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Motivation for physical activity in young adults with a physical disability during a rehabilitation stay: A longitudinal test of Self-Determination Theory.

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Abstract

We tested a Self-Determination Theory process model (SDT; Deci & Ryan, 2000) during a 3-week physical activity rehabilitation stay among young adults with a physical disability (N = 44, M_{age} = 24.7, SD = 5.1). As hypothesized, perceived autonomy support positively predicted needs satisfaction at the end of the stay (r = .38, p <.01). Further, needs satisfaction was positively linked to changes in autonomous motivation for physical activity (r = .47, p <.01).Both changes in autonomous motivation and self-efficacy were associated with physical activity increases over the stay (r = .57, p <.01 and r =. 47, p <.01, respectively). Bootstrapping results supported the SDT process-model, indicating a support for a development towards more self-determined motivation in rehabilitation.

Key words: physical activity, self-determination, rehabilitation

The present study tested the Self-Determination Theory process model (SDT; Deci & Ryan, 2000) in the domain of physical activity in a group of young adults with a physical disability (age 18-35) admitted to a rehab centre for rehabilitation.

Despite the numerous health benefits of physical activity (Heath & Fentem, 1997; Physical Activity Guidelines Advisory Committee, 2008), several studies indicate that people with a physical disability are less likely to engage in regular physical activity than non-disabled (US Department of Health and Human Services, 2000; Rimmer, Rubin, Braddock, & Hedman, 1999). This was supported by recent research among young Norwegian adults (age 18-30) that indicated that those with a disability were less physically active than their able-bodied peers (Saebu & Sorensen, 2010). Using the concepts from the ICF - International Classification of Functioning, Disability and Health (WHO, 2001), personal factors explained more of the variance in physical activity than both the environmental factors and factors related to functioning and disability. Similar to research among able-bodied, identity as an active person and intrinsic motivation were powerful factors for explaining variance in physical activity behaviour (Bauman, Sallis, Dzewaltowski, & Owen, 2002). However, results in this domain are not consistent, and studies have reported that other self-determined extrinsic motives like introjected regulation (e.g., Thogersen-Ntoumani & Ntoumanis, 2006) and in particular identified regulation (e.g., Wilson, Rodgers, Fraser, & Murray, 2004) may be as important as intrinsic regulation for explaining the variance in physical activity participation. In addition, Burton, Lydon, D'Alessandro and Koestner (2006) has demonstrated that controlling motives also can underpin persistence behavior, but acting for this reason may led to reduced psychological health and well-being for the individual.

Research on motivation for physical activity among people with a disability is scarce and we need to increase our knowledge about the processes that can enhance healthy behaviour, i.e. physical activity. However, some studies exist. Martin (2006) found that

enjoyment was a critical personal factor in commitment to disability sport. Another study indicated that health status and lack of money, and the unsuitability of local sports facilities rather than lack of motivation were cited as the main barriers to explain the low participation in sport by young disabled people (Finch, Lawton, Williams, & Sloper, 2001). Scelza, Kalpakjian, Zemper and Tate (2005) reported that lack of motivation, lack of energy, and lack of interest were the most frequently cited barriers to exercise among individuals with spinal cord injury, while another study reported that lack of interest was one of the least frequently perceived barriers to exercise among people with a stroke (Rimmer, Wang, & Smith, 2008). Similar results were observed in a study among American African women with disabilities (Rimmer, Rubin, & Braddock, 2000). In sum, the findings thus seem to be contradictory.

In rehabilitation, it has proved to be a challenge to maintain the level of physical activity in everyday life as during rehabilitation (van der Ploeg et al., 2007). This was supported by a study reporting that the increase in the activity level during in-patient rehabilitation did not continue after discharge among people with spinal cord injury (van den Berg-Emons et al., 2008). Therefore a stronger focus on motivational aspects in rehabilitation research has been emphasized (Roe, Dalen, Lein, & Bautz-Holter, 2008). Maclean, Pound, Wolfe and Rudd (2000) found that highly motivated patients were more likely to take responsibility for their own rehabilitation and health outcomes, and that motivation for rehabilitation seem to be influenced by the environment in which the patient is rehabilitated. These findings indicate that factors other than health benefits are important for the motivation for physical activity for persons with disabilities. More knowledge about how motivation for physical activity in everyday life can be improved during rehabilitation is needed.

Theoretical Framework

Self-determination theory (SDT) has been strongly recommended as a suitable framework for understanding motivated physical activity behaviour (Biddle & Nigg, 2000;

Landry & Solmon, 2002). Moreover, SDT has been recently used in physical activity research (Chatzisarantis & Hagger, 2009; Fortier, Sweet, O'Sullivan, & Williams, 2007; Wilson et al., 2004), and over the past 15 years a growing body of work has also applied SDT in studies of health-related behaviour change (Patrick & Williams, 2008; Ryan & Deci, 2007; Williams, Freedman, & Deci, 1998). Further, autonomous functioning and self-determination may be a particular challenge for people with a disability, since many of them are dependent of help and assistance both in physical activity and daily activities. Limited work has been done in adapted physical activity using SDT, but we are aware of one study examining the contribution of two different models of psychological need satisfaction to well-being in a sample of sport athletes with a disability (Lightheart, Wilson, & Oster, 2010). In our opinion, there is a need for additional research using self-determination theory as a framework in a rehabilitation setting among non-athlete participants. The SDT theory was therefore used as a theoretical framework for identifying and understanding the motivation mediators of physical activity in this study.

Motivation and Psychological Needs Satisfaction

According to SDT, maintenance of behaviours over time requires that patients are autonomously motivated for that behaviour (Deci & Ryan, 2000). Autonomous motivation includes intrinsic, integrated and/or identified forms of behaviour regulation. The theory further argues that if health-care settings maximize patient's satisfaction of the needs for autonomy, competence, and relatedness, their regulation of health-related behaviours are more likely to be autonomously motivated, and behaviour change will be better maintained (Williams, Deci, & Ryan, 1998). Need for autonomy can be satisfied by experiences of choice and volition (e.g., DeCharms, 1968); satisfaction of the need for competence can be a result of behaviour that lead to intended outcomes (e.g., White, 1959); and perceptions of being attached to and understood by others can lead to satisfaction of the need for relatedness (e.g.,

Baumeister & Leary, 1995). These basic needs, according to Ryan and Deci (2000), apply to all people, regardless of gender, group or culture, and presumably disability.

