A Brief Intervention to Increase Physical Activity Behavior among Adolescents Using Mental Simulations and Action Planning

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Abstract

This study evaluated the effectiveness of a brief integrated theory-based intervention to increase physical activity among adolescents over a three-month follow-up period. A 2 (mental simulation: present vs. absent) x 2 (action planning: present vs. absent) x 4 (time: baseline vs. one-month vs. two-month vs. three-month follow-up) mixed-model randomized controlled design was adopted. Adolescents aged 14-15 years (N=267) completed baseline psychological measures and self-reported physical activity followed by the relevant intervention manipulation, if appropriate, with follow-up measures collected one, two, and three months later. Results revealed no significant effects for the mental simulation and action planning strategies nor the interaction of the two strategies. However, among participants with low levels of baseline physical activity, participants in both mental simulation alone and action planning alone groups reported significantly higher levels of physical activity at one-month follow up than other groups, suggesting that individual intervention components may be effective in low-active adolescents.

Key words: adolescents, action planning, outcome mental simulation, physical activity, randomized controlled trial

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Low rates of physical activity (PA) reported among populations in multiple countries (Hallal et al., 2012) highlight the need for interventions to promote PA among adolescents. Researchers have turned to motivational and social cognitive theories as a basis for effective health behavior interventions (Hagger & Chatzisarantis, 2014). Interventions should take two phases of decision-making into account: a pre-decisional or 'motivational' and a post-decisional or 'implemental' phase (Gollwitzer & Sheeran, 2006; Schwarzer, 2008).

Two intervention strategies, mental simulation (Taylor, Pham, Rivkin, & Armor, 1998) and implementation intention or action planning (Hagger & Luszcynska, 2014; Luszcynska & Schwarzer, 2003), have been identified as influential in enacting changes in psychological constructs in the motivational and implemental phases, respectively. Research has revealed that the combined effects of mental simulation and implementation intention strategies are more effective in changing behaviors such as fruit intake (Knäuper et al., 2011) and alcohol consumption (Hagger, Lonsdale, & Chatzisarantis, 2012) than each strategy alone, especially among participants with low fruit intake and high alcohol consumption at baseline.

The social cognitive constructs specified in the theory of planned behavior (TPB; Ajzen, 1991) have been implicated in the mechanism by which motivational intervention strategies exerted their impact. According to the theory (Ajzen, 1991) intentions are the most proximal predictor of behavior and are a function of attitude, perceived behavioral control, and subjective norms with respect to the behavior. Research has suggested that effects of mental simulation on health behavior occur through changes in intentions and its immediate determinants (Chan & Cameron, 2012; Vasques & Buehler, 2007). Similarly, effects of action

planning are proposed to occur through changes in the extent and accuracy of self-reported planning (Scholz, Schuz, Ziegelmann, Lippke, & Schwarzer, 2008).

There is no evidence, however, in the literature on the effectiveness of the combined effects of mental simulation and action planning in promoting PA in adolescents. We expected that adolescents assigned to a combined condition would exhibit higher frequency of PA participation than adolescents assigned to receive either strategy alone and those receiving the control condition. A unique contribution of the current study is that is examines the unique and interactive effects of two theory-based intervention strategies to promote adolescents' PA using a full-factorial design with the required statistical power.

Method

Participants

Participants were 449 high-school students aged 14-15 years old with no restrictions on their PA. Of these, 267 participants remained in the analysed sample after attrition over time or due to missing values (Figure 1). Given the small-to-medium effect size (d = 0.31) for implementation intention or action planning interventions on PA (Belanger-Gravel, Godin, & Amireault, 2013), a power analysis setting power at 0.80 and alpha at 0.05, estimated a target sample size of 168 with 42 participants per condition.

Study Design

A 2 (mental simulation: present vs. absent) x 2 (action planning: present vs. absent) x 4 (time: baseline vs. one- vs. two- vs. three-month follow-up) between-participants design was adopted. Following completion of baseline measures for all participants, the sample was randomized into mental simulation, action planning, combined, and control conditions. The intervention manipulation exercises were presented after the baseline measures for the participants allocated to the intervention conditions.

