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Temporal dynamics of need satisfaction and need frustration. Two sides of the same coin?

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We study the dynamics of need satisfaction and need frustration by examining how need satisfaction and need frustration change over time and how these changes relate to changes in motivation. To investigate this, volunteers were assessed daily during a delineated activity, resulting in a total sample of 77 volunteers and 467 completed daily diaries. Bayesian confirmatory factor analysis on the within-person level confirmed a bifactor solution: autonomy, competence, and relatedness were distinguished by three specific factors, but the majority of variance was explained by two strongly correlated (need satisfaction and need frustration) factors. The strong correlation between need satisfaction and need frustration further translated in the development of their relationship over time. That is, Bayesian latent growth curve modelling revealed a simultaneous, yet opposite, growth curve. Contrary to our expectations, neither of them could be related to behavioural internalization or externalization. These results imply that, at the within-person level, momentary need satisfaction and frustration are difficult to distinguish, and affecting one may automatically affect the other. Also, the relationships within the self-determination framework, such as the proposed link between need satisfaction and behavioural internalization may be better reframed with attention to the time-frame in which they occur.

Keywords: Self-determination theory; motivational change; need satisfaction; need frustration; Bayesian latent growth curve modelling

Introduction

Employees sometimes face tasks they find neither interesting, nor pleasant. However, often these tasks are part of the job description and employees are therefore expected to accomplish them. Under these circumstances, the best guarantee for success—both for the employee and the organization—is developing a willingness to complete these tasks (Deci, Eghrari, Patrick, & Leone, 1994). According to Self-Determination Theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000), this willingness increases when one's reasons (e.g., regulations) for enacting these tasks shift from external (e.g., "they want me to do this") to internal regulations (e.g., "I want to do this"). People identify with the tasks through these *internalization* processes and approach them as valuable parts of the job, instead of being mere obligations (Ryan & Deci, 2000). Consequently, behavioural internalization is a prerequisite for a successful work performance (Gagné & Deci, 2005). This performance may however deteriorate again when maladaptive interactions with one's environment foster the *externalization* of an earlier internalized behavioural regulation (Deci & Ryan, 2000).

According to SDT, behavioural internalization is encouraged by environmental factors that satisfy the employees' basic psychological needs for autonomy,

competence, or relatedness (Ryan & Deci, 2000). Following these premises, previous research has shown that individual differences in need satisfaction relate to individual differences in employees' behavioural regulation or motivation (e.g., Van den Broeck, Vansteenkiste, De Witte, Soenens, & Lens, 2010). What is missing in these studies, however, is the notion that internalization and externalization are dynamic processes that unfold over time; processes in which increases and decreases in need satisfaction relate to changes in motivation (Gagné & Deci, 2005). Indeed, applying snapshot research to accumulate knowledge on phenomena that are inextricably intertwined with the time frame in which they occur may provide a distorted picture of what really happens (Roe, 2008). To entirely grasp the dynamic concepts of internalization and externalization, one should acknowledge and study the key role of time. By studying the dynamic process underlying internalization and externalization, the present study explicitly addresses this gap in the literature.

The second contribution of our study follows from growing interest in the concept of need frustration, which is conceptually different from need satisfaction and is referred to as the active undermining or frustration of one's needs (e.g., Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011; Vansteenkiste &

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Ryan, 2013). Building on the distinction between need satisfaction and need frustration, it has been demonstrated that need frustration has unique predictive validity on top of need satisfaction when it comes to predicting, for example, maladaptive eating patterns in women (e.g., Verstuyf, Vansteenkiste, Soenens, Boone, & Mouratidis, 2013), negative functioning of athletes (e.g., Bartholomew, Ntoumanis, Ryan, & Thogersen-Ntoumani, 2011), and ill-being at work (e.g., Gillet, Fouquereau, Forest, Brunault, & Colombat, 2012). The theoretical rationale for this differential effect is that need satisfaction and need frustration trigger different psychological processes, that is, the internalization and externalization of behavioural regulations, respectively (Deci & Ryan, 2000). However, up until now and to the best of our knowledge, this proposition has not been tested empirically. In the current study, we address this lacuna by investigating how dynamic, intra-individual changes (i.e., within-person changes) in need satisfaction and need frustration relate to the processes of behavioural internalization and externalization, respectively.

Behavioural regulation

According to SDT, a certain external drive is required when behaviours are not interesting but nevertheless essential for a healthy functioning and personal growth (Gagné & Deci, 2005). In these cases, personal development is maintained by absorbing the regulations of these behaviours in the self and by fully assimilating or integrating these behaviours with one's norms, values, and beliefs (Deci & Ryan, 2002); a process that is referred to as the internalization of activities (Ryan & Deci, 2000). To account for the fact that not all behaviours become fully accepted as one's own, SDT has suggested different types of extrinsic motivation (i.e., regulations) that are internalized to a greater (i.e., autonomous motivation) or lesser (i.e., controlled motivation) extent.

External regulation represents the least effective form of motivation. In the case of external regulation, one engages in an activity because of forces outside of the activity, such as the expectance of rewards or the fear of being punished when not engaging in the activity. As individuals typically feel pressured by others to engage in these activities, this behavioural regulation is referred to as the prototype of controlled motivation (Gagné & Deci, 2005). The second type of controlled motivation is *introjected regulation*. Although individuals engage in activities without external pressures, they feel pressured from inside as they perform the behaviour only because they are concerned with their image. In other words, they want to avoid disappointing others, they want to feel proud, and they want to be acknowledged by relevant others. When people are autonomously motivated, they enact behaviours or activities because they want them themselves, rather

than feeling pressured. *Intrinsic motivation* is the prototype of autonomous motivation as individuals who are intrinsically motivated are spontaneously attracted to enact their activities because they experience them as fun or interesting to do. However, an activity that is not found interesting or fun can still be autonomous, depending on the degree to which the activity is geared to one's values, norms, and expectations. SDT distinguishes between two types of externally regulated and internalized behaviours; identified and integrated regulation. Whereas *identified regulation* refers to the execution of activities that are of personal value, *integrated regulation* is the full acceptance of the behaviour and its assimilation in the self-concept, fostering self-determined motivation. Because it has been proven to be difficult to distinguish integrated regulation from intrinsic motivation (e.g., Gagné et al., 2010), SDT research has started to omit integrated regulation when calculating the composite scores of autonomous (i.e., identified regulation and intrinsic motivation) and controlled motivation (i.e., external regulation and introjected regulation) (e.g., Bono & Judge, 2003; Gagné & Deci, 2005; Reinhold, Pedersen, & Foss, 2011; Van den Broeck, Lens, De Witte, & Van Coillie, 2013).