Although autonomy and competence have been found to be the most powerful influences on autonomous types of motivation and its maintenance, theory and research suggest that relatedness also plays a role, albeit a more distal one (Deci & Ryan, 2000). The practitioner-patient relationship has been emphasized as an important social context for change. Because patients are vulnerable and often insecure about their own capability, individuals are expecting guidance from professionals, and this is especially important in health care. In this process, a sense of being respected and understood is essential to form the experiences of relatedness that nurture internalization (Ryan, Patrick, Deci, & Williams, 2008). At the rehabilitation centre in the present study the group setting is considered important, with peer work and exchange of activity experiences among the patients. The patients' feeling of relatedness to the rest of the group may also be important for the outcome of the rehabilitation stay.

In sum, to increase autonomous motivation, the satisfaction of basic psychological needs for autonomy, competence and relatedness are supposed to be important. The theory argues that all three needs are essential and that if any is thwarted there will be distinct functional costs. Thus satisfaction of all three needs were included in this study of participants with a disability, because optimal functioning seems to be important for their engagement in physical activity (Jahnsen, Villien, Aamodt, Stanghelle, & Holm, 2003).

Autonomy Support, Autonomous Motivation and Perceived Competence.

SDT differentiates motivation in terms of the degree to which it has been internalized, suggesting that the more fully it is internalized, the more it will be the basis for autonomously regulated behaviour. There are three different autonomous types of regulation; identified (for personally held values such as learning new skills; internally referenced contingency),

integrated (behaviours that are fully incorporated into the repertoire of behaviours that satisfy psychological needs), and intrinsic (for enjoyment, pleasure and fun, without reward or reinforcement). These three types of regulation comprise *autonomous motivation* in research (Williams, Freedman, & Deci, 1998). Patients who are regularly physically active would be autonomous if they freely chose to exercise because they enjoy being physically active, or are personally committed to improving their health. Practitioners may facilitate autonomous motivation and perceived competence for change by supporting patients as they explore resistances and barriers to change, and helping them identify congruent pathways to health (Ryan et al., 2008). In Self-Determination Theory, such environments are termed autonomy-supportive contexts and defined as: "ones in which significant others offer choice, provide a meaningful rationale, minimize pressure, and acknowledge the target individual's feelings and perspectives" (Williams, Grow, Freedman, Ryan, & Deci, 1996, p. 117). Effective behaviour change requires people to be both autonomously motivated and to perceive themselves as competent in doing it (Deci & Ryan, 2000). Competence refers to a felt sense of confidence and effectance in a social context, and it is not an attained skill or capability. The need for competence leads us to seek optimal challenges (Ryan & Deci, 2002). People perceive themselves to be competent when they feel capable of attaining important health outcomes in a social setting, such as meeting a physical activity goal. Autonomy-supportive patient care has been found to enhance autonomous motivation and perceptions of competence, which improved health outcomes (Williams et al., 1998; Williams, McGregor, Zeldman, Freedman, & Deci, 2004).

Along with a sense of autonomy, internalization requires that a person experience the confidence and competence to change. In SDT, support for competence is integrated in the concept of autonomy support defined above and afforded when practitioners provide effectance, relevant inputs and feedback. This means that the patient is afforded the skills and

tools for change, encouraged to choose among them, and is supported when competence or control-related barriers emerge. Patients are not over-challenged, but rather helped to experience mastery in terms of the health behaviour change that needs to be engaged (Ryan et al., 2008). Fortier, Sweet, O'Sullivan and Williams (2007) outlined that the construct of perceived competence is very similar to the self-efficacy concept (Bandura, 1997). It may be discussed if general self-efficacy is more related to issues of social cognition central to Bandura's (1997) model of human agency rather than Deci and Ryan's (2002) formulation that is based on different theoretical orientations concerned with volitional action. In the present study, items measuring efficacy refer to perceived confidence related to overcoming barriers and challenges in physical activity in general. Thus, the present measure of efficacy may be very similar to measures of perceived competence in SDT (Williams et al., 1996). Efficacy has been found to be one of the strongest predictors of physical activity in adults (Trost, Owen, Bauman, Sallis, & Brown, 2002). Similar results have also been revealed in populations with a disability (Bean, Bailey, Kiely, & Leveille, 2007; Kroll, Kehn, Ho, & Groah, 2007). The term efficacy has been used in this study.

Recent research has revealed that autonomous motivation and perceived competence for making change were important for involvement in physical activity among able-bodied (Bagoien & Halvari, 2005; Chatzisarantis & Hagger, 2009; Chatzisarantis, Hagger, Biddle, & Karageorghis, 2002; Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). Due to a lack of self-determination theory research on persons with a disability in rehabilitation settings, we examined some studies of other health related behaviours as a basis for our hypotheses.

Autonomous motivation and perceived competence were found to be important for better self-management of diabetes behaviours and better glucose control for patients with diabetes (Williams et al., 2004; Williams et al., 1998), active participation in an alcohol

treatment program (Ryan, Plant, & Omalley, 1995), adherence to exercise programs and long term weight management in overweight and obese middle-aged women (Palmeira et al., 2007; Teixeira et al., 2006), and in morbidly obese patients (Williams et al., 1996), smoking cessation (Williams, Gagne, Ryan, & Deci, 2002), and long-term medication adherence (Williams, Rodin, Ryan, Grolnick, & Deci, 1998). In sum, it seems as if autonomous motivation and perceived competence may be important for participation in and adherence to various health related behaviours.

The Self-Determination Theory Process Model of Change

Autonomy-supportive practitioners will facilitate the patients' satisfaction of psychological needs. This is expected to enhance autonomous motivation and perceived competence, which both are expected to yield maintained healthy functioning (Williams et al., 2004). Research has emphasized the importance of autonomy support in several health care related studies (Halvari & Halvari, 2006; Teixeira et al., 2006; e.g. Williams et al., 2006). However, the process model has to our knowledge never been applied in the domain of physical activity among young adults with a physical disability. Thus, we tested a Self-Determination Theory process model in which perceived autonomy support during a 3-week physical activity rehabilitation stay was hypothesized to positively predict psychological needs satisfaction at the end of the stay. This was expected to increase autonomous motivation and self-efficacy for physical activity (motivation variables), which both were expected to be linked to physical activity increases over the stay. We also examined whether autonomy support would be indirectly linked to change in motivation variables through needs satisfaction; and that needs satisfaction would be indirectly associated with changes in physical activity through motivation variables.

