European Journal of Work and Organizational Psychology, 2015
Vol. 24, No. 4, 491–504, http://dx.doi.org/10.1080/1359432X.2014.931326

Routledge
Taylor & Francis Group

Keep the fire burning: Reciprocal gains of basic need satisfaction, intrinsic motivation and innovative work behaviour

Toon Devloo[1], Frederik Anseel[1], Alain De Beuckelaer[1,2], and Marisa Salanova[3]

[1]Department of Personnel Management and Work and Organizational Psychology, Ghent University, Ghent, Belgium
[2]Institute for Management Research, Radboud University Nijmegen, Nijmegen, The Netherlands
[3]Wont Research Team, Universitat Jaume I, Castellón, Spain

Drawing on insights from self-determination theory, we explored the dynamic relationship between intrinsic motivation and innovative work behaviour (IWB) over time. Specifically, we investigated how basic need satisfaction influences IWB through its effect on intrinsic motivation and how IWB in turn affects basic need satisfaction as measured the next day (i.e., a reciprocal relationship). The current study used a longitudinal design comprising a 6-day period and relied on multi-source data from 76 students in industrial product design and electronic engineering who participated in an innovation boot camp. In general, results provided support for the mediating role of intrinsic motivation in the relationship between basic need satisfaction and IWB, as well as the reciprocal relationship between basic need satisfaction and IWB.

Keywords: Basic need satisfaction; Intrinsic motivation; Innovative work behaviour; Reciprocal relationship.

To ensure future success in a fiercely competitive and changing environment, organizations are expected to continuously reinvent themselves, anticipate future challenges, search for new ways to approach their core business and keep their target market interested. Past research has identified creativity and innovation as important factors for organizational success (e.g., Amabile, 1988; Janssen & Huang, 2008; Janssen, Van De Vliert, & West, 2004; Scott & Bruce, 1994; Van Der Vegt & Janssen, 2003). Hence, it is crucial for organizations to nurture employee creativity to obtain new ideas, help them in promoting their ideas and in developing innovative products and implementing new working strategies. In the academic literature, these three components of employee innovation (i.e., idea generation, promotion and implementation) are commonly referred to as innovative work behaviour (IWB).

Since the origins of innovation research, intrinsic motivation (i.e., the extent to which an individual engages in an activity for the sake of the activity itself) has been advanced as one of the main motivational drivers of IWB (Amabile, 1983, 1996; Collins & Amabile, 1999; Hüttermann & Boerner, 2011). Unfortunately, this perspective of motivation as an antecedent of IWB may be too simplistic, as it does not specify on conceptual grounds how motivational states and IWB interact over time. The present study suggests that a longitudinal reciprocal model might conceptually be the most viable representation of the relationship between one's motivational orientation and IWB. Hence, the aim of this article is to extend the relatively narrow perspective on the one-directional causal relationship between motivation and IWB by developing and testing a model that depicts reciprocal dynamics. Our reciprocal framework is developed in two steps. First, drawing on self-determination theory, the present study specifies the motivational sequence underlying fluctuations of IWB over time. More specifically, we investigate the motivational potential of basic psychological need satisfaction (i.e., satisfaction of the need for autonomy, competence and relatedness) on IWB through the mediating role of intrinsic motivation (Deci & Ryan, 2000; Van Den Broeck, Vansteenkiste, De Witte, & Lens, 2008). In a second step, to account for reciprocal influences of this relationship, we test whether engaging in IWB leads to subsequent basic psychological need satisfaction.

Correspondence should be addressed to Toon Devloo, Department of Personnel Management and Work and Organizational Psychology, Ghent University, Henri Dunantlaan 2, 9000 Ghent, Belgium. E-mail: Toon.Devloo@UGent.be

We would like to thank Filip Lievens (Ghent University) and Karoline Strauss (University of Sheffield) for their suggestions on earlier versions of this paper. The first and second author's contribution was supported by a grant from the Fund for Scientific Research Flanders (FWO-Vlaanderen) [grant number G.0790.10N].

Thus, the current study contributes to the literature in two substantial ways. First, by modelling the reciprocal relationship between motivational states and IWB in a longitudinal research design, this study goes beyond the traditional approach that exclusively conceptualized innovation as the endpoint of preceding motivational processes. Second, by introducing basic need satisfaction as a central motivational construct in the innovation process, the present study aims to integrate and apply insights from self-determination theory to disentangle the reciprocal nature of sustainable employee innovation processes.

MOTIVATIONAL DRIVERS OF INDIVIDUAL INNOVATION

In accordance with previous research, the present study defines individual innovation as: "the intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption designed to significantly benefit the individual, group, or organization" (West & Farr, 1990, p. 9). Scott and Bruce (1994) conceptualized individual innovation into the overarching construct IWB. This construct represents a set of multiple behaviours that correspond with different stages of the innovation process, being the generation or introduction of ideas in the work environment, mobilizing support for these ideas and finally realizing and implementing accepted ideas. Furthermore, it is not uncommon for individuals to be engaged in various combinations of these activities (i.e., idea generation, idea promotion, idea realization) at any given moment in time as the innovation process is frequently characterized by discontinuous activities (Janssen, 2000; Scott & Bruce, 1994). A construct closely related to IWB is creative behaviour which refers to the generation of ideas that are original and useful (Amabile, 1988, 1996; Zhou, 1998). IWB can be considered as a broader and encompassing behavioural construct as it not only involves the generation of ideas (i.e., creative behaviour) but also refers to those sociopolitical activities that are important to transform ideas into concrete innovations (Chen, Sharma, Edinger, Shapiro, & Farh, 2011; Janssen & Van Yperen, 2004; Yuan & Woodman, 2010).

A substantial body of literature has emphasized the importance of the motivational orientation of individuals when engaging in creative activities (e.g., Amabile, Hill, Hennessey, & Tighe, 1994; De Stobbeleir, Ashford, & Buyens, 2011; Rego, Sousa, Marques, & Cunha, 2012a). In general, research on the relationship between work motivation and creativity has been based on insights provided by the intrinsic motivation perspective, which has later been developed more broadly into self-determination theory (Deci & Ryan, 1987; Gagne & Deci, 2005). Intrinsically motivated individuals are found to be more creative because such motivation increases their tendency to be curious, cognitively flexible and risk taking (Deci & Ryan, 1985; Grant & Berry, 2011; Rego, Sousa, Marques, & Cunha, 2012b; Zhou, 2003), all of which should facilitate the development of creative ideas. As research on IWB has been developed from the creativity literature, it has also adopted the influential intrinsic motivation perspective (Frese, Teng, & Wijnen, 1999; West, 1987, 2002). However, several scholars have called attention to the fact that employee innovation is not a straightforward linear process with motivational antecedents directly affecting IWB. Instead, they urged the need to model the inherent reciprocal nature of the innovation process to better understand the relationship between motivation and IWB (Anderson, De Dreu, & Nijstad, 2004). Too often, innovation is treated as a single outcome variable. This approach fails to recognize that innovative actions may also initiate or affect other psychological processes (Anderson et al., 2004; Janssen et al., 2004). Specifically, the degree to which people will engage in innovative activities and the corresponding motivational orientation as to why they behave in that particular way may vary over time and will affect each other over time. Hence, a longitudinal design is necessary to adequately capture the dynamic relationship between one's motivational state and IWB. Furthermore, current theory needs to be expanded to understand how the relationship between motivation and IWB unfolds over time. The present study proposes "basic need satisfaction" as a motivational construct to study the reciprocal relationship between motivational states and IWB over time.