Basic psychological need satisfaction and frustration

People's environment can either promote or hinder the internalization process through the satisfaction or frustration of the individual's basic psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2000). These basic psychological needs are present in everyone (Deci & Ryan, 2008), irrespective of one's cultural background (e.g., Deci et al., 2001), which is why they are often considered as universal (Deci & Ryan, 2008). The need for autonomy refers to people's need to volitionally engage in behaviours, so that these behaviours originate from the self and result in outcomes that one owns (Deci & Ryan, 2000). The need for competence refers to people's need to master the tasks for which they engage themselves, so that the effective functioning in these tasks stimulates one's feelings of capability (Deci & Ryan, 2000). Finally, the need for relatedness refers to people's need to connect with others, to feel supported in their endeavours, and to feel cared for by others (Deci & Ryan, 2000).

Whereas low need satisfaction may hinder people's flourishing, it is believed that the experience of need frustration—or being actively obstructed in the satisfaction of one's needs—relates to people's malfunctioning and ill-being (Vansteenkiste & Ryan, 2013). According to this idea, employees who have little contact with their colleagues are not necessarily unhappy at work, because they merely experience a low level of relatedness need satisfaction. Instead, their emotional well-being at work will actively be harmed when they feel excluded by their

team, because this actively frustrates their need for relatedness. In line with this notion, a growing set of studies at the between-person level has demonstrated the unique added value of need frustration on top of need satisfaction; showing that need satisfaction and need frustration are two distinctive factors that have a non-symmetric relationship with various outcomes (e.g., Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011; Gillet et al., 2012; Schultz, Ryan, Niemiec, Legate, & Williams, 2014).

Changes in need satisfaction and need frustration and the link to motivation

According to SDT, recurring experiences of need satisfaction should lead to the internalization of the (reason for doing the) activity, and this internalization should then in turn boost positive health and well-being related outcomes. When people feel that satisfaction of their needs is actively forestalled, they may engage in behaviours that they think will compensate for their experienced negative state of need frustration. However, these goals are often inherently extrinsic, and will therefore only temporarily provide feelings of satisfaction. In the end, they further distract people from the essence which is need satisfaction (Vansteenkiste & Ryan, 2013; Vansteenkiste, Soenens, & Duriez, 2008). For example, an employee who feels lonely at work may engage in activities to overcome the negative experience of need frustration, such as using Facebook to enhance her/his feelings of self-worth. Although this will result in short-term, positive experiences, this activity interferes with profound need satisfaction, and maintains the original frustration of not feeling a part of the team (e.g., Sheldon, Abad, & Hinsch, 2011). Note that this contradicts with motive theories in which one believes in the effectiveness of compensation mechanisms after experiences of low need satisfaction (“needs as motives”; Sheldon, 2011; Sheldon & Gunz, 2009). When individuals increasingly experience perceptions of being incompetent at work, being excluded by their coworkers, and being controlled by their supervisor, it is likely that their reason for working changes from doing their job because working is fun and interesting (intrinsic) to doing it because it is a prerequisite for living (extrinsic) (see Vansteenkiste et al., 2007). Internalized behaviour may thus become externalized when employees believe that their basic psychological needs are increasingly frustrated.

Despite wide recognition of the relationship between need satisfaction and need frustration and the processes of behavioural internalization and externalization, empirical support remains rather limited. Whereas studies have shown that need frustration plays a role in the relationship between controlling

environments and people’s malfunctioning (e.g., Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011; Costa, Ntoumanis, & Bartholomew, 2015; Stebbings, Taylor, Spray, & Ntoumanis, 2012), we are not aware of studies that support the explicit relationship between need satisfaction and behavioural internalization, and between need frustration and behavioural externalization. Moreover, the limited set of studies that has focused on the link between need satisfaction and motivation have disregarded their dynamic nature (e.g., Deci et al., 1994; Markland & Tobin, 2010), thereby failing to capture the dynamic, process-like nature of internalization and externalization. In sum, it is still unknown whether the same distinction between the concepts of need satisfaction and need frustration can be made at the within-person, momentary level. Moreover, although motivation is represented as a state that fluctuates alongside people’s environment, SDT’s processes of internalization and externalization are systematically described without reference to the time frame in which they occur.

In the present study, we will add to the existing research by examining the development of need satisfaction and need frustration over the course of time, and by linking their changes to changes in motivation. Hence, we searched for a sample of respondents with well-defined, medium-term activities with a clear start and end point; characteristics that allowed us to measure motivation in the beginning and at the end of the activity, along with changes in need satisfaction and need frustration during the activity. Therefore, we collected our data in a group of volunteers engaged in social care programmes. Although volunteers are strictly speaking different from paid workers, they often perform the same activities, have the same responsibilities, and undergo similar psychological processes as paid employees (Bidee et al., 2013; Vantilborgh et al., 2014). In line with one of SDT’s core premises, we tested the following hypotheses:

Hypothesis 1: Need satisfaction is positively related to the internalization of behaviour, with increases in need satisfaction being associated with increases in autonomous motivation over time.

Hypothesis 2: Need frustration is positively related to the externalization of behaviour, with increases in need frustration being associated with increases in controlled motivation over time.

Methods

Participants and procedure

Three Belgian social care organizations participated in the study. All of them organized holiday camps, either for children, adolescents, or adults with or without physical and mental disabilities or for socially marginalized groups.

To ensure their daily functioning and activities, they all rely on a large number of volunteers.

The volunteer coordinator of each organization—i.e., the paid employee who coordinates the (work of) the volunteers—gave her/his permission to contact and follow the volunteers during their volunteering activities. Prior to the start of the holiday camp (which typically lasted one week) all volunteers were asked to complete a general questionnaire measuring demographics. Motivation was measured in the beginning and at the end of the holiday camp period with the aim of capturing changes in behavioural regulations. Finally, the volunteers completed a short diary survey at the end of each camp day, in which they reported on their daily need satisfaction and need frustration.

The distribution of the questionnaires is as follows: The volunteer coordinator of each organization delivered the questionnaires at the start of the holiday camp to the holiday camp responsible—these are the “volunteers’ supervisors” or the volunteers that monitor and direct the work of the other volunteers, and supervise the whole holiday camp—who distributed the questionnaire booklets among the other volunteers. At the end of the holiday camp, the booklets were returned to the researchers, either by the holiday camp responsible and volunteer coordinators, or by the volunteers themselves using pre-stamped envelopes.

