



# Exploring the working mechanisms of a web-based physical activity intervention, based on self-determination theory and motivational interviewing



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## ABSTRACT

The aim of this study was to compare a web-based computer tailored physical activity intervention based on self-determination theory and motivational interviewing (I Move) to a traditional web-based computer tailored physical activity intervention (Active Plus) with regard to their basic psychological need supporting capabilities. We also aimed to assess the extent to whether self-determination constructs played a stronger mediating role in the effects of I Move than in the effects of Active Plus. A randomized controlled trial was conducted among 3089 participants (age  $44.9 \pm 12.9$ , 69.1% women), comparing 1) I Move, 2) Active Plus, and 3) a waiting list control condition. Physical activity behavior (measured at baseline, and at six months after baseline), potential mediators (intrinsic motivation, identified regulation, perceived competence and perceived choice, measured at baseline, and at three months after baseline) and basic psychological need support (measured six weeks and six months after baseline) were assessed through self-report, using web-based questionnaires. I Move was found to be more effective in supporting participants' basic psychological needs (sessions 1 and 2;  $p = .001$ ; sessions 3 and 4;  $p = .004$ ). The results of the mediation analyses show that the effects of both interventions were (equally) mediated by perceived competence, but not by intrinsic motivation, identified regulation or perceived choice.

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## 1. Introduction

Web-based computer tailored physical activity (PA) interventions are promising for PA promotion (Enwald and Huotari, 2010; Laplante and Peng, 2011; Davies et al., 2012). The content of these interventions is modified according to participants' characteristics, and this makes them more likely to be effective than non-tailored, generic programs (Enwald and Huotari, 2010; Broekhuizen et al., 2012; Lustria et al., 2013). Because the intervention materials are provided via the internet, these programs can be used to reach large numbers of inactive individuals at relatively low costs (Lustria et al., 2013). To date most web-based computer tailored PA interventions have been grounded in traditional health behavior theories such as social cognitive theory (SCT), the trans-theoretical model (TTM) and the theory of planned behavior (TPB) (Davies et al., 2012). Interventions of this type, hereafter referred to as 'traditional interventions', make use of theoretical constructs such as stages of change, modeling, attitude and self-efficacy (Davies et al., 2012). Recent research on PA promotion, however, shows another

theoretical construct to be of major importance: autonomous motivation (Bagoien et al., 2010; Silva et al., 2011; Sweet et al., 2009; Sebire et al., 2011). Substantial evidence suggests that having higher autonomous motivation makes an individual more likely to undertake PA regularly and persist with a PA routine (Teixeira et al., 2012). Although the concept of autonomous motivation does not feature explicitly in SCT, TTM or TPB, it is central to self-determination theory (SDT) and motivational interviewing (MI) (Miller and Rollnick, 2013; Ryan and Deci, 2000). This suggests that web-based computer tailored PA interventions based on SDT and MI could be effective in promoting PA on a large scale.

In order to explore the effectiveness of using SDT and MI as the basis of web-based PA interventions, we developed I Move, a web-based computer tailored PA intervention, based on SDT and MI (Miller and Rollnick, 2013; Ryan and Deci, 2000; Friederichs et al., 2014a). I Move was shown to be effective in increasing PA behavior six months after the baseline assessment (Friederichs et al., submitted for publication). The present study was intended to investigate the processes by which I Move influences PA behavior, specifically whether these are consistent with SDT and whether they are different from those associated with traditional web-based computer tailored PA interventions. We begin with a brief overview of SDT and MI in general, and in the context of PA promotion.

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### 1.1. Self-determination theory and motivational interviewing

SDT is a comprehensive theory of behavioral motivation (Ryan and Deci, 2000; Deci and Ryan, 2008; Ryan et al., 2008) which has proved particularly useful in the context of PA research, both for accounting for patterns of PA behavior and for informing the development of interventions for promoting PA (Teixeira et al., 2012; Patrick et al., 2013). One of the key principles of SDT is that motivation varies in the extent to which it is autonomous or controlled (Ryan and Deci, 2000; Deci and Ryan, 2008). More specifically, SDT proposes several forms of motivation. In ascending order of autonomy these are: external regulation (i.e. execution of a specific behavior is motivated by a desire to avoid punishment or obtain reward); introjected regulation (i.e. execution of a specific behavior is motivated by a desire to avoid negative emotions such as guilt or shame); identified regulation (i.e. execution of the behavior in question produces outcomes which are valued by the individual); integrated regulation (i.e. behavior is executed because it is congruent with personal beliefs and values) and intrinsic motivation (i.e. the individual is motivated to execute a behavior because he or she finds it intrinsically interesting or enjoyable) (Ryan and Deci, 2000; Deci and Ryan, 2008). Both autonomous and controlled motivation are held to influence behavior, but to lead to different outcomes, with autonomous motivation leading to greater commitment and long-standing maintenance of behavior (Ryan and Deci, 2000; Deci and Ryan, 2008; Ryan et al., 2008; Markland and Ingledew, 2007).