RECIPROCAL GAINS OF BASIC NEED SATISFACTION AND INNOVATIVE WORK BEHAVIOUR

Self-determination theorists have suggested that intrinsically motivated behaviour is a function of the extent to which one's basic psychological needs are satisfied, that is, the needs for autonomy, competence and relatedness (Deci, Koestner, & Ryan, 1999; Grolnick, Ryan, & Deci, 1991). In self-determination theory, this set of three psychological needs is advanced as the vital nutriment for the psychological growth of individuals, their well-being and optimal functioning (Deci & Ryan, 2000; Patrick, Knee, Canevello, & Lonsbary, 2007). Although basic need satisfaction is typically conceptualized as a higher-order construct referring to the extent to which individuals' overall needs are satisfied, three different needs can be distinguished (Greguras & Diefendorff, 2010; Leroy, Anseel, Gardner, & Sels, in press). First, the need for autonomy refers to the desire that individuals have to experience a certain degree of psychological freedom regarding their behaviour and thus to have a sense of choice rather than feeling controlled or pressured. Second, the need for competence involves feelings of efficiency when individuals interact with their environment rather than feeling incompetent when displaying a particular behaviour. Finally, the

need for relatedness represents individuals' desire to be meaningfully connected to others and to feel accepted as a group member (Greguras & Diefendorff, 2009; Ryan & Deci, 2000).

Self-determination theory postulates that these three psychological needs are innate to all individuals and that the combined satisfaction of these needs is essential to maintain and promote one's intrinsic motivation (Deci & Ryan, 2000; Sheldon & Filak, 2008). However, it should be noted that self-determination theory defines psychological needs as a function of the extent to which these needs are satisfied rather than how basic needs differ in strength between or within persons. Previous research findings in the work domain suggest that the satisfaction of basic psychological needs is a crucial factor leading to better work performance and should therefore be considered as a motivational condition for sustained proactive behaviour over time (e.g., Greguras & Diefendorff, 2009; Leroy et al., in press). We build on these work-context studies by investigating the motivational impact of basic need satisfaction when engaging in innovative work activities.

First, satisfying the need for autonomy makes individuals more likely to engage in self-directed and self-started behaviours (Strauss & Parker, 2013). More specifically, individuals who experience a sense of choice with regard to their activities tend to set and strive for proactive goals (Den Hartog & Belschak, 2012; Frese & Fay, 2001). In the light of innovative work, satisfying the need for autonomy seems particularly relevant as people who engage in IWB aim to challenge the status quo and actively seek to initiate change. Interestingly, empirical evidence indicates that experiencing autonomy is conducive to several innovation-related activities as previous work has demonstrated positive associations between autonomy at work and idea suggestion efforts (Axtell et al., 2000; Krause, 2004), voice behaviours (Fuller, Marler, & Hester, 2006) and idea implementation activities (Frese et al., 1999).

Second, satisfying the need for competence makes individuals more willing to engage in challenging activities and to explore new ways of doing things at work (Van Den Broeck, Vansteenkiste, Witte, Soenens, & Lens, 2010). In this regard, it can be expected that satisfying the need for competence should be conducive to innovative performance in individuals. Innovation is a complex and risky process, especially compared to more routine activities, and therefore it requires individuals taking roads that will confront them with obstacles and setbacks (Janssen et al., 2004). Consequently, individuals who do not believe they are capable of dealing with the challenges that are associated with innovation attempts and fear that their efforts will be in vein are not likely to set and pursue innovative goals. This reasoning is consistent with literature on self-efficacy which has extensively documented the positive impact of a sense of competence on change-related behaviour such as creative and innovative activities (e.g., Beghetto, Kaufman, & Baxter, 2011; Gong, Huang, & Farh, 2009; Michael, Hou, & Fan, 2011; Richter, Hirst, Van Knippenberg, & Baer, 2012; Tierney & Farmer, 2002, 2011).

Third, satisfying the need for relatedness implies a sense of belongingness and is said to induce perceptions of one's interpersonal environment as being non-threatening and supportive (Van Den Broeck et al., 2008). This notion of social acceptance has been described as an important factor to enable creative and innovative efforts in the workplace (i.e., which are cognitive and sociopolitical in nature). Previous research suggests that individuals are more likely to innovate if they can propose and pursue new ideas without feeling judged by their peers and when feeling psychologically safe (Anderson & West, 1998; Eisenbeiss, Van Knippenberg, & Boerner, 2008; Mathisen, Torsheim, & Einarsen, 2006). Hence, satisfying the need for relatedness should also have a positive influence on one's innovative work efforts.

Taken together, we propose that work-related basic need satisfaction will be associated with higher levels of IWB. More specifically, it is our contention that the relationship between basic need satisfaction and IWB will be mediated through the development of intrinsic motivation. In line with a vast body of research using the perspective of self-determination theory, we argue that individuals who simultaneously have a feeling of control about their actions, have a sense of mastery about their tasks and feel well connected to their colleagues are more likely to experience intrinsic motivation (for reviews, see Deci & Ryan, 2000; Gagne & Deci, 2005; Vansteenkiste, Niemiec, & Soenens, 2010). In turn, because the generation, promotion and realization of ideas all concern non-routine and challenging activities, IWB should be spurred by increased levels of intrinsic motivation (Amabile, 1985, 1988). Given that intrinsically motivated individuals are more likely to explore alternative cognitive pathways (Oldham & Cummings, 1996; Shalley, Zhou, & Oldham, 2004), they should not only be better able to generate original ideas but also to anticipate and prepare for possible difficulties that are associated with the promotion (e.g., political climate of the organization) and realization (e.g., availability of resources) of their ideas. This reasoning is consistent with Fredrickson's (2001) broaden-and-build theory of positive emotions, which posits that positive emotions broaden people's momentary thought–action repertoires. Therefore, when individuals feel good and enjoy the activity at hand (i.e., intrinsically motivated), they should be more willing to explore, to experiment and hence to engage in IWB. Furthermore, intrinsic motivation should also be conducive to IWB when promising ideas need to be explored more in depth or to systematically address those obstacles that prevent the successful realization of an idea, because it makes people more goal oriented and persistent in the face of such challenges (Gagne & Deci, 2005; Ryan & Deci, 2000). In contrast, when basic needs are thwarted, intrinsic motivation should diminish, and

in this case individuals are expected to exhibit low levels of IWB. Furthermore, consistent with past work (e.g., Leroy et al., in press), we combined the three needs to form a composite score for general need satisfaction. Self-determination theory suggests that the satisfaction of one particular need typically occurs in concert with the satisfaction of the other two needs, so that all three are positively associated (e.g., Deci et al., 2001; Leroy et al., in press; Van Den Broeck et al., 2008). Also, it is important to note that momentary psychological states (i.e., such as the variables under study) are likely to influence future states (Judge & Ilies, 2004). Hence, serial dependence of each variable should be accounted for when testing the hypothesized relationships in the present study.

> *Hypothesis 1:* Intrinsic motivation mediates the relationship between basic need satisfaction and IWB.

Basic need satisfaction is said to have an energizing power, in the sense that once individuals' psychological needs are fulfilled, they are more likely to proactively engage in subsequent need-fulfilling activities (Deci & Ryan, 2000). In other words, need fulfilment may not exclusively depend on external conditions (e.g., organizational/ job characteristics), but can also be facilitated by individuals' behavioural actions. Consistent with this theoretical rationale, Greguras and Diefendorff (2010) demonstrated that the pursuit of autonomous goals is positively related to basic need satisfaction (i.e., the combined satisfaction of the need for autonomy, competence and autonomy needs). More specifically, they argue that people who engage in goal striving for autonomous reasons are more likely to satisfy their basic needs as they may engage in self-directed activities (i.e., satisfaction of the need for autonomy), develop new skills (i.e., satisfaction of the need for competence) or rely on a group to achieve their goals (i.e., satisfaction of the need for relatedness). Furthermore, it has been proposed by Strauss and Parker (2013) that proactive behaviour such as taking initiative, scanning the environment for opportunities or challenging the status quo is an effective way to satisfy one's psychological needs of autonomy, competence and relatedness. These types of behaviours are self-initiated, involve the pursuit of challenging goals and are often socially oriented.

