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# Need for Cognition as an Antecedent of Individual Innovation Behavior

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*The authors propose that need for cognition, an individual's tendency to engage in and enjoy thinking, is associated with individual innovation behavior. Moreover, drawing on an interactionist perspective, the authors suggest that need for cognition becomes more important when individuals face lower job autonomy and time pressure in their work. This is because, when these job characteristics are low, there is no contextual driving force for individual innovation, so personality has a stronger influence. In a multisource study of 179 employees working in a Dutch research and consultancy organization, the authors' expectations were largely supported. They found that need for cognition was positively associated with peer-rated innovation behavior, as were job autonomy and time pressure, even when controlling for openness to experience and proactive personality. Furthermore, the relationship between need for cognition and innovation behavior was strongest for individuals with low job autonomy and low time pressure and indeed was nonexistent at high levels of these contextual variables. This study, therefore, suggests that context can substitute for an individual's need for cognition when it comes to individual innovation.*

***Keywords***: *innovation; proactivity; personality; job design*

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Individual innovation behavior at work refers to "the intentional creation, introduction and application of new ideas within a work role, group or organization, in order to benefit role performance, the group, or the organization" (Janssen, 2000: 288). In contrast to innovation at the team or organization level, individual innovation behavior is based on an individual's engagement in generating and applying new ideas and approaches in the workplace. Such behavior is clearly important, as it facilitates product and service product development and better ways of doing things. Individual innovation behavior, thus, positively contributes to individual effectiveness (e.g., Janssen & Huang, 2008) and, ultimately, to organizational creativity and effectiveness (Woodman, Sawyer, & Griffin, 1993). As summarized by Janssen (2000: 288), "[P]rofits from innovation could include both better functioning of the organization and social-psychological benefits for individual workers . . . such as more appropriate fit between perceived job demands and a worker's resources, increased job satisfaction, and better interpersonal communication."

Because of its potential benefits, the antecedents of individual innovation behavior have been widely examined (see Unsworth & Parker, 2003; Zhou & Shalley, 2003). Many studies have focused on identifying dispositional antecedents (e.g., cognitive style, openness to experience, creative personality, and self-efficacy) and contextual antecedents such as job characteristics, leader and teammates' support, and climate for innovation (e.g., Axtell et al., 2000; Janssen, 2000, 2005; Ramamoorthy, Flood, Slattery, & Sardessai, 2005; Scott & Bruce, 1994; Unsworth & Parker, 2003). However, to date, we know relatively little about how dispositional and contextual aspects might work together.

Our purpose in this article is to expand our understanding of the antecedents of individual innovation in two ways. First, we propose a dispositional antecedent of innovation behavior that has, thus far, not been considered—need for cognition, defined as individuals' dispositional tendency to engage in and enjoy thinking (Cacioppo & Petty, 1982). Need for cognition directly influences the amount of effort devoted to cognitive elaboration (Cacioppo, Petty, Feinstein, & Jarvis, 1996). As such, individuals high in need for cognition relative to those low in need for cognition prefer engaging in complex situations, have better learning abilities, develop more confidence, are likely to be more persuasive in championing their ideas, and will develop stronger overall attitudes toward their ideas. As we will elaborate shortly, we expect individuals high in need for cognition to engage more often in innovation behavior. By considering need for cognition as an antecedent, we go beyond individual differences in knowledge, skills, and abilities that have already been associated with innovation behavior, such as creative personality and openness to experience (Madjar, 2008; Madjar, Oldham, & Pratt, 2002; Zhou, 2003) and specific cognitive styles (Tierney, Farmer, & Graen, 1999). In particular, when cognition is related with innovation behavior, the typical emphasis has been on cognitive *ability* rather than one's *motivation* in relation with cognition.

Second, we propose that the role of need for cognition depends on the context. Many scholars have argued for an interactionist perspective: that human behavior "is a function of a continuous multidirectional process of person-by-situation interactions" (Endler, 1983: 160). Drawing on this perspective, we hypothesize that the potential influence of need for cognition on innovation diminishes for individuals with particular job characteristics. More specifically, we suggest that job autonomy and time pressure moderate the relationship between need for cognition and innovation behavior. Only a handful of studies have considered how dispositional and contextual antecedents can work together to shape individual innovation behavior (George & Zhou, 2001; Liu, Chen, & Yao, 2011; Madjar, 2008; Madjar et al., 2002; Oldham & Cummings, 1996; Tierney et al., 1999; Zhou, 2003). Although the aforementioned studies focus mainly on contextual forces in the social environment (e.g., relationships with leaders or support from others or work units), we focus on job characteristics (i.e., job autonomy and time pressure). Job characteristics have been shown to be significant in motivating various work behaviors (e.g., Latham & Pinder, 2005; Morgeson & Campion, 2003; Parker & Ohly, 2008), and although their direct association with individual innovation behavior (and broader proactive behaviors) is well established (Unsworth & Parker, 2003), their potential role as a moderator of dispositional antecedents has rarely been considered.

Overall, our study contributes to research on individual innovation behavior by investigating whether the dispositional variable of need for cognition is associated with innovation, especially in interaction with work characteristics that are already known to be connected with individual innovation behavior. This person–situation interactional perspective may have practical implications, that is, when the dispositional trait of need for cognition is likely to be most critical for innovation behavior or, alternatively, what job characteristics can motivate individuals with a low need for cognition to engage in innovation behavior.

## Theoretical Background

Innovation behavior refers to individuals' intentional efforts to create, introduce, and apply new ideas. Researchers generally concur that individual innovation begins with problem recognition and the generation of ideas or solutions but also includes seeking sponsorship for ideas and attempting to build coalitions of supporters to implement ideas (Janssen, 2000; Kanter, 1988; Scott & Bruce, 1994). The domain of the innovation behavior construct entails these multiple activities in which individuals "can be expected to be involved in any combination . . . at any one time" (Scott & Bruce, 1994: 582), and in line with this supposition, it has been found that innovative behaviors tend to form a single behavioral construct (e.g., Janssen, 2000; Yuan & Woodman, 2010). Because individual innovation involves self-initiated action to bring about change, particularly when it comes to idea implementation, individual innovation behavior can be considered a type of proactive work behavior (Parker & Collins, 2010).

