human relations
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Routinization, free cognitive resources and creativity: The role of individual and contextual contingencies

human relations
2019, Vol. 72(2) 420–443

DOI: 10.1177/0018726718765630
journals.sagepub.com/home/hum
SAGE

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Abstract

In job design and creativity literature, challenging and complex jobs drive individual creativity, whereas routinization impedes creative outcomes. This study challenges this prevailing view by exploring the intermediate psychological mechanism and boundary conditions enabling the potential benefits of routinization to foster creativity in organizations. Routinization economizes employees' use of resources in performing tasks, thereby generating free cognitive resources that can be utilized for creative problem-solving. In addition, the effect of routinization on creativity, as mediated by free cognitive resources, is positively moderated by two boundary conditions: learning goal orientation of employees and supervisor support for creativity. Field data collected from 198 engineers and technicians and 56 supervisors working in manufacturing companies in South Korea confirm the moderated mediation hypotheses. The conditional indirect effects of routinization on creativity through free cognitive resources are significant and positive when the learning goal orientation of employees and supervisor support for creativity are high. These findings highlight the need for a balanced consideration of the ambivalent effects of task complexity and routinization on employee creativity along with further investigations on the contingencies of their effects.

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Keywords
creativity, free cognitive resources, job complexity, learning goal orientation, routinization, supervisor support for creativity

Creativity is essential for organizational innovation, effectiveness and survival in the contemporary business environment, in which organizations must adapt to fast-changing markets and technological conditions, and exploit emerging opportunities (Anderson et al., 2014). In identifying the predictors of workplace creativity, scholars have highlighted the importance of job design or task characteristics (Grant and Parker, 2009; Oldham and Cummings, 1996). Specifically, the full engagement of employees in challenging and complex tasks or 'enriched' jobs has been linked to intrinsic motivation (Hackman and Oldham, 1980; Shalley et al., 2009), intellectual flexibility (Frese et al., 2007), and utilization and expansion of task knowledge and skills (Holman and Wall, 2002). These cognitive and motivational processes develop creative ideas that are novel and useful in the given task and organizational context.

In contrast to the prevailing endorsement of complex and challenging tasks favoring creativity, another (although less developed) strand of creativity research highlights the importance of having 'time off' from busy work to reflect on a problem and generate creative ideas (Elsbach and Hargadon, 2006; Sonnentag et al., 2010). For example, 3M allows its employees to spend 15% of their work time on experimental projects not directly related to their regular task duties. These practices are partly inspired by numerous anecdotes of the 'Eureka' or 'Aha!' effect, which comes with previously unimagined and innovative ideas when a person is released from conscious and effortful thought processes. Given these contrasting mechanisms underlying creativity, scholars have begun to question whether formalized or routinized work possesses uniformly detrimental effects on creativity (Gilson et al., 2005; Sonenshein, 2016).

Task behaviors in organizations are often routinized responses to familiar situations (Becker, 2005). For example, Pentland and Rueter (1994) observed that complex and disorderly work, such as consultations at a software helpdesk, may exhibit high degrees of regularity and routinization with repeated rules for operation over time. Although routinization is a common phenomenon in workplaces, current understanding regarding its effect on creativity is limited (Anderson et al., 2014; Grant and Parker, 2009). Despite the prevailing contention that routine and creative action contradict each other (Sonenshein, 2016), Feldman and Pentland (2003) asserted that organization-level routines can promote change and flexibility. At the group level, Gilson et al. (2005) demonstrated that creativity and standardization can complement each other to improve team performance. At the individual level, Ohly et al. (2006) revealed that routinization is positively related to self-reported creativity. However, no further studies have been conducted to validate the effect of routinization on employee creativity or to elaborate on the underlying mechanisms. Given that routinized task behavior comprises a significant portion of the daily activities of employees, this deficiency presents a substantial gap in organizational creativity literature (Becker, 2005).

