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Developing and evaluating utility of school-based intervention programs in promoting leisure-time physical activity: an application of the theory of planned behavior

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Building upon tenets of the theory of planned behavior, the present study examined whether school-based intervention programs that aimed to change attitudes, perceptions of control, or both attitudes and perceptions of control in combination, was successful in promoting participation in leisure time physical activities. Participants were 1372 pupils recruited from 10 secondary schools and exercised for less than 3-days per week in the previous month. Using a cluster-randomized design, participants were presented with one of the intervention conditions each lasting 10 minutes delivered as part of physical education classes twice per week over a period of 8 weeks. The interventions included: (i) an attitude-based intervention that targeted salient behavioral beliefs; (ii) a second attitude-based intervention that targeted non-salient behavioral beliefs; (iii) a control-based intervention program that targeted salient control beliefs; and (iv) a combined intervention program that targeted both salient control beliefs and salient behavioral beliefs. Results indicated that while all of the intervention programs resulted in increased participation in leisure time physical activity, the combined intervention program targeting change in attitudes and perceptions of control was least effective. Overall, the findings suggest that schools and teachers can promote leisure time physical activity through brief, cost-effective interventions.

KEY WORDS: Additive effects, Physical activity behavior, Theory of planned behavior

Health organizations and governments worldwide have recognized adoption of physical activity as an important strategy that improves health

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and helps young people and adults cope with stress induced by uncertain economic environments of the future (i.e., Economic Review Committee, 2006; U.S. Department of Health and Human Services, 1996). Schools can play an important role in promoting lifelong participation in physical activities because they provide an existing network where interventions to produce sustainable changes in health behavior can be implemented (Hagger & Chatzisarantis, 2005; Standage, Gillison, Ntoumanis, & Treasure, 2013). However, educators and health professionals have found the communication of persuasive health messages aimed at changing health behaviors (e.g., physical activity) of the public notoriously difficult (Haynes et al., 1996). One possible reason for this is that physical activity interventions are not directly related to theories of social behavior (Harde-man et al., 2002). Hence, development and evaluation of school-based interventions that are founded on rigorous psychological theories may be the first step toward promoting lifelong participation in physical activities among young individuals.

The present study built upon tenets of the theory of planned behavior to develop and evaluate the utility of a number of school-based interventions in promoting participation in physical activities during leisure-time. The present research makes two significant contributions to the extant literature. First, it investigates the intervention techniques that are most effective in promoting participation in physical activities during leisure-time. For example, it is possible to develop interventions that emphasize the benefits of physical activity or helps young people overcome barriers related to physical activity. Hence, by comparing the different types of interventions, we aim to discover which type of intervention is the most effective (or least effective) in promoting physical activity participation.

Second, a strength of the theory is that it allows researchers and practitioners to design brief intervention programs that can be implemented in classroom settings. This is important because it means that it is possible to design effective intervention programs that do not interfere with physical education classes or schools in any substantial way. For example, our intervention sessions were delivered by physical educators at the end of physical education classes because they did not last more than 10 minutes. Because of this brief nature of our intervention, the present research shows how physical education classes and existing networks could be utilized to alter leisure-time behavior of pupils without distracting educators' and schools' daily schedules or routines in any substantial way. Our approach provides an alternative to intervention programs based on other theoretical frameworks (i.e., motivational interviewing, Miller, & Rollnick, 2002) that are considerably

more demanding in that they require regular one-on-one sessions that last considerably longer than 10 minutes.

The Theory of Planned Behavior

When applied to young people and physical activity, the theory of planned behavior proposes that participation in physical activities is a function of intentions and perceived behavioral control. Intention is an indicator of how hard young people are willing to try, and how much effort they plan to exert, toward engaging in physical activity. Perceived behavioral control refers to the extent to which young people believe that they command sufficient resources, and can overcome salient barriers, to engage in physical activity (Ajzen, 1991, 1998). The theory also proposes that intention is an *additive* function of three variables: attitudes (positive or negative evaluation of performing physical activity), subjective norms (perceived influences that significant others may exert on the execution of physical activity), and perceived behavioral control. This means that the combined effect of attitudes, subjective norms and perceptions of control produce, when used in combination, an effect that is greater than the individual effects related to attitudes, subjective norms or perceptions of control (Ajzen & Fishbein, 1980). An implication of the proposed additive effect is that interventions that target all antecedents of intentions will be more effective in promoting physical activity intentions and behavior than specific interventions that target attitudes, subjective norms or perceptions of control alone.

The theory of planned behavior also deals with antecedents of attitudes, subjective norms and perceived behavioral control. The theory proposes that attitude is a multiplicative function of beliefs that physical activity will lead to certain positive or negative consequences (behavioral beliefs) and evaluations of these consequences (Ajzen, 1991). Changing a person's physical activity attitudes requires changing the salient behavioral beliefs regarding the positive (advantages) or negative (disadvantages) consequences or the evaluation of those consequences. Subjective norms and perceived behavioral control are also proposed to be function of normative beliefs and control beliefs respectively. Subjective norms are determined by a combination of normative expectations of specific referent groups (normative beliefs) and a motivation to comply with those groups (Ajzen, 1991). Changing subjective norms requires changing what an individual perceives a specific referent group (i.e., peers, parents) would want and the individual's desire to comply with the opinion of that group. Perceived behavioral control is determined

by beliefs about the presence of barriers that may impede performance of physical activity (control beliefs) and a perceived power of these barriers (Ajzen, 1991). Therefore, the key to changing perceived behavioral control lies in changing beliefs that behavioral barriers are relatively easy to overcome (see Rhodes, Blanchard, Courneya, & Plotnikoff, 2009; Sniehotta, 2009). Overall, according to the theory of planned behavior, physical activity behavior and intentions can change through attitudes, subjective norms, or perceptions for control or by changing a combination of these three variables.