Intervention Manipulations

Students in the mental simulation condition received Pham and Taylor's (1999) outcome mental simulation script modified to make reference to the target behavior of participating in vigorous PA for at least 30 minutes a time, at least 5 days per week over the next three months. In line with previous studies (e.g., Milne, Orbell, & Sheeran, 2002), students in the action planning condition were asked to specify the time, place and type of PA they would engage in over the next three months. The introductory passage and scripts for the intervention exercises are available as online supplemental materials (Appendix A).

Measures and Procedure

Ethical approval was obtained prior to data collection. At all four measurement points in time, participants completed consent forms, questionnaires containing the following: self-reported PA (Prestwich, Perugini, & Hurling, 2009); motivation towards PA (Pham & Taylor, 1999); PA intentions, attitudes, subjective norms, and perceived behavioral control from the TPB based on previous studies on this theory in the context of PA (Pihu, Hein, Koka, & Hagger, 2008). At baseline, a measure of planning was included (Pham & Taylor, 1999). All measures had acceptable internal reliability at each time point ($\alpha s > 0.79$). Full details of the measures are available as online supplemental materials (Appendix B). The questionnaires at all points in time were administered in regular classes during the school day.

Data Analyses

Participants' written responses to the intervention exercises were content analysed to evaluate compliance with the intervention (i.e., manipulation check). Responses to the action planning exercise that provided relevant contingencies to the 'when...', 'where...' and 'how...' prompts, and responses to the outcome mental simulation manipulation that identified physuical activity as an outcome and mentioned feelings of satisfaction, were coded as compliant. A series of repeated-measures ANOVAs were conducted to examine the effects of the interventions on study variables, using the two intervention conditions as between-

participants factors and time as within-participants factor. In addition, participants were grouped into upper and lower tertiles based on PA levels at baseline to examine whether the intervention was more effective among participants with low levels of PA. [1]

Results

Manipulation Checks

The content analysis revealed that 33 participants from those allocated to the intervention conditions were considered as non-compliant. Only 14 of these provided follow-up data, and, in order to provide a conservative estimate of intervention effectiveness, their data were included in subsequent analyses in their original randomized groups.

Intervention Effects

Main analyses. Repeated-measures ANOVAs revealed no significant two-way or three-way interaction on any of the study variables (Table 1). As there was no significant intervention effects on psychological variables, we did not test for mediation effects.

Sub-group analyses. Separate repeated-measures ANOVAs revealed a significant three-way interaction ($F(3, 201) = 3.98$, $p = .01$, $\eta_p^2 = 0.06$) only for the low PA sub-group[2]. Figure 2 shows that the control group exhibited significantly lower numbers of self-reported PA occasions at one-month follow-up relative to all three intervention groups ($p = .01$). Furthermore, contrary to our prediction, the combined group exhibited significantly fewer self-reported PA occasions at one-month follow-up relative to the action planning only and

[1]Sample sizes were 71 for low PA sub-group (control, n = 18; action planning only, n = 13; mental simulation only, n = 17; combined, n = 23) and 80 for high PA sub-group (control, n = 19; action planning only, n = 17; mental simulation, n = 21; combined action, n = 23).

[2]We specified the following contrasts. First, for the between-participant factor 'intervention condition', two sets of contrasts were specified. The first contrast tested the efficacy of the action planning only, mental simulation only, and combined condition relative to the control condition by using 1, 1, 1, and -3 weights, respectively. The second contrast compared the action planning only and mental simulation only with the combined condition (by using 1, 1, -2, and 0). Second, for the within-participant factor 'time', three sets of contrasts were specified. Specifically, the baseline was used as a reference category and was compared with the one-, two, and three-month follow-up, respectively.

mental simulation only group (p = .02). There were no other significant condition x time interaction effects.