The present study clarifies the relationship between routinization and creativity by elaborating when and how this relationship becomes positive. Accordingly, we specify

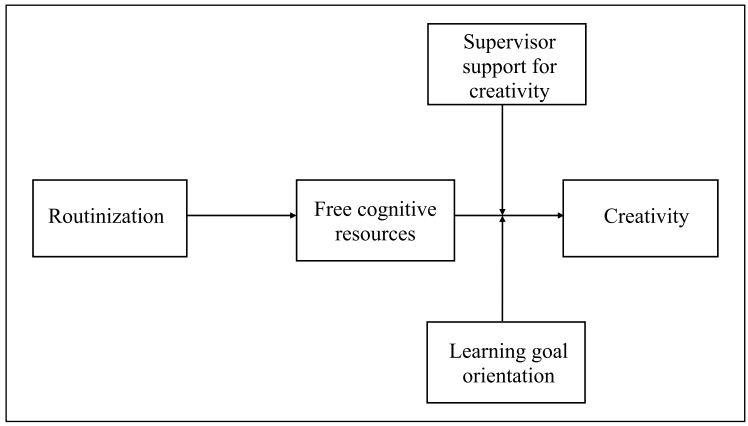

Figure 1. Conceptual framework.

the process through which routinization promotes creativity and the boundary conditions that accentuate the positive process. As routinized tasks may not require substantial intentionality and awareness, employees can automatically perform their actions; that is, because 'no decision about what to do is needed anymore; so, employees are able to think about other aspects of work' (Ohly et al., 2006: 259). The automaticity of task behavior in a given situation associated with task routinization allows individuals to conserve mental resources, which can provide energy for creativity. Hence, this function of routinization may affect creativity by supplying additional and free cognitive resources to employees.

However, the conserved mental resources of employees from routinization may not necessarily be invested in creative efforts. Therefore, isolating contingencies that urge employees to allocate free cognitive resources in exploring ideas is crucial. In the present study, we identify the learning goal orientation of employees and supervisor support for creativity as individual/motivational and contextual/normative factors that channel extra cognitive resources to creative efforts. We focus on the two individual and contextual moderators because they shape the fundamental work motivation and the immediate normative pressure that direct employees' attention and cognitive energy toward developing innovative and useful ideas.

Figure 1 shows the overall theoretical model comprising moderated mediation relationships. The model departs from the prevailing job design perspective identifying enriched jobs as a motivational driver toward individual creative efforts (Grant and Parker, 2009; Ohly et al., 2006). Instead, the current framework identifies task routinization as a provider of additional free cognitive resources, which can be channeled toward creative efforts by second-stage motivational drivers, such as learning goal orientation and supervisor support for creativity. This distinct framing should offer new insights into the relationship between workplace task design and creativity.

As an initial effort to theorize and validate this new perspective, we empirically investigate the current hypotheses by using data collected from engineers and technicians

working in manufacturing companies. The manufacturing sector provides an appropriate field setting for this study because task routines prevail in this kind of environment, where the routinization of processes is critical for employee performance (Lillrank, 2003). The current empirical analysis is based on multi-source data involving 198 employees and their supervisors working in five manufacturing organizations in South Korea.

Theoretical background and hypotheses

Job characteristics and creativity

The job characteristics model proposes that increased performance is a result of intrinsically enriched and complex jobs (Hackman and Oldham, 1980). Job complexity is the extent to which jobs provide employees with opportunities for personal challenges, responsibility and self-direction. Complex and challenging tasks increase intrinsic motivation, thereby promoting creative achievement of individuals (Oldham and Cummings, 1996; Sung et al., 2017). On the contrary, job complexity and cognitive burden can stress, depress and exhaust individuals, ultimately reducing performance because of their limited mental resources (Byron et al., 2010). Elsbach and Hargadon (2006) reported that the chronic and intensive workload involving cognitively challenging tasks and the constant time pressure to complete multiple tasks diminish creative outputs from professionals. Individuals require time and freedom from challenging tasks to generate creative ideas and experiment with transformational changes. Thus, job complexity can promote employee creativity but can also stifle the creative process.