Persuasive Communication as a Strategy for Behavioral Change

Ajzen (1998) suggested that persuasive communication is a strategy of behavioral change that can be used to alter intentions and behavior. In general, a persuasive communication involves *belief-targeted messages* that target salient behavioral, normative, and/or control beliefs (see also Rhodes et al., 2009). The actual structure of belief-targeted messages involves a set of arguments that are in favor of health behavior such as physical activity (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 2009). In addition, the messages should aim to enhance the credibility of the arguments and/or include factual evidence designed to support the arguments (Ajzen & Fishbein, 1980). These arguments should also emphasize salient beliefs of health behavior such as salient benefits or provide strategies for overcoming salient barriers.

The theory of planned behaviour has received considerable support in terms of predicting and explaining health-related behaviors (see Hagger, Chatzisarantis, & Biddle, 2002; McEachan, Conner, Taylor, & Lawton, 2012). In the domain of physical activity, prospective studies have shown that physical activity intentions and behaviours are additive function of attitudes and perceptions of control. Subjective norms do not predict physical activity intentions (Hagger, Chatzisarantis, & Biddle, 2002). Most relevant, intervention studies that adopted the theory have been relatively successful in changing physical activity intentions but less so in changing physical activity behaviour (Chatzisarantis & Hagger, 2005; Hardeman et al., 2002; Webb & Sheeran, 2006). For example, Jones, Courneya, Fairey, and Mackey (2005) demonstrated that an intervention that targeted normative beliefs was effective in promoting participation in physical activities among cancer survivors. Likewise, Darker, French, Eves and Sniehotta (2010) have provided support for effectiveness of persuasive messages addressing salient control beliefs and perceptions of control in promoting actual walking (see also Jones et al., 2005; Sniehotta, 2009). However, these studies did not compare a combined

intervention program that targeted both attitudes and perceptions of control against more specific interventions than targeted perceptions of control or attitudes only. It is important to test additive effects because such tests will confirm whether the combined effects of attitudes and perceptions of control on physical activity intentions and behaviors are larger than effects associated with interventions that target attitudes or perceptions of control alone. This is consistent with recent research that has called for factorial designs to evaluate the effectiveness of individual components of interventions to change behaviour in health contexts (Michie & Johnston, 2012).

There is also a relative dearth of research on theory-based interventions to promote physical activity in young people. A recent school based intervention, conducted by Chatzisarantis and Hagger (2005), focused on young people did not provide conclusive support for the intervention or theory on which it was based. Specifically, it was shown that while an intervention that targeted salient behavioural beliefs was successful in changing attitudes and physical activity intentions, the intervention did not change physical activity behaviour. The absence of a behavioural effect is also consistent with a recent meta-analysis showing that manipulations to change intentions do not always lead to concomitant changes in behaviour (Webb & Sheeran, 2006). However, as with previous studies, this study did not evaluate a combined intervention that targeted attitudes and perceptions of control. This might have been a reason for the lack of behavioral change given that previous prospective studies showed that lack of control over physical activity reduces pupils' intentions to participate in physical activity in future and actual physical activity behaviour (Hagger, Anderson, Kyriakaki, & Darkings, 2007). It is clear that this is an area that is in need of further research to ascertain whether interventions based on theories like the theory of planned behavior are effective in bringing about greater physical activity in young people and, most importantly, identify the psychological variables (e.g., attitudes, perceived behavioral control, or a combination of the two) that should be targeted in interventions to bring about the largest effects on behavior change.

Overview of the Study and Hypotheses

The present study built upon tenets of the theory of planned behavior to develop and evaluate utility of a number of interventions in promoting leisure-time physical activity among young people. Our interventions were conducted in schools and included communication of brief persuasive messages. Specifically, we evaluated two attitude-based interventions that tar-

geted salient behavioral beliefs or non-salient behavioral beliefs. In addition, our design included a control-based intervention program that targeted salient control beliefs. Further, we evaluated a combined intervention program that targeted both salient control beliefs and salient behavioral beliefs. This design allowed us to ascertain which school-based intervention program was most effective in increasing pupils' participation levels in leisure-time physical activities.

Building upon previous research (Chatzisarantis & Hagger, 2008; Darker et al., 2010; Sniechotta, 2009; Jones et al., 2005), we hypothesized that all intervention programs would be successful in changing physical activity behavior of pupils (H_1). Empirically, this means that pupils will report more frequent participation in physical activities at the midpoint and end of the intervention programs relative to baseline. We evaluated this hypothesis by using participants' baseline measures of physical activity as a control. It is important to note that our hypothesis predicts that the program that targeted non-salient behavioral beliefs would change intentions and behavior because there is some evidence to suggest that even non-salient beliefs have a significant impact upon physical activity intentions and behavior (i.e., Jones et al., 2003). Most critical, Ajzen (2003) does not rule out the possibility that an intervention targeting non-salient behavioral beliefs will affect a significant change in behavior or variables from the theory of planned behavior. However, we reasoned that if the effects of attitudes and perceptions of control on physical activity intentions or behaviors were additive then a combined intervention program targeting salient control beliefs and salient behavioral beliefs would produce the largest amount of change in physical activity intentions and behavior (H_2). We evaluated this second hypothesis by comparing effects of a combined program that targeted salient control beliefs and salient behavioural beliefs against effects of the two intervention programs that targeted salient control beliefs only or salient behavioural beliefs only. Further, we hypothesized that the interventions would affect a change in the variables from the theory of planned behavior in directions consistent with the theory (H_3). Specifically, we predicted that while the combined intervention program would increase attitudes and perceptions of control, the more specific programs that targeted salient or non-salient behavioral beliefs would increase attitudes only. Analogously, we predicted that the program that targeted salient control beliefs would increase perceptions of control.