Discussion

Findings of our brief intervention did not reveal statistically significant overall effects on adolesctents' PA at any of the follow-up periods. This may be due to the fact that regular PA involves an elaborated process of decision-making and is considered a complex health behavior which difficult to change, compared to a simple health behaviors like taking medication or vitamin supplements. Also, because the intervention components were brief, the effects were relatively short lived and may have diminished after 1 month (Chatzisarantis & Hagger, 2005), and we did not test for short-term effects because we did not measure the behavior over a short interval (e.g., 1 or 2 weeks).

Inconsistent with our expectation and previous studies (Hagger et al., 2012; Knäuper et al., 2011), we found significant increases in PA at one-month follow-up among low-active participants that receiced each strategy rather than the combination of these strategies. This suggests that the motivational and implemental process may be independent, and together they may even interfere with each other. Planning may, for example, undermine intrinsic motivation by introducing an element that may be interpreted as controlling (Smith, Ntoumanis, & Duda, 2010).

The current research has some limitations. All variables asures including behavior were assessed using self-reports. Incorporating objective measures of PA would maximise accuracy in prediction. Also, a 'no measurement' control group was not included that would have ruled out potential measurement effects (Godin, Sheeran, Conner, & Germain, 2008). Finally, inclusion of key socio-demographic (e.g., parental education, income) and psychological variables (e.g., planning or imagery ability) may have controlled for potential unmeasured moderators (Hagger et al., in press).

In conclusion, this study provided evidence that a brief intervention comprising mental simulation and action planning strategies may be effective among low-active adolescents. Replication of this finding is important to inform consistency of the effects across multiple samples. Nevertheless, physical education teachers and health care workers are encouraged to introduce adolescents with low PA with these simple mental exercises to increase their PA. More research is needed to understand how mental simulation and action planning can be more effectively implemented in interventions with adolescents.

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Table 1. Means, Standard Deviations, and Tests of the Effects of the Outcome Mental Simulation and Action Planning Manipulations on Physical Activity and Theory of Planned Behaviour Variables and Motivation Across Time (N = 267)

	Baseline	1-month follow-up	2-month follow-up	3-month follow-up			
Dependent variables	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	F^a	F^b	F^c
Physical activity					1.16	1.04	0.12
Control	2.69 (1.41)	2.78 (1.54)	2.73 (1.38)	2.78 (1.45)			
Mental simulation	2.94 (1.94)	2.88 (1.61)	2.75 (1.63)	2.77 (1.68)			
Action planning	2.79 (1.55)	2.82 (1.56)	2.90 (1.62)	2.62 (1.36)			
Combined	2.66 (1.47)	2.45 (1.36)	2.44 (1.21)	2.29 (1.25)			
Attitude					0.44	0.79	0.70
Control	4.79 (0.77)	5.00 (0.88)	5.03 (0.73)	4.92 (0.84)			
Mental simulation	4.93 (0.72)	5.03 (0.74)	5.01 (0.87)	5.08 (0.74)			
Action planning	4.96 (0.73)	4.99 (0.78)	5.02 (0.91)	5.01 (0.81)			
Combined	4.94 (0.84)	5.02 (0.95)	4.97 (0.97)	4.95 (0.87)			
Subjective norms					1.72	0.25	0.43
Control	4.68 (0.82)	4.85 (0.80)	4.89 (0.76)	4.79 (0.75)			
Mental simulation	4.84 (0.64)	4.91 (0.83)	4.97 (0.85)	5.07 (0.82)			
Action planning	4.81 (0.80)	4.91 (0.83)	4.88 (0.78)	4.89 (0.82)			
Combined	4.81 (0.76)	4.82 (0.87)	4.94 (0.89)	4.96 (0.88)			
PBC					0.31	0.89	1.27
Control	4.66 (0.90)	4.56 (1.05)	4.75 (0.86)	4.69 (0.97)			
Mental simulation	4.52 (0.97)	4.59 (1.13)	4.57 (1.12)	4.61 (1.07)			
Action planning	4.50 (0.93)	4.65 (0.92)	4.55 (0.98)	4.60 (0.95)			
Combined	4.58 (0.87)	4.57 (1.07)	4.55 (1.09)	4.66 (1.03)			
Intention					1.60	0.60	0.81
Control	4.68 (0.85)	4.63 (0.98)	4.69 (0.99)	4.65 (0.98)			
Mental simulation	4.64 (0.89)	4.49 (1.08)	4.52 (1.16)	4.57 (1.12)			
Action planning	4.50 (1.06)	4.73 (1.01)	4.53 (1.09)	4.58 (0.99)			
Combined	4.65 (1.03)	4.50 (1.21)	4.57 (1.13)	4.58 (1.09)			
Motivation					1.69	0.25	0.67
Control	4.29 (0.76)	4.47 (0.98)	4.65 (0.90)	4.56 (0.94)			
Mental simulation	4.22 (0.95)	4.41 (0.94)	4.52 (1.08)	4.63 (1.04)			
Action planning	4.22 (0.88)	4.54 (0.93)	4.59 (1.03)	4.59 (0.98)			
Combined	4.27 (0.97)	4.34 (1.05)	4.44 (1.09)	4.59 (1.04)			