Routinization and creativity

Studies on job characteristics and job design suggest that routinization can cause negative outcomes through the negative motivational consequences of unenriched jobs (Hackman and Oldham, 1980). However, routinization does not necessarily imply simple and boring work tasks or a lack of autonomy in making decisions; rather, it is characterized as automaticity in behavior, which is typified by 'unintentionality, uncontrollability, lack of awareness, and efficiency' (Ohly et al., 2006: 258). Routinization does not only occur outside of awareness (i.e. an individual is unaware of the initiation or flow of the activity) but is also effortless in that abundant cognitive resources are not required (Verplanken and Orbell, 2003).

Routinization should be distinguished from other constructs such as work monotony or standardization. The concept of work monotony is commonly classified into repetitive work (jobs characterized by a relatively short time cycle and monotonous motor demands) and work underload (jobs without an apparent cycle of operations but necessitating sustained attention and immediate response to certain predetermined events) (Melamed et al., 1995). Routinization does not just refer to simple or repetitive tasks. Routinized tasks are performed as habitual responses to familiar situations, thereby reducing cognitive demands and the need to make rational decisions (Verplanken and Orbell, 2003). In addition, routinization differs from standardization, which details how work should be performed in a formal and a priori manner (March, 1991). Developing prescribed work

patterns that must be consistently followed by individuals and using statistical tools to monitor and analyze work processes to avoid any deviations are important components of standardization (Crosby, 1989). Routinization is an atomized behavior often customized to a specific individual in the absence of explicit consideration of others' behavior or the external task environment.

Routinization generates mental slack by economizing the limited information processing and decision-making capacity of agents (Voss et al., 2008). Reduced cognitive demands arising from routinization and automaticity in task behavior increase cognitive slack during task performance and the extra time gained through efficiency, both of which can be used to attend to non-routine events and problems (Morgan and Hancock, 2011; Voss et al., 2008). When the components of a task become automatic, individuals shift their attention to the high-level components of the task. The more actions an individual can delegate to the sub-conscious, the more room becomes available to execute activities that require conscious processing (Quinn et al., 2012). This function of routinization is critical for creativity, which necessitates strenuous mental energy. Increased cognitive effort is required to generate multiple alternatives, suspend judgments and look at problems divergently. Creativity at work becomes feasible when a slight surplus of cognitive resources becomes available (De Jonge and Dormann, 2003). Without these additional resources, task demands may only be addressed using available and tested strategies. Routinization can be positively related to proactive behaviors such as creativity, innovation and personal initiative, all of which require extra resources beyond routinized task performance (Ohly et al., 2006). Therefore, we propose the following hypothesis:

Hypothesis 1: Routinization is positively related to creativity.

Mediating mechanism: Free cognitive resources

Routines, as repetitive task patterns requiring minimal cognitive resources, are positively related to creativity because they may increase the cognitive slack while performing a task and the extra time off to focus on the development of new ideas (Voss et al., 2008). Routinization contributes to creativity to the extent that it supplies extra and free cognitive resources that can be used for creative efforts. Ohly et al. speculated that 'routinization might be beneficial for creativity because it frees cognitive resources to think about other aspects of work' (Ohly et al., 2006: 259). Therefore, we advance free cognitive resources as an intervening and underlying psychological mechanism accounting for the routinization–creativity relationship. 'Free cognitive resources' denotes the difference between an individual's cognitive capacity in terms of working memory and information processing and the cognitive capacity needed to complete assigned tasks (Brunken et al., 2003).[1]

Routinization automates an individual's performance to the point where minimal thought is required (Ackerman and Humphreys, 1990). Routines can be performed with minimal attentional resources and without conscious effort, thereby freeing cognitive resources for other activities. The performance–resource function is altered under several key situations (Norman and Bobrow, 1975). For example, in performing a routinized task, task performance changes from controlled, intensive and resource-dependent processing to automatic and resource-insensitive processing (Ackerman and Humphreys,

1990). Ultimately, if a task becomes automatic, fast and effortless, then individuals can spare cognitive resources, thus gaining extra mental energy while performing their tasks (Quinn et al., 2012). The efficiency from routinization also generates free time to cope with a problematic situation in different ways. Without additional break time, employees may resort to tried and tested methods rather than experiment, and attempt to produce new ideas with creative approaches (Shalley and Gilson, 2004).