According to SDT, satisfaction of basic psychological needs represents essential nutriments for individuals' healthy functioning (Deci & Ryan, 2000), and previous research

has demonstrated that satisfaction of the three basic psychological needs are important (Hagger, Chatzisarantis, & Harris, 2006; Wilson, Longley, Muon, Rodgers, & Murray, 2006). Further, previous studies have observed direct effects of perceived autonomy support upon self-reported physical activity, when experiences related to need satisfaction were not taken into consideration (Chatzisarantis & Hagger, 2009; Hagger et al., 2005; Hagger et al., 2003). Based on this, we tested an alternative Basic Need Theory Model and predicted that perceived autonomy support will be positively correlated with satisfaction of basic psychological needs as in the SDT process model outlined above, and that needs satisfaction would be directly positively associated with physical activity (see Figure 1, model 2).

Method

Participants

Young adults with a disability (aged 18-35 years) were during the winter 2009 invited to one of four similar three-week rehabilitation stays with up to 14 persons in each group. Sixty-two persons applied for a stay. Of those, nine persons got another rehabilitation offer because they were seriously cognitively challenged. Fifty-three persons were accepted by the admission team, and 48 persons (28 women) accepted the terms for the stay, and were included in the study. Four of them dropped out during the follow-up period, and did not answer the last questionnaire. Thus, 44 persons (27 women) completed the study. Mean age was 24.7 years (*SD* = 5.1; women: *M* = 25.3, *SD* = 5.7; men: *M* = 23.9, *SD* = 4.3). For additional descriptive information, see Table 1.

All the persons who applied for a stay at the national rehabilitation centre had the right to treatment over a limited time period. Participants were divided into four groups, based on their preferences. Some of the participants were either employed, studying, and/or were dependent on assistance and had to decide the best possible time for the three week

rehabilitation stay. The study was approved by the Regional Medical Committee for Research Ethics in Norway.

Design

This was a longitudinal study, based on repeated measures. Data was collected through an internet-based questionnaire. Two persons with visual impairment were interviewed by the researcher because they could not complete the questionnaire themselves. The participants filled out the questionnaire three times; respectively at arrival of the rehabilitation centre (Time 1 = baseline), at departure from the centre (Time 2), and twelve weeks after departure (Time 3). According to Rogasa (1995), three or more observations are preferred to detect individual change, and for thee estimation of individual growth curves. The period for the intervention was given by the terms of condition for a stay at the rehabilitation centre. A third measure and a follow-up period of 12 weeks was considered as important because it provided opportunities for the participants to implement a more healthy behaviour and physical activity routines in daily life.

Intervention at the rehabilitation centre

The rehabilitation programme at the rehabilitation centre is based on the vision of Adapted Physical Activity (APA; Hutzler & Sherrill, 2007), by means of physical activities adapted to the specific needs of each individual with a disability. The rehabilitation includes social and cultural activities and extensive use of outdoor natural facilities, on a year-round basis. A wide range of services is offered, including adaptation of the environmental factors, technical aids and individual instruction. The programme is intensive, with 3 - 5 hours of physical activity a day, six days a week

Before the intervention period, the professional staff at the rehabilitation centre was given four lectures on Self-Determination Theory, where the facilitation of autonomy-support, possibilities for demonstrating competence, and facilitation for relatedness were especially

emphasized. The intervention was based on patient autonomy by providing opportunities for choice and self-initiation during goal-setting, priority of activities, and support and surveillance during the rehabilitation stay. Further, extended instruction in the activities was given priority in order to enhance efficacy in activities, and finally, relatedness support in the group of 11-14 participants was emphasized.

Most of the activities were arranged in groups. The group setting is considered important (cfr. relatedness), facilitating for the participants to work together, giving feedback to each other and exchange of activity experiences. During the stay, individual's schedules are constantly assessed and adjusted when necessary. The range of activities (e.g., traditional ones such as swimming, cross-country skiing and riding, and less traditional activities such as aerobics, alpine skiing and kayaking) offered by the rehabilitation centre provide opportunity to determine activities best suited to the individual.

Measures

Autonomy support. The Health-Care Climate Questionnaire (HCCQ) concerns support for healthy behaving (Williams et al., 1996). The original HCCQ is a 15-item measure that assesses participants' perceptions of the degree to which they experience their health-care providers during the intervention to be autonomy supportive versus controlling in providing the treatment. The short form of the HCCQ that includes six of the 15 items was used. Psychometric properties were established in a sample of 1183 patients in various studies where the measure yielded a one factor solution with all factor loadings above .74. In another study on persons with diabetes (a sample which has some challenges in common with the sample in the present study), the short version represented good internal consistency (α = .80), and correlated .91 with the full version (Williams et al., 1998). A sample item is: "I feel that the staff provided me choices and options". Items were responded to on a 7-point scale ranging from *strongly disagree* (1) to *strongly agree* (7). Scores were calculated by averaging

the individual item scores. Autonomy support was measured after one week of the rehabilitation stay (baseline + 1 week = Time 1b).

Basic Psychological Needs. Basic psychological needs were assessed by the Basic Psychological Needs in Exercise Scale (BPNES: Vlachopoulos & Michailidou, 2006). The BPNES was preferred because it was accessible in a translated version (from the English version to Norwegian, and back-translated to English), it has been developed in Europe, and other researchers have called for more research using this new BPNES (Wilson, Mack, & Grattan, 2008). According to Wilson and Bengoechea (2011), the BPNES are suitable for structured exercise settings and should apply well for the present study. This 12-item scale assesses perceptions of the extent to which the innate needs for autonomy, competence, and relatedness (Deci & Ryan, 2000) are satisfied in the domain of exercise. Sample items are: "The exercise program I follow is highly compatible with my choices and interests" (autonomy); "I feel I have been making huge progress with respect to the end result I pursue" (competence); and "I feel extremely comfortable when together with the other exercise participants" (relatedness). Each item was responded to on a 7-point scale ranging from *strongly disagree* (1) to *strongly agree* (7). Participants completed the scale at the end of the rehabilitation stay (Time 2). Separate scores for autonomy, competence and relatedness were made by averaging the sum of each four items. A score for total needs satisfaction was also calculated by averaging the sum of the 12 items.