In total, 133 questionnaire booklets were distributed. 56 volunteers returned a blank questionnaire and were omitted from the analysis. The other 77 volunteers (response rate = 57.89%) filled out the daily diary survey questionnaire for a different number of days: 1 day ($N = 3$), 2 days ($N = 1$), 3 days ($N = 2$), 4 days ($N = 8$), 5 days ($N = 13$), 6 days ($N = 12$), 7 days ($N = 17$), or 8 days ($N = 21$). Hence, we obtained 467 completed daily diaries on a maximum of 554. Our final sample consisted of 77 volunteers of whom 43 volunteered in organization A (56%), 20 in organization B (26%), and 14 in organization C (18%). Most of these volunteers were female (62%), although 20 of the 77 volunteers did not report their gender. The average age of the volunteers was 29 years ($SD = 17.39$). The majority was student (60%) or retired (20%). The other groups of volunteers were either working as a paid employee in a different organization (12%), unemployed (7%), or self-employed (1%). One volunteer did not reveal her/his occupational status (1%).

Measures

Motivation to volunteer

The motivation to volunteer was measured with the Multidimensional Work Motivation Scale (MWMS; Gagné et al., 2015). This scale does not measure integrated regulation, based on the argument that integrated regulations and intrinsic motivation are psychometrically

difficult to distinguish (e.g., Gagné et al., 2010). We adapted this scale to the volunteer context by changing the subject of the original items from “employee”, to “volunteer”. We used three items to measure external regulation (e.g., “I volunteer to get others’ approval”), four items to measure introjected regulation (e.g., “I volunteer because I have to prove myself that I can”), three items to measure identified regulation (e.g., “I volunteer because putting efforts in this volunteer work aligns with my personal values”), and three items to measure intrinsic motivation (e.g., “I volunteer because this volunteer work is interesting”). Note that this scale distinguishes between a social and a material approach of external regulation. We only included the items referring to engaging in behaviours because of pressure from significant others (i.e., social approach), as the items referring to monetary rewards or punishments (i.e., material approach) were less applicable to a volunteer context. To assess the degree to which the volunteer behaviour was internalized or externalized, we relied on the composite scores of autonomous and controlled motivation (e.g., Gagné & Deci, 2005). Controlled motivation was obtained by aggregating the items measuring extrinsic regulation and introjected regulation ($\alpha_{conT1} = .79$; $\alpha_{conT2} = .80$), whereas autonomous motivation was obtained by aggregating the identified regulation and intrinsic motivation items ($\alpha_{autT1} = .78$; $\alpha_{autT2} = .80$).

Daily psychological needs

Daily need satisfaction and frustration were measured by asking respondents to rate their level of autonomy, competence, and relatedness need satisfaction and frustration using a scale ranging from 1 (not true at all) to 7 (completely true). The items were selected from the Basic Psychological Needs Scale (Chen et al., 2014) and were adapted to the daily context (i.e., adding “today, I felt. . .”). To adhere to the time recommendations of Hektner, Schmidt, and Csikszentmihalyi (2007) and to avoid drop out due to irritation resulting from repetitive questions, we selected two items with the highest factor loadings and face validity for each of the basic needs (see also Fisher & To, 2012; Hofmans, Gelens, & Theuns, 2014 for a similar approach). By doing so, two items measured competence need satisfaction (e.g., “Today, I felt confident that I could do things well”), two items measured competence need frustration (e.g., “Today, I felt insecure about my abilities”), two items measured relatedness need satisfaction (e.g., “Today, I experienced a warm feeling with the people I spent time with”), two items measured relatedness need frustration (e.g., “Today, I felt excluded from the group I wanted to belong to”), two items measured autonomy need satisfaction (e.g., “Today, I felt that my decision reflected what I really wanted”), and two items measured autonomy need frustration (e.g., “Today, most of

the things I did felt like “I had to”). Since the investigation of momentary need frustration next to momentary need satisfaction is relatively new in SDT research, we do not know whether the same factor structure as shown in earlier cross-sectional, between-person research holds at the within-person level. We will therefore start our analysis by examining the factor structure of both concepts at the within-person level, using confirmatory factor analysis. The result of this analysis will be further used as the input for the latent growth analysis.

Results

Preliminary analyses

Confirmatory factor analysis

According to SDT, the three basic psychological needs are continuously satisfied and frustrated to some extent. Therefore, the items of the Basic Psychological Needs Scale (Chen et al., 2014) tap into satisfaction and frustration on one hand and autonomy, competence, and relatedness on the other hand. To explicitly model these two separate sources of variation, we tested the factor structure of the Basic Psychological Needs Scale (Chen et al., 2014) using bifactor modelling in Mplus version 7.31 (Muthén & Muthén, 1998–2012). Bifactor modelling simultaneously models variation that is common to all items (i.e., satisfaction/frustration) and variation shared by a subset of the items (i.e., the three basic psychological needs) (Chen, Hayes, Carver, Laurenceau, & Zhang, 2012). In line with this idea, we first tested a bifactor model with three specific factors (autonomy, competence, and relatedness) and one overall needs factor (Figure 1(a)). In this model, correlations between the specific factors and between the specific factors and the general factor were constrained to be zero (Morin, Arens, & Marsh, 2015;

Reise, 2012). We also tested a second bifactor model with three specific (autonomy, competence, and relatedness) and two general factors (need satisfaction and need frustration (Figure 1(b))). In this model, only the general factors were allowed to inter-correlate. Note that in the first model need satisfaction and frustration lie on the same dimension, whereas in the second model they are considered separate dimensions.

To deal with the complexity of bifactor models and the potential non-normality in our relatively small sample, we conducted Bayesian confirmatory factor analysis (see e.g., Schmitt, 2011). Although Bayesian analysis is relatively new in organizational research, it proves to be especially suitable when dealing with data that violate standard analysis assumptions, or with models that are hard to fit (for a detailed discussion of Bayesian analysis see Kruschke, Aguinis, & Joo, 2012). Because we were interested in the factor structure at the within-person level, we saturated the model at the between-person level (i.e., we allowed for all possible item correlations). In this way, model misfit was only due to misfit in the within-person model. Subsequently, we compared both models using the Deviance Information Criterion (DIC; Spiegelhalter, Best, Carlin, & van der Linde, 2002). The DIC is the Bayesian variant of the Akaike information criterion and depicts the likelihood of the model as a function of the actual number of parameters. The best fitting model is represented by the model with the lowest DIC value.