Finally, we incorporated booster sessions into our programs in order to examine whether an eight-week intervention program was more effective in terms of maintaining changes in physical activity behavior and in variables contained in the theory of planned behavior than a four-week intervention

program. In general, booster sessions are ‘smaller doses’ of the original intervention that are usually delivered at specific times after termination of the intervention itself (Stice et al., 2006). Booster sessions are important to build into research designs because they facilitate maintenance of behavioral change by preventing undesirable change in physical activity intentions and behavior after the initial intervention session (Hennessy et al., 1999). This is particularly germane for our intervention programs because, according to Ajzen and Fishbein (1980), interventions that target beliefs are prone to undesirable changes in behavior. Given that there are no studies examining effects of booster sessions based on the theory of planned behavior on physical activity, we did not develop any specific hypothesis with respect to effectiveness of booster sessions. However, we reasoned that if a four-week intervention program was not effective in terms of maintaining behavior change then pupils who received the four-week program would exhibit a decline in physical activity participation after termination of the program. In contrast, such a decline would be less pronounced among pupils who received the eight-week program.

Method

RESEARCH PARTICIPANTS, DESIGN AND PROCEDURES

We adopted a 2 (booster sessions: yes versus no) \times 4 (type of intervention: attitude-based intervention that targeted non-salient behavioral beliefs vs. attitude-based intervention that targeted salient behavioral beliefs vs. a control belief-based intervention that targeted salient control beliefs vs. combined intervention that targeted salient behavioral beliefs and salient control beliefs) design. Our dependent variables were attitudes, subjective norms perceptions of control, intentions and physical activity participation. All dependent variables were measured repeatedly at baseline, midpoint and end of the intervention programs.

The study protocol received approval from the University ethical review panel. Participants were pupils attending mixed secondary schools. The goal of the intervention program was “engaging in physical activities for at least 4-days per week, 40-minutes at a time during leisure-time”. We targeted pupils who exercised for less than 3 days per week so that we could evaluate whether the intervention program was effective in facilitating meaningful changes in physically activity behaviour among children who are unlikely to meet physical activity guidelines which may have adverse effects on their long-term health. This procedure is consistent with Ajzen’s (1991) recommendations that effectiveness of interventions based on theory of planned behavior should be evaluated against individuals who exhibit less positive attitudes or intentions towards goals of the intervention programs. However, it is important to note that our participants were not physically inactive but they exercised for less than 3-days per week.

We randomly selected and contacted head teachers from 16 schools from a list of secondary schools. Head teachers from ten schools agreed to participate in the study. After discussing with head teachers and physical education teachers content of the intervention pro-

grams, pupils and their parents were provided with information sheets explaining risks and benefits of the study via a take-home letter. The letter contained a consent form for parents and pupils to complete. Consent forms were returned to the research team via the physical education teachers. The inclusion criteria were that participants (i) must have exercised less than three days per week during leisure time the last month and (ii) must have had physicians' permission to participate in physical education classes. These criteria produced gender imbalance across conditions mainly because females were more likely to be physically inactive than males. For this reason, we statistically controlled for gender in our analysis.

After obtaining parental consent, we randomly allocated the ten schools into intervention programs by using a random number generator. The interventions took place in schools. The persuasive messages communicated via a printed leaflet administered to participants at the end of their physical education classes. Teachers were also instructed to deliver messages at the end of physical education classes. Specifically, at baseline, pupils read a definition of leisure time physical activity adopted from Godin and Shephard (1985). This definition explained the meaning of mild, moderate, and vigorous physical activity. Pupils were told that we were interested in the amount of vigorous physical activity that they undertook during their leisure time and not during school time. Pupils were also asked to give examples of vigorous physical activities and they were encouraged to ask questions about the distinction between leisure-time and school-time physical activity. Immediately afterwards, pupils reported the frequency with which they engaged in vigorous physical activity during leisure time over the previous four weeks. This baseline measure of behavior is a measure of past behavior because it captures the extent to which pupils engaged in physical activity prior to the intervention. Measures of past behavior were used to identify physically inactive pupils' who exercised less than three days per week.

After reporting past behavior, a researcher and the physical education teacher informed pupils that the study required them to actually engage in vigorous physical activities, four days per week, for at least 40 minutes each time, over the next eight weeks, during leisure time. Immediately afterwards, participants were presented with the intervention protocol. The interventions took the form of written persuasive messages that were presented in a printed paper leaflet. The researcher together with the physical education teacher also read the persuasive messages to pupils. Thereafter, pupils completed a questionnaire measuring attitudes, subjective norms, perceptions of control and intentions.

Four weeks after obtaining baseline measures, the researcher visited the schools again. By that time, schools were randomly allocated to booster or non-booster conditions. Consistent with the procedures we adopted at baseline, pupils first reported the frequency with which they engaged in leisure time physical activity the last four weeks. The method of measuring physical activity was identical to the method used at baseline. This measure of behavior captures compliance to the intervention programs because it measured the extent which pupils engaged in physical activity during the first four weeks of the program.

Participants then completed a questionnaire containing measures related to constructs of the theory of planned behavior for second time. In the booster conditions, teachers continued to deliver the persuasive messages twice per week at the end of physical education classes for over a period of four-weeks. In contrast, in the no-booster conditions, teachers stopped delivering the persuasive messages. However, in the no-booster conditions, teachers reminded pupils about their agreement to engage in leisure time physical activity. Hence, comparisons between groups of participants who received and did not receive booster sessions provided an indication as to whether persuasive messages that emphasized benefits or barriers to physical

activity contributed to the maintenance of physical activity participation over and above simple reminders that did not emphasize the benefits or barriers related to physical activity. Finally, at the end of the intervention program, the researcher visited all schools for a final time. During that time, the researcher obtained measures indicating the frequency with which pupils had been engaging in leisure time physical activity the last 4 weeks. This measure of behavior captured compliance with the intervention programs because it measured the extent to which pupils engaged in physical activities the last four weeks of the programs. In addition, we measured the theory of planned behavior variables. These measures captured the impact of persuasive messages and teachers on tendencies to continue engaging in physical activities at post-intervention or post-booster periods. The methods of measuring these variables were identical to the methods used at baseline. Figure 1 presents a consort diagram that shows the flow of participants through the study.

