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The Effects of Teacher Communication During a Health Intervention on Older Adolescents' Predictors of Health Behaviour

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Abstract

This study investigated the influence of teacher communication behaviours on predictors of alcohol use, snack intake, and physical exercise during a school-based health intervention. Additionally, we investigated whether students' evaluations of the intervention mediated these effects. In a two-way prospective study, 389 adolescents (222 females; M_{age} = 16.64, SD_{age} = 1.97) completed a survey. Key variables were teacher communication behaviours (i.e., clarity, verbal immediacy, and content relevance), predictors (i.e., attitudes, social norms, perceived behavioural control, and intentions) of alcohol use, snack intake, and physical exercise, and students' evaluations of the health intervention were investigated. Results showed that teacher clarity resulted in significantly healthier injunctive norms and higher perceived behavioural control regarding alcohol use, and for exercise in significantly healthier attitudes, descriptive norms, and intentions to exercise. No effects of teacher clarity were found for snack intake. Furthermore, teacher clarity, verbal immediacy, and content relevance did not indirectly result in healthier predictors of health behaviour through evaluations of the intervention. Findings support the role of teacher clarity for intervention effectiveness, and advise designers of health interventions to incorporate the role of teacher clarity in their teacher training programs to achieve more desired changes in health behaviour.

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Keywords
Interpersonal communication, health behaviour, adolescents, school-based health intervention, teacher communication.

Adolescents often engage in unhealthy lifestyle behaviours, such as consumption of alcohol and a poor diet (Akseer et al., 2017; Johnston et al., 2016). At the same time, adolescents spend much of their time physically inactive (Salmon et al., 2011). These lifestyle behaviours generally become increasingly unhealthier during adolescence, and reach their peak during late adolescence (16 years and older; Kwan et al., 2012; Mahalik et al., 2013), which is worrisome because excessive alcohol use, a poor diet, and physical inactivity have been found to strongly influence health and mortality (World Health Organization, 2017). For example, excessive alcohol use among adolescents has been associated with many harmful consequences such as blackouts (Boekeloo et al., 2011), injuries (Hingson et al., 2009), alcohol dependence (Olsson et al., 2016), and impaired brain development (Jones et al., 2018). In regards to a poor diet and physical inactivity, both have been related to obesity (Akseer et al., 2017), which has been associated with increased psychological and cardiovascular problems (Reilly et al., 2003). Considering the risks of unhealthy lifestyles during late adolescence, it is important to reduce these unhealthy behaviours.

To encourage healthier lifestyles, school-based health interventions are common, and often taught by teachers (e.g., Jacob et al., 2021). These school-based health interventions are potentially great vehicles for delivering health messages to adolescents, especially because a large number of adolescents can be reached. Despite this promising aspect, effects of school-based health interventions are generally small and inconsistent (Onrust et al., 2016; Strøm et al., 2014). One factor that might explain these inconsistent effects is how teachers communicate health interventions. Investigating teacher communication behaviour is important because teachers are often primarily responsible for implementing school-based health interventions. Moreover, the role of teachers in health intervention implementations is crucial because poorly implemented interventions have limited results (Durlak & DuPre, 2008; Lendrum & Humphrey, 2012). So far the role of teacher communication has hardly been studied in health interventions (see Pettigrew et al., 2015 for an exception). However, in a broader health communication context, previous studies have found a connection between interpersonal communication about health topics and (predictors of) health behaviours. For example, a recent meta-analysis showed that interpersonal communication had a positive effect on a variety of health predictors and behaviours (Jeong & Bae, 2017). Given the importance of interpersonal communication for health behaviour, it is likely that teacher communication behaviours influence the effectiveness of school-based health interventions. The current study tests this notion.

Although teacher communication behaviours have hardly been studied in the context of school-based health interventions, they have been studied in academic contexts. For our study, we focused on three teacher communication behaviours, which are teacher clarity, verbal immediacy, and content relevance. Research on these three teacher communication behaviours has shown that all three communication behaviours resulted in better evaluations of academic courses (Rodríguez et al., 1996; Titsworth et al., 2015; Witt et al., 2004). These evaluations are relevant for health interventions as well because positive evaluations of health interventions are related to more desired outcomes of prevention programs (Hafstad & Aarø, 1997; Low et

al., 2014). Additionally, research on teacher clarity has shown that teaching clearly improved students' understanding of content in academic contexts (Titsworth et al., 2015). As the content of an intervention is developed to stimulate healthier lifestyles, clearly teaching a school-based health intervention could help students to gain a better understanding of the content, which can serve as a prerequisite for potential effects on healthier behaviours. Therefore, teacher clarity could direct influence predictors of health behaviour, and teacher clarity, verbal immediacy, and content relevance could also indirectly influence predictors of health behaviour through evaluations of the health intervention.

Our first research objective was to investigate the effects of teacher clarity, verbal immediacy, and content relevance on predictors of alcohol use, snack intake, and exercise during a school-based health intervention. Our second research objective investigated whether students' evaluations of the health intervention functioned as an intermediate variable between teacher communication behaviours and predictors of health behaviour. Doing so, these results can be used to inform how the implementation of school-based health interventions can be more effective to achieve more desired results.