### *Need for Cognition and Individual Innovation Behavior*

We propose that need for cognition, or the dispositional tendency of an individual to engage in and enjoy thinking (Cacioppo & Petty, 1982), will be positively associated with individual innovation behavior. Our reasoning revolves around social psychological theories on the role of need for cognition in attitude formation and persuasion and includes four arguments. First, people high in need for cognition tend to engage in and enjoy situations marked by novelty, complexity, and uncertainty and to "reach and draw out information from their environment" (Cacioppo et al., 1996: 245). This elicits their curiosity to seek new information and opportunities (Berlyne, 1960), which is likely to lead to individual innovation. Second, in the pursuit of comprehension, people with a high need for cognition are better able to link new and existing knowledge and to flexibly and effectively acquire new information (Evans, Kirby, & Fabrigar, 2003). As such, they can deeply and quickly process information that is helpful in generating new ideas and solving complex problems (Nair & Ramnarayan, 2000). Third, individuals with a high need for cognition engage in deeper cognitive elaboration (Briñol & Petty, 2005), including the evaluation of their own thoughts (Petty, Briñol, & Tormala, 2002). As such, they can be expected to be more confident about their own thoughts and ideas, which, in turn, is helpful in promoting and championing ideas. Individuals high in need for cognition are also likely to generate a larger number of arguments to support their views (Shestowsky, Wegener, & Fabrigar, 1998) and, accordingly, be more persuasive to others. Fourth, after cognitive elaboration, those with a high need for cognition tend to develop a strong overall attitude toward the issue at hand (Haugtvedt & Petty, 1992), which helps them to persist in their goal pursuit (Cacioppo, Petty, Kao, & Rodriguez, 1986).

Compared to those low in need for cognition, individuals high in need for cognition are more likely to recognize problems and generate ideas, to develop a strong and positive attitude toward issues they work on, and to be more persuasive champions of their ideas. In this vein, Dollinger (2003) reported that need for cognition is positively related to self-reported creative behaviors and performance in various tasks such as drawings, photo essays, and dream reporting. We go beyond creativity in the arts and investigate whether need for cognition predicts innovation behavior in the work context.

To investigate the relationship between need for cognition and innovation behavior, it is relevant to note that we also controlled for individuals' openness to experience and proactive personality. Those who are more open to experience are marked by enhanced imagination, curiosity, and access to a variety of perspectives; accordingly, they are more likely to engage in innovation behaviors (George & Zhou, 2001; Madjar, 2008). Similarly, those with a more proactive personality tend to embrace behaviors to influence their environment and bring about change (Bateman & Crant, 1993). By including these as control variables, we established the incremental validity of need for cognition over these two well-known dispositional antecedents of innovation and related behaviors. We hypothesize,

> *Hypothesis 1 (H1):* Need for cognition will be positively associated with individual innovation behavior, even when controlling for openness to experience and proactive personality.

## *Contingent Influence of Job Characteristics*

Drawing on an interactionist perspective of human behavior, we suggest that the relationship between need for cognition and individual innovation behavior is contingent on particular job characteristics. Specifically, we propose that job autonomy and time pressure are contextual variables that, beyond a direct association with innovation behavior, moderate the relationship between need for cognition and innovation behavior.

Job autonomy has been shown to predict innovation behavior in several studies (e.g., Axtell et al., 2000; Ohly & Fritz, 2010; Ramamoorthy et al., 2005). Autonomy increases individuals' felt responsibility and ownership at work (Hackman & Oldham, 1976; Parker, Wall, & Jackson, 1997) as well as their breadth of understanding and perspective taking (Parker & Axtell, 2001). Job autonomy also facilitates incremental learning (Daniels, Boocock, Glover, Hartley, & Holland, 2009), the development of expertise (Leach, Wall, & Jackson, 2003), and individuals' control beliefs to bring change (Axtell et al., 2000). All of these mechanisms enhance the likelihood that employees will engage in the generation and pursuit of ideas.

We propose that need for cognition will be less related with innovation behavior when job autonomy is high and more related when autonomy is low. We argue that job autonomy evokes similar mechanisms as need for cognition would and, accordingly, can substitute for this dispositional trait. First, high job autonomy implies that the work context is less defined and not restricted by formal rules and procedures (Meyer, Dalal, & Hermida, 2010). This implies a challenging work context in which individuals are required to engage in cognitive activities. Second, high autonomy gives individuals better opportunities to link new and existing knowledge and to acquire new information (Daniels et al., 2009; Leach et al., 2003; Parker & Axtell, 2001). In such a context, individuals' dispositional motivation to think and cognitively explore matters less. Third, as high autonomy enables individuals to make their own decisions, increasing their perceived control and self-efficacy (Parker, 1998), individuals in high-autonomy jobs are more likely to develop strong beliefs that they can be effective champions of their ideas. Fourth, as they develop stronger feelings of felt responsibility for and ownership of their work (Hackman & Oldham, 1976; Parker et al., 1997), they are more likely to persist in bringing about innovation that improves their work (Shalley & Gilson, 2004). As a consequence, individuals with high job autonomy are more likely to innovate even when their need for cognition is low. On the other hand, when individuals lack job autonomy, the impact of need for cognition will be more pronounced because the job context does not require them to act within challenging situations or stimulate knowledge acquisition or ownership. Our hypothesis is,

*Hypothesis 2 (H2):* The positive relationship between need for cognition and individual innovation behavior will be weaker for individuals in high-autonomy jobs relative to those in low-autonomy jobs.

Time pressure is another familiar antecedent of individual innovation behaviors. Although experimental studies have suggested that time pressure can impair innovation when individuals need time to explore alternative possibilities (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Shalley & Gilson, 2004), field studies have more often reported a positive association (e.g., Andrews & Farris, 1972; Ohly & Fritz, 2010) because time pressure represents a challenge stressor that motivates individuals to seek new ways to accomplish their work on time (Unsworth & Parker, 2003; Wu & Parker, 2011). Two theoretical explanations have been offered to explain this association. Drawing on activation theory

(Gardner, 1986), Ohly and Fritz (2010) proposed that time pressure will lead to higher activation so that individuals are stimulated and more likely to try deviating from routines. Drawing on control theory (Carver & Scheier, 1982), Fay and Sonnentag (2002: 224) proposed that time pressure can be regarded as a signal "indicating that a process, procedure, or design is below an optimal level." From this perspective, higher time pressure indicates a suboptimal condition that requires more effort to achieve the expected goal and, thus, stimulates individuals to initiate new ideas and take different approaches.