Free cognitive resources and extra time gained from routinization are critical to creativity because these surpluses urge individuals to ponder task problems and propose new ideas to improve existing processes (Ohly et al., 2006; Voss et al., 2008). Individuals can develop innovative ideas if they have additional time and the mental resources necessary to explore alternative possibilities (De Jonge and Dormann, 2003). Reduced mental capacity because of cognitive busyness and overwhelming task challenges may cause individuals' narrow thinking and hinder their ability to explore new opportunities (Santanen et al., 2004). Therefore, routinization may spare cognitive resources of employees, which in turn may fuel their efforts to develop creative solutions. Thus, we propose the following mediation hypothesis:

Hypothesis 2: Free cognitive resources mediate the relationship between routinization and creativity.

Moderating contingencies: Learning goal orientation and supervisor support for creativity

The presence of free cognitive resources may not always lead to increased creativity because of the high-level individual discretion in allocating such extra resources, enabling them to convert slack resources to variable uses should the need or opportunity arise (Quinn et al., 2012). With the relatively high discretion associated with the cognitive slack attained from routinization, the latter may be channeled to various task activities or personal matters other than creative efforts, such as avoiding errors in task completion or planning for post-work activities. For example, conscientious individuals with strong prevention focus under a strict leader may devote additional cognitive resources to repeatedly monitoring their performance and avoiding mistakes (Barrick and Mount, 2009). The question that naturally follows is: at what point do individuals invest these additional resources to explore and experiment with new ideas?

Moderating contingencies should be identified and examined to elaborate the understanding of the routinization–creativity relationship mediated by free cognitive resources. To this end, we focus on the critical individual and contextual factors that may operate as boundary conditions of the mediated relationship. On one hand, we isolate learning goal orientation as the motivational driver of individuals. On the other hand, we consider supervisor support for creativity as social, normative pressure that urges individuals to utilize additional cognitive resources for generating creative ideas.

Learning goal orientation. Goal orientation is a motivational inclination shaping perceptual–cognitive frameworks of how individuals approach, interpret and respond to achievement situations (Dweck, 1999). Learning goal orientation motivates individuals

to develop their competence and task mastery (Dweck, 1999; VandeWalle et al., 1999) and is associated with a preference for challenging work and risk-taking (Ames and Archer, 1988). To complement the previous focus on the main effect of learning (or mastery) goal orientation as a trait motivation beneficial for creativity (Hirst et al., 2009; Janssen and Van Yperen, 2004), we focus on its potential moderating function in the present study. Individuals with learning goal orientation use task efforts to activate their current ability for task achievement and develop it for future task mastery (VandeWalle et al., 1999). These individuals tend to invest their free cognitive resources to resolve task-related challenges and master task competence (Dweck, 1999). This spontaneous pursuit of challenging tasks and willingness to explore new ways of doing things increase the likelihood that learning-oriented individuals will allocate free cognitive resources to creative endeavors (Hirst et al., 2009).

Learning goal orientation may also strengthen the connection between cognitive slack and creative efforts by increasing an individual's sensitivity to and persistence in problematic situations. Individuals valuing mastery prefer channeling free cognitive resources to reflect on task-related problems and challenges, thereby leading to learning opportunities and skill improvement (Hirst et al., 2009; VandeWalle et al., 1999). They are also willing to invest additional efforts to overcome the tension and stress from task challenges by taking risks and exploring new alternatives to improve the status quo (Dweck, 1999; VandeWalle et al., 1999). On the contrary, individuals with low learning goal orientation succumb to obstacles and fail to employ complex and effortful problem-solving and learning strategies. Thus, individuals with high learning goal orientation will likely use the free cognitive resources obtained from routinization for creative problem-solving. Accordingly, we propose the following hypothesis:

> *Hypothesis 3*: Learning goal orientation positively moderates the relationship between routinization and creativity, which is mediated by free cognitive resources.