In line with this reasoning, we propose that this mechanism of need fulfilment is crucial for the understanding of how sustainable innovation processes are developed across time as we hypothesize that IWB not only results from sufficient need fulfilment and intrinsic motivation, but can also be approached as a need-fulfilling experience itself. Specifically, we argue that people who engage in IWB and thus challenge the status quo by looking for new ways to do things are more likely to create opportunities for themselves that enable subsequent basic need fulfilment across time. For example, by coming up with ideas on their own initiative, individuals are more likely to produce new professional opportunities for themselves and expand their impact on their work environment, which should lead to the satisfaction of their need for autonomy. Given that IWB also can be carried out to benefit other actors in the work environment (i.e., team or the broader organization), it may stimulate individuals to reflect on the needs of others (e.g., perspective taking), and to actively engage in sociopolitical-oriented activities (e.g., to build connections) to successfully promote ideas. In this sense, IWB should lead to the satisfaction of one's need for relatedness. Finally, individuals that develop ideas and eventually aim to get their ideas implemented are facing a highly challenging endeavour with many obstacles. However, when successfully pursuing their innovative goals, engaging in IWB should help individuals to acquire a sense of mastery and thus also satisfy their need for competence. Overall, by engaging in innovative behaviours, we believe individuals to be more likely to experience the concerted satisfaction of all three needs. Hence, this study proposes a reciprocal relationship between IWB and basic need satisfaction, such that engaging in IWB contributes to basic need satisfaction. Consequently, a new motivational chain should be fuelled, which should eventually influence intrinsic motivation and IWB (i.e., as proposed in Hypothesis 1).

> *Hypothesis 2:* Engaging in IWB leads to subsequent basic need satisfaction.

METHOD

Sample and setting

We conducted a longitudinal field study (i.e., a 6-day period) in an educational setting involving students in industrial product design and electronic engineering. Although at first, a student sample may seem to be limited in its potential for generalizability to work settings, the current setting is particularly relevant for organizations. The use of innovation boot camps as the one studied in the current study has increasingly grown in contemporary organizations for developing innovation and entrepreneurial skills in their technologists (Clarysse, Mosey, & Lambrecht, 2009). The sample consisted of a group of 99 students from several European universities who participated in an innovation boot camp on designing "sustainable products". Due to missing values in some of the study variables over the entire 6-day period, the sample size for the main analyses was reduced to 76 valid cases. Of these 76 participants, 56 were men (73.7%) and the mean age was

21.26 years (*SD* = 2.32). The main objective of this innovation boot camp was to provide future designers and engineers the opportunity to work in an international and multidisciplinary context on a real-life industrial case, put together by innovation managers of multiple participating companies. Participants worked on one of the six industrial cases that were provided by collaborating organizations (i.e., the number of people that worked on a particular case ranged from 11 to 14). All industrial cases were equivalent in that they all shared the same objective: the development of more sustainable green products or processes. During the innovation boot camp, participants had to attend a theoretical session in the morning (e.g., on energy-saving technology and cleaner production techniques), and they could apply the knowledge acquired in the afternoon workshop. During the afternoon sessions, participants worked on the development of innovative solutions related to their case. Furthermore, the end result (i.e., prototype or concept) had to be presented to the enterprise involved at the end of the innovation boot camp. Hence, the highly realistic nature of this innovation boot camp (i.e., real-life case) contributed to the external validity of our study, as the key components representing the dynamic nature of the innovation process were present.

Procedure

A week before starting the innovation boot camp, participants were contacted by email to inform them about the study. Participants were told that one of the purposes of this innovation boot camp was to map their experiences of psychological factors during the innovation process. They were promised to receive a personalized feedback report on the basis of the surveys that would be completed throughout the entire training period. Furthermore, in the same email, they were requested to complete a first electronic survey providing demographic information.

During the actual innovation boot camp (at the end of each full training day), participants were instructed to complete a survey concerning the activities they conducted during the afternoon session. All survey items were in English as this was the common language used among the participants and trainers. To reduce the common method bias, we also included peer ratings. More specifically, each afternoon participants had to evaluate the extent to which two of their companion students (i.e., that worked on the same case) engaged in IWB (see description later). The students to be evaluated changed every day to ensure a balanced performance assessment. This way, each day an IWB score was obtained for every participant by averaging the two ratings that were provided by a different combination of raters (i.e., neutralizing rater biases whenever present). Complete confidentiality was guaranteed to all participants.

Measures

All items included in the daily surveys were adapted so that they referred to the particular activities that were completed during the afternoon sessions.

Basic need satisfaction. This construct was assessed by the work-related basic need satisfaction scale of Van Den Broeck and colleagues (2009). Instead ozf the original scale with 18 items, we used a shorter scale by selecting 10 items, based on face and content validity and in consultation with Van den Broeck, to go into the daily questionnaire. Sample items are "The tasks, activities that I had to do this afternoon, are in line with what I really want to do" (satisfaction of the need for autonomy; four items); "This afternoon, I felt competent" (satisfaction of the need for competence; three items); "This afternoon, I felt part of a group/team" (satisfaction of the need for relatedness; three items). The answers were scored on a seven-point anchored Likert scale ranging from 1 = totally disagree to 7 = totally agree. Coefficients alpha (i.e., Cronbach's alpha) across all measurement moments ranged from .77 to .85 (mean alpha composite score of basic need satisfaction = .81; satisfaction of the need for autonomy = .69; satisfaction of the need for competence = .66; satisfaction of the need for relatedness = .58).

Intrinsic motivation. This construct was assessed by the intrinsic motivation subscale of the situational motivation scale of Guay, Vallerand, and Blanchard (2000). For the purpose of conciseness, we used the three highest loading items of the four-item subscale of Guay et al. (2000) to measure intrinsic motivation. A sample item is "I conducted the activities this afternoon because I think that they were interesting". The answers were scored on a seven-point anchored Likert scale ranging from 1 = totally disagree to 7 = totally agree. Coefficients alpha (i.e., Cronbach's alpha) across all measurement moments ranged from .86 to .96 (mean alpha = .88).

Innovative work behaviour (IWB). This construct was assessed by Janssen's (2000) nine-item IWB scale. To reduce the common method bias, we opted to measure this variable by using peer ratings instead of self-ratings. Peer ratings of each individual were obtained from two peers each day. Sample items are "Create new ideas for difficult issues regarding your case" (idea generation); "Mobilize support for innovative ideas" (idea promotion); "Transform innovative idezas into useful applications" (idea realization). The answers were scored on a seven-point anchored Likert scale ranging from 1 = never to 7 = always. Given that we found strong intercorrelations between the three dimensions of IWB (i.e., idea generation and idea promotion: r = .84/idea generation and idea realization: r = .79/idea promotion

and idea realization: $r = .85$) and following the recommendation of Janssen (2000), we averaged the nine items to obtain an overall score of IWB. Moreover, we averaged the two peer ratings to obtain one final score for IWB as the intra-class correlation (ICC) between these two peer ratings, amounting to .33, indicates an adequate level of agreement between the two raters (Bliese, 1998). Coefficients alpha (i.e., Cronbach's alpha) across all measurement moments ranged from .89 to .97 (mean alpha = .94).

Analytical approach

To test our hypotheses, we used path analysis by estimating a system of linear equations including only observed variables. Actually, for every respondent, the mean indicator scores for basic need satisfaction, intrinsic motivation and IWB at a specific day (i.e., day *t*) were treated as "observed variables". To simultaneously estimate all path coefficients, we used maximum likelihood estimates with robust standard errors (i.e., maximum likelihood estimation (MLM) as implemented in the software package Mplus version 6.11). By using robust standard errors, one ensures that the estimation is not affected by the fact that the data are non-normally distributed.