Our focus is on the interaction of time pressure with need for cognition. We propose that need for cognition will be less related with innovation behavior when time pressure is high and vice versa. Again, we anticipate that time pressure elicits similar mechanisms in individuals as need for cognition would. First, high time pressure stimulates individuals to engage in novel actions that deviate from the status quo to solve their problems in new ways to save time. Second, high time pressure also makes it important for individuals to process information quickly (Ben Zur & Breznitz, 1981; Payne, Bettman, & Johnson, 1988) because they need to finish a certain amount of work within a relative short time period—in line with Hockey's (1993) supposition that stress can increase effort and concentration to deal with tasks at hand. As a consequence, such individuals are more likely to develop their capabilities to combine knowledge and to acquire and process new information effectively. Third, as a result of repeatedly acting under time pressure, individuals are likely to develop stronger beliefs that they can master situations that are cognitively demanding. Fourth, as time pressure induces a higher activation level, individuals will become more engaged with their tasks (Gardner, 1986), making them more likely to develop strong attitudes toward potential time-saving ideas. These mechanisms, in turn, imply that those facing high time pressure are likely to innovate even when their need for cognition is low. On the other hand, for individuals without time pressure, the association between need for cognition and innovation will be stronger, as their job context does not trigger them to engage in cognitively demanding situations, to develop skills in combining and acquiring knowledge, and to develop a strong overall attitude toward potential solutions. Thus, we predict,

*Hypothesis 3 (H3):* The positive relationship between need for cognition and individual innovation behavior will be weaker for individuals in high time pressure jobs relative to those in low time pressure jobs.

## Method

### *Organizational Context*

The data were collected at a Dutch company specializing in policy research and consultancy services. Its customer base includes Dutch ministries, provinces and cities, industry associations, chambers of commerce, antitrust authorities, financial services firms, and various services of the European Commission. The organization structure of the research company is relatively flat and flexible, with (at the time) a staff size of 271. The organization chart contained nine business units, which were all managed by one or more managers to whom other staff members directly reported.

Employees work on externally commissioned research and/or consultancy projects. These projects are diverse and may relate to various policy themes (e.g., entrepreneurship, innovation, administrative costs, transport, education, social affairs, marketing research, internationalization, competition, alleviating poverty, assisting the disabled, and more) with diverse budgets (ranging from 5,000 to 1,000,000) and completion times (ranging from one week to three years).

In practice, the staff members operate in temporary teams with different compositions, depending on the size, theme, and duration of a project. Team sizes range from 2 to 15 workers, although a typical project includes 2 to 5 persons. Occasionally, staff members work on smaller projects on an individual basis. Thus, individual employees and managers may collaborate with any other worker in the company, including multiple other business units. Most workers, nevertheless, have a “hard core” of people with whom they collaborate more often.

The focal company’s employees have different degrees of job autonomy and face different time pressure, which has to do with their distinct jobs (e.g., junior data analyzer vs. sales worker) and project types (some research themes are quite open and undefined, whereas others such as marketing research involve standardized methodologies and prescribed work practices).

## *Procedure*

All employees first received an introductory letter, signed by the CEO of the organization, explaining the scholarly purpose of the research. One week later, the employees received a paper-based survey, along with a letter assuring confidentiality and providing contact information for one of the authors of this article in case of questions. This survey contained multiple-item scales for need for cognition, job autonomy, time pressure, openness to experience, and proactive personality. Over a period of six weeks, up to three reminders were sent by e-mail to those who had not yet responded. Ultimately, 189 employees participated (70% response rate).

At the time that the employees completed the survey, we asked them to identify three peers or managers with whom they had collaborated most intensively in the past three years (or since they started their job). We chose this approach because the nature of the work in the organization (highly collaborative research) implied that collaborator ratings would be more accurate than supervisor ratings—in the organization, supervisors did not work with their employees much on a day-to-day basis.

Altogether, 216 individuals were identified as close collaborators by at least one employee. These individuals (whom we refer to as peers) received an introductory e-mail with a web link that enabled them to answer all questions for the first, second, and any other colleagues who had mentioned their names. The peers then assessed the innovation behavior of their named colleagues. Confidentiality was assured. The number of colleagues who were rated by their peers varied from 1 to 9 ($M$ = 2.63, $SD$ = 2.13). As anticipated, sales workers and managers, who were generally central “nodes” in the organization, were selected relatively often. Thus, ratings were obtained from multiple peers, which could include the manager but did not necessarily do so. Over eight weeks, up to three reminders were sent to those peers who had not responded. Ultimately, 144 of 216 invited peers provided assessments, resulting in a response rate of 67%.

After matching both data sets, at least one peer rating was obtained for 179 employees, that is, 66% of all employees. In all, 28 employees (15.6%) were rated once, 62 employees (34.6%) were rated twice, and 89 employees (49.7%) persons obtained ratings from all of their identified colleagues.

For all employees, including nonrespondents, we also obtained data from the human resources department regarding their age, years of tenure, job type, education attainment, and gender. To examine the potential selectiveness of responses, we computed various $\chi^2$ and $t$ tests to compare respondents in the final sample ($n$ = 179) with those who had not participated or obtained any peer ratings ($n$ = 92). Responses were not selective for age, years of tenure, education type, or job type ($p > .05$). Women, however, were less inclined to participate ($p < .01$), so that, among nonparticipants, the share of women was 59%, whereas 35% of the participants were women. We do not believe that this gender difference has greatly compromised our findings. In the broader category of proactive behaviors (of which innovation behavior is part; see Parker & Collins, 2010), gender generally has a small or null effect when other variables (e.g., job level) are controlled for (Bindl & Parker, 2010). Moreover, gender is included as a control variable in the cross-classified multilevel models presented hereafter.

## *Participants*

The final sample included 179 employees with at least one peer rating on their innovation behavior. The participants were 22 to 64 years old ($M$ = 42.6, $SD$ = 11.5). Their tenure ranged from 0.2 years to 40.9 years, with a mean of 10.6 years ($SD$ = 10.3). Only five employees had tenure of less than 6 months. Because the results did not change after excluding these newcomers, we kept them in the analysis to gain more statistical power. In the final sample, 35% of the respondents were women, 13% had a managerial position (job type), and 66% had a postgraduate degree.

## *Measures*

All constructs were measured with multiple items. Items were translated from their original language (English) into Dutch by one of the authors. A back-translation procedure was applied to ensure that all items were adequately translated. The management of the organization allowed us to repeatedly survey its employees, provided that the respondent burden was minimized. This implied that we faced restrictions in developing our surveys and had to shorten some of our measures. All items are listed in the appendix to this article.

*Need for cognition*. We adopted three items from the Need for Cognition Scale developed by Cacioppo, Petty, and Kao (1984). Although the original measure contains 18 questions, we selected those items that directly reflect enjoyment of thinking and can be applied in a work context. The response scale ranged from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's alpha was .77. To support the validity of these three items, we collected two samples of undergraduate students from the National Taiwan University ($n$ = 210, $n$ = 151). In both samples, we found that the total score for our three items was highly related to the total score for the remaining items ($r$ = .82 and .80, respectively) and to the total score for all items ($r$ = .89 and .88). Moreover, exploratory factor analysis revealed for both samples that the item set was one dimensional and that the three selected items had high factor loadings (.78, .70, and .67 in the first sample and .81, .79, and .60 in the second sample) that exceeded the average factor loading (factor loadings ranged from .32 to .78 with a mean of .57 in the first sample and from .24 to .81 with a mean of .55 in the second sample). These findings support the validity of the three items used here.