Psychometric properties of the BPNES have been established in a sample of 1012 persons employed from fitness centres. The results demonstrated an adequate factor structure, internal consistency, generalizability of the factor dimensionality across the calibration and the validation samples, discriminant validity and predictive validity. In addition, acceptable stability of the BPNES scores over four weeks was also presented. The scores of the scale

were found to be largely unaffected by socially desirable responding and the tendency to impress management (Vlachopoulos & Michailidou, 2006).

Motivation Regulation. Autonomous motivation for physical activity was measured by the Exercise Self-Regulation Questionnaire (SRQ-E) (Ryan & Connell, 1989). The SRQ-E was translated into Norwegian by a bilingual researcher. Back translation into English by a second bilingual translator was performed to ensure conceptual accuracy. The SRQ-E has demonstrated acceptable validity and reliability in Norway, reflecting the motivational regulations among adolescents and young adults (Ommundsen & Kvalo, 2007). Sample items are: "I try to be physically active on a regular basis because I feel like it's the best way to help myself" (identified regulation); and "I try to be physically active on a regular basis because I enjoy exercising" (intrinsic regulation). The responses were given on a seven-point Likert-type scale ranging from *very true* (7) to *not at all true* (1). Autonomous motivation scores were estimated by averaging the sum of intrinsic and identified regulation items. The SRQ-E also included items for controlled motivation (i.e., introjected and external regulations) which in most cases are found to be unrelated to long-term adherence (Deci & Ryan, 2000). This was also the case in the present study, and controlled motivation is therefore not included in further analyses. The scale were used in a Norwegian study among young adults with a disability (N = 327), and demonstrated good reliability on intrinsic and identified regulations, α = .80 and .85, respectively. Factor analysis revealed two factors representing intrinsic and identified regulation. All factor loadings above .60 (Saebu & Sorensen, 2010).

Efficacy. Exercise Self-Efficacy was measured by the ESES - Exercise Self-Efficacy Scale. A sample item is: "I am confident that I can overcome barriers and challenges with regard to physical activity and exercise if I try hard enough". Responses were given on a ten point Likert scale ranging from *not at all true* (1) to *always true* (10). The scale has been tested for validity in a sample with 368 individuals with spinal cord injury. Preliminary

findings indicate that the ESES is a reliable instrument with high internal consistency and scale integrity. Content validity both in terms of face and construct validity was satisfactory (Kroll et al., 2007). In the present study, Principal Component Analysis extracted only one factor, accounting for 62.3% of the variance, with a good internal consistency (α = .86).

Physical Activity. Physical activity was assessed using an adapted version of the self-administered short form of the International Physical Activity Questionnaire (IPAQ). This measure assesses total time (minutes) in vigorous intensity physical activity, total time (minutes) in moderate intensity physical activity, and total time (minutes) in walking and time spent sitting during the last seven days. Time spent sitting was excluded in this study because there is no value in asking wheelchair-users to report their time spent sitting during the last seven days. IPAQ short form has been developed and tested for use with adults with an age range of 15-69 years and has shown acceptable reliability (Spearman's clustered ρ around 0.8) and criterion validity (ρ = .30) (Craig et al., 2003). IPAQ had been translated into Norwegian previously and has been used by the Survey of Living conditions (Wilhelmsen, 2009).

The examples of vigorous and moderate intensity activities used were not relevant for our sample. The IPAQ protocol allows the use of culturally applicable examples (IPAQ Research Committee, 2005). According to this, "time in fast wheeling/pushing in wheelchair" (vigorous-intensity), "time in wheeling/pushing the wheelchair with moderate speed" (moderate-intensity), and "time in wheeling/pushing the wheelchair" as an alternative to walking was included (Saebu & Sorensen, 2010). IPAQ provides a continuous variable (metabolic equivalent – minutes pr. week = MET-minutes pr. week) that was used as the dependent variable.

Analyses

All data were analysed using SPSS, version 15.0.1. Pearson correlations were performed to detect bivariate associations between the variables. Regression analysis was

used to create change scores (standardized residuals) for variables. Residual change scores were used to obtain gain scores that are uncorrelated with the pre-test scores, and measures if a person's post-test score is larger or smaller than a predicted value for that person (Waltz, Strickland, & Lenz, 2010). To test the process model and indirect relations, we used bootstrapping. Bootstrapping is a nonparametric resampling procedure, advocated for testing mediation that does not impose the assumption of normality of the sampling distribution. Compared to multiple regression, bootstrapping was used because it is more suitable and recommended for small sample sizes (Preacher & Hayes, 2008). Guidelines for final reporting were used, recommending 5000 bootstrap samples (Preacher & Hayes, 2008). Repeated measures ANOVA were performed to analyse increases or decreases in mean scores of variables from Time 1 (baseline), over Time 2 (end of rehabilitation stay), to Time 3 (12 weeks after the end of the stay).

Results

Descriptive Statistics and Reliability

Table 2 shows the means, standard deviations, and reliabilities for all variables. The scores for all motivation-related variables are distributed around a high mean (1 *SD* above scale midpoint) at all three times of measurement. The scores for total physical activity are distributed around a high mean, which is comparable to about four hours of walking or three hours of moderate physical activity daily. Relatively high levels of SD emerged in relation to mean scores since there are some participants who are not physically active at all at time 1 and time 3.

Correlations for SDT-related Variables and Physical Activity

Bivariate correlations between all measures emerge in Table 2. According to the predicted links in the SDT process model described, autonomy support was significantly

positively associated with needs satisfaction, which was significantly linked to both autonomous motivation and efficacy at Time 2. In turn, both autonomous motivation and efficacy at Time 2 predicted positively physical activity at Time 3, but only efficacy is significantly linked to physical activity at Time 2. All predicted associations were significant in the expected direction, except the correlation between autonomous motivation at Time 2 and physical activity at Time 2.