Inspection of the DIC values revealed that the bifactor model with one general needs factor (i.e., Model 1a) fitted the data better than the bifactor model with a general need satisfaction and a general need frustration factor (i.e., Model 1b) ($DIC_{1a} = 13846.84$; $DIC_{1b} = 13860.53$). However, at the same time, the lack of meaningful loadings on the global

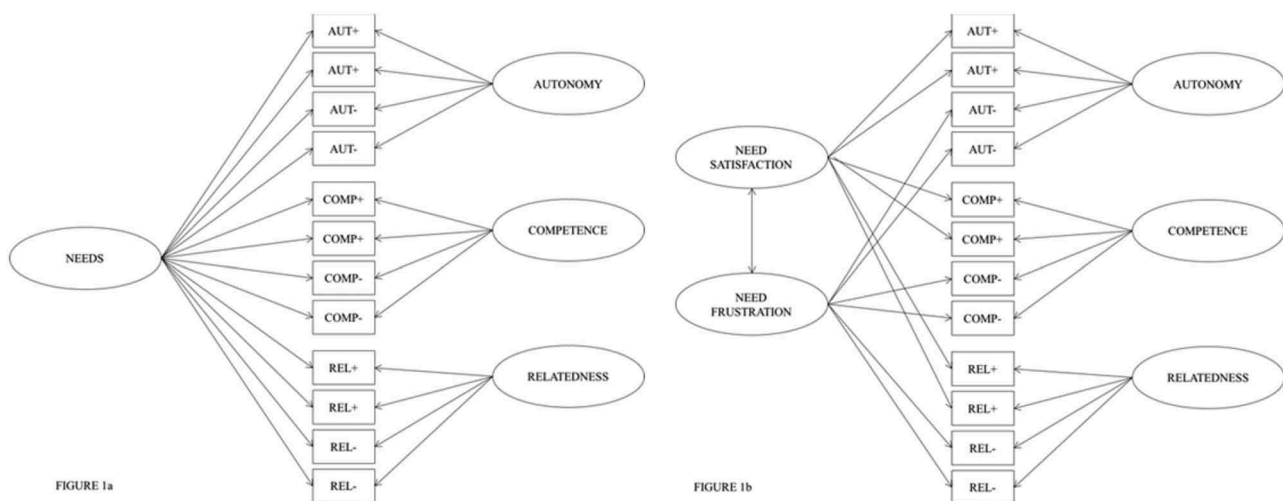


Figure 1. Comparison of two within-person, bifactor models.

Table 1. Standardized factor loadings and item uniqueness of the bifactor model with two oblique general factors (need satisfaction and need frustration) and three orthogonal specific factors (autonomy, competence, and relatedness).

	Item Uniqueness	Specific factors			General factors	
		Aut	Comp	Rel	Nsat	Nfrus
I feel a sense of choice and freedom in the things I undertake	.82	-.46*	—	—	.43*	—
I feel that my decisions reflect what I really want	.89	-.09	—	—	.34*	—
Most of the things I do feel like “I have to”	.82	.39*	—	—	—	.43*
I feel forced to do many things I wouldn't choose to do	.85	.52*	—	—	—	.39*
I feel confident that I can do things well	.74	—	-.33	—	.51*	—
I feel capable at what I do	.58	—	-.13	—	.65*	—
I feel disappointed with many of my performance	.87	—	.21	—	—	.36*
I feel insecure about my abilities	.78	—	.33	—	—	.47*
I feel connected with people who care for me, and for whom I care	.85	—	—	.10	.39*	—
I experience a warm feeling with the people I spend time with	.72	—	—	.08	.53*	—
I feel excluded from the group I want to belong to	.85	—	—	.17	—	.38*
I feel that people who are important to me are cold and distant towards me	.97	—	—	.26	—	.16*

Notes: 1. Aut = Autonomy; Comp = Competence; Rel = Relatedness; Nsat = Need satisfaction; Nfrus = Need frustration.

2. Factor loadings with * refer to loadings for which the 95% credibility interval does not include zero.

3. Correlations between the specific factors and between the specific factors and the general factors were constrained to be zero. The two general factors were highly negatively correlated ($r = -.83$, 95% credibility interval = $[-.97, -.68]$).

needs factor in Model 1a was at odds with typical bifactor modelling, as global factors should explain the variance that is shared among all items. In contrast, in model 1b there were substantial factor loadings of the satisfaction items on the general need satisfaction factor, and of the frustration items on the general need frustration factor (see Table 1). These findings suggest that—despite being highly correlated ($r = -.83$, 95% credibility interval = $[-.97, -.68]$)—need satisfaction and need frustration are separate dimensions, rather than being unidimensional. Drawing on this finding, we computed a need satisfaction and a need frustration variable by aggregating the need satisfaction (within-person Ω reliability coefficient = .64) and need frustration (within-

person Ω reliability coefficient = .54) items, respectively, and used these variables in subsequent analyses.

Descriptive statistics

Table 2 presents the mean scores and standard deviations of all study variables per measurement moment. For the need satisfaction and need frustration variables this means that there are descriptive statistics for each day of the holiday camp (= 8 measurements). For the autonomous and controlled motivation variables the descriptives are only measured (and thus shown) at the beginning and the end of the holiday camp (= 2 measurements).

Table 2. Descriptives for the need satisfaction, need frustration, autonomous motivation, and controlled motivation scores at each measurement moment.

	N	Mean	SD	Min	Max
Need Satisfaction, T1	60	5.34	.65	3.67	7
Need Satisfaction, T2	70	5.31	.70	2.50	7
Need Satisfaction, T3	69	5.37	.80	3.17	7
Need Satisfaction, T4	70	5.57	.65	4.17	6.83
Need Satisfaction, T5	63	5.56	.73	3.33	7
Need Satisfaction, T6	58	5.65	.67	3.67	7
Need Satisfaction, T7	42	5.73	.61	3.67	7
Need Satisfaction, T8	35	5.63	.87	3.17	7
Need Frustration, T1	63	2.05	.73	1	3.83
Need Frustration, T2	65	1.97	.70	1	3.67
Need Frustration, T3	68	2.03	.79	1	4.17
Need Frustration, T4	68	1.89	.69	1	4
Need Frustration, T5	62	1.97	.77	1	4
Need Frustration, T6	57	1.84	.73	1	4.33
Need Frustration, T7	40	1.75	.56	1	3.33
Need Frustration, T8	34	1.91	.81	1	4.33
Autonomous Motivation, T1	72	5.59	.81	3.50	7
Autonomous Motivation, T2	63	5.96	.72	4.17	7
Controlled Motivation, T1	74	2.21	.93	1	4.67
Controlled Motivation, T2	62	2.08	.85	1	4.75