*Openness to experience*. Openness to experience was measured with four items taken from Gosling, Rentfrow, and Swann's (2003) openness personality measure. The response scale ranged from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's alpha was .68.

*Proactive personality*. Proactive personality was measured with four items selected from the Proactive Personality Scale developed by Bateman and Crant (1993). These four items had the highest factor loadings in their report and have been previously used to reflect proactive personality in several studies (e.g., Parker & Collins, 2010; Parker & Sprigg, 1999; Parker, Williams, & Turner, 2006; Williams, Parker, & Turner, 2010). The response scale ranged from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's alpha was .79.

*Job autonomy*. Job autonomy was operationalized in two dimensions, including decision-making autonomy and work methods autonomy; each dimension was measured with three items taken from Morgeson and Humphrey's (2006) Work Design Questionnaire. These dimensions were both previously applied to indicate job autonomy in innovation behavior studies (e.g., Axtell et al., 2000; Ramamoorthy et al., 2005). The response scale ranged from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's alpha values were .88, .83, and .89 for decision-making autonomy, work methods autonomy, and total score, respectively.

*Time pressure*. Three items for time pressure were adopted from Karasek (1979). The response scale ranged from 1 (*never*) to 7 (*extremely often*). Cronbach's alpha was .82.

*Individual innovation behavior*. Each participant's innovation behavior was assessed by up to three nominated peers. Innovation behavior was assessed using three items from Scott and Bruce's (1994) innovative behavior measure, which had the highest factor loadings in Yuan and Woodman (2010). Supporting its validity, individual innovation behavior assessed by these three items was convergent, along with voice, taking charge, and problem prevention, to the concept of proactive work behavior aiming to take control of and bring about change within the internal organizational environment, and it was discriminant from indicators for proactive strategic behavior (e.g., issue selling) or proactive person–environment fit behavior (e.g., career initiative; Parker & Collins, 2010). The response scale ranged from 1 (*not at all*) to 5 (*very often*). To facilitate the analysis of the factor structure among this study's variables in a measurement model, ratings from multiple peers were averaged. This within-person aggregation was appropriate, as the intraclass correlation coefficient for the participants' effect was .43 when the cross-classified structure of the innovation behavior scores was taken into account. This value suggests that 43% of the variance in innovation behavior resulted from the participants' characteristics rather than peers' characteristics or measurement errors. Cronbach's alpha was .93 using these aggregated scores.

Nevertheless, because some peers rated several participants and the aggregated score does not take the rater effect into account, we used only aggregated peer ratings in the measurement model to examine the validity of our constructs. When formally testing our hypotheses, raw peer ratings of innovation behavior were entered in a range of cross-classified multilevel models to control for the rater effect. Details are provided in the results section.

*Control variables*. Additional control variables included education (dummy coded such that a master's degree or better = 1), job level (1 = *manager*, 0 = *nonmanager*), and familiarity with participants' tasks (ranging from 1 = *not at all* to 5 = *a great deal*).

Education has been found to be related with need for cognition (see Cacioppo et al., 1996). Moreover, it can be considered a proxy for individuals' cognitive abilities and stock of knowledge and has been found to correlate with innovation behavior (e.g., Janssen, 2000; Scott & Bruce, 1994). Therefore, we controlled for its effect while examining the hypothesized relationship between need for cognition and innovation behavior.

For job level, that is, individuals in managerial positions, it has been found that people in higher positions feel more responsible for change and innovate more because of the role expectations tied to their positions (Fuller, Marler, & Hester, 2006; Kanter, 1988). At the same time, they also have more job autonomy compared to those in lower positions (Fuller et al., 2006). As we aim to examine the potential moderating role of job autonomy, controlling for job level is essential to distinguish the potential impact of felt responsibility for change resulting from role expectations, especially when analyzing managers and nonmanagers together.

In the follow-up web survey, nominated peers also rated their familiarity with each participant's tasks before rating his or her innovation behavior. The response scale ranged from 1 (*not at all*) to 5 (*a great deal*). This rating was included as a control because familiarity can influence the accuracy of any behavior rating.

## *Measurement Model*

To assess our measurement model, we carried out a confirmatory factor analysis using the statistical software package Mplus 5 (Muthén & Muthén, 2007). We examined a hypothesized model in which (a) need for cognition was indicated by three items, (b) the decision-making autonomy factor was indicated by three items, (c) work methods autonomy was indicated by three items, (d) time pressure was indicated by three items, (e) innovation behavior was indicated by three items, (f) openness to experience was indicated by four items, and (g) proactive personality was indicated by four items.

All the factors were allowed to correlate, but the items' error terms were not. We estimated the model with maximum likelihood estimators with Satorra–Bentler scaled chi-square values and assessed model fit by (apart from SB-$\chi^2$/df) assessing Tucker–Lewis index (TLI) and comparative fit index (CFI; values > .90 are acceptable and > .95 excellent), root mean square error of approximation (RMSEA; < .08 is acceptable and < .05 is excellent), and standardized root mean square residual (SRMR; < .08 is acceptable; see Bentler, 1990; Browne & Cudeck, 1993; Hoyle, 1995; Hu & Bentler, 1999).

The fit of the measurement model was acceptable (SB-$\chi^2$ = 273.51, *df* = 209; CFI = .97, TLI = .96, RMSEA = .042, SRMR = .057). All estimates in the model were significant at $p < .01$. Except for the two autonomy factors ($r = .80$), we found that openness to experience and proactive personality were highly related ($r = .72$). Other correlations among factors were consistently small to moderate (*r*s ranging from .01 to .58). Given that (a) both autonomy factors were highly related, (b) our theoretical reasoning was identical for decision-making autonomy and work methods autonomy, and (c) our findings (presented hereafter) were the same for both autonomy measures, we used the six items to construct a single job autonomy measure and report our findings drawing on this variable.[1] We did not collapse the measures of openness to experience and proactive personality because they are included for different theoretical considerations, and the empirical results of these two measures are not the same.

## Results

### *Descriptive Statistics*

Table 1 presents the descriptive statistics and correlations amongst all variables. As shown in Table 1, men (gender effect: $r = -.18$, $p < .05$), highly educated people ($r = .32$, $p < .01$), those with a managerial position ($r = .18$, $p < .05$), openness to experience ($r = .23$, $p < .01$), proactive personality ($r = .38$, $p < .01$), need for cognition ($r = .43$, $p < .01$), job autonomy ($r = .40$, $p < .01$), and time pressure ($r = .26$, $p < .01$) all correlated with higher individual innovation behavior.