Note. PBC = Perceived behavioural control; Control = control condition; Mental simulation = outcome mental simulation only condition; Action planning = action planning only condition; Combined = combined outcome mental simulation and action planning condition. [a]Refers to the time x outcome mental simulation interaction. [b]Refers to the time x action planning interaction. [c]Refers to the time x outcome mental simulation x action planning interaction.

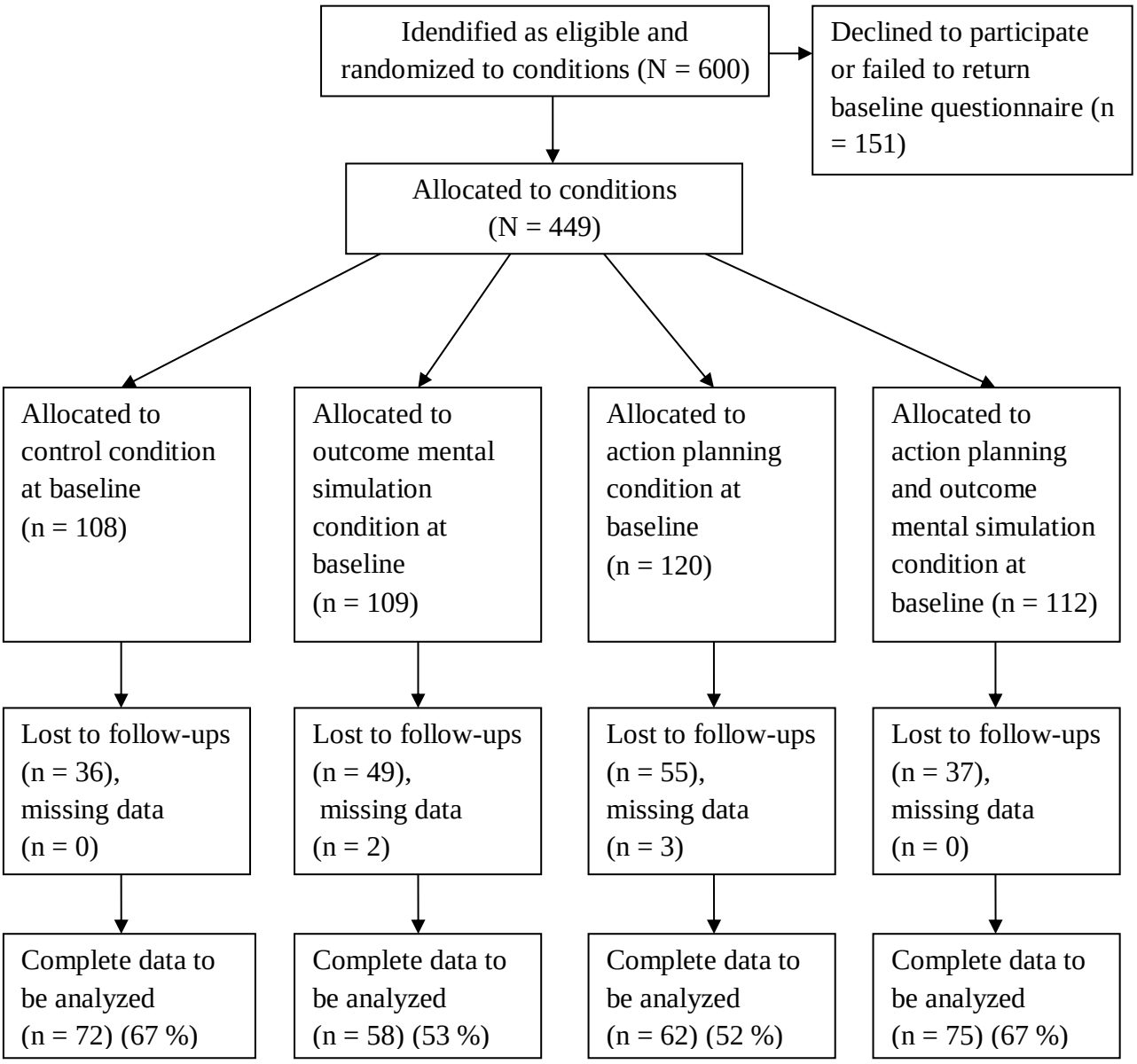