Teacher Communication Behaviours

Previous literature has investigated several teacher communication behaviours which have led to better evaluations of academic courses (Frymier & Shulman, 1995; Witt et al., 2004) and communication behaviours that improved learning during courses (Titsworth et al., 2015). In our study, we focused on clarity, verbal immediacy, and content relevance.

First, *teacher clarity* refers to the ability to effectively communicate the meaning of course content to the students (Chesebro & McCroskey, 1998a). For example, clear teachers speak fluently and organize content explicitly, so that students can easily integrate the information (Chesebro & McCroskey, 2001; Myers et al., 2014). Second, *teacher immediacy* refers to verbal and nonverbal behaviours that promote perceptions of psychological closeness between teacher and students (Zhang & Witt, 2016). In our study, we focused on verbal immediacy as it is often more effective than nonverbal immediacy (Christensen & Menzel, 1998; Furlich, 2016). Examples of verbal immediacy are the use of humour or personal examples, mentioning students by name, and stimulating students to talk or provide input during class (Gorham, 1988). Lastly, *content relevance* refers to whether the course satisfies personal needs or personal goals of students (Keller, 1983). Teachers can enhance the relevance of course content by relating content to students' future job requirements or other goals and interests (Keller & Suzuki, 2004).

Direct Influence of Teacher Clarity on Predictors of Health Behaviour

The first research objective of our study investigated the influence of teacher clarity on predictors of health behaviour. The predictors of health behaviour that we studied are based on the theory of planned behaviour (TPB; Ajzen, 1991), which considers intention, attitudes towards behaviour, injunctive norms, descriptive norms, and perceived behavioural control (PBC) as important predictors of health behaviour. Research has shown that the TPB has often successfully been used to predict alcohol use (Cooke et al., 2016), eating behaviour (Riebl et al., 2015), and physical activity (Plotnikoff et al., 2013). Therefore, we assessed these predictors for alcohol use, snack intake, and exercise.

In regards to the direct influence of teacher clarity on predictors of health behaviour, the assimilation-to-schema theory states that meaningful learning takes place when new information can be integrated in existing schema's (Mayer, 1977). Teacher clarity contributes to meaningful learning because teacher clarity facilitates how easily students can integrate information (Chesebro & McCroskey, 2001). A meta-analysis by Titsworth and colleagues (2015) showed that teacher clarity during academic courses resulted in students gaining a better understanding of the course content. Although, to our knowledge, this has not been studied so far in the context of school-based health interventions, clearly teaching a school-based health intervention could be helpful because improved understanding of health information and how to implement healthier lifestyles could translate in more desired changes in health behaviour. Therefore, teacher clarity during a school-based health intervention could result in healthier behaviour change. We posed the following hypothesis:

> *H1:* Clearly teaching a school-based health intervention leads to healthier attitudes towards health behaviour (*H1a*), injunctive norms (*H1b*), descriptive norms (*H1c*), PBC (*H1d*), and intention (*H1e*) towards health behaviour.

Although relevance and verbal immediacy contribute to more relevant and enjoyable courses, immediate and relevant teaching do not relate to how easily students can understand new information such as teacher clarity does. For content relevance, no studies showed that relevant teaching directly improved how much students learned during courses. For immediacy, a meta-analysis investigating 81 studies showed only few weak relations between immediacy and cognitive learning (e.g., Witt et al., 2004). Given that content relevance and verbal immediacy do not directly promote learning, it is unlikely that immediate and relevant teaching are directly related to predictors of health behaviour. However, it is possible that there is a more indirect effect of verbal immediacy and content relevance on predictors of health.

Indirect Influences of Teacher Communication Behaviours on Predictors of Health Behaviour

The second research objective was to investigate whether teacher communication behaviours indirectly influenced predictors of health behaviour through evaluations of the health intervention. This is inspired by the social cognitive theory (SCT), which emphasizes the importance of internal factors (e.g., evaluations of intervention) in explaining behaviour and assumes that external factors (e.g., teacher communication behaviours) can influence behaviour through these internal factors (Bandura, 2002). Following this line of thought, the external factors teacher clarity, verbal immediacy, and content relevance might influence the internal factor how students evaluate the health intervention, which in turn, influences predictors of health behaviour. Thus, we propose that how students evaluate a health intervention could function as a mediator between how effectively the teacher communicates during the intervention and predictors of health behaviour.

Regarding the relation between teacher communication behaviours and evaluations of the intervention and in line with the SCT, empirical studies indeed supported the relationship between teacher communication behaviours and evaluations of courses. For teacher clarity, a meta-analysis has shown that clearly teaching courses improved students' evaluations of the course (Titsworth et al., 2015). For immediacy, a meta-analysis has shown that immediate teaching was positively related to how students evaluate courses (Allen et al., 2006), which was explained by enhanced interpersonal closeness between teachers and students (Mehrabian,

1981). Finally, a study has demonstrated that enhancing the relevance of content related to evaluations of courses because of increased motivation during the course (Frymier & Shulman, 1995). Based on these findings, we argue that the three teacher communication behaviours could improve how students evaluate a school-based health intervention. Thus, we hypothesized the following:

> *H2:* Teacher clarity (*H2a*), verbal immediacy (*H2b*), and content relevance (*H2c*) are positively related to evaluations of the health intervention.