Instead of using mean indicator scores as construct scores, we also considered conceptualizing each construct as a single factor underlying its indicator variables (i.e., all corresponding survey items). However, the analysis sample of this study was rather small (i.e., $N = 76$ valid cases), implying that one must be cautious about unnecessarily increasing model complexity, for instance by substituting mean indicator scores by estimated factor scores. Given the small sample size, we also relied on a 90% confidence interval (i.e., $p < .10$) when testing the significance of structural relations. We are very aware that, notwithstanding repeated calls for abandoning $p < .05$ significance testing (Fidler, Thomason, Cumming, Finch, & Leeman, 2004), the prevalent convention in organizational sciences is to keep on relying on one fixed nominal level for alpha, typically (an upper bound of) .05. Because two indicative power analyses for the method of path analysis showed that to keep a minimum chance of 70% (i.e., power) to detect a path coefficient as small as 0.25 (for intrinsic motivation and basic need satisfaction) or below 0.20 (this smaller effect size is feasible for IWB), the nominal level for alpha was set at .10 rather than .05. In other words, to keep power levels of our path analysis at a reasonable level, some decrement in confidence (from 95 to 90%) was deemed necessary. The longitudinal nature of our study offered the possibility to test all psychological effects on a daily basis. Through an analysis with day-specific results including multiple tests of the focal relations on consecutive days, "overall confidence" in the test results should increase (despite a slightly lower level of confidence in the results obtained on a specific day; Lubinski, Webb, Morelock, & Benbow, 2001).

The analytical procedure to test the hypothesized dynamic mechanisms consisted of two consecutive steps. The first step involved deciding on the most adequate baseline model describing the extent to which construct scores (i.e., basic need satisfaction, intrinsic motivation and IWB) develop over time. To this end, a statistical evaluation (based on information criteria such as the Akaike information criterion (AIC) and the Bayesian information criterion (BIC)) was made of a "first-order autoregressive model" using day-specific mean indicator scores as observed variables. The first-order regressive model is based on the idea that every score for a variable observed at any given point in time (i.e., a specific day) is influenced by the score of the same variable at the previous point in time (i.e., the previous day) (see for instance, Frese, Garst, & Fay, 2007). A second, alternative model concerned the "autoregressive one-factor model", which models the stability of factors over time. In the autoregressive one-factor model, every factor (basic need satisfaction, intrinsic motivation and IWB) is measured by its mean indicator scores at different points in time (i.e., at different days). In the autoregressive one-factor model, stability over time is indicated by the height of the estimated factor loadings accompanying time-specific construct scores (i.e., mean indicator scores), whereas instability over time is indicated by the height of the estimated measurement errors. Factor loadings, item intercepts and measurement errors are all freely estimated in the autoregressive one-factor model. Information criteria (i.e., AIC and BIC) as derived for the two alternative (non-nested) baseline models revealed that the first-order autoregressive model was to be preferred over the autoregressive one-factor model for all constructs under study.

Hence, from a comparison of both models modelling (in)stability of construct scores over time, we drew our conclusions as to how we should provide adequate statistical control for the across-time dependency of the variables under study. This first step revealed that autoregressive effects (i.e., of the previous day on the current day) should be incorporated in any path-analytical model describing the relationships in our study.

In the second step, we estimated a so-called "autoregressive path-analytical model"; the model is labelled as such because it includes an autoregressive trajectory of the constructs under study. In fact, the autoregressive path-analytical model jointly estimates both the autoregressive effects and the theoretical relationships under study (see H1 and H2). Joint estimation ensures that the estimated effects for the theoretical relationships can be interpreted meaningfully. Joint estimation also seems to be particularly adequate for our study setting, namely an innovation boot camp. In essence, an innovation boot camp is a developmental setting in which non-controlled, time-specific contextual factors may also affect the focal structural relationships between constructs (see H1 and

H2). Hence, an autoregressive path model was used to account for the underlying across-time dependencies in our data. Moreover, by repeatedly testing the hypothesized relationships (see H1 and H2) and finding a consistent pattern across time, a high level of confidence can be obtained. Using the autoregressive path-analytical model, the relationships between basic need satisfaction, intrinsic motivation and IWB (at any given point in time) as well as the reciprocal effect of IWB on basic need satisfaction (i.e., over consecutive days) can be assessed empirically. More specifically, on the basis of the size and the significance of the estimated path coefficients as derived from this autoregressive path-analytical model, one can test the hypothesized relationships. As far as the mediating role of intrinsic motivation in the relationship between basic need satisfaction and IWB is concerned (H1), the estimated effects will determine whether the mediating effect concerns a partial or a full mediation effect.

In addition to the previously mentioned autoregressive path-analytical model and in line with commonly encountered analytical procedures applied to this kind of repeated measurement data (e.g., Binnewies, Sonnentag, & Mojza, 2009; Ohly, Sonnentag, Niessen, & Zapf, 2010), we also ran a multilevel model with repeated measurements (level 1) nested within individuals (level 2). In a sense, this is an aggregated model, which does not allow for identifying a pattern in the observed relationships over time, and as a consequence does not provide the high level of confidence that can be obtained from our autoregressive path-analytical model. Therefore, this multilevel model provides less fine-grained information about hypothesized effects as observed on specific days. However, the results of this multilevel model may serve as a rough overall test of the hypothesized relationships (H1 and H2) and provide further confidence in the conclusions drawn. To keep our multilevel analysis aligned with our autoregressive path-analytical model, we statistically controlled for across-time dependency by including the autoregressive effects of the variables under study (in the same way as in the autoregressive path model) and by estimating within-subject variance (i.e., controlling for shared variance among all day-specific measurements obtained for the same participant).

Furthermore, in addition to the multilevel model tests with basic need satisfaction comprising one construct, we also ran a similar multilevel model including all three sub-dimensions of basic need satisfaction, namely satisfaction of the need for autonomy, competence and relatedness next to one another (i.e., controlling for their shared variance). This additional exploratory multilevel model accounts for potential differences between the three separate basic needs with respect to the hypothesized relationships (H1 and H2). This additional multilevel model provides complementary information to our main hypotheses as previous research has suggested that different effects with respect to the three basic need satisfactions might be observed (Gagne, Senécal, & Koestner, 1997).

RESULTS

Descriptive statistics (i.e., mean, standard deviation, correlations and coefficients alpha) of the main variables of this study are presented in Table 1.[1]

Our autoregressive path-analytical results are presented in Table 2. Inspection of the R^2-values displayed in Table 2 shows that for all constructs under study (i.e., basic need satisfaction, intrinsic motivation and IWB) reasonable R^2-values were obtained (i.e., mostly exceeding .30). R^2-values lower than .30 were observed in only 4 out of 15 R^2-values (R^2 [basic need satisfaction, day $t + 1$] = .27; R^2 [basic need satisfaction, day $t + 5$] = .21; R^2 [intrinsic motivation, day $t + 4$] = .14; R^2 [IWB, day t] = .19).

As shown in Table 2, we found support for the mediating role of intrinsic motivation in the relationship between basic need satisfaction and IWB. For 5 out of 6 days (i.e., all days except for day $t + 5$, the last day), intrinsic motivation mediated the relationship between basic need satisfaction and IWB (see H1). Four out of five times (see Table 2: days t, $t + 1$, $t + 2$ and $t + 3$), we found support for *full* mediation.

The results presented in Table 2 provide support for the hypothesized reciprocal relationship (i.e., the effect of IWB at the previous day on basic need satisfaction at the next day). In all tests (i.e., five out of five tests), the relationship between IWB at the previous day and basic need satisfaction at the next day was significant. However, it should be noted that one of these five significant relationships yielded a negative effect of IWB at the previous day on basic need satisfaction at the next day.[2]

Table 3 presents the results of the multilevel model providing an overall test of our hypotheses. In general, results are consistent with the findings from our main analysis (see Table 2; autoregressive path-analytical model). Although this multilevel model provides support for the mediating role of intrinsic motivation in the relationship between basic need satisfaction and IWB, results suggest partial mediation rather than full mediation. Hence, this multilevel model provides partial support for Hypothesis 1. In support of Hypothesis 2, we

[1]The full correlation table, including the separate dimensions of basic need satisfaction, is available from the first author on request.