Supervisor support for creativity. Supervisor support for creativity refers to the extent to which supervisors recognize, respect and support creativity (Madjar et al., 2002). Supervisors comprise the most immediate and important work context for employees; thus, supervisor support for creativity is a significant predictor of employee creativity (Anderson et al., 2014). The present study extends this line of research by examining the potential moderating role of supervisor support for creativity on the relationship between free cognitive resources and creativity.

The degree to which free cognitive resources elevate into creativity may depend on the extent to which employees channel their attention toward idea generation. Within this context, supervisors may play a significant role because they have the authority to allocate team resources to specific directions and prescribe how employees must perform tasks (Kim et al., 2010; Zhang and Bartol, 2010). When supervisors provide employees the necessary encouragement and tangible assistance (e.g. opportunities to present ideas and refine their initial solutions) (Amabile et al., 1996), employees may willingly allocate available cognitive slack to creative efforts because they perceive creativity to be normatively appropriate (Zhou and George, 2001).

In addition, a high level of supervisor support for creativity establishes a climate of psychological safety (Edmondson, 2003). The openness of supervisors to new ideas and appreciation of individual contributions may decrease potential social risks and the threat of being penalized for challenging the status quo (Amabile et al., 1996). This social climate may boost the intention of employees to utilize available cognitive resources for generating new ideas. On the contrary, a low level of support for creativity indicates that creative ideas are blocked, and challenging current practices comes with substantial risk. Under this circumstance, employees will not allocate additional cognitive resources to identifying deficiencies and exploring alternatives for improving the status quo. Instead, they will disregard creativity and focus on other outcomes valued by their supervisors. Thus, we hypothesize that the positive indirect effect of routinization on creativity through free cognitive resources intensifies under high supervisor support for creativity:

Hypothesis 4: Supervisor support for creativity positively moderates the relationship between routinization and creativity, which is mediated by free cognitive resources.

Method

Sample and data collection procedure

To test our hypotheses, we collected survey data from five South Korean manufacturers of electronic components for televisions, smartphones and computers. Participating employees performed various technical and engineering functions related to operating and maintaining computerized manufacturing devices and controlling product quality. We personally distributed the survey questionnaires to 230 engineers and technicians, who voluntarily completed the survey during regular working hours. To increase voluntary participation and the reliability of responses, we provided written and verbal assurances that individual responses were confidential. A total of 220 employees returned completed surveys to the researchers (response rate = 95.7%).

In the five manufacturing sites, we also contacted the immediate supervisors of the participating employees and requested them to evaluate the creativity of their employees. Supervisor ratings were obtained for 210 out of 230 target employees (response rate = 91.3%). By matching the employee and supervisor responses, we obtained usable data from 198 employees and 56 supervisors (response rate = 86.1%). Each participating supervisor evaluated two to six employees, with an average of 3.54.

The average age of employees was 32.22 years (SD = 7.88), and their average organizational tenure was 4.26 years (SD = 6.86). The sample included 61 women (30.8%) and 137 men (69.2%). In terms of education level, 76 employees (38.4%) were high school graduates, 37 (18.7%) graduated from junior college, 74 (37.4%) possessed a bachelor's degree and five (2.5%) earned a graduate degree. The supervisor sample included 51 males (91%) and five females (9%). Their average age and organizational tenure were 41.07 years (SD = 6.48) and 7.68 years (SD = 7.80), respectively. The distribution of supervisors according to education was as follows: high school graduates (5.4%), junior college (17.9%), bachelor's degree (66.1%) and graduate degree (10.6%).

Measures

Participating employees and supervisors rated all items using a seven-point Likert scale ranging from 1 (not at all) to 7 (extremely). The measures were originally developed in English, and then translated to Korean following standard back-translation procedures (Brislin, 1986).