Turning to the relation between evaluations of the interventions and predictors of health behaviour, little previous research has considered how evaluations of school-based health interventions influence predictors of health behaviours. As an exception, a study investigating a school-based anti-bullying campaign found that positively evaluating the intervention resulted in stronger attitudes against bullying and subsequently lower levels of school bullying (Low et al., 2014). Furthermore, research on health campaigns also showed that positively evaluating mass-mediated smoking campaigns increased smoking cessation among adolescents (Hafstad & Aarø, 1997; Tangari et al., 2007). These effects might be explained by research showing that people in positive states are often more receptive for persuasive messages (Batra & Stayman, 1990; Mackie & Worth, 1989). Health messages may thus be more effective for students that were positive towards the health intervention compared to students that were more negative towards the health intervention. Together, these studies suggest that positive evaluations of an intervention could also stimulate healthier predictors of behaviours in school-based health interventions. We therefore expected:

> *H3:* Positive evaluations of the intervention result in healthier attitudes (*H3a*), injunctive norms (*H3b*), descriptive norms (*H3c*), (more) perceived behavioural control (PBC; *H3d*), and intentions (*H3e*) towards health behaviour.

As stated earlier, our first objective was to investigate the direct influences of teacher clarity on predictors of health behaviour (H1). The second objective of our study was to test whether evaluations of the intervention mediated the effects of teacher clarity, verbal immediacy, and content relevance on predictors of health behaviour. To do so, the second and third hypothesis each partly tested the relationships of the hypothesized model (see Figure 1). To test whether there is a mediated effect of verbal immediacy and content relevance and a partially mediated effect of teacher clarity on predictors of health behaviour, we hypothesized the following:

> *H4:* Evaluations of the intervention mediate the effects of verbal immediacy and content relevance and partially mediates the effects of teacher clarity on attitudes (*H4a*), injunctive norms (*H4b*), descriptive norms (*H4c*), PBC (*H4d*), and intention (*H4e*) towards health behaviour.

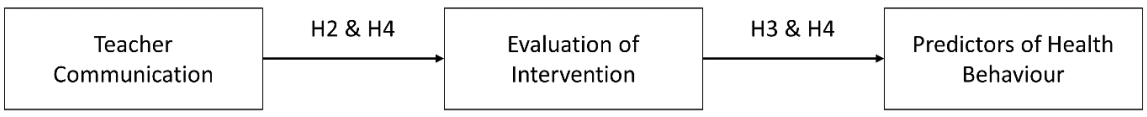

Figure 1. Theoretical Model of the Effects of Teacher Communication on Predictors of Health Behaviour in a School-Based Health Intervention

Note. H1 tests the direct effect of teacher clarity on predictors of health. Predictors of health behaviour are attitudes, injunctive norms, descriptive norms, PBC, and intention.

Materials and Method

We studied InCharge. This is a newly developed health intervention based on the TPB by the Trimbos Institute, the Netherlands Institute for Mental Health and Addiction. In addition to addressing the TPB determinants, the intervention targeted self-control abilities, but these abilities were not examined in this paper. The reason for this is that improving self-control was not trained in class, but built around the seven-days challenge, which was a take-home assignment where students tried to resist a self-chosen temptation for seven days. Because the challenge was a homework assignment, the role of teachers was much less and therefore not included in this paper. The goal of InCharge was to increase adolescents' self-control abilities and ultimately healthy behaviours through a variety of in class assignments such as class discussions as well as homework assignments (e.g., resisting a self-chosen temptation for one week) during four 45-minute sessions. This study is part of a larger research project examining intervention classes and comparing intervention classes with non-intervention classes (Mesman et al., 2020; Mesman et al., 2020; Mesman et al., 2021). One example of a study that is currently in preparation aims to investigate whether adhering to the protocol of a school-based health interventions benefits the effectiveness of a school-based health intervention. The present paper, however, focused on intervention classes to examine how teacher communication behaviours affects predictors of alcohol use, snack intake, and exercise. The trial has been approved by the Ethics Review Board of the Faculty of Social and Behavioural Sciences of the University of Amsterdam (Ref no. 2017-PC-8244).

Participants

After receiving ethical approval, schools were recruited throughout the Netherlands. Of the initial 628 participants that were randomly assigned to the experimental condition, five classes forgot to either fill out the first or second questionnaire (n = 128), parents of 5 students refused participation, 31 students were absent when the second questionnaire was administered, and 71 refused participation or did not return the questionnaire for other reasons. We then removed 5 participants who reported inconsistent birthdates between questionnaire 1 and 2. This resulted in a final sample of 389 students (222 females; M_{age} = 16.64, SD_{age} = 1.97)[1]. We obtained informed consent from all these 389 individual participants. Regarding educational level, 37.3% were students at intermediate vocational education, 10% were students at higher general secondary education, and 52.7% were students at pre-university college.