### *Testing Hypotheses*

Because up to three peers rated the innovation behavior of each participant and some peers rated multiple participants, peer-rated innovation behavior is nested within a participant and also within a peer. To account for this nonindependent data structure, we conducted cross-classified multilevel analyses to test our hypotheses. This approach is warranted, as the intraclass correlations for participant and peer effects were .43 and .08, respectively. Together, they explained 51% of the variance in the innovation behavior scores.

**Table 1**
**Descriptive Statistics of Variables**

| | | | Correlations | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1. Female | 1.35 | 0.48 | | | | | | | | | | | |
| 2. Age | 42.59 | 11.54 | –.25** | | | | | | | | | | |
| 3. Postgraduate degree | 0.66 | 0.47 | –.08 | –.21** | | | | | | | | | |
| 4. Tenure | 10.60 | 10.25 | –.26** | .69** | –.17* | | | | | | | | |
| 5. Job level (managerial position) | 0.13 | 0.34 | –.14 | .27** | .06 | .23** | | | | | | | |
| 6. Openness to experience | 4.72 | 0.91 | .01 | –.06 | .00 | –.15* | .09 | | | | | | |
| 7. Proactive personality | 4.63 | 0.99 | –.06 | –.01 | .10 | –.07 | .11 | .57** | | | | | |
| 8. Need for cognition | 5.42 | 1.02 | –.14 | –.03 | .39** | –.04 | .16* | .33** | .44** | | | | |
| 9. Job autonomy | 5.44 | 0.93 | –.24** | .19* | .21** | .05 | .24** | .17* | .30** | .39** | | | |
| 10. Time pressure | 5.19 | 1.08 | .03 | .02 | .24** | –.01 | .21** | .03 | –.03 | .03 | .07 | | |
| 11. Familiarity with participants' tasks | 3.83 | 0.78 | –.08 | .10 | –.02 | .14 | .15* | .03 | .11 | –.02 | .08 | .22** | |
| 12. Innovation behavior | 3.43 | 0.73 | –.18* | –.08 | .32** | –.09 | .18* | .23** | .38** | .43** | .40** | .26** | .05 |

*Note:* $N = 179$. Familiarity with participants' tasks and innovation behavior were rated by nominated peers.
$^*p < .05$. $^{**}p < .01$.

Our cross-classified multilevel model includes two levels. At Level 1, the dependent variable is the innovation behavior of an individual rated by each peer. The predictor variable at this level is the peer's ratings of his or her familiarity with the participant's tasks. A grand mean centering procedure was applied for the familiarity rating. The equation for the Level 1 model was,

$$\textit{Innovation behavior}_{i(jk)} = \beta_{0(jk)} + \beta_{1(jk)}(\textit{familiarity}_{i(jk)} - \textit{familiarity}_{..}) + e_{i(jk)}.$$

In this equation, innovation behavior $_{i(jk)}$ represents an innovation behavior score $i$ rated for a participant $j$ by a peer $k$. The subscript $_{(jk)}$ indicates that participants and peers are at the same level; that is, an innovation behavior rating score is nested within the combination of participants and peers. $\beta_{0(jk)}$ represents the mean innovation behavior score over all innovation behavior rating scores when the score for familiarity of participants' tasks is equal to the grand mean of the score for familiarity. The subscript $_{(jk)}$ of $\beta_{0(jk)}$ denotes that the mean of innovation behavior varies independently across participants and peers. The $\beta_{1(jk)}$ coefficient, then, represents the effect of familiarity with the participant's tasks on innovation behavior ratings. Similarly, the subscript $_{(jk)}$ of $\beta_{1(jk)}$ denotes that the effect of familiarity of participants' tasks on innovation behavior ratings varies independently across participants and peers. Finally, $e_{i(jk)}$ represents a random residual error term for the innovation behavior scores.

At Level 2, the dependent variables are the $\beta_{0(jk)}$ and $\beta_{1(jk)}$ coefficients of Level 1. To predict the mean innovation behavior ($\beta_{0(jk)}$), the participants' gender, education, job level, openness to experience, proactive personality, need for cognition, job autonomy, and time pressure were included as predictors. We added the gender dummy as a control variable because it was significantly correlated with innovation behavior in Table 1. A grand mean centering procedure was first applied to all continuous variables, whereas gender, education, and job level were dummy variables coded 0 or 1. We were not concerned with the variability of the effect of familiarity ratings across participants or peers, so we included only an intercept in predicting the effect of familiarity with participants' tasks ($\beta_{1(jk)}$). The equations for the Level 2 model were,

$$
\begin{aligned}
&\beta_{0(jk)} = \gamma_{00} + \gamma_{01}(female)_j + \gamma_{02}(postgraduate_j) + \gamma_{03}(job\ level_j) + \\
&\gamma_{04}(openness_j - openness_.) \\
&\gamma_{05}(proactive\ personality_j - proactive\ personality_.) + \\
&\gamma_{06}(need\ for\ cognition_j - need\ for\ cognition_.) + \\
&\gamma_{07}(job\ autonomy_j - job\ autonomy_.) + \gamma_{08}(time\ pressure_j - time\ pressure_.) + \\
&\mu_{0j} + \nu_{0k}, \\
&\beta_{1(jk)} = \gamma_{10}\ .
\end{aligned}
$$

In this equation, $\gamma_{00}$ represents the overall mean of the innovation behavior rating scores after adjustment for other predictive variables; $\gamma_{01}$ to $\gamma_{08}$ represent the predictive effects of gender, education, job level, openness to experience, proactive personality, need for cognition, job autonomy, and time pressure; and $\mu_{0j}$ and $\nu_{0k}$ are random residual error terms for participants and peers, respectively. Finally, $\gamma_{10}$ represents the mean effect of familiarity with participants' tasks.

We then estimated a range of cross-classified multilevel models with HLM6 (Raudenbush, Bryk, & Congdon, 2004). Table 2 shows our findings. Model 1 reveals that need for cognition is positively associated with innovation behavior while controlling for openness and proactive personality, supporting H1. Moreover, we found that the coefficients for job autonomy and time pressure were significant with their expected signs. Openness for experience, education, job level, and gender were not significant after controlling for the other variables in Table 2.