Latent growth curve modelling

Analytical strategy

To model change in need satisfaction and need frustration, we tested individual growth trajectories using Latent Growth Curve Modelling (LGM; Von Soest & Hagtvet, 2011) in Mplus version 7.31 (Muthén & Muthén, 1998–2012). In LGM, the individual growth trajectories are represented by two parameters: a person-specific intercept (capturing the initial status) and a person-specific slope (capturing the direction and rate of change or growth). To model change in autonomous and controlled motivation, we used latent change scores (see Cheung, 2009; McArdle, 2009). This was done by first including four single-indicator latent variables (i.e., autonomous motivation_{t1}, autonomous motivation_{t2}, controlled motivation_{t1}, controlled motivation_{t2}), with loadings of the individual indicators fixed to one, and the uniqueness of the single-indicator latent variables fixed to $((1-\alpha)*\sigma^2)$ (with α being the internal consistency reliability and σ^2 being the sample variance). The means of these single-indicator latent variables were fixed to 0 and their variances to 1. Second, for controlled and autonomous motivation two latent initial level variables were defined by fixing the loading of the paths from the respective time 1 single-indicator latent variables to 1. Third, two latent change variables were defined by (a) fixing the loadings of the paths from the time 2 single-indicator latent variables to the change variables to 1, and (b) regressing the single-indicator time 2 latent variables on the single-indicator time 1 latent variables with regression weights fixed to 1. In order to control for ceiling effects—in that a high initial level of autonomous motivation may limit one's potential to change—the initial level and change factors were allowed to correlate.

Furthermore, we corrected for possible ceiling effects in need satisfaction and need frustration. We also estimated the cross-correlations between the intercepts and slopes of need satisfaction and need frustration, the cross-correlations between the initial levels and changes in autonomous and controlled motivation, and the cross-correlations between the initial levels and changes in autonomous and controlled motivation. Finally, we correlated the initial levels of autonomous and controlled motivation on the one hand, and the intercepts of need satisfaction and need frustration on the other hand. The complete model can be found in [Appendix 1](#).

To test the hypotheses, we relied on a Structural Equation Modelling operationalization. We regressed the latent change score of autonomous motivation on the intercept and slope of need satisfaction (Hypothesis 1), and the latent change score of controlled motivation on the intercept and slope of need frustration (Hypothesis 2). Because of the complexity of the combination of LGM and latent change score modelling, we again relied on

Bayesian analysis. Note that, as opposed to the traditional frequentist approach, Bayesian analysis does not yield confidence intervals. Instead, it yields a credibility interval for each parameter, referring to the likelihood that the interval covers the true parameter value, based on the observed data (Yuan & MacKinnon, 2009). For example, if we obtain a parameter estimate of 1 with a 95% credibility interval = [.50, 2.00], this means that there is a 95% chance that the true parameter ranges between .50 and 2.00. In our analysis, we specified diffused or uninformative priors. Missing data are handled with an approach similar to Full Information Maximum Likelihood (i.e., FIML). An overview of the parameter estimates for the overall model is provided in [Table 3](#).

Correlational results

We found ceiling effects for need satisfaction, need frustration, and autonomous motivation, as the intercept of need satisfaction was negatively correlated to the slope of need satisfaction ($r = -.44$, 95% credibility interval = $[-.56, -.35]$), the intercept of need frustration was negatively correlated to the slope of need frustration ($r = -.44$, 95% credibility interval = $[-.48, -.38]$), and the initial level of autonomous motivation was negatively correlated to change in autonomous motivation ($r = -.64$, 95% credibility interval = $[-.86, -.45]$). Thus, volunteers who showed high levels of need satisfaction at the start of the holiday camp showed a decrease in need satisfaction throughout the week, volunteers who showed high levels of need frustration at the start of the holiday camp showed a decrease in need frustration throughout the week, and volunteers who showed high levels of autonomous motivation at the start of the holiday camp showed a decrease in autonomous motivation at the end of the week. Next, it appeared from the analysis that the amount of change in need satisfaction, need frustration, and autonomous motivation was related to the intercept of need frustration ($r = .18$, 95% credibility interval = $[.01, .41]$), the intercept of need satisfaction ($r = .27$, 95% credibility interval = $[.06, .59]$), and the initial level of controlled motivation ($r = -.52$, 95% credibility interval = $[-.79, -.30]$), respectively. Thus, when people start with high levels of need satisfaction, they will probably have increasing experiences of need frustration throughout the holiday camp, whereas when people start with high levels of need frustration, they have a greater possibility to increase in their feelings of need satisfaction throughout the week. Interestingly, when people start with generally high levels of controlled motivation, they are more likely to also experience a decrease in their levels of autonomous motivation. We also found a positive correlation between the initial level of autonomous motivation and the slope of need satisfaction ($r = .30$, 95% credibility interval = $[.12, .53]$), which means that more autonomous motivation at

Table 3. Parameter estimates for the overall model.

	Estimate	95% Credibility interval	
		Lower 2.5%	Upper 2.5%
Mean levels			
Initial level _{aut mot}	5.61*	5.34	5.89
Change _{aut mot}	.38*	.08	.69
Initial level _{contr mot}	2.19*	1.92	2.47
Change _{contr mot}	-.08	-.40	.24
Intercept _{need sat}	5.28*	5.12	5.45
Slope _{need sat}	.03	-.02	.08
Intercept _{need frust}	1.93*	1.65	2.21
Slope _{need frust}	-.03	-.06	.01
Variances			
Initial level _{aut mot}	.67*	.16	.99
Change _{aut mot}	.72*	.42	1.09
Initial level _{contr mot}	.51*	.15	.82
Change _{contr mot}	.39*	.22	.53
Intercept _{need sat}	.35*	.30	.45
Slope _{need sat}	.02*	.01	.02
Intercept _{need frust}	.41*	.25	.52
Slope _{need frust}	.01*	.01	.01
Correlations			
Initial level _{contr mot} ↔ Change _{contr mot}	-.31	-.73	.28
Initial level _{contr mot} ↔ Initial level _{aut mot}	.92*	.83	.97
Initial level _{contr mot} ↔ Change _{aut mot}	-.52*	-.79	-.30
Initial level _{contr mot} ↔ Intercept _{need frust}	.17	-.07	.39
Initial level _{contr mot} ↔ Intercept _{need sat}	.07*	.03	.12
Initial level _{aut mot} ↔ Change _{aut mot}	-.64*	-.86	-.45
Initial level _{aut mot} ↔ Change _{contr mot}	-.23	-.77	.42
Initial level _{aut mot} ↔ Intercept _{need frust}	.11	-.11	.36
Initial level _{aut mot} ↔ Intercept _{need sat}	.02	-.01	.05
Intercept _{need frust} ↔ Slope _{need frust}	-.44*	-.48	-.38
Intercept _{need frust} ↔ Intercept _{need sat}	-.53*	-.60	-.43
Intercept _{need sat} ↔ Slope _{need sat}	-.44*	-.56	-.35
Intercept _{need sat} ↔ Slope _{need frust}	.27*	.06	.59
Change _{contr mot} ↔ Change _{aut mot}	.09	-.69	.93
Slope _{need frust} ↔ Initial level _{contr mot}	-.06	-.36	.12
Slope _{need frust} ↔ Initial level _{aut mot}	-.11	-.33	.09
Slope _{need sat} ↔ Initial level _{contr mot}	.18	-.03	.47
Slope _{need sat} ↔ Initial level _{aut mot}	.30*	.12	.53
Slope _{need sat} ↔ Intercept _{need frust}	.18*	.01	.41
Slope _{need sat} ↔ Slope _{need frust}	-.71*	-.94	-.50
Unstandardized (rep. standardized) regression coefficients			
Intercept _{need frust} → Change _{contr mot}	.05 (.06)	-.29	.31
Slope _{need frust} → Change _{contr mot}	.34 (.08)	-6.90	6.54
Intercept _{need sat} → Change _{aut mot}	.18* (.22*)	.09	.26
Slope _{need sat} → Change _{aut mot}	.14 (.03)	-3.75	3.73