INTERVENTIONS

Intervention that targeted salient behavioral beliefs (attitudes). Development of the persuasive communication that targeted modal salient behavioral beliefs was based on Hagger et al.'s (2001) study that identified modal salient behavioral beliefs of young people. These behavioral beliefs reflected outcomes related to "having fun", "stay fit", "improve skills", "socialize" "getting an injury" and "feeling hot and sweaty" (see Appendix).

Intervention that targeted non-salient behavioral beliefs (attitudes). This message emphasized non-salient beliefs reflecting outcomes related to health. These outcomes reflected "prevention of cardiovascular disease", "prevention of cancers", "pain in muscles" "getting tired" and "keep healthy weight". These outcomes are non-salient because previous studies showed that young people do not easily recall from memory health-related outcomes (Chatzisarantis & Hagger, 2005; Hagger et al., 2001) (see Appendix).

Interventions that targeted salient control beliefs. Development of the persuasive communication that targeted salient control beliefs was also based on Hagger et al.'s (2001) study that identified modal salient control beliefs of young people. These control beliefs reflected barriers related to "other hobbies", "weather", "doing homework", and "not being good at sports" (see Appendix).

Combined intervention program (attitudes and perceived behavioral control). In this combined condition, pupils received a message that targeted salient behavioral beliefs and a message that targeted salient control beliefs. The content of these messages was identical to content of messages that targeted salient behavioral beliefs only or the message that targeted salient control beliefs only.

Teachers' input. Physical education teachers delivered the persuasive messages twice per week for a four-week (in non-booster conditions) or eight-week period of time (in booster conditions). Teachers asked pupils to study the persuasive messages for five minutes. In addition, teachers prompted pupils to elaborate on these different types of beliefs by asking them some leading questions. (i.e., "Why do you think that leisure time physical activity improves your fitness, what can you do so that you avoid getting injured?"). Teachers spent between 5 to 10 minutes in doing this exercise. Teachers delivered the persuasive messages at the end of physical education classes.

Booster sessions. This variable was operationally defined as the extent to which teachers delivered persuasive messages from midpoint to end of the intervention programs. Schools

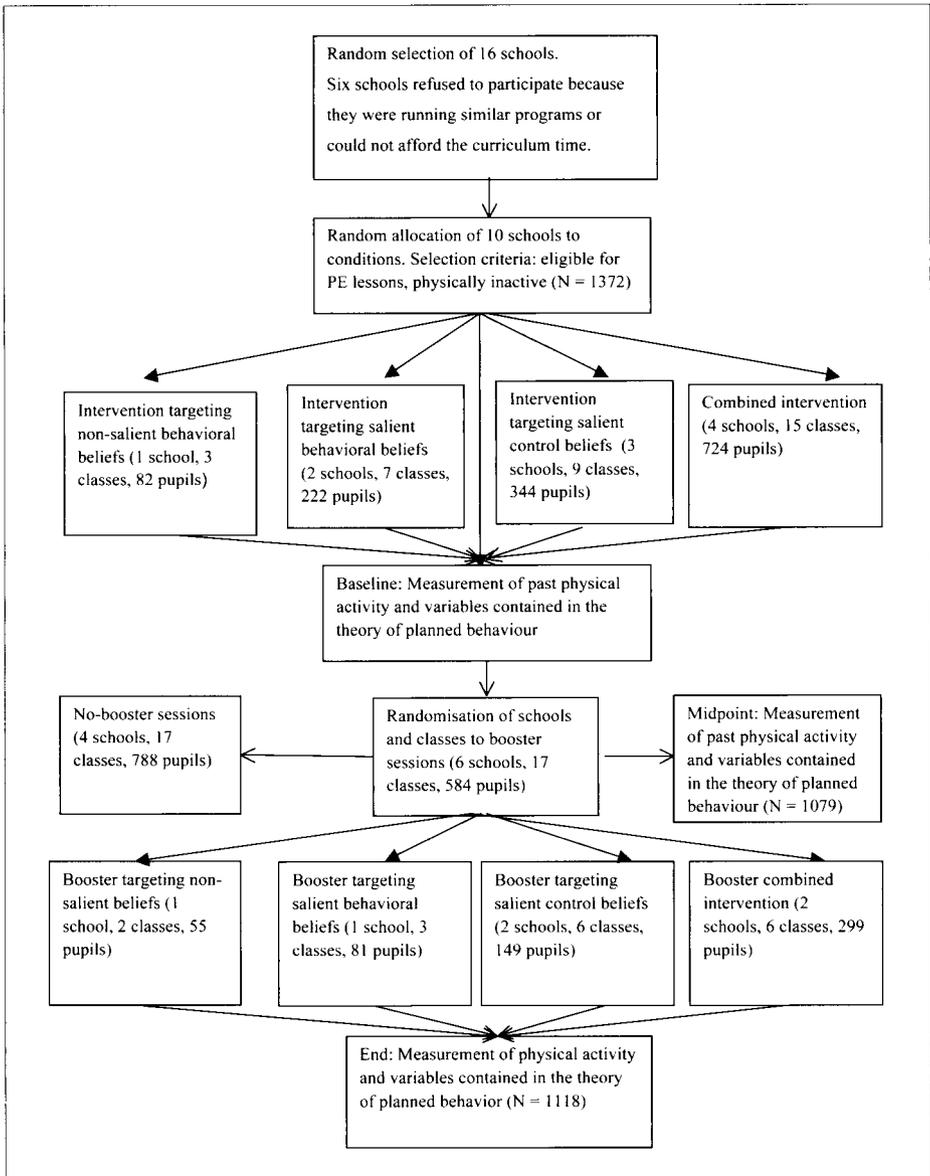


Fig. 1 - CONSORT diagram of flow of participants through the intervention.

and teachers who were allocated to the no-booster conditions delivered persuasive messages twice per week during the first 4 weeks of the intervention program. In addition in the no-booster conditions, teachers were instructed to remind students about their commitment to

engage in physical activities at the end of each physical education class for the last 4 weeks. In the booster conditions, teachers delivered persuasive messages twice per week during the first and last 4 weeks of the intervention program.