Model 2, then, included both interaction terms to test the potential moderating role of job autonomy and time pressure. Adding these interaction terms significantly improved overall model fit ($\Delta$Deviance = 10.66, $p < .01$), whereas both interaction coefficients were significant, too. Models 3 and 4 provide alternative tests of the anticipated interaction effects. Following the common practice of hierarchically nested models, the interaction effects were then tested one at a time—with nearly identical results. The deviance difference test repeatedly suggested that the models including an interaction effect were better than those without ($\Delta$Deviance = 5.72 and 5.20, *p*s < .05).[2]

**Table 2**
**Results of Cross-Classified Multilevel Modeling of Innovation Behavior**

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|---|---|
| | β | *SE* | β | *SE* | β | *SE* | β | *SE* |
| Fixed effect | | | | | | | | |
| $\beta_{0(jk)}$ | | | | | | | | |
| Intercept ($\gamma_{00}$) | 3.49 | 0.10 | 3.42 | 0.09 | 3.43 | 0.10 | 3.38 | 0.09 |
| Female ($\gamma_{01}$) | −0.10 | 0.09 | −0.08 | 0.09 | −0.09 | 0.09 | −0.09 | 0.09 |
| Education (postgraduate degree) ($\gamma_{02}$) | 0.16 | 0.10 | 0.18 | 0.10 | 0.15 | 0.10 | 0.19 | 0.10 |
| Job level (managerial position) ($\gamma_{03}$) | 0.04 | 0.13 | 0.06 | 0.13 | 0.06 | 0.13 | 0.04 | 0.13 |
| Openness to experience ($\gamma_{04}$) | −0.03 | 0.06 | −0.04 | 0.06 | −0.05 | 0.06 | −0.02 | 0.06 |
| Proactive personality ($\gamma_{05}$) | 0.21** | 0.05 | 0.20** | 0.04 | 0.22** | 0.05 | 0.20** | 0.05 |
| Need for cognition (NFC) ($\gamma_{06}$) | 0.15** | 0.05 | 0.15** | 0.05 | 0.15** | 0.05 | 0.15** | 0.05 |
| Job autonomy ($\gamma_{07}$) | 0.15** | 0.05 | 0.10* | 0.05 | 0.11* | 0.05 | 0.14** | 0.05 |
| Time pressure ($\gamma_{08}$) | 0.13** | 0.04 | 0.13** | 0.04 | 0.13** | 0.04 | 0.13** | 0.04 |
| NFC × job autonomy ($\gamma_{09}$) | | | −0.09* | 0.04 | −0.09* | 0.04 | | |
| NFC × time pressure ($\gamma_{010}$) | | | −0.11* | 0.04 | | | −0.10* | 0.04 |
| $\beta_{1(jk)}$ | | | | | | | | |
| Intercept ($\gamma_{10}$) (familiarity with participants' tasks) | 0.05 | 0.04 | 0.05 | 0.04 | 0.05 | 0.04 | 0.05 | 0.04 |
| Random effect | | | | | | | | |
| Variance of residual errors for innovation behavior scores ($e_{i(jk)}$) | 0.35 | | 0.35 | | 0.35 | | 0.35 | |
| Variance of residual errors for participants ($\mu_{0j}$) | 0.13 | | 0.11 | | 0.12 | | 0.12 | |
| Variance of residual errors for peers ($\nu_{0j}$) | 0.08 | | 0.08 | | 0.08 | | 0.08 | |
| Model evaluation | | | | | | | | |
| Deviance | 918.62 | | 907.96 | | 913.90 | | 913.42 | |
| *df* | 13 | | 15 | | 14 | | 14 | |
| ΔDeviance | | | 10.66** | | 5.72* | | 5.20* | |

*Note:* $N = 179$. Deviance difference test is one-tailed (deviance decreases only when predictors are added).
*$p < .05$. **$p < .01$.

To further interpret the significant interaction effect for job autonomy, we computed the simple slope of innovation behavior on need for cognition, evaluated at high values of job autonomy (one standardized deviation above the mean), moderate values (mean score), and low values (one standardized deviation below the mean), based on Model 3. The interaction plot is shown in Figure 1. Need for cognition did not predict innovation behavior when job autonomy was high, $\gamma = .06$, $t(408) = 1.02$, $p > .05$, but it positively predicted innovation behavior when job autonomy was moderate, $\gamma = .15$, $t(408) = 2.94$, $p < .01$, and it was even stronger when job autonomy was low, $\gamma = .24$, $t(408) = 3.62$, $p < .01$. H2 is supported.

We also evaluated the simple slopes of need for cognition at high, moderate, and low values of time pressure (based on Model 4). The interaction plot is shown in Figure 2. Need for cognition was not related with innovation behavior at high values of time pressure, $\gamma = .04$,

**Figure 1**
**Simple Slope at High, Moderate, and Low Values of Job Autonomy**

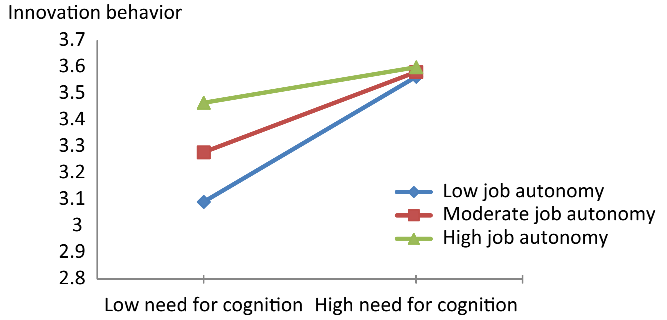
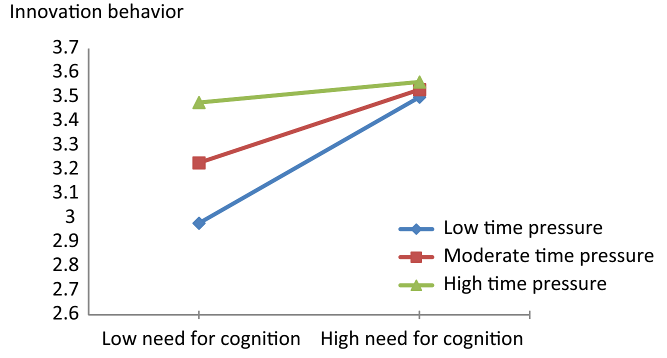



**Figure 2**
**Simple Slope at High, Moderate, and Low Values of Time Pressure**




$t(408) = 0.52$, $p > .05$, but at moderate values it was, $\gamma = .15$, $t(408) = 2.83$, $p < .01$, and the relationship became stronger at low values of time pressure, $\gamma = .26$, $t(408) = 3.69$, $p < .01$. H3 is supported as well.

