moderator								
1. Lifetime alcohol	−.332 (.007)	.140 (.035)	−.189 (.130)	.070 (.293)	24.91 (18)	.127	.998	.011
2. Overall use alcohol	−.243 (.016)	.089 (.017)	−.118 (.249)	.053 (.161)	46.68 (27)	.011	.996	.015
3. Binge drinking	−.111 (.549)	−.064 (.773)	−.097 (.591)	.286 (.351)	27.59 (24)	.278	.997	.007
4. Lifetime tobacco	.064 (.598)	−.009 (.851)	.131 (.294)	.033 (.607)	21.09 (18)	.275	1.000	.007
5. Overall use tobacco	.089 (.437)	−.044 (.309)	.163 (.155)	−.015 (.747)	32.69 (27)	.207	.999	.008
6. Lifetime marijuana	.584 (.366)	−.756 (.015)	.571 (.369)	−.378 (.206)	–	–	–	–
Anxiety sensitivity as moderator								
1. Lifetime alcohol	.042 (.621)	−.038 (.366)	.136 (.113)	−.022 (.622)	36.96 (20)	.012	.997	.016
2. Overall use alcohol	.024 (.739)	−.012 (.636)	.123 (.086)	−.029 (.262)	63.33 (29)	<.0001	.994	.019
3. Binge drinking	.109 (.386)	−.140 (.292)	.166 (.163)	−.002 (.988)	30.27 (26)	.257	.997	.007
4. Lifetime tobacco	.088 (.312)	−.042 (.223)	.051 (.558)	−.047 (.202)	22.69 (20)	.304	1.000	.006
5. Overall use tobacco	.137 (.085)	−.051 (.092)	.082 (.319)	−.051 (.122)	44.25 (29)	.035	.999	.012
6. Lifetime marijuana	.445 (.333)	−.345 (.107)	.678 (.143)	−.507 (.019)	–	–	–	–
Hopelessness as moderator								
1. Lifetime alcohol	−.058 (.563)	−.003 (.959)	−.218 (.026)	.013 (.809)	35.53 (20)	.017	.997	.015
2. Overall use alcohol	−.065 (.411)	.026 (.392)	−.202 (.010)	.063 (.031)	58.32 (29)	.001	.994	.017
3. Binge drinking	−.079 (.535)	.105 (.206)	−.159 (.188)	.050 (.474)	33.77 (26)	.141	.995	.009
4. Lifetime tobacco	−.014 (.889)	.023 (.574)	−.154 (.113)	.041 (.289)	21.83 (20)	.349	1.000	.005
5. Overall use tobacco	-.060 (.492)	.051 (.168)	−.201 (.020)	.046 (.183)	43.27 (29)	.043	.999	.012
6. Lifetime marijuana	−.247 (.587)	.245 (.277)	−.583 (.204)	.249 (.263)	–	–	–	–
Sensation seeking as moderator								
1. Lifetime alcohol	.001 (.991)	−.035 (.339)	.102 (.221)	−.097 (.024)	41.63 (20)	.003	.995	.018
2. Overall use alcohol	−.001 (.991)	−.015 (.557)	.044 (.531)	−.037 (.174)	65.22 (29)	<.0001	.993	.019
3. Binge drinking	.072 (.474)	−.058 (.207)	.079 (.417)	−.067 (.155)	36.00 (26)	.092	.993	.011
4. Lifetime tobacco	.116 (.179)	−.061 (.069)	.121 (.154)	−.070 (.044)	25.69 (20)	.176	1.000	.009
5. Overall use tobacco	.128 (.113)	−.066 (.036)	.139 (.080)	−.074 (.020)	42.51 (29)	.051	.999	.012
6. Lifetime marijuana	−.035 (.942)	.033 (.881)	.227 (.636)	−.039 (.860)	–	–	–	–
Impulsivity as moderator								
1. Lifetime alcohol	−.031 (.706)	.019 (.640)	.065 (.444)	−.042 (.309)	45.68 (20)	.001	.995	.020
2. Overall use alcohol	−.044 (.505)	.014 (.529)	.030 (.666)	−.012 (.606)	69.77 (29)	<.0001	.992	.020
3. Binge drinking	.122 (.314)	−.038 (.053)	.213 (.612)	−.073 (.308)	30.96 (26)	.230	.997	.008
4. Lifetime tobacco	−.003 (.968)	.006 (.861)	−.062 (.487)	.017 (.642)	30.08 (20)	.043	.999	.013
5. Overall use tobacco	.015 (.850)	.009 (.775)	−.044 (.584)	.007 (.810)	42.58 (29)	.050	.999	.012
6. Lifetime marijuana	.303 (.504)	.031 (.883)	−.001 (.998)	.095 (.656)	–	–	–	–