[2]The path analyses used in this study did not model shared variance at the group (i.e., industrial case) level in addition to variation at the individual level. However, using the new Bayesian estimator implemented in Mplus (Asparouhov & Muthén, 2010), we derived a two-level path solution attesting to the stability of our key model results (i.e., mediation and reciprocal effect; see Appendix, Table A1).

TABLE 1
Descriptive statistics, correlation coefficients and Cronbach's alpha

Variables	*M*	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
1. BNS T1	5.07	0.78	.81																	
2. BNS T2	5.13	0.84	.51**	.85																
3. BNS T3	5.12	0.80	.50**	.66**	.81															
4. BNS T4	5.01	0.82	.53**	.60**	.66**	.77														
5. BNS T5	5.01	0.86	.55**	.57**	.66**	.58**	.83													
6. BNS T6	4.94	0.79	.49**	.49**	.40**	.33**	.44**	.78												
7. IM T1	5.35	1.01	.63**	.39**	.34**	.30**	.34**	.34**	.89											
8. IM T2	5.54	0.91	.36**	.70**	.50**	.36**	.46**	.39**	.48**	.87										
9. IM T3	5.55	0.93	.35**	.43**	.64**	.46**	.47**	.39**	.49**	.70**	.88									
10. IM T4	5.46	0.86	.14	.49**	.45**	.58**	.49**	.27*	.20	.53**	.56**	.84								
11. IM T5	5.03	1.37	.02	.20	.33**	.10	.34**	.18	.20	.39**	.40**	.33**	.96							
12. IM T6	5.16	1.08	.17	.40**	.29*	.19	.34**	.47**	.33**	.55**	.48**	.58**	.47**	.86						
13. IWB T1	4.79	0.65	.29*	.26*	.02	.16	.07	.07	.43**	.19	.08	.01	.12	.00	.89					
14. IWB T2	4.96	0.71	.25*	.41**	.05	.10	.21	.11	.29*	.42**	.24*	.14	.07	.17	.60**	.93				
15. IWB T3	4.96	0.78	.28*	.38**	.33**	.32**	.28*	.30*	.37**	.50**	.53**	.34**	.14	.34**	.30**	.57**	.93			
16. IWB T4	5.14	0.89	.19	.37**	.38**	.31**	.30**	.37**	.22	.31**	.40**	.34**	.02	.33**	.23*	.28*	.48**	.96		
17. IWB T5	5.10	0.88	.23*	.26*	.34**	.34**	.41**	.31**	.24*	.32**	.47**	.29*	.21	.23*	.30**	.35**	.58**	.59**	.95	
18. IWB T6	5.14	0.91	.30**	.37**	.36**	.39**	.34**	.40**	.17	.32**	.39**	.27*	.02	.12	.27*	.43**	.55**	.56**	.64**	.97

Cronbach's alpha coefficients are reported on the diagonal. BNS = basic need satisfaction, IM = intrinsic motivation, IWB = innovative work behaviour. T1 = day t, T2 = day $t + 1$, T3 = day $t + 2$, T4 = day $t + 3$, T5 = day $t + 4$, T6 = day $t + 5$.

*$p < .05$.

**$p < .01$.

TABLE 2
Path coefficients as estimated in the elaborated "autoregressive path-analytical model" using robust MLM in Mplus (N = 76)

	Day t	*Day t ± 1*	*Day t ± 2*	*Day t ± 3*	*Day t ± 4*	*Day t ± 5*
Structural relations						
A: Effect of IWB (previous day) on BNS	NA	.13*	−.31**	.16**	.12*	.17**
Diagnosis: Existence of a reciprocal effect	Not testable	Yes	Yes	Yes	Yes	Yes
B: Effect of BNS on IM (same day)	.62**	.59**	.40**	.41**	.23**	.40**
C: Effect of IM on IWB (same day)	.41**	.25**	.40**	.14*	.12*	−.14
D: Effect of BNS on IWB (same day)	.02	.09	−.07	.09	.20**	.28**
Diagnosis: type of mediation: full mediation (B and C significant), partial mediation (B, C and D significant) and no mediation (B and/or C not significant)	Full	Full	Full	Full	Partial	No
Statistical control[a]						
Effect of BNS (previous day) on BNS	NA	.47**	.76**	.61**	.54**	.37**
Effect of IM (previous day) on IM	NA	.24**	.51**	.37**	.23**	.39**
Effect of IWB (previous day) on IWB	NA	.51**	.48**	.46**	.55**	.59**
R^2-values (this model)						
BNS	NA	.27	.49	.43	.34	.21
IM	.39	.51	.58	.43	.14	.36
IWB	.19	.44	.45	.31	.45	.48

[a]Relationships as determined by the autoregressive path-analytical model; NA = not applicable (in the model), BNS = basic need satisfaction, IM = intrinsic motivation, IWB = innovative work behaviour.
*$p < .10$.
**$p < .05$.

TABLE 3
Estimation of the hypothesized relationships with the higher-order construct "basic need satisfaction" included in the multilevel model

Structural relations	
A: Effect of IWB (previous day) on BNS	.09**
Diagnosis: Existence of a reciprocal effect	Yes
B: Effect of BNS on IM (same day)	.47**
C:Effect of IM on IWB (same day)	.12**
D: Effect of BNS on IWB (same day)	.17**
Diagnosis: Type of mediation: full mediation (B and C significant), partial mediation (B, C, and D significant) and no mediation (B and/or C not significant)	Partial
R^2-values (this model)	
BNS	.32**
IM	.32**
IWB	.38**

N = 460 observations nested within 98 individuals (exceeding N = 76 because individuals with missing data on specific days are also included). To ensure consistency with our analysis of day-level fluctuations (see Table 2), we statistically corrected for autoregressive effects in our data (i.e., effects of previous on current observations for all focal constructs). BNS = basic need satisfaction, IM = intrinsic motivation, IWB = innovative work behaviour.
**$p < .05$.

found a significant positive relationship between IWB (at the previous day) on subsequent basic need satisfaction (at the next day).[3]

[3]The same analytical multilevel procedure was followed to test the hypothesized relationships (H1 and H2) using self-rated IWB scores. Given that analyses with self-rated IWB measures provided similar results as the analyses with peer-rated IWB measures adds to our confidence about the overall robustness of our results.

Finally, the results of the exploratory multilevel model including the three separate dimensions of basic need satisfaction are presented in Table 4. Specifically, support was found for Hypothesis 1 as we observed a full mediation effect of intrinsic motivation in the relationship between the three separate basic needs and IWB. As explained in the section "Method", in this model we included and adequately controlled for the shared variance between all three basic need dimensions. With regard to Hypothesis 2, we found that IWB (at the previous day) was significantly related to the satisfaction of two basic needs as measured at the subsequent day, namely the satisfaction of the need for autonomy and the need for relatedness. However, the relationship between IWB at the previous day and the satisfaction of the need for competence at the next day was not significant.

In sum, we conclude that evidence was found for at least partial mediation of intrinsic motivation in the relationship between basic need satisfaction and IWB (H1). Moreover, our data also supported Hypothesis 2 as IWB generally predicted basic need satisfaction over time. This implies that the central constructs of this study are reciprocally related to each other.

DISCUSSION

The creativity and innovative behaviour literatures have advanced intrinsic motivation as one of the most important motivational mechanisms that are associated with individual innovation (e.g., Amabile, 1985, 1988; Janssen & Van Yperen, 2004). Although this intrinsic motivation perspective has importantly contributed to

TABLE 4
Estimation of the hypothesized relationships with the three separate basic psychological needs jointly included in the multilevel model

	Need for autonomy	*Need for competence*	*Need for relatedness*
Structural relations			
A: Effect of IWB (previous day) on BNS dimension	.10**	.05	.13**
Diagnosis: existence of a reciprocal effect	Yes	No	Yes
B: Effect of BNS on IM (same day)	.29**	.18**	.11*
C: Effect of IM on IWB (same day)	.07**	.07**	.07**
D: Effect of BNS on IWB (same day)	.04	.05	.06
Diagnosis: type of mediation: full mediation (B and C significant), partial mediation (B, C and D significant) and no mediation (B and/or C not significant)	Full	Full	Full

N = 460 observations nested within 98 individuals (exceeding N = 76 because individuals with missing data on specific days are also included). To ensure consistency with our analysis of day-level fluctuations (see Table 2), we statistically corrected for autoregressive effects in our data (i.e., effects of previous on current observations for all focal constructs). BNS = basic need satisfaction, IM = intrinsic motivation, IWB = innovative work behaviour.