SDT posits that individuals are more likely to exhibit autonomous motivation when three basic psychological needs are supported. These basic needs are the need for autonomy (i.e. the need to feel that one can choose one's behaviors), competence (the need to feel competent and confident) and relatedness (the need to feel connected to and understood by others) (Ryan and Deci, 2000; Deci and Ryan, 2008; Ryan et al., 2008). When these three needs are supported, individuals are enabled to develop autonomous motivation based on the feeling of being competent and in control of one's behavior (Vansteenkiste et al., 2007; Coroy et al., 2007). Several researchers have argued that the specific client-centered communication skills used in MI can be used to support client's basic psychological needs (Patrick et al., 2013; Patrick and Williams, 2012; Markland et al., 2005; Vansteenkiste et al., 2012).

Several SDT-based PA counseling interventions focused on supporting the participants' needs for autonomy, competence and relatedness have been developed and evaluated over the recent past years (Silva et al., 2011; Van Hoecke et al., 2013; Van Hoecke et al., 2014; Silva et al., 2008; Silva et al., 2010a; Duda et al., 2014; Jolly et al., 2009; Fortier et al., 2012; Fortier et al., 2007a; Fortier et al., 2011; Silva et al., 2010b). In general these interventions are effective in promoting a sustained increase in PA (Silva et al., 2011; Van Hoecke et al., 2013; Van Hoecke et al., 2014; Silva et al., 2008; Silva et al., 2010a; Silva et al., 2010b). Some studies have used mediation analysis to investigate whether SDT-based PA interventions exert their effects via the pathways specified by SDT (Silva et al., 2011; Sweet et al., 2009; Van Hoecke et al., 2013; Halvari et al., 2009). These studies have shown that the effects of the SDT-based PA intervention on PA behavior are mediated by autonomous motivation and/or perceived competence.

### 1.2. Research questions

Large scale PA promotion may benefit from the development of web-based computer tailored PA interventions, based on SDT and MI. To date, however, no research has investigated whether web-based computer tailored PA interventions based on SDT and MI are able to support participants' basic psychological needs; nor is it known how such interventions exert their effects. In particular there has been no research into whether the pathways specified by SDT are valid in the context of this type of PA intervention and whether the processes underlying the effects of web-based computer tailored interventions based on SDT and MI are different from those underlying traditional

web-based PA interventions. Indeed, web-based computer tailored PA interventions based on traditional theories may also influence SDT constructs such as autonomous motivation or perceived competence. However, the working mechanisms of an intervention that is specifically based on SDT may be more in line with SDT tenets than the working mechanisms of an intervention based on other theoretical frameworks.

The aim of this study was to compare the effectiveness of I Move (a web-based computer tailored PA intervention, based on SDT and MI) and a traditional web-based computer tailored PA intervention in supporting participants' basic psychological needs. We also explored the extent to which the effects I Move on PA behavior were mediated by intrinsic motivation, identified regulation, perceived competence and perceived choice and whether the mediation effects were stronger than for a traditional web-based computer tailored PA intervention. The conceptual mediation model for this study is presented in Fig. 1.

## 2. Methods

We conducted a randomized controlled trial using a protocol approved by the Medical Ethics Committee of Atrium-Orbis-Zuyd. The trial was registered with the Dutch Trial Register (NTR 4129).

### 2.1. Participants and procedure

Individuals were eligible to participate in this study if they were aged between 18 and 70 years old; were not seriously limited in their ability to be physically active, had not taken part in one of the pilot studies (Friederichs et al., 2014b; Friederichs et al., 2013) and were physically active for less than 60 min per day, 5 days per week (Friederichs et al., 2014a). A power calculation ( $ES = .25$ ; power = .80), indicated that data from 600 participants would be needed to investigate the effects of interest. Calculations based on a dropout rate of 40–70%, based on other studies on web-based interventions (Elfeddali et al., 2012; Peels et al., 2013), indicated that an initial sample of at least 2000 participants was required.

During the period September–December 2013 participants were recruited via advertisements placed in national newspapers and social media which contained a link to the study website, and via an online panel. The study website required individuals to indicate that they wanted to participate in the study by clicking on an 'I want to participate' button. After responding to the questions designed to establish that they met the inclusion criteria and giving informed consent participants were randomly assigned to one of the three research conditions by an automatic randomizer that was built into the website. After that, they were asked to fill in the baseline questionnaire. The three research conditions were 1) the I Move condition: participants in this condition received I Move, a web-based computer tailored PA intervention based on SDT and MI (Friederichs et al., 2014a); 2) the Active Plus condition: participants in this condition received Active Plus, a traditional web-based computer tailored PA intervention, based on TPB, SCT and TTM (Peels et al., 2012; van Stralen et al., 2008) and 3) the control condition: participants in this condition were placed on a waiting list (after completion of the RCT, these participants were routed to the I Move intervention). During the period September–December 2013, over 3000 participants were enrolled in the study.

Variables of interest were assessed at baseline, and three and six months later. All assessments were web-based questionnaires administered via the study website. Participants in the two intervention conditions were also asked to fill in a questionnaire six weeks after the baseline assessment. The responses to this questionnaire were used to tailor the content of the intervention; the questionnaire also elicited feedback about participants' experience of the intervention. To reduce attrition the participants who completed each separate questionnaire were entered into a prize draw offering ten €50 prizes (Robroek et al., 2009).

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