Procedure

Two weeks before the two-wave study started, schools sent a passive informed consent form to the students' parents. After these two weeks, if parents did not refuse participation, participants first gave their active informed consent and then completed a first questionnaire (T0) to assess demographic information and predictors of alcohol use. One week after T0, participants attended four 45-min sessions of InCharge, generally given once a week during a four-week period and led by one of their school teachers. One week after the fourth session, which was entirely dedicated to alcohol, participants completed the second questionnaire which again assessed predictors of alcohol use as well as how students evaluated the health intervention and how they perceived their teacher's communication. Students filled out questionnaires at school under supervision of the school teachers.

Measures

Background Variables

Alcohol Use. Alcohol use was assessed using the statement "On how many days in the last four weeks have you drank alcohol?" Response categories were 1 = *never*, 2 = *one or two days*, 3 = *three to five days,* 4 = *six to nine days*, 5 = *ten to nineteen days*, 6 = *twenty to twenty-nine days,* and 7 = *thirty days or more.* Binge drink behaviour was assessed using the statement "On how many days of the last four weeks have you drank five or more glasses of alcohol on one occasion?" Response categories were 1 = *never*, 2 = *once*, 3 = *twice,* 4 = *three or four times,* 5 = *five or six times*, 6 = *seven or eight times*, 7 = *nine times or more*.

Exercise Behaviour. Exercise was assessed using the statement "On how many of the last seven days have you exercised for at least 60 minutes?" Response categories were 1 = *zero days*, 2 = *one day*, 3 two days*,* 4 = *three days,* 5 = *four days*, 6 = *five days*, 7 = *six days*, and 8 = *seven days.*

Snack Behaviour. Snack intake was assessed using the statement "On how many of the last seven days have you eaten snacks or candy?" Response categories were 1 = *never*, 2 = *less than once a week*, 3 = *once,* 4 = *two to four times a week*, 5 = *five or six times a week*, 6 = *seven times a week*, 7 = *multiple times a day*.

Perceived Temptation of Health Behaviours. The perceived temptation of the health behaviours was assessed using the statement "Indicate how tempting you find the following behaviours:" followed by "skipping sports or exercise," "eat snacks and candy," and "drink alcohol." Response categories varied from 1 (*totally not tempting*) to 5 (*totally tempting*).

Teacher Communication Behaviours

Teacher Clarity. Teacher clarity was measured using the following five statements of the teacher clarity short inventory (Chesebro & McCroskey, 1998): "My teacher clearly defined major concepts," "In general, I understood my teacher," "My teacher was clear when explaining assignments during class," "My teacher was clear when explaining out of class assignments," and "My teacher used clear and relevant examples." Response categories varied from 1 (*strongly disagree*) to 5 (*strongly agree*). We averaged all items to compute a scale score for teacher clarity.

Verbal Immediacy. Verbal immediacy was assessed using six items of the immediacy behaviour scale (Gorham, 1988). The statement "My teacher" was followed by "used humour in class," "praised students' work," "encouraged students to talk about the course content," "asked questions about the course content," "asked how students felt about assignments," and "asked questions that solicit opinions." Response categories varied from 1 (*strongly disagree*) to 5 (*strongly agree*). We averaged all items to compute a scale score for verbal immediacy.

Content Relevance. Content relevance was assessed using two items of the content relevance scale (Frymier & Shulman, 1995). The statement "My teacher" was followed by "asked me to apply content to my own interests" and "provided explanation to make the content relevant for me." All response categories varied from 1 (*strongly disagree*) to 5 (*strongly agree*). We averaged all items to compute a scale score for content relevance.

Intervention Evaluation. We measured intervention evaluations at Wave 2. The set of questions regarding intervention evaluations were introduced with the following sentence: "The following questions are about how you experienced the four lessons about temptations/self-control." The sentence was followed by eight differential items preceded with the header "My experience with the four lessons about temptations/self-control:". The eight semantic differential items were: 1 (*I was motivated*) to 5 (*I was unmotivated*), 1 (*I was excited*) to 5 (*I was bored*), 1 (*I was uninterested*) to 5 (*I was interested*), 1 (*I was involved*) to 5 (*I was uninvolved*), 1 (*I was dreading it*) to 5 (*I was looking forward to it*), 1 (*totally not enjoying*) to 5 (*totally enjoying*), 1 (*totally not informative*) to 5 (*totally informative*), and 1 (*totally not good*) to 5 (*totally good*). The first, second, and fourth items were recoded such that higher values represented more positive evaluations of the intervention. These statements were derived from the affective learning scale (McCroskey, 1994) and the state motivation scale (Richmond, 1990). Previous literature showed moderate to strong correlations between the affective learning scale and the state motivation scale (Christophel, 1990; Webster et al., 2011). A factor analysis showed that there was indeed overlap between the affective learning scale and the state motivation scale. Therefore, it was decided to combine the two scales.