*$p < .10$.

**$p < .05$.

our understanding of how and when IWBs are more likely to occur, fluctuations in motivational states during these dynamic innovation processes remained underexplored to date. The present study extends current IWB theory by proposing basic need satisfaction as a central construct to explain the reciprocal relationship between motivational states and IWB across subsequent days. Findings from this study are consistent with predictions of self-determination theory as they indicate that intrinsic motivation at least partially mediates the relationship between basic need satisfaction and IWB (Hypothesis 1). Furthermore, lagged effects of IWB at the previous day on basic need satisfaction at the next day were observed (Hypothesis 2). Taken together, these results point to reciprocal gains between basic need satisfaction and IWB across time.

Furthermore, an exploratory test revealed similar results regarding both hypotheses when including all three basic needs separately into our model. The only divergent finding (i.e., compared to the multilevel analysis with the composite score of basic need satisfaction) concerns the lagged relationship between IWB and the need for competence as we observed that this relationship was not significant. This non-significant relationship might be explained by different reciprocal patterns between IWB and basic need satisfaction at a day level. More specifically, one of the five significant cross-lagged effects of IWB on basic need satisfaction appeared to be negative (i.e., day $t + 2$). This negative relationship may have obscured the overall impact of IWB on subsequent basic need satisfaction, especially in the case of the need for competence. To test this assumption, we re-analysed the overall relationship (i.e., multilevel model) between IWB and subsequent satisfaction of the need for competence without the lagged link between IWB at day $t + 1$ and basic need satisfaction at day $t + 2$. In line with Hypothesis 2, this new analysis indicated a significant lagged relationship between IWB and the satisfaction of the need for competence ($B = 0.11$, $SE = 0.05$; $p < .05$).

We interviewed the trainers post hoc to inquire about this unexpected negative relationship. Apparently, on day $t + 2$, a first "formal" feedback moment was organized as participants received explicit feedback from the trainers concerning the ideas they had been working on so far. However, to ensure that participants would not start too hasty with the development of a particular idea, all trainers instructed the students to continue generating more ideas (i.e., regardless of the quality of the ideas they already had). Hence, it may be the case that participants who "invested" a considerable amount of effort and time in an idea on the previous day ($t + 1$) may have felt frustrated as they were asked to take a step back and further explore the problem from a different perspective. Consequently, this feedback intervention may have led to decreased basic need satisfaction on day $t + 2$, among those individuals who strongly engaged in IWB on the day before. In this regard, Janssen and colleagues (2004) have argued that innovative actions may not exclusively lead to beneficial outcomes but can also be associated with potential costs such as a decrease in intrinsic motivation. The outcomes of innovative behaviours may be context dependent and, therefore, individuals do not solely depend on their own efforts when pursuing innovative ideas. In other words, failure or success of innovative actions also depends on the amount of support received, resistance to change by colleagues or the availability of sufficient resources (Hakanen, Perhoniemi, & Toppinen Tanner, 2008; Janssen, 2003; West & Farr, 1990). Thus, it may well be that at one particular day (i.e., $t + 2$), participants who displayed high levels of IWB somehow got frustrated or were not satisfied with the results of their work due to a shared, external cause (e.g., an unsatisfying feedback intervention, insufficient support from trainers). Consequently, such a situation may have led to a decrease rather than an increase in subsequent basic need satisfaction on the next day. This reasoning is consistent with self-determination theory which states that intrinsic motivation might decrease when individuals experience that their environment hinders them to properly execute their own behavioural intentions (Deci & Ryan, 1985).

This research adds to the literature of IWB and self-determination theory in a number of ways. First, by highlighting the reciprocal influences between motivational states and IWB that can arise across subsequent days, the present study provides a theoretical and empirical framework that corresponds more directly to the inherent dynamic and cyclical nature of innovation processes. Consequently, this reciprocal framework also deepens knowledge on how engaging in task-related behaviours (i.e., IWB) may facilitate the development of future optimal motivational states. Second, by further elaborating on the theoretical link between intrinsic motivation and IWB (i.e., which not only comprises idea generation but also idea promotion and idea realization activities), this study establishes a meaningful rationale for the role of intrinsic motivation in innovation processes that goes beyond the well-documented intrinsic motivation–creativity relationship. Finally, as we have taken a day-level approach on the motivational potential of basic need satisfaction on IWB, findings of the present study add to initial empirical evidence in the domain of self-determination theory regarding the short-term dynamics of this motivational construct (e.g., Reis, Sheldon, Gable, Roscoe, & Ryan, 2000).

In spite of its contributions to a more complete modelling of the motivational dynamics of the innovation process, the present study is not without limitations. The small sample size clearly imposed restrictions on the complexity of our analytical model (e.g., number of cross-lagged paths). Further, to extend the current theoretical framework, future research should study moderators of the reciprocal relationship between IWB and basic need satisfaction. For instance, we expect feedback climate and a supportive leadership style to affect the reciprocal relationship between basic need satisfaction and IWB. Furthermore, our sample comprised of students in industrial product design and electronic engineering. Although the participating companies selected a number of innovative solutions that were developed during the boot camp, demonstrating the realistic character of our study setting, future research needs to investigate these processes in an organizational setting. More specifically, it might be necessary to investigate these motivational processes over a longer time period in a sample of "regular" employees. The definition of IWB implies that innovation is not an exclusive matter for R&D professionals but can also be carried out by all employees in a wide range of divisions of an organization. For instance, employees can suggest new working methods to improve their effectiveness, reflect on how current services may be facilitated or provide support or resources when a particular idea needs to get implemented in the organization. Some of these smaller, incremental innovations might, however, take a long time or may meet resistance in colleagues or superiors. It remains unclear whether basic need satisfaction and IWB will reciprocally affect each other in settings that are less focused on innovation. A second remaining issue is to what extent intrinsic motivation might be differentially related to more specific innovative activities. Whereas IWB is typically conceptualized as the common denominator involving a diversity of innovation-related behaviours (Janssen, 2000), it would be worthwhile to identify specific innovative behaviours that are less strongly affected by intrinsic motivation than idea generation. For instance, one could argue that activities such as idea implementation and planning might also involve a more extrinsic motivation component as it might entail working towards externally imposed goals and rewards.

Results of the current study imply that organizations aiming to stimulate and maintain high levels of IWB among their employees should target their efforts on stimulating basic need satisfaction. In this respect, previous research has demonstrated the strong impact that supervisor' leadership styles (e.g., authentic leadership; Leroy et al., in press) and job characteristics (e.g., social support; Van Den Broeck et al., 2008) have on basic need satisfaction.

In sum, this study extended the traditional perspective on IWB depicting motivation exclusively as an antecedent of IWB. Specifically, we demonstrated that motivational states and IWB affect each other reciprocally and identified basic need satisfaction as a key motivational construct in this dynamic relationship. We believe this study provides an important first step for one of the main challenges for future innovation research, namely the adoption of a dynamic and reciprocal perspective on the innovation process.

REFERENCES

Amabile, T. M. (1979). Effects of external evaluation on artistic creativity. *Journal of Personality and Social Psychology*, *37*, 221–233.

Amabile, T. M. (1983). *The social psychology of creativity.* New York, NY: Springer.