Note. The regression coefficients for marijuana use are based on logit regression. All other coefficients are based on probit regression.

school and to the adolescents and their parents. Unfortunately, the few intervention schools in our trial made it impossible to reliably test program implementation. The wide dissemination of the HSD prevention program might easily lead to insufficient implementation, resulting in loss of program effectiveness (Dusenbury et al., 2003; Ennett et al., 2011). A good assessment of program implementation is important to assess possible efficacy effects of parts of the HSD prevention program. Monitoring the implementation on different domains and in different ways might help to understand the efficacy versus effectiveness gap in prevention research (Dusenbury et al., 2003; Ennett et al., 2011; Helmond, 2013). When prevention components are efficacious, future research is necessary in order to capture how effects can be sustained and how key objectives can be achieved. Based on the findings of Koning et al. (2009, 2011), one might argue that the implementation of a good arranged, structured parental meeting by one of the investigators leads to promising results in combination with the alcohol information lessons of the HSD program. This might indicate that more attention should be paid on implementation quality, perhaps through constant supervision or certification procedures of trainers.

The complete absence of intervention effects might be explained by the popularity of substance use in early adolescence among Dutch media and policymakers after the development of the HSD program. This increasing general attention has led to decreases in adolescent substance use (Monshouwer et al., 2008; Verdurmen et al., 2012), which might have eliminated the (mostly) minimal effect of these types of interventions. However, the absence of effects might also be an indication that universal school-based prevention programs are not the best strategy to reduce substance use among Dutch early adolescents. Although some universal school-based prevention programs seem effective (e.g., Koning et al., 2009; Koning et al., 2011), these types of programs generally sort small effects if any (e.g., Foxcroft & Tsertsvadze, 2012; Tobler et al., 2000; West & O'Neal, 2004). More promising results come from focused prevention efforts in which 'at risk' populations are targeted (Conrod et al., 2008; Cuijpers, Scholten,

& Conijn, 2006; Gottfredson & Wilson, 2003; Kreamer et al., 2002; Kumpfer, Williams, & Baxley, 1997; Spoth, Greenberg, & Turrisi, 2008; Springer et al., 2004). A selective or indicated prevention strategy might be more appropriate to account for the variety of risk factors in diverse at risk populations.

4.1. Limitations

Some limitations of the present study should be mentioned. First of all, for general limitations of the HSD effectiveness trial we refer to an earlier report (Malmberg et al., 2014). Secondly, the imbalance of educational level between conditions at baseline was substantial. Although we adjusted for this observed imbalance in our analyses, it is not certain that this approach sufficiently corrected for all confounding influence of this imbalance. If not, program effects would be harder to find since students of lower educational tracks generally use earlier and more often compared to students of higher educational tracks (Verdurmen et al., 2012). However, our lack of findings on program interactions with education level substantiates our conclusion that the HSD program is ineffective. Finally, in line with the previous limitation schools were our unit of randomization. Considering that 23 schools were included in our effectiveness trial one might question if this is sufficient in order to obtain successful randomization. Many trials in which (a small amount of) schools were the unit of randomization show baseline differences on demographics between study conditions (e.g., Koning et al., 2009). Although including more units (i.e., schools) in an effectiveness trial would reduce the risk for baseline differences, but would lead to very high sample sizes (>10.000) at baseline and might not feasible in all cases.

Overall, the non-significant impact of the Healthy School and Drugs program on the development of substance use and the fact that there are no beneficial program effects for any specific subgroup, substantiate our previous conclusion that the program should not be delivered as it is currently implemented. Careful consideration is necessary in order to decide if the program should be replaced by another strategy or that it will be redeveloped and renewed. The field of substance abuse prevention might also benefit from the implications of the present study.

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Contributors

All authors contributed to and have approved the final manuscript.

Conflict of interest

All authors declare that they have no conflict of interest.

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