Predictors of Health Behaviour

Attitudes Towards Health Behaviour. Attitudes towards binge drinking was assessed using the statement "I believe that drinking five or more glasses alcohol in one sitting would be…," attitudes towards physical inactivity was assessed using the statement "I belief that exercising less than once a week would be…," and attitudes towards unhealthy snacking was assessed using the statement "I belief that snacking or eating candy every day would be…" All statements were followed by four semantic differential items from: 1 (*unpleasant*) to 7 (*pleasant*), 1 (*irresponsible*) to 7 (*responsible*), 1 (*harmful*) to 7 (*harmless*), and 1 (*bad*) to 7 (*good*). For exercise, items were recoded such that positive attitudes represented healthier attitudes. For each health behaviour, we averaged these four items to compute a scale score.

Injunctive Norms. Injunctive norms regarding binge drinking was assessed using the statement "How positive are the following people about drinking five or more glasses of alcohol in one sitting?," injunctive norms regarding physical inactivity was assessed using the statement "How positive are the following people about exercising less than once a week?," and injunctive norms regarding unhealthy snacks were assessed using the statement "How positive are the following people about snacking every day?" Response categories varied from 1 (*very negative*) to 5 (*very positive*). Included referent groups were most of my friends, most of my classmates, my parents, and my teacher. For exercise, items were recoded such that positive injunctive norms represented healthier norms towards exercise. For each health behaviour, we averaged these four items to compute a scale score.

Descriptive Norms. Descriptive norms regarding binge drinking were assessed using the statement "How often do you think the following people drink five or more glasses in one sitting?," descriptive norms regarding unhealthy snack intake was assessed using the statement "How often do you think the following people eat snacks or candy?," and descriptive norms regarding physical inactivity was assessed using the statement "How often do you think the following people do sports or exercise?" Response categories varied from 1 (*never*) to 5 (*very often*). Included referent groups were most of my friends, most of my classmates, my parents, and my teacher. For alcohol use and snack intake, higher values represent more unhealthy

descriptive norms, whereas for exercise, higher values represent healthier descriptive norms. For each health behaviour, we averaged these four items to compute a scale score.

Perceived Behavioural Control. PBC was assessed using the statement "If you were confronted with the following temptations, could you resist it if you wanted to?" followed by "drink alcohol," "skip sports or exercise," and "eat snacks or candy." Response categories varied from 1 (*definitely not*) to 5 (*definitely*). Higher values represent more control to make healthy decisions.

Intention. We assessed intentions using the statement "Indicate how often you intend to do the following things in the upcoming four weeks," followed by "exercise intensely," "exercise mildly," "eat snacks or candy," "drink alcohol," and "drink five or more glasses of alcohol on one occasion." Response categories were 1 = *never*, 2 = *less than once a week*, 3 = *once a week*, 4 = *several times a week*, and 5 = *every day*. For alcohol use and snack intake, higher values represent more unhealthy intentions, whereas for exercise, higher values represent healthier intentions.

Data-Analysis

In our final sample of 389 participants, the proportion of missing data was less than five percent, which is considered inconsequential for the quality of statistical inferences (Schafer, 1999). To test our model, we used Amos version 24 (Arbuckle, 2014) and estimated parameters using the maximum likelihood method. Specifically, we used the expectation-maximization (EM) method to handle the few missing data because maximum likelihood methods such as EM generally produce the best results (Cheema, 2014).

The theoretical model in Figure 1 has been modelled three times, separately for each of the three health behaviours (i.e., binge drinking, snacking, and exercising). This means that in all three models, teacher communication behaviour was used as the independent variable and intervention evaluations as the mediator. As the dependent variables, predictors of exercise were used in one model, predictors of snack intake in a second model, and predictors of alcohol use in a third model. The baseline measures of the predictors of health behaviour were used as control variables in the three models for the predictors of health behaviour at T1. Unfortunately, due to time restrictions on questionnaire length, we were only able to ask for a limited number of variables. Therefore, error terms of the predictors of health behaviour at T1 were allowed to covary because unmeasured variables such as sensation seeking for instance have been shown to influence alcohol use (Del Boca et al., 2004). All variables were standardized to facilitate comparison. For model fit, we reported chi-square, standardized root mean residual (SRMR), comparative fit index (CFI), and root mean square error of approximation (RMSEA).

The model fitted the data for exercise, χ^2 (48) = 132.06, $p < .001$, CFI was .96, SRMR was .07, and RMSEA was .07, and for snack intake, χ^2 (35) = 97.83, $p < .001$, CFI was .96, SRMR was .06, and RMSEA was .07. For alcohol use, the model nearly fitted the data, χ^2 (48) = 238.77, $p < .001$, CFI was .95, SRMR was .11 (slightly higher than the threshold of .08; Hu & Bentler, 1999), and RMSEA was .10 (slightly higher than the threshold of .07; Steiger, 2007).