DEPENDENT VARIABLES

Our dependent variables included assessments of components of the theory of planned behavior (attitudes, perceptions of control, subjective norms and intentions) and physical activity behavior. These constructs were measured repeatedly at baseline, midpoint and end of the programs. In our analysis, we averaged responses to items that were used to measure these constructs. Two items drawn from Ajzen, (1991) were used to measure behavioral intentions. An example item was: "I intend to do active sports and/or vigorous physical activities, for at least 40 minutes, four days per week, during my leisure time, over the next eight weeks". This item was measured on 7-point scales anchored by *strongly disagree* (1) to *strongly agree* (7). The alpha coefficients for the intention measure was satisfactory at baseline ($\alpha = .82$), midpoint ($\alpha = .84$) and end ($\alpha = .85$) of the programs.

Subjective norms were measured through two items. An example item was: "Most people who are important to me would pressure me to do active sports and/or vigorous physical activities for at least 40 minutes, four days per week, during my leisure time, over the next eight weeks." This item was measured on 6-point scales ranging from *strongly disagree* (1) to *strongly agree* (6). The inter-item correlation coefficients for the subjective norms measure were satisfactory at baseline ($r = .70$), midpoint ($r = .64$) and end ($r = .67$) of the programs (Chatzisarantis & Hagger, 2008).

Attitudes were assessed through 10 bipolar adjectives (useful/no-use, important/unimportant, worthwhile/not worthwhile, healthy/unhealthy, beneficial/harmful, satisfying/unsatisfying, enjoyable/unenjoyable, wise/foolish, good/bad, pleasant/unpleasant). All adjectives were measured on 6-point semantic differential scales (Ajzen, 2003). The stem item was: "For me doing active sports and/or vigorous physical activities for at least 40 minutes, four days per week, during my leisure time, over the next eight weeks....". The alpha coefficients for the attitude measure was satisfactory at baseline ($\alpha = .91$), midpoint ($\alpha = .92$) and end of the programs ($\alpha = .93$).

Perceived behavioral control was assessed through four items on 6-point scales ranging from *strongly disagree* (1) to *strongly agree* (6) (Ajzen, 1991). An example item that was measured on this scale was: "I feel in complete control over whether I exercise for at least 40 minutes, four days per week, during my leisure time, over the next eight weeks". The alpha coefficients for the perceived behavioral control measure were satisfactory at baseline ($\alpha = .75$), midpoint ($\alpha = .76$) and end of the programs ($\alpha = .78$).

We used Godin and Shephard's (1985) Leisure-Time Exercise Questionnaire in measuring physical activity at baseline, midpoint and end of the programs. Independent evaluations of this questionnaire found it to be valid, reliable, easy to administer, and to display concurrent validity with objective activities and fitness indexes (Jacobs, Ainsworth, Hartman, & Leon, 1993). The instrument contains three open-ended questions capturing the frequency of mild, moderate and vigorous physical activity. Because the present study targeted vigorous physical activity only, participants were asked to report the extent to which they engaged in vigorous physical activity the last four weeks. The stem item was: "During the last 4 weeks, how many times on average did you engage in active sport and/or vigorous physical activities

for at least 40 minutes at a time?” Participants reported frequency with which they exercised the past five weeks on a six point scale ranging from *not at all* (1) to *most of the days per week* (6).

Results

We conducted a 4 (type of intervention: attitude-based (non-salient beliefs), attitude-based (salient beliefs), control-based, combined) \times 2 (booster sessions: yes, no) \times 3 (time of observation: baseline, midpoint, end) analysis of co-variance (MANCOVA) to examine effects of booster sessions and interventions on dependent variables. In this analysis, type of intervention and presence of booster sessions were the between-participants factors. Time of observation was the within-participants factor. Attitudes, intentions, perceptions of control, subjective norms and physical activity behavior were the dependent variables. Age and gender were the covariates. Results revealed a statistically significant multivariate effect of “time of observation” on the dependent variables ($F(10, 879) = 2.67, p = .01, \eta_p^2 = .03$). This effect was qualified by a statistically significant interaction between “time of observation” and “type of intervention” ($F(30, 2643) = 1.54, p = .03, \eta_p^2 = .02$). Post-hoc univariate analysis of variance of that interaction revealed statistically significant effects for physical activity behavior ($F(3, 888) = 2.83, p = .01, \eta_p^2 = .01$).

In accordance with our first hypothesis, pairwise comparisons using Bonferoni adjustments revealed that all intervention programs changed the physical activity behavior of young individuals. This is because pupils reported increases in physical activity participation from baseline (past behavior) to midpoint of the interventions (see Table I). Participants reported similar levels of physical activity participation from midpoint to the end of the intervention programs. Interestingly, effect sizes (d s) of the intervention programs ranged from medium (in the combined conditions) to large (in all other conditions) (see Table I)¹. However, contrary to our second hypothesis, planned contrasts revealed that the combined program that tar-

¹ Regression analysis did not support mediation of the effects of the combined program on physical activity intentions or behavior by attitudes and perceptions of control. The reason for this is that the combined program did not yield more positive attitudes or perceptions of control than the programs that targeted attitudes or perceptions of control. This is also evident in the analysis of variance which showed that the combined program did not alter perceptions of control, attitudes or intention in predicted directions. Hence, results from this analysis are not reported in the manuscript.