Change scores (standardized residuals) from baseline to the end of the rehabilitation stay of autonomous motivation, efficacy, and physical activity were created by regression of T 2 measures onto T 1 measures for each variable. The same procedure was applied when creating change scores for motivation and physical activity variables from the end of the rehabilitation stay (T 2) to 12 weeks after (T 3). The correlations among autonomy support, total needs satisfaction, the three needs for autonomy, competence, relatedness and changes in autonomous motivation, efficacy, and physical activity are presented in Table 3. The correlation between autonomy support and needs satisfaction is the same as presented in Table 2. Further, needs satisfaction was significantly positively associated with change in autonomous motivation (T1-T2) but not with change in efficacy (T1-T2). In turn, change in both these motivation variables (T1-T2) was significantly positively linked to change in physical activity (T1-T2), and to total physical activity at Time 3 (12 weeks after T2). However, changes in motivation variables are not significantly related to change in physical activity from T2 to T3.

Hypotheses Testing of Relations in the SDT Process Model

The overall SDT process model suggests that autonomy support would predict needs satisfaction, which would enhance people's efficacy and autonomous motivation, which, in turn, would predict increases in total volume of physical activity. Table 3 shows that autonomy support was positively related to needs satisfaction ($r = .38$, $p < .01$); that needs

satisfaction was linked to positive change in autonomous motivation (T1-T2: $r = .47$, $p < .01$) and non-significantly related to change in efficacy (T1-T2: $r = .21$, $p > .05$); and that changes in both autonomous motivation (T1-T2: $r = .57$, $p < .01$) and efficacy (T1-T2: $r = .47$, $p < .01$) were related to increased physical activity (T1-T2).

Looking at the single needs (see Table 3), relatedness seems to contribute to a change in autonomous motivation from T1 to T2 ($r = .52$, $p < .01$), which in turn is correlated with the reduction in autonomous motivation from T2 to T3. ($r = -.48$, $p < .01$). Some of the reduction in autonomous motivation from T2 to T3 can also be explained by relatedness ($r = -.28$, $p < .05$). This is not the situation for autonomy and competence. Further, changes in autonomous motivation and efficacy is correlated ($r = .46$, $p < .01$), indicating that relatedness contributes indirectly to the increase in efficacy (T1-T2) through the change in autonomous motivation (T1-T2). This indirect link between the relatedness need and change in efficacy through change in autonomous motivation was significant, path a X path b = .20, *SE* = .09, bias corrected 95% CI [.06, .45]. Probably because the relatedness need contribute most to the increase in autonomous motivation from T1 to T2, the decrease in the latter variable from T2 to T3 is negatively linked to the same need (relatedness need – change in autonomous motivation from T2 to T3: $r = -.28$, $p < .05$). We also notice that the autonomy need is positively correlated with changes in the autonomous motivation from T2 to T3 ($r = .26$, $p < .05$) and the change in efficacy at the same time ($r = .28$, $p < .05$). The competence need is also positively correlated with changes in autonomous motivation and efficacy, but not significantly.

We tested the SDT process models of physical activity that appears in Figure 1 by bootstrapping. Bootstrapping was applied because it is suitable and recommended for small samples (Preacher & Hayes, 2008). Due to the small sample size, we reduced the number of variables in the analyses by testing two process models separately: (1) a model including

autonomy support, needs satisfaction, and changes in autonomous motivation, efficacy and physical activity from Times 1 to 2; and (2) an alternative model including autonomy support, needs satisfaction and total physical activity at Time 3.

Model 1: Autonomy support → needs satisfaction → autonomous motivation and efficacy→ physical activity. First, we analysed the paths between autonomy support at Time 1b (Independent Variable = IV), needs satisfaction at Time 2 (Mediator = M), and autonomous motivation at Time 2 (Dependent Variable = DV), using autonomous motivation at Time 1 as a Control Variable (CV) (see Figure 1, model 1). The path between autonomy support and needs satisfaction was significant (Point Estimate, PE, for path a = .39, $p < .01$), as was the path between needs satisfaction and autonomous motivation at Time 2 (PE for path b = .24, $p < .01$), controlling for autonomous motivation at Time 1 (partial PE of CV on DV = .83, $p < .001$). The indirect link between autonomy support and change in autonomous motivation through needs satisfaction was significant because the bias-corrected confidence intervals (for the bands of products of coefficients after *n* re-samplings) did not include zero or negatively valued coefficients, path a X path b = .10, *SE* = .04, bias corrected 95% CI [.01, .19]. See Table 4, row 1.

Second, we analysed the paths between autonomy support at Time 1b (IV), needs satisfaction at Time 2 (M), and efficacy at Time 2 (DV), controlling for efficacy at Time 1 (CV). The path between autonomy support and needs satisfaction was significant (PE for path a = .28, $p < .05$), whereas the path between needs satisfaction and efficacy at Time 2 was non-significant (PE for path b = .31, $p > .10$), controlling for efficacy at Time 1 (partial PE of CV on DV = .77, $p < .001$). The indirect link between autonomy support and change in efficacy through needs satisfaction was non-significant, path a X path b = .09, *SE* = .08, bias corrected 95% CI [-.03, .29]. See Table 4, row 2.

Third, we analysed the paths between needs satisfaction at Time 2 (IV), change in autonomous motivation and efficacy from T1 to T2 (M), and physical activity at T2 (DV), controlling for physical activity at Time 1 (CV). The path between needs satisfaction and change in autonomous motivation was significant (PE for path a^1 = .61, $p < .001$), but the path between needs satisfaction and change in efficacy was not significant (PE for path a^2 = .22, $p > .05$). Analyzing the b paths, we revealed that the b^1 path between change in autonomous motivation and change in physical activity was significant (PE for path b^1 = 843, $p < .01$), and the b^2 path between change in efficacy and change in physical activity was marginally significant (PE for path b^2 = 491, $p = .06$), controlling for physical activity at Time 1 (partial PE of CV on DV = .93, $p < .001$). The indirect link between needs satisfaction and change in physical activity through change in autonomous motivation was significant, path a X path b = 516.41, *SE* = 206.67, bias corrected 95% CI [191.68, 1062.24]. See Table 4, row 3. In addition, the indirect link between needs satisfaction and change in physical activity through change in efficacy was not significant, path a X path b = 110.31, *SE* = 145.08, bias corrected 95% CI [-5.56, 537.05], because it included a negatively valued coefficient. See Table 4, row 4, and the path coefficients illustrated in Figure 1, Model 1.

The correlations between autonomy support and the three needs for autonomy, competence and relatedness, respectively, were all weaker than the correlation between autonomy support and total needs satisfaction (see Table 3). Partly due to this, no single need did significantly mediate the links between autonomy support and change in motivational variables. Thus, as shown above, total needs satisfaction including all three needs is the important construct mediating the link between autonomy support and change in autonomous motivation.