Amabile, T. M. (1985). Motivation and creativity: Effects of motivational orientation on creative writers. *Journal of Personality and Social Psychology*, *48*, 393–399.

Amabile, T. M. (1988). A model of creativity and innovation in organizations. In B. M. Staw & L. L. Cummings (Eds.), *Research in organizational behavior* (pp. 187–209). Greenwich, CT: JAI Press.

Amabile, T. M. (1996). *Creativity in context: Update to the social psychology of creativity.* Boulder, CO: Westview.

Amabile, T. M., Hill, K. G., Hennessey, B. A., & Tighe, E. M. (1994). The work preference inventory: Assessing intrinsic and extrinsic motivational orientations. *Journal of Personality and Social Psychology*, *66*, 950–967.

Anderson, N., De Dreu, C. K. W., & Nijstad, B. A. (2004). The routinization of innovation research: A constructively critical review of the state-of-the-science. *Journal of Organizational Behavior*, *25*, 147–173.

Anderson, N., & West, M. A. (1998). Measuring climate for work group innovation: Development and validation of the team climate inventory. *Journal of Organizational Behavior*, *19*, 235–258.

Asparouhov, T., & Muthén, B. (2010). *Bayesian analysis using Mplus: Technical implementation*. Retrieved from http://www.statmodel.com

Axtell, C. M., Holman, D. J., Unsworth, K. L., Wall, T. D., Waterson, P. E., & Harrington, E. (2000). Shopfloor innovation: Facilitating

the suggestion and implementation of ideas. *Journal of Occupational and Organizational Psychology*, *73*, 265–285.

Beghetto, R. A., Kaufman, J. C., & Baxter, J. (2011). Answering the unexpected questions: Exploring the relationship between students' creative self-efficacy and teacher ratings of creativity. *Psychology of Aesthetics, Creativity, and the Arts*, *5*, 342–349.

Binnewies, C., Sonnentag, S., & Mojza, E. J. (2009). Daily performance at work: Feeling recovered in the morning as a predictor of day-level job performance. *Journal of Organizational Behavior*, *30*, 67–93.

Bliese, P. D. (1998). Group size, ICC values, and group-level correlations: A simulation. *Organizational Research Methods*, *1*, 355–373.

Chen, G., Sharma, P. N., Edinger, S. K., Shapiro, D. L., & Farh, J.-L. (2011). Motivating and demotivating forces in teams: Cross-level influences of empowering leadership and relationship conflict. *Journal of Applied Psychology*, *96*, 541–557.

Clarysse, B., Mosey, S., & Lambrecht, I. (2009). New trends in technology management education: A view from Europe. *Academy of Management Learning & Education*, *8*, 427–443.

Collins, M. A., & Amabile, T. M. (1999). Motivation and creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 297–312). Cambridge: Cambridge University Press.

De Stobbeleir, K. E. M., Ashford, S. J., & Buyens, D. (2011). Self-regulation of creativity at work: The role of feedback-seeking behavior in creative performance. *Academy of Management Journal*, *54*, 811–831.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, *125*, 627–668.

Deci, E. L., & Ryan, R. M. (1985). The general causality orientations scale: Self-determination in personality. *Journal of Research in Personality*, *19*, 109–134.

Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology*, *53*, 1024–1037.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits : Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*, 227–268.

Deci, E. L., Ryan, R. M., Gagne, M., Leone, D. R., Usunov, J., & Kornazheva, B. P. (2001). Need satisfaction, motivation, and well-being in the work organizations of a former eastern bloc country: A cross-cultural study of self-determination. *Personality and Social Psychology Bulletin*, *27*, 930–942.

Den Hartog, D. N., & Belschak, F. D. (2012). When does transformational leadership enhance employee proactive behavior? The role of autonomy and role breadth self-efficacy. *Journal of Applied Psychology*, *97*, 194–202.

Dysvik, A., & Kuvaas, B. (2011). Intrinsic motivation as a moderator on the relationship between perceived job autonomy and work performance. *European Journal of Work and Organizational Psychology*, *20*, 367–387.

Eisenbeiss, S. A., Van Knippenberg, D., & Boerner, S. (2008). Transformational leadership and team innovation: Integrating team climate principles. *Journal of Applied Psychology*, *93*, 1438–1446.

Fidler, F., Thomason, N., Cumming, G., Finch, S., & Leeman, J. (2004). Editors can lead researchers to confidence intervals, but can't make them think: Statistical reform lessons from medicine. *Psychological Science*, *15*, 119–126.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology. *American Psychologist*, *56*, 218–226.

Frese, M., & Fay, D. (2001). 4. Personal initiative: An active performance concept for work in the 21st century. *Research in Organizational Behavior*, *23*, 133–187.

Frese, M., Teng, E., & Wijnen, C. J. D. (1999). Helping to improve suggestion systems: Predictors of making suggestions in companies. *Journal of Organizational Behavior*, *20*, 1139–1155.

Frese, M., Garst, H., & Fay, D. (2007). Making things happen: Reciprocal relationships between work characteristics and personal initiative in a four-wave longitudinal structural equation model. *Journal of Applied Psychology*, *92*, 1084–1102.

Fuller, J. B., Marler, L. E., & Hester, K. (2006). Promoting felt responsibility for constructive change and proactive behavior: Exploring aspects of an elaborated model of work design. *Journal of Organizational Behavior*, *27*, 1089–1120.

Gagne, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, *26*, 331–362.

Gagne, M., Senécal, C., & Koestner, R. (1997). Proximal job characteristics, feelings of empowerment, and intrinsic motivation : A multidimensional model. *Journal of Applied Social Psychology*, *27*, 1222–1240.

Gong, Y., Huang, J. C., & Farh, J. L. (2009). Employee learning orientation, transformational leadership, and employee creativity: The mediating role of employee creative self-efficacy. *Academy of Management Journal*, *52*, 765–778.

Grant, A. M., & Berry, J. W. (2011). The necessity of others is the mother of invention: Intrinsic and prosocial motivations, perspective taking, and creativity. *Academy of Management Journal*, *54*, 73–96.

Greguras, G. J., & Diefendorff, J. M. (2009). Different fits satisfy different needs: Linking person-environment fit to employee commitment and performance using self-determination theory. *Journal of Applied Psychology*, *94*, 465–477.

Greguras, G. J., & Diefendorff, J. M. (2010). Why does proactive personality predict employee life satisfaction and work behaviors? A field investigation of the mediating role of the self-concordance model. *Personnel Psychology*, *63*, 539–560.

Grolnick, W. S., Ryan, R. M., & Deci, E. L. (1991). Inner resources for school achievement: Motivational mediators of children's perceptions of their parents. *Journal of Educational Psychology*, *83*, 508–517.

Guay, F., Vallerand, R. J., & Blanchard, C. (2000). On the assessment of situational intrinsic and extrinsic motivation: The situational motivation scale. *Motivation and Emotion*, *24*, 175–213.

Hakanen, J., Perhoniemi, R., & Toppinen Tanner, S. (2008). Positive gain spirals at work: From job resources to work engagement, personal initiative and work-unit innovativeness. *Journal of Vocational Behavior*, *73*, 78–91.

Hüttermann, H., & Boerner, S. (2011). Fostering innovation in functionally diverse teams: The two faces of transformational leadership. *European Journal of Work and Organizational Psychology*, *20*, 833–854.

Janssen, O. (2000). Job demands, perceptions of effort–reward fairness and innovative work behaviour. *Journal of Occupational and Organizational Psychology*, *73*, 287–302.

Janssen, O. (2003). Innovative behaviour and job involvement at the price of conflict and less satisfactory relations with co-workers. *Journal of Occupational and Organizational Psychology*, *76*, 347–364.

Janssen, O., & Huang, X. (2008). Us and me: Team identification and individual differentiation as complementary drivers of team members' citizenship and creative behaviors. *Journal of Management*, *34*, 69–88.