TABLE I
Mean scores representing effects of interventions on physical activity behavior and variables included in The Theory Of Planned Behavior

Variables	Time	Program targeting Non-salient Behavioral beliefs	Program targeting salient behavioral beliefs	Program targeting control beliefs	Combined program
Physical Activity	Baseline	2.69 _a (.57)	2.40 _a (.74)	2.21 _a (.79)	2.18 _a (.76)
	Midpoint	3.26 _b (1.08)	2.84 _b (1.08)	2.96 _b (1.06)	2.79 _b (1.09)
	End	3.33 _b (.91)	3.10 _b (1.21)	3.00 _b (1.05)	2.63 _b (1.11)
	d	.85	.73	.97	.52
Intentions	Baseline	4.17 _a (1.26)	4.05 _a (1.28)	3.76 _a (1.21)	3.92 _a (1.30)
	Midpoint	4.25 _a (1.34)	4.15 _a (1.30)	3.86 _a (1.25)	3.92 _a (1.28)
	End	4.27 _a (1.14)	4.25 _a (1.29)	4.16 _b (1.13)	3.91 _a (1.26)
	d	.22	.18	.30	-.02
PBC	Baseline	3.95 _a (.70)	3.76 _a (.76)	3.57 _a (.76)	3.65 _a (.81)
	Midpoint	3.97 _a (.50)	3.90 _a (.76)	3.77 _b (.75)	3.76 _a (.80)
	End	3.96 _a (.50)	3.89 _a (.74)	3.78 _b (.70)	3.69 _a (.85)
	d	.01	.11	.28	.05
Attitudes	Baseline	5.00 _a (.77)	4.51 _a (.73)	4.39 _a (.80)	4.36 _a (.73)
	Midpoint	4.67 _b (.72)	4.55 _a (.71)	4.40 _a (.84)	4.27 _b (.77)
	End	4.53 _b (.84)	4.37 _b (.76)	4.32 _a (.94)	4.20 _b (.82)
	d	-.61	-.19	-.13	-.20
Subjective norms	Baseline	4.15 _a (.93)	3.88 _a (.98)	3.80 _a (.97)	3.77 _a (1.07)
	Midpoint	4.09 _a (1.00)	3.88 _a (1.00)	3.95 _a (.90)	3.76 _a (.94)
	End	4.30 _a (.80)	3.98 _a (.89)	3.88 _a (.96)	3.83 _a (.93)
	d	.01	.10	.10	.07
Male		30	94	146	142
Female		50	125	197	581
Age		13.64	13.49	13.83	13.93
SD		.98	.59	.84	.90

Note. Seven participants did not report their gender. Parameters with different subscripts are statistically different from each other at $p < .05$. Parameters with the same subscript are not statistically different from each other at $p < .05$.

get attitudes and perceptions of control improved engagement in physical activities to a lesser extent than the program that targeted attitudes only or the program that targeted perceptions of control only (see Table II).

Turning now into effects of intervention programs on variables included in the theory of planned behavior, the analysis of variance revealed statistically significant interactions between "type of intervention" and "time of observation" on intentions ($F(3, 888) = 2.81, p = .04, \eta_p^2 = .01$) and attitudes ($F(3, 888) = 2.59, p = .05, \eta_p^2 = .01$) but not on subjective norms ($F(3, 888) = .10, p = .96, \eta_p^2 = .00$) or perceptions of control ($F(3, 888) = 1.92, p = .13, \eta_p^2 = .01$). Contrary to our third hypothesis, pairwise comparisons using Bonferroni adjustments indicated that the combined intervention and the intervention programs that targeted salient or non-salient behavioral beliefs undermined (instead of increasing) pupils' attitudes over time. The control-based

TABLE II
Planned Comparisons Indicating Relative Effectiveness of Intervention Programs

Type of intervention	Attitude	Subjective norms	Perceived behavioral control	Intentions	Physical activity behavior
Non-salient behavioral beliefs versus salient behavioral beliefs	.08	.14	.10	2.03	1.23
Non-salient behavioral beliefs versus salient control beliefs	5.78*	.11	2.20	1.00	.38
Non-salient behavioral beliefs versus combined program	4.30*	.35	.10	.15	.68
Salient behavioral beliefs versus control beliefs	.39	.00	.69	.94	.34
Salient behavioral beliefs versus combined program	.45	.10	1.74	1.79	5.77*
Salient control beliefs versus combined program	1.52	.13	4.94*	7.16*	7.70*

Note. Parameters are *F* values. Parameters with an asterisk are statistically significant at $p < .05$.

program did not change attitudes towards physical activity. Further, the combined intervention program did not change perceptions of control from baseline to midpoint or end of the intervention programs (see Table I)¹. However, in accordance with tenets of the theory of planned behavior, an exception was the control-based program that increased perception of control and intentions over time. Moreover, planned comparisons revealed that the program that targeted control beliefs produced greater amount of change in perceptions of control and intentions relative to the combined program but not relative to all other programs (see Table II)².

Finally, with respect to booster sessions, the analysis of variance revealed a statistically significant interaction between type of intervention, time of observation, and booster sessions on physical activity behavior ($F(3, 888) = 6.85, p < .001, \eta_p^2 = .02$). Pairwise comparisons using Bonferroni adjustments showed that changes in physical activity participation (from midpoint to the end of the intervention programs) were maintained among pupils who received booster sessions (see Table III). However, these effects could not be attributed to booster sessions because pupils who did not receive booster sessions sustained

² A different analytic approach that used past behaviour as a covariate and repeated measures of attitudes, intentions, subjective norms and perceptions of control as dependent variables revealed similar results. Specifically, in that analysis of covariance, effects of the interaction between "type of intervention" and "time of observation" on intentions ($F(3, 928) = 3.10, p = .03, \eta^2 = .10$) and attitudes ($F(3, 928) = 3.18, p = .02, \eta^2 = .10$) were statistically significant. No other effects were statistically significant.