Routinization. To assess the essential characteristics of routinization, such as recurrent patterns and behavioral automaticity, we employed the scale developed by Verplanken and Orbell (2003), which was also used by Ohly et al. (2006). Routinization was measured using the following five items ($\alpha = .71$): 'I do my main tasks without consciously remembering the method,' 'I do my main tasks automatically,' 'I do my main tasks without thinking,' 'My main tasks belong to my daily/weekly/monthly routine,' and 'I do my main tasks frequently.'

Free cognitive resources. We measured free cognitive resources by using the Subjective Workload Assessment Technique (SWAT) developed by Reid and Nygren (1988). SWAT is one of the most widely used standardized tools for assessing multidimensional subjective mental workloads (Rubio et al., 2004). In SWAT, the mental effort required to perform main tasks or activities is rated based on three aspects: density of the main tasks (time load), required concentration (mental effort load) and subjective feelings of emotional stress and anxiety (psychological stress load). We used the following three items ($\alpha = .74$) to assess the workload of the participants: (a) 'In my main tasks, I almost never have spare time, and interruptions or overlap among activities are very frequent or occur all the time' (time load); (b) 'In my main tasks, extensive mental effort and concentration are necessary with very complex activities requiring total attention' (mental effort load); and (c) 'In my main tasks, very intense stress due to confusion, frustration, or anxiety occurs' (psychological stress load). These three items were reverse-coded and averaged to construct the scale of free cognitive resources.

Learning goal orientation. We adopted the five items ($\alpha = .85$) developed by VandeWalle (1997) to assess the learning goal orientation of employees. Sample items were 'I often look for opportunities to develop new skills and knowledge' and 'I enjoy challenging and difficult tasks at work where I'll learn new skills.'

Supervisor support for creativity. To measure supervisor support for creativity, we adopted the 10-item scale ($\alpha = .92$) of *supervisory encouragement*, which is one of the five stimulant scales from the KEYS instrument designed to assess the climate for creativity (Amabile et al., 1996). Sample items included the following: 'My supervisor is open to new ideas,' 'My supervisor values individual contributions to projects' and 'My supervisor shows confidence in our work group.'

Creativity. Similar to previous research, creativity was assessed through supervisor ratings (Oldham and Cummings, 1996; Zhang and Bartol, 2010). We adopted six items from Zhou and George (2001) to assess the creativity of participating employees as rated by their supervisors. The six items ($\alpha = .93$) were: (a) 'This employee comes up with new and practical ideas to improve performance;' (b) 'This employee suggests new ways to increase quality;' (c) 'This employee develops adequate plans and schedules for the implementation of new ideas;' (d) 'This employee has new and innovative ideas;' (e) 'This employee suggests new ways to achieve goals or objectives;' and (f) 'This employee comes up with creative solutions to problems.'

Control variables. On the basis of recommendations for the inclusion of control variables (Becker, 2005; Bernerth and Aguinis, 2016), we controlled important demographic variables to reduce the likelihood of other variables related to creativity confounding our results. Education is positively related to creativity because it reflects task domain expertise or knowledge that can influence creative performance (Anderson et al., 2014; Zhang and Bartol, 2010). Moreover, creativity is related to demographic factors, such as age, gender and organizational tenure, which may imply social status in Korean organizations, thereby affecting the motivation of employees to exercise their creativity (Sung et al., 2017). The present analysis included four control variables: age (in years), gender (0 = male, 1 = female), education (1 = high school, 2 = junior college, 3 = bachelor degree and 4 = graduate degree) and tenure (in years).

Apart from these demographic characteristics, we also controlled for other task-related characteristics. The present sample comprised two job types (engineers and technicians) that may require different levels of creativity. Thus, we controlled for these job types (0 = engineers, 1 = technicians). As different hierarchical positions may allow disparate opportunities and demands for creativity, we also controlled for the hierarchical positions of participants (0 = staff, 1 = assistant manager, 2 = manager). We likewise controlled for job complexity as a critical job design factor that influences employee creativity (Ohly et al., 2006; Shalley et al., 2009). Given the contrasting reasons for job complexity and routinization in promoting creativity (Anderson et al., 2004), examining the effect of routinization after controlling for that of job complexity is important. In the current study, we assessed job complexity using the 15 items ($\alpha = .82$) adopted from the Job Diagnostic Survey (JDS: Hackman and Oldham, 1980) that assesses the levels of five job characteristics, such as skill variety, task identity, task significance, autonomy and job feedback. The sample items included the following: 'The job gives me considerable opportunity for independence and freedom in how I do the work' and 'The job itself is highly significant or important in the broader scheme of things.' Prior to conducting full-scale analyses, we also assessed the differences in results between the inclusion and exclusion of control variables to detect any irregularities (Becker, 2005; Bernerth and Aguinis, 2016).