Table 1. Descriptive Statistics of Background Variables and Variables Included in the Model

Variables	*M*		*SD*		α	
	T0	T1	T0	T1	T0	T1
Background						
Alcohol use	2.03		1.26			
Binge drink	1.98		1.50			
Exercise	5.16		2.01			
Snack intake	4.98		1.36			
Temptation alcohol	2.41		1.36			
Temptation exercise	2.43		1.27			
Temptation snack	3.71		1.06			
Teacher and intervention						
Teacher clarity		3.89		0.85		.92
Teacher Immediacy		3.77		0.79		.87
Content relevance		3.62		0.88		.73
Evaluation of intervention		2.96		0.73		.85
Alcohol model						
Attitudes towards alcohol	2.69	2.90	1.59	1.64	.90	.86
Injunctive norms	2.48	2.52	0.91	0.88	.78	.77
Descriptive norms	2.71	2.68	0.87	0.79	.72	.67
PBC	4.26	4.09	1.06	1.08		
Intention to drink	1.90	2.07	0.99	1.06		
Intention to binge drink	1.63	1.79	0.90	1.01		
Exercise model						
Attitudes towards exercise	5.33	5.55	1.49	1.55	.88	.89
Injunctive norms	2.34	2.48	0.83	0.87	.80	.85
Descriptive norms	3.16	3.21	0.54	0.54	.46	.53
PBC	3.97	3.83	1.17	1.22		
Intention to exercise intensely	3.71	3.72	0.89	0.92		
Intention to exercise mildly	3.88	3.86	1.03	0.99		
Snack model						
Attitudes towards snack	3.29	3.43	1.35	1.30	.84	.73
Injunctive norms	2.75	2.81	0.72	0.72	.76	.74
Descriptive norms	3.42	3.44	0.52	0.55	.66	.64
PBC	3.72	3.53	1.04	1.09		
Intention to snack	3.63	3.60	0.93	1.08		

Note. T0 = Baseline, T1 = the second wave, and N/A = not applicable. Attitude varied from 1 to 7 and all other variables were measured on a scale from 1 to 5. For snack intake and alcohol use, higher values represent more unhealthy predictors, whereas for exercise, higher values represent healthier predictors.

Results

The means (*M*), standard deviations (*SD*), and Cronbach's alpha's (α) of the variables in the alcohol model, exercise model, and snack model are displayed in Table 1. Alcohol was being consumed once or twice in the past four weeks and students binge drank once in the past four

weeks. In the last seven days, students indicated that they had exercised on four days and that they had eaten snacks or candy on five or six times. Students found eating snacks or candy more tempting compared to alcohol use and skipping exercise or sports. On average, there was little change in the predictors of health behaviour between T0 and T1. Predictors of alcohol use and attitudes, injunctive norms, and PBC became more unhealthy, whereas descriptive norms and intention towards snack remained stable. For exercise, attitudes, injunctive norms, and descriptive norms became healthier, PBC became lower, and intentions remained stable between T0 and T1.

First, we tested the effects of teacher clarity on the predictors of health behaviour (H1). Table 2 shows the results of the exercise, snack, and alcohol use model. The exercise model showed four significant findings. Teacher clarity increased attitudes towards exercise ($b^* = 0.10$, $p = .036$), descriptive norms on exercising ($b^* = 0.24$, $p < .001$), intention to exercise intensely ($b^* = 0.15$, $p < .001$), and intention to exercise mildly ($b^* = 0.16$, $p < .001$). For alcohol consumption, we found that teacher clarity decreased injunctive norms towards binge drinking ($b^* = -0.08$, $p = .037$) and increased PBC to resist drinking alcohol ($b^* = 0.13$, $p = .009$). For snacking, teacher clarity changed descriptive norms in an undesired direction ($b^* = 0.12$, $p = .011$), as they became more positive regarding snacking behaviour. Thus, in contrast to the overall changes shown in Table 1, teacher clarity was related to desired changes in a healthy direction for predictors of exercise and alcohol use, but not for snack intake. Thus, we found support for desired influences of teacher clarity on attitudes (H1a), descriptive norms (H1c), and intentions towards exercise (H1e), and on injunctive norms (H1b) and PBC (H1d) towards alcohol use.

Second, we tested whether teacher clarity, verbal immediacy, and content relevance related to evaluations of the health intervention (H2). In line with our second hypothesis, we found that verbal immediacy related to significantly better evaluations of the health intervention ($b^* = 0.28$, $p < .001$), supporting H2b. In contrast, we did not find that teacher clarity ($b^* = 0.06$, $p = .342$) and content relevance ($b^* = 0.01$, $p = .901$) influenced how students evaluated the health intervention, thereby not supporting H2a and H2c.

Third, we tested the effects of evaluations of the intervention on predictors of health behaviour (H3). Findings showed that evaluations of the intervention decreased snack-related PBC ($b^* = -0.12$, $p = .017$). Evaluations of the intervention did not significantly influence other predictors of health behaviour, thereby not supporting H3. Furthermore, we tested the indirect influences of teacher communication behaviours on predictors of health behaviour through evaluations of the intervention (H4). Findings showed that teacher communication behaviours did not indirectly result in healthier predictors of behaviour, rejecting H4.