Further, the correlation between total needs satisfaction and change in autonomous motivation was relatively strong (r = .47, p<.001). Regarding single needs, it is only the

relatedness need that could match this correlation strength in relation to autonomous motivation (r = .52, p<.001), whereas this correlation was much lower for the autonomy need (r = .30, p<.05) and the competence need (r = .27, p<.05). Consequently, for single needs, only the Relatedness Need (RN) was significantly indirectly linked to change in Physical Activity (PA) through change in Autonomous Motivation (AM), a-path: RN --> AM (.42, p<.001); b-path: AM --> PA (939.24, p<.001); c-path: RN --> PA (485.13, p<.05); c'-path, RN --> PA controlling for the AM mediator: 87.45, p =.68. Because the RN --> PA path became non-significant after controlling for the mediator, a full mediation is supported. This is also indicated by the indirect link, point estimate = 397.68, SE = 167.34, bias corrected 95% CI [144.93, 804.99]. Regarding the indirect links between single needs and change in physical activity through change in efficacy, none of them were significant. Further, using a similar model, we changed physical activity measured at Time 2 with physical activity measured at Time 3 (twelve weeks after the intervention) as the dependent variable, but the model did not demonstrate any strong support to the change model.

An alternative Model 2: Autonomy support at time 1b → needs satisfaction at time 2 → total physical activity at Time 3. Because autonomy support and needs satisfaction yielded the strongest correlations observed (r = .33, p < .05) with total physical activity at Time 3 (12 weeks after the end of the rehabilitation stay), we tested an alternative model with these three variables. We analysed the paths between autonomy support at Time 1b (IV), needs satisfaction at Time 2 (M), and physical activity at Time 3 (DV). The path between autonomy support and needs satisfaction was significant (PE for path a = .39, p < .01), and the path between needs satisfaction and physical activity was marginally significant (PE for path b = 1558.85, p < .10). The indirect link between autonomy support at Time 1b and physical activity at Time 3 through needs satisfaction at Time 2 was significant, path a X

path b = 608.81, *SE* = 437.02, bias corrected 95% CI [36.91, 1811.08]. See Table 4, row 5, and the path coefficients illustrated in Figure 1, Model 2.

In sum, the results supported significantly the indirect relations between autonomy support and change in autonomous motivation through needs satisfaction, and between needs satisfaction and change in physical activity through change in autonomous motivation. We also noticed support for the positive indirect link between autonomy support and total physical activity 12 weeks after the intervention through needs satisfaction.

Increases and Decreases in Mean Scores for Motivation and Physical Activity Variables

Repeated measures ANOVA revealed that physical activity (see Table 2) increased significantly from the start of the rehabilitation stay at T1 and until the follow up (T3) twelve weeks after the intervention, $F(1.26, 54.12) = 12.05$, $p < .001$. (Degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity). Further, efficacy increased significantly from T1 to T3, $F(2, 79) = 3.95$, $p = .023$. Finally, mean for autonomous motivation increased, but not significant, from T1 to T2, and remained relatively high at T3 (see Table 2).

Discussion

The purpose of the present study was to test the Self-Determination Theory process model in the domain of physical activity in a group of young adults with a physical disability (age 18-35) admitted to a rehabilitation centre. The results supported the model and should have some practical implications for how we plan and implement rehabilitation. We have not previously seen the SDT health process model applied in a setting with people with a disability. As predicted, autonomous motivation was associated with increased total physical activity This provides additional evidence for findings in previous studies among able-bodied persons (Bagoien & Halvari, 2005; Chatzisarantis & Hagger, 2009; Chatzisarantis et al., 2002; Fortier et al., 2007; Hagger et al., 2005; Hagger et al., 2003). It also corresponds with

other research on people with disabilities (Saebu & Sorensen, 2010). In rehabilitation, the focus has often been on the health imperatives of physical activity, but this study indicates that autonomy support and autonomous motivation plays an important role in predicting physical activity for people with a disability. It further supports the self-determination theory, by confirming the relation between autonomy support, basic psychological needs, autonomous motivation and healthy behaviour (Ryan & Deci, 2000; Wilson et al., 2006).

According to Williams et al. (2004), patients are more likely to feel able to control important health outcomes when they are initiating the behaviour themselves. Results from the present study correspond well with Williams et al. (2004) who emphasized the importance of clinicians to support patients' self-initiated attempts to master a new technique or skill, and to encourage them to make informed decisions about healthy behaviour. Over time, the patients will internalize the regulation of the behaviour, and become more autonomous and competent in making healthy behaviour changes and then sustaining the changes over time. This should also apply to people with a physical disability in a rehabilitation setting. Different studies have shown that autonomous motivation has strong connections with positive emotions, interest, and enjoyment of physical activities (Reeve & Deci, 1996; Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997). In the present study, the strength of correlation between autonomous motivation and total physical activity indicates that this type of motivation is very important for persons with a disability too.

Further, perceived efficacy for physical activity was positively associated with total physical activity. It corresponds well with results among able-bodied, where efficacy and perceived competence are important correlates of physical activity (Trost et al., 2002) and recent research in populations with a disability (Bean et al., 2007; Kroll et al., 2007). We noticed that there was no significant positive relation between autonomy support and efficacy, or between need satisfaction and efficacy, indicating that autonomy support alone is not

enough to impact efficacy for physical activity among persons with a disability in the present study. Similar results have been demonstrated among able-bodied by Fortier et al (2007), which did not reveal any differences in perceived competence in physical activity after an autonomy-supportive intervention. However, this is contrary to other research (Williams et al., 2006), and there is a need for future research may in the domain of physical activity and the SDT process-model. Results in the present study regarding efficacy may also be explained due to the ceiling effect on the efficacy scale, since the mean scores were high already at Time 1 (see Table 2). According to Fortier et al , (2007), the time frame for assessment is important, because it takes time to build feelings of competence. This may explain why the efficacy level also increased from the end of the intervention and up to the follow-up after twelve weeks (see Table 2).