Note: $N = 74$; correlations with an * have a credibility interval that does not contain 0.

the start of the camp is associated with a stronger increase in need satisfaction throughout the week.

Inspection of the correlations between the initial levels of autonomous/controlled motivation and the intercepts of need satisfaction/frustration also revealed several meaningful relationships. First, it appeared that intercepts of need satisfaction and need frustration were moderately negatively correlated ($r = -.53$, 95% credibility interval = $[-.60, -.43]$). Thus, people showing high levels of

need satisfaction also show lower levels of need frustration, and the other way around. Second, the initial levels of autonomous and controlled motivation were positively correlated ($r = .92$, 95% credibility interval = $[.83, .97]$), which suggests that people are in general more or less motivated, regardless of the specific type of motivation. Third, and counter to our expectations, we also found a relatively low but positive correlation between the initial level of controlled motivation and the intercept of need

satisfaction at the beginning of the camp ($r = .07$, 95% credibility interval = [.03, .12]). Thus, people showing high levels of controlled motivation at the beginning of the camp, are likely to show higher levels of need satisfaction at this first day of the camp.

The last correlation focuses on the relationship between the slopes of need satisfaction and need frustration. Results showed that this relationship was strongly negative ($r = -.71$, 95% credibility interval = [-.94, -.50]), suggesting that changes in need satisfaction and need frustration over time go hand in hand.¹

Predicting change in autonomous and controlled motivation

The intercept of need satisfaction was 5.28 (95% credibility interval = [5.12, 5.45]), whereas the mean slope was .03 (95% credibility interval = [-.02, .08]) and the variance around the slope was .02 (95% credibility interval = [.006, .023]). The intercept of need frustration was 1.93 (95% credibility interval = [1.65, 2.21]), whereas the mean slope was -.03 (95% credibility interval = [-.06, .01]) and the variance around the slope was .006 (95% credibility interval = [.005, .006]). The analysis revealed that the intercept of need satisfaction was related to positive change in autonomous motivation ($\beta = .18$, 95% credibility interval = [.09, .26]), whereas the intercept of need frustration was unrelated to change in controlled motivation ($\beta = .05$, 95% credibility interval = [-.29, .31]). Moreover, the slope of need satisfaction was unrelated to change in autonomous motivation ($\beta = .14$, 95% credibility interval = [-3.75, 3.73]), and the slope of need frustration was unrelated to change in controlled motivation ($\beta = .34$, 95% credibility interval = [-6.90, 6.54]). This means that the level of need satisfaction at the beginning of the holiday camp is positively related to an increase in autonomous motivation. In contrast, the level of need frustration at the beginning of the holiday camp is unrelated to changes in controlled motivation. More importantly, however, the slopes of need satisfaction and need frustration were unrelated to changes in autonomous and controlled motivation. The results of these predictions are depicted in Figure 2.

Discussion

Our study aimed to investigate one of SDT's core premises; namely that positive change—or growth—in need satisfaction is associated with change in autonomous motivation (i.e., behavioural internalization). In addition, we investigated the relationship between growth in need frustration and change in controlled motivation (i.e., behavioural externalization). By acknowledging the role of time, we deviated from the traditional focus on between-person differences and scrutinized motivation processes

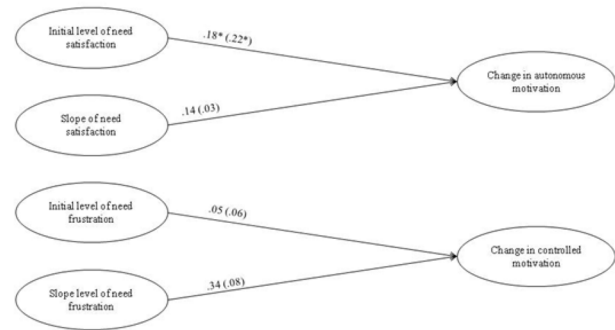


Figure 2. Unstandardized and standardized (between parentheses) parameter estimates in the prediction of change in autonomous and controlled motivation using the intercepts and slopes of need satisfaction and need frustration.

Note: * Result of the growth curve and latent change score modelling using Bayesian estimation supported this relationship.

that occur within people, over a one-week time span (i.e., a volunteer work week).

Results of Bayesian confirmatory factor analyses revealed that although need satisfaction and need frustration can be distinguished at the within-person level, both factors are highly correlated. Following this result, we found that the slopes of need satisfaction and need frustration were very highly and negatively correlated, suggesting that growth patterns in need satisfaction mirror growth patterns in need frustration. Finally, the redundancy of within-person change in need satisfaction and frustration was also shown by the fact that both were unrelated to change in autonomous and controlled motivation. Although these findings were not fully in line with our expectations, they have strong implications for theory and practice.