## Discussion

Although the role of cognitive abilities in individual innovation behavior has been discussed in the literature (Unsworth & Parker, 2003; Zhou & Shalley, 2003), an individual's need for cognition has not been considered. Based on social psychology theories regarding the role of need for cognition in attitude formation and persuasiveness, we argued that people with a high need for cognition will have a positive attitude toward novelty, complexity, and uncertainty; are better able to engage in information processing; develop higher confidence in their ideas and are more likely to develop persuasive arguments; and develop stronger overall attitudes toward their ideas, which enhances their persistence when pursuing their ideas. As a consequence, we expected that need for cognition would be associated with individual innovation behavior. Some of these mechanisms have been proposed in past individual innovation studies (e.g., Howell & Boies, 2004; Unsworth & Parker, 2003; Zhou & Shalley, 2003), but in those cases they were suggested in isolation and without a theoretical framework. We offered here an integrated view by suggesting that enjoyment and engagement in cognitive elaboration, or need for cognition, is what evokes these mechanisms. Drawing on multisource survey data of 179 employees in a research and consultancy organization, we found empirical support for the idea that need for cognition predicts individual innovation behavior, even when we controlled for individuals' openness to experience and proactive personality, two well-known dispositional antecedents of innovation and related behaviors. Need for cognition has not previously been considered as a driver of individual innovation.

Beyond individual innovation, our findings regarding the role of need for cognition have implications for proactive work behavior. Parker and Collins (2010) demonstrated that individual innovation behavior is closely related to proactive behaviors such as taking charge, voice, and problem prevention. However, in this broader proactivity literature, cognitive traits have been given little attention as dispositional antecedents. Buss and Finn (1987) classified personality traits as (a) instrumental, depicting attempts to influence the environment (e.g., dominance); (b) affective, capturing emotional experiences (e.g., shyness); and (c) cognitive, describing involvement in information handling and processing (e.g., self-consciousness). In the proactivity literature, instrumental and affective traits are well covered (e.g., proactive personality, positive affect; see Bindl & Parker, 2010; Wu & Parker, 2011), but cognitive traits have rarely been examined. Therefore, we recommend proactivity studies to consider cognition-related dispositional traits.

We further predicted that the relationship between need for cognition and innovation behavior would be moderated by job autonomy and time pressure. Here, our reasoning was based on the interactionist model of personality (Endler, 1983), which proposes that dispositional and contextual forces work together to shape individual behavior. We argued that job autonomy and time pressure both evoke similar mechanisms to those that we theorized would be evoked by need for cognition—namely, engagement in complex and novel situations, enhancement of one's ability to process information, and development of higher confidence and stronger overall attitudes toward ideas. In line with this reasoning, we found that the influence of need for cognition diminished with increasing job autonomy and time pressure. Indeed, somewhat contrary to our expectations, the positive relationship between need for cognition and innovation was nonsignificant at high values of the proposed moderator variables—implying a boundary condition of the relationship between need for cognition and innovation. In essence, our findings suggest that these contextual variables can "wipe out" the effect of individual differences in need for cognition on innovation behavior. Although further research is needed to investigate why this effect occurs, we speculate that, in the case of high job autonomy or time pressure, individuals are stimulated to think irrespective of their need for cognition. In contrast, when job autonomy and time pressure are low, a high need for cognition appears to stimulate innovation behavior. Although extreme time pressure might inhibit innovation behavior as reported by Ohly, Sonnentag, and Pluntke (2006) and Baer and Oldham (2006), in this study we found a linear positive association of time pressure on innovation behavior.[3] Our finding is consistent with research reporting a positive role for time pressure when it comes to other types of proactive behavior (e.g., Binnewies, Sonnentag, & Mojza, 2009; Fay & Sonnentag, 2002; Ohly & Fritz, 2010; Sonnentag, 2003).

It is relevant to consider in more depth our finding that need for cognition was most influential in an unfavorable context (low autonomy and time pressure). This conclusion is in line with the results of past studies showing that dispositions to innovate are more important in unfavorable contexts (Liu et al., 2011; Madjar, 2008; Madjar et al., 2002; Tierney et al., 1999; Zhou, 2003), suggesting a substitution-type effect. However, some studies have shown a contrasting pattern in which dispositions predict innovation more strongly in a favorable environment (George & Zhou, 2001; Oldham & Cummings, 1996), a complementary type of effect. We believe that the explanation for our substitute pattern of findings relative to these latter complementary-type patterns lies partly in the nature of need for cognition. Need for cognition is internal (it involves thinking); therefore, compared to more behaviorally oriented dispositions (such as conscientiousness and openness in George & Zhou, 2001), it is likely to be relatively unconstrained by a lack of opportunities in a situation.

Consistent with this possibility, evidence suggests that people with a high need for cognition tend to engage in thinking regardless of the favorability of the context (Cacioppo et al., 1996). Bailey (1997) reported an experimental study that showed that people high in need for cognition conducted a similar and higher amount of information searching relative to those low in need for cognition, and this applied to both an encouraging situation and a nonencouraging situation. In another study, Axsom, Chaiken, and Yates (1987) found that people high in need for cognition generated a similar and higher number of thoughts than those low in need for cognition, regardless of the level of situational involvement. These studies also showed that the situation (e.g., encouragement of thorough searching or situational involvement) mattered for people low in need for cognition. The pattern of findings from these experimental studies—that the situation makes a difference for those low in need for cognition but not for those high in need for cognition—is exactly the same pattern we observed in our study. Together, we suspect that the findings might be attributable to the highly internalized nature of need for cognition, meaning that individuals high in this attribute can engage in thinking regardless of behavioral constraints in the context. Thus, although the context can substitute for a low need for cognition (high autonomy and time pressure likely stimulate thinking irrespective of need for cognition), the context does not have much effect on those high in need for cognition because of the internalized nature of thinking.

The findings from our study have important potential practical implications. From an intervention perspective, it is important to consider job redesign such as empowerment or job enrichment to increase job autonomy (and possibly also time pressure) to enhance innovation behavior. Our findings suggest that such interventions will be particularly influential for workers low in need for cognition. Simplified and less demanding jobs (e.g., production work) may be more likely to be carried out by individuals with a lower need for cognition, so job redesign might, then, be a powerful intervention method in such contexts. Alternatively, there are highly standardized, low-autonomy jobs that are difficult to redesign, yet innovation behavior might still be important—consider nuclear power plants or airplanes, where safety is critical and work procedures are tightly prescribed, yet generating and championing ideas is still important in preventing latent errors or injuries (e.g., Grote, 2007; Mark et al., 2007). Recruiting individuals with a high need for cognition could be an option in such settings, as it might facilitate innovation, despite the highly constrained and unfavorable job context.