Discussion

Given that school-based health interventions generally produce limited and inconsistent effects (Onrust et al., 2016), research is needed to gain insight in how to improve the effectiveness of school-based health interventions. Our study investigated the role of teacher communication during a school-based health intervention. To our knowledge, this study is the first to investigate the effects of teacher communication behaviours on adolescents' predictors of health behaviour. In response to our first research objective, we found support for a direct effect of teacher clarity on predictors of health behaviour. In line with our first hypothesis, teacher

clarity resulted in significantly healthier injunctive norms and higher PBC for alcohol use, and in significantly healthier attitudes, descriptive norms, and intentions for exercise. Teacher clarity did not result in significantly healthier predictors of snack intake. Our second research objective investigated the indirect effects of teacher clarity, verbal immediacy, and content relevance on predictors of health behaviour through evaluations of the intervention. In line with our second hypothesis, we found a relationship between verbal immediacy and evaluations of the intervention, but not for teacher clarity and content relevance. In contrast to our third and fourth hypothesis, we found that evaluations of the intervention did not result in healthier predictors of health behaviour, nor did these evaluations mediate the effects of the teacher communication behaviours on predictors of health behaviour.

Table 2. Predictors of Health Behaviour as a Function of Teacher Communication Behaviours and Evaluations of the Intervention

Exercise model	Evaluation of intervention	Attitudes towards exercise	Injunctive norms	Descriptive norms	PBC	Intention to exercise intensely	Intention to exercise mildly
Teacher clarity	0.06	0.10*	-0.06	0.24***	-0.02	0.15***	0.16***
Verbal immediacy	0.28***						
Content relevance	0.01						
Evaluation of intervention		-0.05	-0.03	-0.03	-0.06	-0.05	-0.07
Alcohol model	Evaluation of intervention	Attitudes towards alcohol	Injunctive norms	Descriptive norms	PBC	Intention to drink	Binge drink intention
Teacher clarity	0.06	-0.06	-0.08*	0.004	0.13**	-0.04	-0.03
Verbal immediacy	0.28***						
Content relevance	0.01						
Evaluation of intervention		-0.03	0.002	0.04	-0.08	-0.01	0.01
Snack model	Evaluation of intervention	Attitudes towards snack	Injunctive norms	Descriptive norms	PBC	Intention to snack	
Teacher clarity	0.06	-0.05	-0.01	0.12*	0.06	-0.01	
Verbal immediacy	0.28***						
Content relevance	0.01						
Evaluation of intervention		0.05	-0.03	0.02	-0.12*	0.11	

Note. For two-wave model that regressed on predictors of health behaviour at T1 controlled for T0: $n = 389$. *$p < .05$, **$p < .01$, ***$p < .001$.

Our study is the first to show that teacher clarity in a school-based health intervention can result in significantly healthier predictors of alcohol use and exercise. These findings are in line with our hypothesis and previous literature showing that clearly teaching courses can lead to more desired results in academic courses (e.g., Titsworth et al., 2015). Our findings provide more insight in the contexts in which teacher clarity can be beneficial. Not only does teacher clarity improve learning outcomes in academic courses, but our study shows that teacher clarity also influences predictors of health behaviour in a school-based health intervention. This also coincides with findings of previous studies demonstrating that the implementation of the intervention is crucial for the effectiveness of the intervention (Durlak & DuPre, 2008; Lendrum & Humphrey, 2012). Although the results showed that clearly teaching the health intervention significantly influences predictors of alcohol use and exercise, teacher clarity appears to be unrelated to predictors of unhealthy snack intake. This finding could potentially be explained by the fact that eating unhealthy snacks was much more tempting for students than the other two health behaviours (see Table 1). Students may have experienced more difficulties resisting the snacking temptation in comparison to alcohol use and skipping exercise or sports. Nevertheless, by demonstrating that teacher clarity influences predictors of alcohol use and exercise behaviour, our study provides insight in how to improve the implementation of interventions to achieve more desired results.

Second, in line with findings of a previous meta-analysis (Allen et al., 2004), our study reveals that verbal immediacy is positively related to students´ evaluations of a school-based health intervention. In contrast to previous studies (e.g., Mottet et al., 2008; Titsworth et al., 2015), however, our findings show that teacher clarity and content relevance do not significantly influence evaluations of the school-based health intervention. In comparison to immediacy, relevance and clarity may be more cognitively focused (i.e., making content more understandable and interesting), whereas previous research has shown that immediacy is more affectively oriented (Witt et al., 2004), with for example, the use of humour in class and praising students (Gorham & Christophel, 1990). Given that the health intervention is obligatory for students and teachers cannot change the content of the intervention, there may be a plateau in the cognitive evaluation of the health intervention. Even though teachers present the content understandably and try to make it relevant, this may not change how interesting students find the content of the intervention. As immediacy behaviours can be perceived as more affectively focused, making jokes and maintaining good relations with students may still influence students' enjoyment in the classroom. Therefore, teacher behaviours that are more affectively focused may still improve how students evaluate a school-based health intervention.

Third, although previous studies have demonstrated that evaluations of health interventions in other contexts influence the effectiveness of the health intervention (e.g., Hafstad & Aarø, 1997), our findings show that evaluations of the intervention do not influence predictors of health behaviour, and subsequently do not mediate the effects of teacher communication behaviours. These inconsistencies may be explained by the fact that school-based health interventions are often obligatory, whereas for mass-mediated health interventions (e.g., Hafstad & Aarø, 1997), people actively decide to pay attention to the health message. People actively consuming health messages may already have a certain interest in changing their health behaviour, while students following an obligatory school-based health intervention may lack a pre-existing interest. Therefore, evaluations may be more important in non-obligatory interventions than in obligatory interventions. Future studies can further investigate whether

evaluations of interventions are less crucial for obligatory interventions compared to non-obligatory interventions.