Theoretical implications

Our findings add to SDT in several ways. First, we demonstrated that growth—or within-person change—in need satisfaction and need frustration are likely to go hand in hand. By demonstrating this, we revealed that findings obtained at the between-person level do not automatically transfer to the within-person level. This is an important realization as in today's SDT literature, need frustration is conceptualized as separate from, and complementary to, need satisfaction (e.g., Bartholomew, Ntoumanis, Ryan, Bosch, et al., 2011; Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). This conceptualization of need satisfaction and frustration as separate processes was supported by cross-sectional research in which between-person differences in need satisfaction or need frustration were related to between-person differences in people's functioning. In these studies, it has been shown that, whereas need satisfaction predicts well-being and healthy functioning, need frustration is especially

predictive for ill-being and malfunctioning. In our study, between-person differences in need satisfaction at the first day of the holiday camp were moderately negatively related to between-person differences in need frustration. Note, however, that we rated volunteers' experienced need satisfaction and need frustration at the end of the day, with respect to the activities in which they were involved (that day). This is not equivalent to measuring people's general feelings of need satisfaction and need frustration in a certain domain. More important, however, investigation of growth in need satisfaction and need frustration within individuals over time revealed that, at the within-person level, these processes mirror each other. This implies that when need satisfaction increases, need frustration decreases, and vice versa. A possible reason for this redundancy may be that need satisfaction suppresses the presence of need frustration, or that need frustration forestalls need satisfaction. Note that similar findings are obtained in research on affect (e.g., Brose, Voelkle, Lövdén, Lindenberger, & Schmiedek, 2015), where positive and negative affect appear to be independent at the between-, but are negatively related at the within-person level. In sum, although between-person, cross-sectional research clearly showed the additive and distinctive value of need satisfaction and need frustration, our study revealed that their growth patterns are highly correlated.

Our study also stimulates further research on SDT as it yielded some thought-provoking results. Whereas the strong positive correlation between autonomous and controlled motivation might seem counterintuitive given the adaptive and maladaptive consequences associated with SDT's autonomous and controlled motivation, respectively; a similar correlation was found in previous research on volunteering (e.g., Haivas, Hofmans, & Pepermans, 2012; Oostlander, Güntert, van Schie, & Wehner, 2014). This correlation might reflect the fact that volunteers typically strongly identify with their volunteering activities and therefore enjoy them, but at the same time are also aware that other people depend on them, and therefore experience a strong pressure to volunteer. Moreover, it is likely that the more volunteers identify with their volunteering activity, the more they become aware of this dependency and the more they feel this pressure. As a result, autonomous and controlled motivation can get confounded. This interpretation is also in line with recent person-centred research showing that there is indeed a group of people that is characterized by high autonomous and high controlled motivation at the same time (e.g., Ratelle, Guay, Vallerand, Larose, & Sénécal, 2007; Van Den Berghe et al., 2014). Provided that such a profile tends to appear in the context of volunteering, an interesting follow-up question pertains to the consequences of such co-variation. We believe that three scenarios are conceivable (see Langan et al., 2015). First, and in line with SDT, the positive effects of high autonomous

motivation might get nullified by the presence of high controlled motivation. Second, and in line with the buffering hypothesis, autonomous motivation might mitigate the negative effects associated with controlled motivation. Third, autonomous and controlled motivation might have additive, positive effects. Support for each of these scenarios can be found in the literature, and for the time being no explanation can be given as to why sometimes the quantity (high autonomous and high controlled) and why in other situations the quality (high autonomous and low controlled) of motivation matters (e.g., Van Den Berghe et al., 2014). Because of this reason, further research on the consequences of the co-occurrence of autonomous and controlled motivation is needed. Moreover, such research might benefit from using a dynamic, temporal approach as our study shows that initial levels of controlled motivation relate to change in autonomous motivation over time.

Finally, this study adds to SDT by indicating that the proposed relationships within SDT—such as internalization or externalization and their links with need satisfaction or need frustration—may best be framed with reference to the time frame in which they occur. We found no evidence for a link between growth in need satisfaction and behavioural internalization, nor did we find evidence for a relationship between growth in need frustration and behavioural externalization. Yet, it appears from earlier research that short-term, momentary experiences of need satisfaction do relate to short-term, momentary elevations in autonomous motivation (e.g., Vandercammen, Hofmans, & Theuns, 2014). Moreover, also longitudinal studies spanning large time-intervals (i.e., weeks or months) have demonstrated that individuals may change their motivation regarding a certain activity (i.e., behavioural regulation) after having experienced need-supportive interventions in their environment (e.g., Edmunds, Ntoumanis, & Duda, 2008; Williams & Deci, 1996). Integrating these previous findings with our own results suggests that, although need satisfaction and frustration may indeed drive individuals' motivation, the establishment of perpetuated *changes* in motivation might only occur after repeated experiences of need satisfaction or need frustration. This reasoning is in line with literature on the development of a volunteer role identity, also known as one's identification with the volunteer job, and the assimilation of this role and its related behaviours and expectations within one's self-concept (Grube & Piliavin, 2000; Penner, 2002). For the development of a volunteer role identity—which is conceptually similar to the internalization of one's behavioural regulation as a volunteer—it has been argued that one needs to volunteer at a “high and involving level” (Penner, 2002, p. 463). In sum, although much more research is needed, the findings of the present study suggest that it would be worthwhile to extend SDT by adding a time-perspective to its framework.

Limitations and further research

Despite the theoretical significance of our study, a number of methodological and conceptual limitations should be taken into consideration. One of these issues involves the weak support we found for the distinction between need satisfaction and frustration at the within-person level. That is, the difference between the DIC values of the two tested models was rather small. In order to really show the distinction between both factors, further research should test their differential predictive validity by for example linking them to exhaustion and recovery over time. Moreover, it might be a good idea to show that need satisfaction and need frustration evoke different physical reactions, such that high need frustration might cause an increase in people's heart rate, whereas low feelings of need satisfaction might not. It is important to stress that demonstrating the suggested asymmetric relationship between need satisfaction and need frustration is impossible by relying on factor analysis only. One should rely on an experimental design in which levels of need satisfaction and need frustration are manipulated and correlated.

Second, to capture the process of change in motivation we followed volunteers during their volunteering activities at a holiday camp. Whereas the advantage of a holiday camp for the study of change is that it is a delineated activity with a clear beginning and end, the downside is that the choice for a holiday camp reduced the sample to a very specific group of volunteers. Indeed, the volunteer population is very heterogeneous, and a lot of volunteers engage themselves for a longer term, high-frequency agreement. Therefore, it remains an open question whether our findings also hold for other groups of volunteers who typically operate in other contexts. A related question is whether our findings generalize to paid employees as well. This question is even more pertinent because of the important differences between paid employees and volunteers. For example, it is typically the case that a-motivated people will refrain from participating in volunteer activities, which might not be possible for paid employees because of financial reasons. Moreover, the lack of formal contracting makes it easier for volunteers than for paid employees to leave their voluntary activities whenever they feel dissatisfied (Pearce, 1993). As a final example, volunteers and paid workers tend to have different expectations with respect to their (volunteer/paid) job (Vantilborgh et al., 2014). Because of these and other important differences between paid employees and volunteers, future research should test whether similar dynamics underlie the motivation of paid employees.