## Limitations and Future Research

Several limitations of the current study need to be acknowledged. First, as we were confined in our length of measures, we used only a subset of items to measure innovation behavior and need for cognition. For innovation behavior, we used three items from Scott and Bruce (1994) reflecting the generation and championing of ideas. Given that past work has shown that their measure is unidimensional (Yuan & Woodman, 2010), we selected the items with the highest loadings. For need for cognition, content validity is a potential concern, as we did not include all the items proposed by Cacioppo et al. (1984). Nevertheless, as we reported in the method section, the summary score of our shorter measure was highly related with the other items in two Taiwanese validation samples. Moreover, we conducted follow-up surveys to examine whether the positive relationship between need for cognition and innovation behavior could be replicated with the same items. More specifically, survey data were collected among employees from two departments in different companies, including a Taiwanese digital media and a Taiwanese computer company. In both departments employees had various positions, including administrative secretaries, engineers, salespeople, and animation designers, and in both cases the organization structure was strongly hierarchical. The sample included 90 employees, of whom 56 were men. The age of the respondents ranged from 19 to 59 years ($M = 35.9$, $SD = 8.7$), and their years of tenure ranged from 1 month to 40 years, with an average of 6 years ($SD = 6.5$). In this sample, we found a similar positive relationship between need for cognition and supervisor- or colleague-rated innovation behavior ($r = .37$), which is in line with our first hypothesis.[4] Nevertheless, we still acknowledge that there are potential limitations in using a limited set of items to measure our key constructs, and, for cross-validation, we recommend using longer versions of these measures.

A second potential limitation of our study is that we assessed innovation behavior drawing on peer ratings rather than supervisor ratings. The particular context of our sample (decentralized organization with very interdependent colleagues) suggested that peers were likely to be able to observe their colleagues' work behavior frequently and much more often than supervisors. Therefore, and because we obtained multiple ratings for most participants (84.4% rated by at least two peers), we are confident that our approach yielded valid assessments of individual innovation. However, we also recognize that peers might apply different assessment criteria compared to supervisors. Although we controlled for their familiarity with participants' tasks (which was not significant in the analyses), further research on this issue when assessing innovation behavior is merited.

A third limitation is that we did not examine the mechanisms that we reasoned would explain the relationship between need for cognition and innovation behavior. It is important to now go further to determine whether people with a high need for cognition are more positive toward complexity, are more capable of combining knowledge and processing information, and so on, and to investigate the question of whether this explains their higher levels of innovation. Moreover, a similar study should be done to assess whether job autonomy and time pressure evoke the same underlying mechanisms, as we reasoned. Such research would extend further our knowledge about the potential trade-offs between the dispositional and contextual factors at work.

A further issue is the generalizability of our findings. We conducted this study in a sample made up largely of researchers and consultants with relatively high job autonomy and time pressure (the mean values of job autonomy and time pressure on a 7-point scale were 5.44 and 5.19, respectively) and found an impact of need for cognition on individual innovation behavior at lower and moderate levels of job autonomy and time pressure. Thus, it is possible that, for people in other industries with lower average levels of job autonomy and time pressure, the impact of need for cognition will be more prominent, albeit with different strengths according to the specific levels of job autonomy and time pressure. This implies that different work types or industries may have different needs to select people according to the level of need for cognition.

Finally, an obvious limitation of our study is that we relied on cross-sectional data, which preclude the drawing of strong causal inferences. Although this is not likely to be an issue in assessing the relationship between need for cognition and innovation behavior (work behavior is unlikely to "cause" a dispositional trait), it means that we were unable to consider potential dynamic processes linking need for cognition and job characteristics. An example is that people with a high need for cognition might select an enriched job via intensive job search efforts (Brown, Cober, Kane, Levy, & Shalhoop, 2006), and then their enriched job may reinforce their tendency to think, which then results in enhanced innovation behavior. A longitudinal within-person analysis is needed to detect such mechanisms. We hope that our study will inspire such investigations.

## Conclusion

In our study, need for cognition was associated with individual innovation behavior, albeit only for individuals with low or moderate job autonomy and time pressure. The influence of individuals' disposition to enjoy thinking and their job context appeared to substitute for each other when it came to individual innovation. Although further research is needed that actually tests these mechanisms, our findings are consistent with the idea that high job autonomy and high time pressure stimulate thinking anyway, so it is only when these work characteristics are lacking that need for cognition makes a difference in innovation.

# Appendix

List of Items Used in This Study

## *Need for Cognition (Cacioppo et al., 1984)*

1. I like to have the responsibility of handling a situation that requires a lot of thinking.
2. Thinking is not my idea of fun (reverse item).
3. I really enjoy a task that involves coming up with new solutions to problems.

## *Job Autonomy (Morgeson & Humphrey, 2006)*

Decision-making autonomy
1. The job gives me a chance to use my personal initiative or judgment in carrying out the work.
2. The job allows me to make a lot of decisions on my own.
3. The job provides me with significant autonomy in making decisions.

Work methods autonomy
1. The job gives me considerable opportunity for independence and freedom in how I do the work
2. The job allows me to make decisions about what methods I use to complete my work.
3. The job allows me to decide on my own how to go about doing my work.

## *Time Pressure (Karasek, 1979)*

1. To what extent does your job require your working fast?
2. To what extent is there not enough time for you to do your job?
3. To what extent do you feel there is not enough time for you to finish your work?

## *Peer-Rated Innovation Behavior (Scott & Bruce, 1994)*

How frequently does he/she . . .
1. Generate creative ideas.
2. Search out new techniques, technologies and or product ideas.
3. Promotes and champions ideas to others.

## *Openness to Experience (Gosling et al., 2003)*

1. I am always open to new experiences.
2. I am a very complex person.
3. I am very creative.
4. I am very imaginative.

### *Proactive Personality (Bateman & Crant, 1993)*

1. No matter what the odds, if I believe in something I will make it happen.
2. I love being a champion for my ideas, even against others' opposition.
3. I am excellent at identifying opportunities.
4. If I believe in an idea, no obstacle will prevent me from making it happen.

## Notes

1. We also tested a model in which the six autonomy items loaded onto a single factor representing job autonomy in general, and the other specifications were the same as the first measurement model. The model fit then was also acceptable (SB-$\chi^2$ = 334.70, *df* = 215; CFI = .94, TLI = .92, RMSEA = .056, SRMR = .060).

2. We also tried alternative model specifications without control variables (excluding gender, education, job level, openness to experience, proactive personality, and familiarity with participants' tasks). The coefficients and significances were then nearly identical. The same findings were also obtained when we included the two dispositional factors (i.e., openness to experiences and proactive personality) but not the other control variables.

3. A curvilinear relationship between time pressure and innovation behavior was not supported in a supplementary analysis.

4. Details are available from the first author.

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