TABLE III
 Mean Scores Representing Effects of Booster Sessions and Interventions on Physical Activity Behavior

Booster	Time of Observation	Program targeting non-salient behavioral beliefs	Program targeting salient behavioral beliefs	Program targeting control beliefs	Combined program
No	Baseline	2.59 _a (.56)	2.50 _a (.65)	2.25 _a (.73)	2.19 _a (.76)
	Midpoint	3.23 _b (1.17)	2.63 _a (1.03)	3.13 _b (1.29)	2.71 _b (1.00)
	End	3.46 _b (.85)	3.21 _b (1.13)	3.05 _b (.97)	2.52 _c (.99)
Yes	Baseline	2.79 _a (.58)	2.30 _a (.77)	2.17 _a (.81)	2.16 _a (.75)
	Midpoint	3.30 _b (.83)	3.05 _b (1.08)	2.81 _b (.93)	2.73 _b (1.14)
	End	3.21 _b (1.05)	3.00 _b (1.24)	2.96 _b (1.09)	2.80 _b (1.16)

Note. Parameters with different subscript are statistically significant at $p < .05$. Standard deviations are presented in parenthesis.

physical activity participation from midpoint to the end of the program. An exception was the combined intervention program the effects of which declined from midpoint to the end of the intervention program. However, even for the combined program, participation levels at the end of the program were greater than participation levels at baseline. Hence, results from this analysis indicated that a four-week intervention program produced sustained behavioral change for at least the interventions that targeted salient or non-salient behavioral beliefs and the intervention that targeted salient control beliefs.

Discussion

The present study evaluated utility of school-based intervention programs derived from the theory of planned behavior in bringing about changes in young people’s physical activity behavior during leisure time. We implemented different types of interventions based on the salient belief-based variables from the theory, namely attitudes and perceived behavioral control, so that we could identify intervention programs that produced the largest amount of behavioral change. We also expected that a combined intervention program that targeted attitudes and perceptions control would affect the largest amount of change in physical activity behavior than programs targeting these variables alone. We also thought that such findings would be theoretically interesting because they would confirm a central tenet of theory of planned behavior concerning additive effects of interventions targeting control beliefs and behavioral beliefs on intentions and behavior. However, while the results supported the effects of the intervention program that targeted the beliefs individually, it did not provide support for our hypothesis for the combined intervention.

Specifically, in accordance with our first hypothesis, results revealed that all intervention programs were effective in facilitating medium-to-large changes in leisure time physical activity. In addition, analysis of the booster sessions indicated that effects of the interventions persisted four weeks after termination of programs. These findings are important because they suggest that schools and educators can alter pupils' physical activity habits by building-in brief sessions that address behavioral beliefs or control beliefs to their classes. However, the combined intervention program produced the smallest, instead of producing the largest, amount of behavioral change. Hence, contrary to our second hypothesis, our interventions did not combine in additive terms in affecting changes in physical activity intentions or behavior. This finding is also inconsistent with tenets of the theory of planned behavior which predict that effects of attitudes and perceptions of control on intentions and behavior are additive.

Although the present study was not designed to explain this unexpected finding, we speculate that the combined program produced smaller effects because of length of the message. By definition, the message from the combined intervention program was long because it addressed benefits and barriers associated with physical activity. In contrast, messages from the more specific attitude-based and control-based interventions were much shorter because they addressed benefits or barriers related to physical activity. Length might have reduced impact of the combined message on physical activity behavior by undermining motivation to scrutinize message content and process it centrally. Indeed, long messages can instigate less pronounced attitudinal and behavioral change by promoting heuristic (or peripheral) modes of information processing that lead people accept message content in a superficial way (Petty & Cacioppo, 1986). The implication of this reasoning is that temporal separation of attitudinal and control components of the combined message may increase its impact on physical activity intentions and behavior by increasing motivation to elaborate on message contents.

Our speculation that message length might have undermined effects of the combined message may also explain results related to booster sessions. In general, the analysis of variance showed that the only group of pupils who exhibited a slight decline in physical activity participation, from midpoint to the end of the intervention programs, was the group of pupils who received the combined program without booster sessions. This finding means that the combined message was difficult to retain, perhaps because it was very lengthy (Hovland, 1959). In contrast, the combined message might have been easier to retain, by pupils who received booster sessions, because in this group pupils were exposed to the combined message for a much longer inter-

val of time (eight-weeks). Hence, combined intervention programs may demand more extensive intervention schedules that communicate behavioral and control beliefs for at least eight-weeks.

It is also important to note that our findings should not be taken to mean that the principle of additivity postulated by theory of planned behavior is false or incorrect. There are two reasons for this. First, it would be premature to draw such conclusion because our study is the first study that systematically tested for additive effects. Hence, it may be important to re-test additive effects with different population (adults) or different procedures. Second, tenets of the theory of planned behavior demand that individuals elaborate and scrutinize content of messages. Although the physical education teachers asked questions about message content at the end of physical education classes, persuasive messages were delivered in groups. As a consequence, not all students within a class might have attended to content of messages carefully. Therefore, our study might have not provided a “fair” test of the kind of additive effects advocated by the theory of planned behavior because our combined conditions did not satisfy the theoretical requisite for central modes of information processing demanded by this theory. The implication of this reasoning is that tests of additive effects should ensure that individuals process components of combined messages centrally.

In addition to examining additive effects, the present study investigated influences of different types of interventions on psychological variables contained in the theory of planned behavior. The major benefit of this analysis was that it allowed us to test whether our interventions influenced attitudes, perceptions of control and physical activity intentions in directions predicted by the theory. Results from the analysis of variance provided mixed support for our hypothesis. Specifically, while the controlled-based intervention that targeted control beliefs changed perceptions of control and intentions, the attitudinal interventions and the combined intervention program did not change attitudes, perceptions of control or intentions. Hence in partial support of our third hypothesis, it appears that only the intervention that targeted control beliefs influenced psychological variables in directions predicted by the theory of planned behavior. The attitudinal intervention and the combined intervention did not produce effects that were consistent with theoretical predictions.