Finally, we only measured volunteers' motivation in the beginning and at the end of the voluntary activity, and because of this choice, we had no information about potential fluctuations in motivation during the activity. Future research may measure motivation on a daily basis

as well, which would then allow the use of latent growth curve modelling and the estimation of a person-specific intercept and slope over measurement moments for the outcome variables as well. Moreover, since it is still unclear how long it may take for these changes in motivation (i.e., internalization and externalization) to occur, one could go even further by combining a daily diary approach with longitudinal research with longer time intervals. Future research might also apply experience sampling techniques to rule out the possibility that this relationship is inflated by common-method bias. By surveying each respondent several times during one activity, respondents can be asked to indicate their levels of need satisfaction and need frustration on different points in time. In this way, respondents may find it more difficult to tune their scores on both variables, whereas at the same time fluctuations in need satisfaction and need frustration during one activity can still be captured.

Practical implications

Our study showed that the level of change in autonomous motivation from the start to the end of the holiday camp is determined by the intercept of need satisfaction. Thus, volunteers who initially feel that their feelings of autonomy, competence, and relatedness are satisfied are also more likely to show positive change in autonomous motivation when comparing the start and the end of the holiday camp. As this need satisfaction probably stimulates the volunteers to search for situations in which they can further satisfy their basic needs for autonomy, competence, and relatedness, volunteer managers might focus on triggering this need satisfaction at the start of the camp. One possibility might be to already meet these volunteers before the actual start of the camp, to offer them some practical information and tips or tricks, to give them the possibility to meet the other volunteers, and to also provide some specific guidelines for the camp. Indeed, all of these practices are known to be stimulating for people's autonomous motivation (e.g., Gagné & Deci, 2005).

As our findings revealed that the processes of need satisfaction and need frustration are mirrored over time, growth in need satisfaction and need frustration over the course of the camp are most probably effected by the same interventions. Therefore, an intervention aimed at satisfying one's need for relatedness will over time result in both increases of relatedness satisfaction feelings and decreases of relatedness frustration feelings. Because we found no relationship between growth in need satisfaction/frustration and behavioural internalization/externalization, our findings suggest that short-term interventions aimed at changing individuals' behaviour are not necessarily effective. Instead, fundamental changes in the effectiveness of

volunteers' behavioural regulation probably require repeated experiences of need satisfaction or frustration, and interventions should therefore focus on long-term, perpetuated exposure. In view of our study, this suggests that one positive holiday camp cannot guarantee the internalization of the reason for being a volunteer, or the development of a volunteer role identity. Instead, volunteers should become continuously attracted to need-satisfying voluntary activities.

Disclosure statement

No potential conflict of interest was reported by the authors.

Note

1. When only modelling the growth curves for need satisfaction and need frustration, the negative correlation between the slope of need satisfaction and the slope of need frustration becomes even stronger ($r = -.84$, 95% credibility interval = $[-.97, -.61]$).

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Appendix 1.

DATA: FILE = FILE_MPLUS.dat;

VARIABLE

NAMES = ID ORG EXT_V AMOT_V INTRO_V IDEN_V
INT_V EXT_N AMOT_N
INTRO_N IDEN_N INT_N nf0 nf1 nf2 nf3 nf4 nf5 nf6 nf7 nf8
nf9
ns0 ns1 ns2 ns3 ns4 ns5 ns6 ns7 ns8 ns9 autmot_time1
autmot_time2
contmot_time1 contmot_time2;
MISSING ARE ALL (9999);
USEVARIABLES ARE nf0 nf1 nf2 nf3 nf4 nf5 nf6 nf7
ns0 ns1 ns2 ns3 ns4 ns5 ns6 ns7
autmot_time1 autmot_time2 contmot_time1 contmot_time2;

ANALYSIS

COVERAGE = 0.000001;
ITERATIONS = 10000;
ESTIMATOR = BAYES;
POINT = MEAN;
PROCESS = 4;
FBITERATIONS = 20000;

ALGORITHM = GIBBS(RW);

MODEL

!defining the individual growth trajectories of need satisfaction and need frustration; ns = need satisfaction; nf = need frustration
i_f s_f nf0@0 nf1@1 nf2@2 nf3@3 nf4@4 nf5@5 nf6@6
nf7@7;
i_s s_s ns0@0 ns1@1 ns2@2 ns3@3 ns4@4 ns5@5 ns6@6
ns7@7;
!defining the main factors by fixing the loadings of each indicator to 1
T1contr by contmot_time1@1;
T2contr by contmot_time2@1;
T1aut by autmot_time1@1;
T2aut by autmot_time2@1;
!fixing the uniqueness of the indicators to their unreliability or $((1-\alpha)*\sigma^2)$
contmot_time1@.12996;
contmot_time2@.2493019;
autmot_time1@.137448;
autmot_time2@.099893;
!fixing the intercepts of the indicators to zero
[contmot_time1@0];
[contmot_time2@0];
[autmot_time1@0];
[autmot_time2@0];
!setting up the latent change factor for controlled motivation
Initialc by T1contr@1;
Changec by T2contr@1;
T1contr@0;
T2contr@0;
T2contr on T1contr@1;
[T1contr@0];
[T2contr@0];
!setting up the latent change factor for autonomous motivation
Initiala by T1aut@1;
Changea by T2aut@1;
T1aut@0;
T2aut@0;
T2aut on T1aut@1;
[T1aut@0];
[T2aut@0];
!correlating initial and change factors
Initialc with Changec;
Initiala with Changea;
i_f with s_f;
i_s with s_s;
!correlating the intercepts of need frustration and need satisfaction
i_f with i_s;
!correlating the initial levels and changes of autonomous and controlled motivation
Changec with Changea;
Initialc with Initiala;
Initialc with Changea;
Initiala with Changec;
!correlating intercepts of need satisfaction/frustration with initial levels of autonomous/controlled motivation
Initialc with i_f i_s;
Initiala with i_f i_s;
!estimating the regression coefficients
Changec on i_f s_f;
Changea on i_s s_s;
OUTPUT:
STANDARDIZED TECH4 TECH8;