Figure 1. Participant flow diagram.

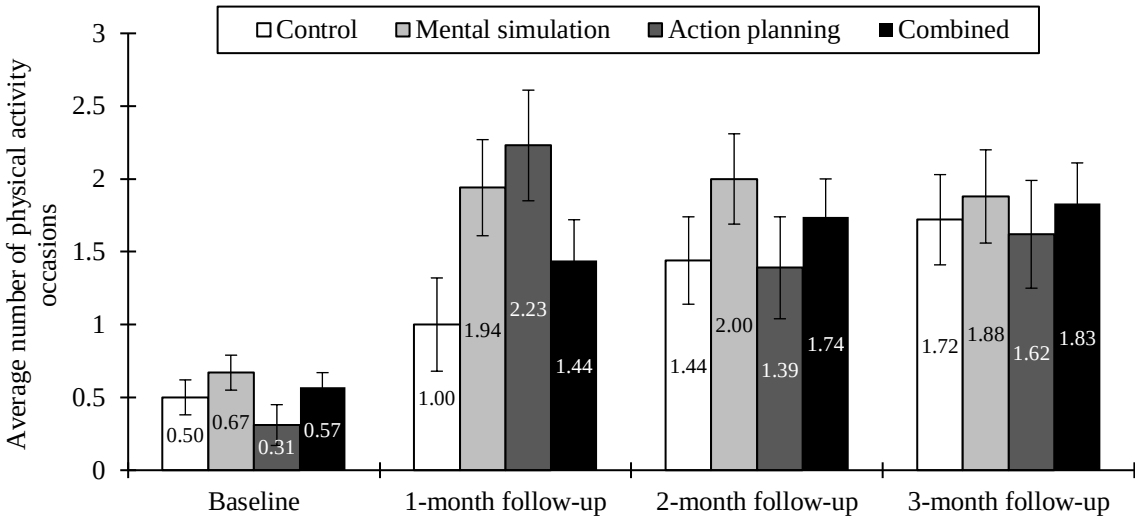

Figure 2. Average number of self-reported leisure-time physical activity occasions at baseline and follow-ups by condition for low physical activity sub-group.

Note. Control = control condition; Mental simulation = outcome mental simulation only condition; Action planning = action planning only condition; Combined = combined outcome mental simulation and action planning condition.