The study revealed three significant indirect effects or mediators. A mediator is on the causal pathway between exposure to the intervention and program effects or outcomes. There may be a single mediator between the intervention and the outcome, or several mediators that intervene and are causally related in sequence, between the program and outcome (Baron & Kenny, 1986). In the present study, autonomous motivation was a mediator of the relation between changes in basic psychological needs and change in physical activity level. This mediation supported previous research among able-bodied (Chatzisarantis & Hagger, 2009; Fortier et al., 2007). Thus, there is a need for additional research to examine other possible mediators between the autonomy supportive intervention and change in physical activity for people with a disability.

Further, we also recognize the indirect link between autonomy support and autonomous motivation, through need satisfaction. The results revealed a high level of need satisfaction (see Table 2), indicating that autonomy, relatedness and competence together played a role for the direct link to autonomous motivation. This is not surprising, as many of

the participants highlighted the autonomy-supportive staff, facilitation for optimal challenges in activity and the social benefits of being with other people with disabilities during the rehabilitation stay. The link between need satisfaction and more autonomous physical activity motives has also been demonstrated in previous research (Hagger et al., 2006; Vlachopoulos & Michailidou, 2006; Wilson et al., 2006).

Among the needs, relatedness seems to be the most important one in this study, as it seems to interplay with autonomous motivation through and after the rehabilitation stay, and is indirectly linked to efficacy through autonomous motivation (see Table 3 and the bootstrapping results in the text above). This may be explained by the participant's unique possibility during the rehabilitation stay for sharing experiences with other persons with disabilities in adapted activities, and to be valued by disabled peers that have the experience to acknowledge the effort made. For many of the participants this is quite unusual in their local environment, due to a limited amount of persons with disabilities being physically active in small communities. However, the results are not in line with previous research among able-bodied, demonstrating that perceived relatedness was linked with controlling regulations for exercise (Peddle, Plotnikoff, Wild, Au, & Courneya, 2008; Wilson, Mack, Muon, & LeBlanc, 2007)

Participants may have felt connected to the staff and the other participants during the stay. Consequently, this may contribute to the changes in autonomous motivation during the stay, and following, indirectly making the participants more vulnerable after the stay, caused by the loss of contact with the rest of the group. We may also speculate in that they gained autonomy and competence during the stay, which is something they internalize, and thus are less vulnerable to. The results also indicated that the lack of relatedness after the stay overran the effects of satisfaction of autonomy and competence, and consequently there were zero correlations between total need satisfaction and the motivational variables (autonomous

motivation and efficacy) from the end of the rehabilitation stay and until twelve weeks. The different impact of the needs may also contribute to the lack of predictive variables for the change in physical activity from T2 to T3, with an exception for autonomy support.

The results connected to relatedness may have the implication that there is a need for making the participants in a rehabilitation stay less vulnerable for the lack of their physical activity peers and the staff after the stay. Key words for such strategies may be local-support groups after a rehabilitation stay, or continued contact with the staff and other participants via e-mail or a web-site.

Although basic psychological needs were included in this study, the study did not have an experimental design, and consequently no causal relations could be drawn. However, the effects of need satisfaction on behaviour may be both directly reflecting automatic processes of influence and indirectly reflecting influences due to deliberative processes.

We also examined an alternative longitudinal model of autonomy support at Time 1, needs satisfaction at Time 2, and physical activity at Time 3 (see Figure 1, model 2). Previous studies have observed direct effects of perceived autonomy support upon self-reported physical activity, when experiences related to need satisfaction were not taken into consideration (Chatzisarantis & Hagger, 2009; Hagger et al., 2005; Hagger et al., 2003). In the present study, need satisfaction was included in the model, and perceptions of autonomy support demonstrated a direct effect upon self-reported physical activity after twelve weeks, indicating a long term effect for the autonomy supportive intervention.

The present study demonstrated effects of a longitudinal intervention programme on physical activity behaviour, but it is not without limitations. Recruitment of participants among young adults with a disability in rehabilitation is difficult. Thus, the number of participants is limited and our sample size small. According to this, the results of the present study may not apply to other people with disabilities with different physical abilities. Future

studies might consider replicating results of the present study by conducting a larger scale intervention, if possible. Further, the intensive treatment led to significant change in physical activity during the rehabilitation stay, but we cannot conclude that changes in perceptions of autonomy and efficacy led to the change in physical activity, because changes in the motivation variables were occurring at the same time as the improvements in physical activity. In other words, improvement in physical activity could have produced the change in motivation or efficacy, or the relations could have been bidirectional. Finally, the study did not examine perceptions of structure and involvement that have been forwarded as important components of perceived interpersonal style (Taylor & Ntoumanis, 2007) that could represent effects in this context. Future studies should include perceptions of structure and involvement in rehabilitation settings, and examine if these constructs are divergent valid from satisfied competence and relatedness needs, respectively.

The present study leads to several conclusions. First, the self-determination model for health behaviour with autonomy support, needs satisfaction, and changes in autonomous motivation and physical activity was supported. The paths with efficacy included were rejected. Second, the results supported significantly the indirect relations between autonomy support and change in autonomous motivation through needs satisfaction, and between needs satisfaction and change in physical activity through change in autonomous motivation. Finally, an alternative model indicated that autonomy support and needs satisfaction during the rehabilitation stay positively predicted total physical activity scores 12 weeks after the stay.

There is a need for additional research to develop and test self-determination interventions that would enhance patients' autonomous motivation and efficacy for physical activity. We therefore support previous calls for studies to include ways to improve health care practitioner autonomy supportiveness (Williams et al., 2004). According to the results

there is also a need for studies that focus on how patients can take more responsibility for their health outcomes, and development of efficient techniques and instruments to improve perceived autonomy support. Traditionally, rehabilitation for people with a physical disability has been directed by the medical expertise, i.e. an externally controlled motivation, with emphasis on the health benefits. However, the last 10-15 years there has been a development towards more self-determination in rehabilitation (Shakespeare, 2006). The results of the present study support this priority.