An explanation for the lack of effect of the evaluations of the school-based health intervention on the predictors of health behaviour could be that teachers did not implement the health intervention as was intended. Previous research has shown that poorly implemented health interventions negatively influenced intervention outcomes (Durlak & Dupre, 2008), illustrating the importance of implementation. Possibly, the health intervention used in this study may not have been implemented as was intended by the developers of the health intervention. If so, this would be problematic because the evaluations are then largely based on a different and potentially less effective version of the school-based health intervention. This may serve as an alternative explanation for finding not effects of the evaluations on the predictors of health behaviour.

Practical Implications

Our findings have important implications for developers of health interventions. Based on this study designers of health interventions may learn that clarity-related behaviours such as fluent speech and explicit organization of content is important for intervention effectiveness. School-based health interventions are mostly not taught by trained health educators, but taught by school teachers to maximize the reach and decrease the costs of these interventions. However, most school teachers are not formally trained to teach health interventions, but are trained for subjects such as mathematics or a foreign language. Therefore, developers of health interventions should inform instructors of the benefits of communication clarity for the effectiveness of the health intervention and can aid instructors in structuring the intervention in a clear manner such that teachers can easily present the content with clarity. Additionally, teachers should be provided with guidelines (e.g., clear and sufficient examples, outlining key information for students) on how to communicate clearly during a school-based health intervention in order to achieve desired results.

Limitations and Future Research

Our study has several limitations. The first concerns the fact that we studied effects of teacher clarity on predictors of health behaviour rather than actual health behaviour. This means that students may have formed healthier intentions towards exercising but that does not necessarily guarantee that they subsequently act upon those intentions. However, a meta-analysis of meta-analyses investigating the relation between intention and behaviour of various health behaviours has shown that intentions and behaviours are strongly related (Sheeran, 2002). Therefore, we think the effects we found on intentions are likely related to behaviours. Nevertheless, future studies should confirm this by investigating the influence of teacher clarity on actual health behaviours.

Second, we did not assess teacher behaviour objectively but as perceived by students. Previous research involving self-reported data has suggested that perceptions of teacher communication behaviours could be biased by general impressions of students' teachers, apart from their behaviour during a specific course (Hess et al., 2001). Although we cannot rule out that students indeed were biased by general impressions of their teacher, the fact that we found a relation only between verbal immediacy and evaluations of the intervention is contradicting such a possibility. If student responses on perceptions of teacher communication behaviours

were biased by general impressions of their teachers, influences on evaluations of clarity, immediacy, and relevance would likely be similar. Nevertheless, it would be interesting to use a more objective measurement technique to investigate teacher communication behaviours through coded observations.

Third, one limitation of this study is related to the scale that we used to measure verbal immediacy (Gorham, 1988). Although recent studies (e.g., Iaconelli & Anderman, 2021; Liu, 2021) still use the verbal immediacy scale from Gorham to measure verbal immediacy, there is also critique on the scale from other researchers. Robinson and Richmond (1995) argued that the verbal immediacy scale represented teacher effectiveness rather than verbally immediate behaviour. In contrast, more recent research demonstrated that the items from the verbal immediacy scale did not measure teacher effectiveness (Wilson & Locker, 2008). These findings dismiss the criticism on the verbal immediacy scale, and therefore, we believe that using the verbal immediacy scale is warranted.

Our study also suggests several new research opportunities. First, interpersonal communication, such as teacher communication behaviours, occurs not only during the lessons. It is possible that students themselves talk about the intervention with each other after the lessons. Interestingly, previous research has shown that exposure to health messages might stimulate negative conversations about the unhealthy behaviour (e.g., Hendriks et al., 2012). It would be interesting to investigate whether interpersonal communication of students about a health behaviour can be affected by a school-based health intervention, and if so, what effects these conversations have on health behaviours. Second, our findings demonstrate that teacher clarity during a school-based health intervention influences predictors of alcohol use and exercise. This was based on previous studies showing that students gained a better understanding of courses content if that course was taught clearly (Titsworth et al., 2015). Future studies could investigate whether influences of teacher clarity on predictors of health behaviour can be explained by students having an improved understanding of health information.

Despite the limitations, the present study adds to previous literature by showing that teacher clarity influences predictors of health behaviour in school-based health interventions. More specifically, for alcohol use, teacher clarity results in significantly healthier injunctive norms and higher PBC, and for exercise, in significantly healthier attitudes, descriptive norms, intention to exercise mildly and intensely. These findings advise designers of health interventions to incorporate the role of teacher clarity for intervention effectiveness in their teacher training programs and provide guidelines for teachers on how to clearly communicate a health intervention to achieve more desired changes in health behaviour.

Notes

1. 15 participants did not report their age. We included these participants for further analyses.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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