Janssen, O., Van De Vliert, E., & West, M. (2004). The bright and dark sides of individual and group innovation: A special issue introduction. *Journal of Organizational Behavior*, *25*, 129–145.

Janssen, O., & Van Yperen, N. W. (2004). Employees' goal orientations, the quality of leader-member exchange, and the outcomes of job performance and job satisfaction. *Academy of Management Journal*, *47*, 368–384.

Judge, T. A., & Ilies, R. (2004). Affect and job satisfaction: A study of their relationship at work and at home. *Journal of Applied Psychology*, *89*, 661–673.

Krause, D. E. (2004). Influence-based leadership as a determinant of the inclination to innovate and of innovation-related behaviors. *The Leadership Quarterly*, *15*, 79–102.

Leroy, H., Anseel, F., Gardner, W. L., & Sels, L. (in press). Authentic leadership, authentic followership, basic need satisfaction, and work role performance: A cross-level study. *Journal of Management*.

Lubinski, D., Webb, R. M., Morelock, M. J., & Benbow, C. P. (2001). Top 1 in 10,000: A 10-year follow-up of the profoundly gifted. *Journal of Applied Psychology*, *86*, 718–729.

Mathisen, G. E., Torsheim, T., & Einarsen, S. (2006). The team-level model of climate for innovation: A two-level confirmatory factor analysis. *Journal of Occupational and Organizational Psychology*, *79*, 23–35.

Michael, L. A. H., Hou, S.-T., & Fan, H.-L. (2011). Creative self-efficacy and innovative behavior in a service setting: Optimism as a moderator. *The Journal of Creative Behavior*, *45*, 258–272.

Ohly, S., Sonnentag, S., Niessen, C., & Zapf, D. (2010). Diary studies in organizational research. *Journal of Personnel Psychology*, *9*, 79–93.

Oldham, G. R., & Cummings, A. (1996). Employee creativity: Personal and contextual factors at work. *Academy of Management Journal*, *39*, 607–634.

Patrick, H., Knee, C. R., Canevello, A., & Lonsbary, C. (2007). The role of need fulfillment in relationship functioning and well-being: A self-determination theory perspective. *Journal of Personality and Social Psychology*, *92*, 434–457.

Rego, A., Sousa, F., Marques, C., & Cunha, M. P. E. (2012a). Optimism predicting employees' creativity: The mediating role of positive affect and the positivity ratio. *European Journal of Work and Organizational Psychology*, *21*, 244–270.

Rego, A., Sousa, F., Marques, C., & Cunha, M. P. E. (2012b). Retail employees' self-efficacy and hope predicting their positive affect and creativity. *European Journal of Work and Organizational Psychology*, *21*, 923–945.

Reis, H. T., Sheldon, K. M., Gable, S. L., Roscoe, J., & Ryan, R. M. (2000). Daily well-being: The role of autonomy, competence, and relatedness. *Personality and Social Psychology Bulletin*, *26*, 419–435.

Richter, A. W., Hirst, G., Van Knippenberg, D., & Baer, M. (2012). Creative self-efficacy and individual creativity in team contexts: Cross-level interactions with team informational resources. *Journal of Applied Psychology*, *97*, 1282–1290.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *The American Psychologist*, *55*, 68–78.

Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal*, *37*, 580–607.

Shalley, C. E., Zhou, J., & Oldham, G. R. (2004). The effects of personal and contextual characteristics on creativity: Where should we go from here? *Journal of Management*, *30*, 933–958.

Sheldon, K. M., & Filak, V. (2008). Manipulating autonomy, competence, and relatedness support in a game-learning context: New evidence that all three needs matter. *British Journal of Social Psychology*, *47*, 267–283.

Strauss, K., & Parker, S. K. (2013). Sustainable proactivity in the workplace. In M. Gagne (Ed.), *The Oxford handbook of work engagement, motivation, and self-determination theory*. New York, NY: Oxford University Press.

Tierney, P., & Farmer, S. M. (2002). Creative self-efficacy: Its potential antecedents and relationship to creative performance. *Academy of Management Journal*, *45*, 1137–1148.

Tierney, P., & Farmer, S. M. (2011). Creative self-efficacy development and creative performance over time. *Journal of Applied Psychology*, *96*, 277–293.

Van Den Broeck, A., Vansteenkiste, M., De Witte, H., & Lens, W. (2008). Explaining the relationships between job characteristics, burnout, and engagement: The role of basic psychological need satisfaction. *Work & Stress*, *22*, 277–294.

Van Den Broeck, A., Vansteenkiste, M., Witte, H. D., Soenens, B., & Lens, W. (2010). Capturing autonomy, competence, and relatedness at work: Construction and initial validation of the work-related basic need satisfaction scale. *Journal of Occupational and Organizational Psychology*, *83*, 981–1002.

Van Der Vegt, G. S., & Janssen, O. (2003). Joint impact of interdependence and group diversity on innovation. *Journal of Management*, *29*, 729–751.

Vansteenkiste, M., Niemiec, C. P., & Soenens, B. (2010). The development of the five mini-theories of self-determination theory: An historical overview, emerging trends, and future directions. In T. Urdan & S. Karabenick (Eds.), *The decade ahead: Theoretical perspectives on motivation and achievement* (pp. 105–165). London: Emerald Publishing.

West, M. A. (1987). Role innovation in the world of work. *British Journal of Social Psychology*, *26*, 305–315.

West, M. A. (2002). Sparkling fountains or stagnant ponds: An integrative model of creativity and innovation implementation in work groups. *Applied Psychology: An International Review*, *51*, 355–387.

West, M. A., & Farr, J. L. (1990). Innovation at work. In M. A. West & J. L. Farr (Eds.), *Innovation and creativity at work* (pp. 3–13). Chichester: Wiley.

Yuan, F., & Woodman, R. W. (2010). Innovative behavior in the workplace: The role of performance and image outcome expectations. *Academy of Management Journal*, *53*, 323–342.

Zhou, J. (1998). Feedback valence, feedback style, task autonomy, and achievement orientation: Interactive effects on creative performance. *Journal of Applied Psychology*, *83*, 261–276.

Zhou, J. (2003). When the presence of creative coworkers is related to creativity: Role of supervisor close monitoring, developmental feedback, and creative personality. *Journal of Applied Psychology*, *88*, 413–422.

Original manuscript received July 2013
Revised manuscript received May 2014
Revised manuscript accepted May 2014
First published online June 2014

APPENDIX

TABLE A1
Path coefficients as estimated in a two-level path model using hierarchical Bayes' estimation as implemented in Mplus ($N = 76$)

Relationships within teams	*Day t*	*Day t ± 1*	*Day t ± 2*	*Day t ± 3*	*Day t ± 4*	*Day t ± 5*
Structural relations						
A: Effect of IWB (previous day) on BNS	NA	.19*	−.34**	.16**	.12*	.15**
Diagnosis: Existence of a reciprocal effect	Not testable	Yes	Yes	Yes	Yes	Yes
B: Effect of BNS on IM (same day)	.80**	.62**	.47**	.43**	.36**	.53**
C: Effect of IM on IWB (same day)	.28**	.21**	.38**	.14*	.12*	−.11
D: Effect of BNS on IWB (same day)	<.01	.09	−.06	.10	.19**	.34**
Diagnosis: Type of mediation: Full mediation (B and C significant), partial mediation (B, C and D significant) and no mediation (B and/or C not significant)	Full	Full	Full	Full	Partial	No
Statistical control[a]						
Effect of BNS (previous day) on BNS	NA	.49**	.71**	.58**	.55**	.34**
Effect of IM (previous day) on IM	NA	.20**	.53**	.35**	.34**	.31**
Effect of IWB (previous day) on IWB	NA	.55**	.57**	.51**	.55**	.62**

[a]Relationships as determined by the autoregressive path-analytical model.
NA = not applicable (in the model), BNS = basic need satisfaction, IM = intrinsic motivation, IWB = innovative work behaviour.
*$p < .10$.
**$p < .05$.