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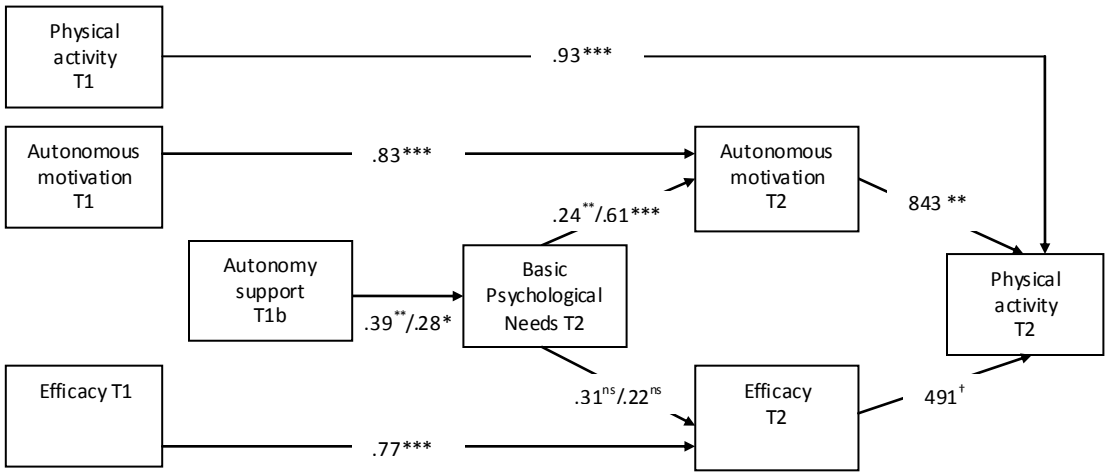
Figure legend

Figure 1. The change model – two different approaches. Bootstrapping models. See text for further information.
Note: T1 = Baseline, T1b = Baseline + one week, T2 = after three weeks intervention, T3 = Twelve weeks after intervention.
*** p<.001, ** p<.01, *p<.05, † p<.10

Model 1)



Model 2)

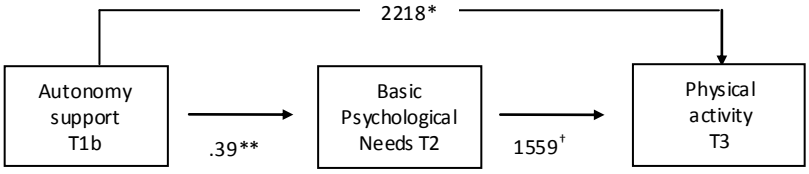


Table 1. Descriptive data of the sample (*N*=44)

Variables		*n*	%
Engagement			
	Student	15	34.1
	Employed	14	31.8
	Social security	11	25.0
	Work related rehabilitation	12	27.3
	Voluntary work	8	18.3
Living			
	Living alone	19	43.2
	Married/cohabitants	5	11.4
	Living with parents	17	38.6
	Living with own children	5	11.4
Activities of daily living			
	Personal assistent	5	11.4
	Leisure time assistent	6	13.6
	Support services	11	25.0
Impairment			
	Congenital	28	63.6
	Acquired	16	36.4
Mobility limitation		37	84.1
	Wheelchair user	24	54.5
	Uses crutches/walker	2	4.5
	Walk without aids	11	25.0
Visual impairment		6	13.6
	Blind	5	11.4

Table 2. Mean, SD and bivariate correlation (Pearson's) among independent and dependent variables.

Measure	*M*	*SD*	*α*	1	2	3	4	5	6	7	8	9	10
1 Autonomy support T1	6.31	.76	.95										
2 Basic Psych. Needs T2	6.22	.78	.88	.38 **									
3 Autonomous motiavtion T1	5.82	.94	.80	-.01	.31 *								
4 Efficacy T1	7.50	1.68	.86	.25 *	.50 **	.43 **							
5 Physical activity T1	4672	4581		.18	.17	.05	.30 *						
6 Autonomous motiavtion T2	5.91	.94	.82	.15	.49 **	.90 **	.39 **	.06					
7 Efficacy T2	7.85	1.74	.89	.31 *	.53 **	.45 **	.83 **	.40 **	.52 **				
8 Physical activity T2	7251	4704		.21	.22	.19	.18	.93 **	.12	.38 **			
9 Autonomous motiavtion T3	5.89	.97	.84	.08	.41 **	.87 **	.52 **	.06	.82 **	.51 **	.01		
10 Efficacy T3	7.88	1.60	.86	.27 *	.44 **	.58 **	.87 **	.26 *	.51 **	.78 **	.17	.64 **	
11 Physical activity T3	5562	5080		.33 *	.33 *	.17	.19	.61 **	.27 *	.32 *	.66 **	.11	.25

* $p < .05$, ** $p < .01$.

Table 3. Bivariate correlations (Pearson's) among independent and dependent variables (residual change score)

Measure	*1*	*2*	3	4	5	6	7	8	9	10	11
1 Aut support T1											
2 Basic Psych need T2	.38 **										
3 Autonomy need T2	.34 **	.84 **									
4 Competence need T2	.36 **	.84 **	.82 **								
5 Relatedness need T2	.25 **	.76 **	.35 **	.37 **							
6 Change aut motivation (T1-T2)	.35 **	.47 **	.30 *	.27 *	.52 **						
7 Change efficacy (T1-T2)	.17	.22	.17	.11	.22	.46 **					
8 Change physical activity (T1-T2)	.12	.19	.00	.03	.34 *	.57 **	.47 **				
9 Change aut motivation (T2-T3)	-.08	.00	.26 *	.15	-.28 *	-.48 **	-.26 *	-.49 **			
10 Change efficacy (T2-T3)	.05	.03	.28 *	.22	-.28 *	-.36 **	-.51 **	-.36 **	.43 **		
11 Change physical activity (T2-T3)	.26 *	.24 .	.17	.25	.18	.13	.03	.01	-.11	.17	
12 Physical activity (T3)	.33 *	.33 *	.24	.36 **	.23	.25 *	.30 *	.25	-.19	.01	.75 **

* p < .05, ** p < .01.

Table 4. Test of indirect links emerging in Figure1

Independent variable (IV)	Mediator (M)	Dependent Variable (DV)	Point estimate	SE	Bootstrapping BC 95% CI
1. Autonomy support	Need Satisfaction	Autonomous motivation	.10	.04	[.01, .19]
2. Autonomy support	Need Satisfaction	Efficacy	.09	.08	[-.03, .29]
3. Need Satisfaction	Autonomous motivation	Physicl activity T2	516.41	206.67	[191.68, 1062.24]
4. Need Satisfaction	Efficacy	Physicl activity T2	110.31	145.08	[-45.56, 537.05]
5. Autonomy support	Need Satisfaction	Physicl activity T3	608.81	437.02	[36.91, 1811.08]

BC - bias corrected; 5000 bootstrap samples, *a-path* IV→ M, *b-path* M → DV