The fact that our findings appear to be more inconsistent than consistent with tenets of the theory of planned behavior is not entirely surprise. Previous research has also reported findings that are inconsistent with the tenets of the theory. Specifically, in the study conducted by Sniehotta (2009), an intervention that targeted behavioral beliefs did not change physical activity inten-

tions. Neither did control-based interventions change perceptions of control or physical activity intentions. However, consistent with our study, Darker et al. (2010) observed effects of an intervention that targeted salient control beliefs on perceptions of control and physical activity intentions. Despite these inconsistent findings, results of the present study have important implications for practice. The fact that all intervention programs affected leisure-time physical activity suggests that it is possible to change the physical activity behavior of young people through a series of 10-minute intervention sessions that take place in schools. Hence, schools and physical educators can make a significant contribution toward achieving health promotion goals advanced by government and organizations world-wide. In addition, the fact that the participation levels of pupils who did not receive booster session did not decline over time suggests that four-week programs that target behavioral or control beliefs suffice in terms of bringing measurable changes in physical activity behavior. Most critical, our intervention programs do not interfere at all with the way that physical education lessons are taught or delivered because they do not target physical education but leisure time physical activity. The brief nature of the intervention sessions also make it possible to be delivered at the end of physical education classes during briefing. Hence, our intervention programs do not place additional demands upon physical educators or altering curricular. They can be built into existing structures.

Finally, it would be remiss to not mention the strengths and limitations of the present study. Strengths include the large sample size and corresponding accuracy of observed effect sizes, the rigorous randomized design, and adoption of appropriate theoretical basis. We also think that our intervention programs are sustainable because they can be built into school curriculum without much interference with teachers' routines. A limitation of the present intervention is concerned with self-reported nature of our physical activity measures. However, it is important to stress that our effect sizes are similar to effects sizes of other studies that used more objective measures of physical activity (Darker et al., 2010). Another limitation of the current intervention programs is that they produced medium effect sizes. Although we agree that there may be an economic benefit associated with obtaining medium effect sizes, we also think that such effects echo previous research showing that the theory of planned behavior does not explain translation of intentions into action (Gollwitzer, 1999). Therefore, it may be important to examine whether interventions that help individuals translate intentions into action (i.e., implementation intentions) augment effectiveness of the current intervention programs in changing physical activity participation (Hagger & Luszczynska, 2014). Further, it is important to note that the current intervention program

aimed to facilitate changes in physical activity behavior over a relatively short period of time (i.e., 8-weeks) (see also Chatzisarantis & Hagger, 2005; Darker et al. 2010). Hence, it is important to evaluate whether effects of intervention programs that built upon the theory of planned behavior last for longer periods of time (i.e., 6 months or a year). Finally, the current study does not demonstrate that students who were exposed to persuasive messages were more likely to engage in physical activities than students who did not receive any treatment because our study lacks a waiting-list control group.

In conclusion, the present study shows that school-based interventions targeting behavioral beliefs or control beliefs were effective in changing pupils' participation levels in leisure-time physical activities. However, a combined intervention program that targeted both sets of beliefs was the least effective in changing leisure time physical activity. Moreover, while effects of interventions that targeted control beliefs increased perceptions of control and intentions, the combined intervention program and the programs that targeted behavioral beliefs did not influence attitudes or perceptions of control in theoretically-predictable directions. The implication of these findings is that it is possible to influence the exercise habits of young individuals through a series of 5-10 minute persuasive communication sessions that are conducted at end of physical education classes, during briefing.

APPENDIX

Persuasive message targeting salient behavioral beliefs

The Ministry of Health (MOH) and Health Promotion Board (HPB) have indicated that participating in vigorous physical activities outside of your PE lessons (during your leisure time) for at least 40 minutes a time, 4 days per week, in the next 8 weeks helps you get fit and stay in shape. Research has also shown that by exercising regularly you can improve your physical skills (e.g., your coordination and strength) and fitness levels. Experts in the area of physical activity and health have also documented that if you exercise with care, you can considerably reduce the risk of getting an injury. In addition, you can avoid feeling too hot and sweaty if you exercise for an appropriate duration (e.g., 40 minutes at a time) and intensity. Overall, exercising on a regular basis during your leisure time is great fun and worthwhile doing. It is also a good way to socialise, make new friends or enjoy your free time with your friends.

Persuasive message targeting non-salient behavioral beliefs

The Ministry of Health (MOH) and Health Promotion Board (HPB) have indicated that participating in vigorous physical activities outside of your PE lessons (during your leisure

time) for at least 40 minutes a time, 4 days per week, in the next 8 weeks prevents cardiovascular disease. Research has also shown that by exercising regularly you can avoid getting other serious diseases later in your life such as cancers. Experts in the area of physical activity and health have also documented that if you exercise with care, you will not get any muscle pain. In addition, you can avoid feeling tired if you exercise for an appropriate duration (e.g., 40 minutes at a time) and intensity. Overall, exercising on a regular basis during your leisure time is worthwhile doing. It is also a good way to keep a healthy weight.

Persuasive message targeting salient control beliefs

The Ministry of Health (MOH) and Health Promotion Board (HPB) have indicated that young people like you find it difficult to participate in physical activities outside of PE lessons (during your leisure time) because other interesting hobbies or friends prevent you from doing so. You can get around these problems by planning to exercise on days and at times that do not clash with your other commitments. In addition, you can arrange meeting your friends on days and at times that do not clash with your exercise program or you can even ask your friends exercise with you. You may also feel that hot weather makes it difficult for you to exercise. You can overcome problems related to hot weather by exercising indoors, in a gym or at home. Of course, doing your school homework is very important, but you can exercise at weekends or perhaps after you completed your homework. Finally, some people avoid exercising because they think that they are not very good at it. However, you can get around this if you choose a sport or physical activity that you find enjoyable and you find easy to do.

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