Results

We performed confirmatory factor analysis (CFA) to examine the empirical distinctiveness of the scales used in this study. Specifically, we compared the fit of the hypothesized six-factor measurement model (i.e. job complexity, routinization, free cognitive resources, learning goal orientation, supervisor support for creativity, and creativity) with that of the alternative five- or four-factor measurement models, in which two or three latent factors (e.g. routinization and free cognitive resources) were combined to represent a single factor. Given that the job complexity scale included 15 items, which rendered an unfavorable ratio between the sample size and the number of parameters to be estimated (Marsh et al., 2013), we used five subscales representing the five job characteristic dimensions (i.e. skill variety, task identity, task significance, autonomy and job feedback) in our CFA. Table 1 presents that the hypothesized measurement model with six separate latent factors provided an acceptable fit to the data ($\chi^2[445] = 749.88$, $p < .001$; CFI = .92, TLI = .91, RMSEA = .06). The hypothesized factor structure also

significantly outperformed all other alternative measurement models, thereby supporting the validity and distinctiveness of the present scales. Table 2 reports the descriptive statistics of all variables used in the study.

Main effect of routinization on creativity

Given that employees are nested within supervisors, we adopted hierarchical linear modeling (HLM) to consider the non-independence of employees rated by the same supervisor (Raudenbush and Bryk, 2002). Table 3 reports the HLM results. After controlling for age, gender, education, organizational tenure, job types, hierarchical positions and job complexity, results showed that routinization was not significantly related to employee creativity ($\gamma = .05$, ns). Therefore, Hypothesis 1 was not supported.

Mediation by free cognitive resources

In Hypothesis 2, we stated that free cognitive resources mediate the effect of routinization on creativity. To verify the significance of this mediation, we applied the bootstrapping procedure of Preacher and Hayes (2004) and tested the significance of the indirect effect of routinization on creativity via free cognitive resources. The bootstrapped results confirmed the significant indirect effect (effect estimate = .04, 95% confidence interval (CI) = .01 and .10). Thus, Hypothesis 2 was supported. Given that the direct effect of routinization on creativity was not significant, this significant mediation by free cognitive resources should be interpreted as an 'indirect-only mediation' following the classification of Zhao et al. (2010).

Mediation moderated by learning goal orientation

To test the moderated mediation proposed in Hypothesis 3, we first tested the significance of the interaction between free cognitive resources and learning goal orientation in predicting creativity (Edwards and Lambert, 2007). Subsequently, we followed the bootstrapping procedure to compare the conditional indirect effects of routinization on creativity via free cognitive resources across low and high levels of learning goal orientation (Preacher et al., 2007). Model 5 of Table 3 reports that the interaction between free cognitive resources and learning goal orientation significantly predicted creativity ($\gamma = .19$, $p < .05$). This significant interaction was further examined using simple slope analysis. Figure 2 presents that the effect of free cognitive resources on creativity was significant and positive for high learning goal orientation or 1 SD above the mean ($b = .30$, $p < .05$), but not significant for low learning goal orientation or 1 SD below the mean ($b = –.08$, ns).

Furthermore, the comparison of bootstrapped indirect effects at different levels of learning goal orientation revealed the significant conditional indirect effect of routinization for high levels of learning goal orientation (conditional indirect effect = .07, 95% CI = .011 and .146). However, the conditional indirect effect of routinization became non-significant for low levels of learning goal orientation (conditional indirect effect = –.02, 95% CI of –.077 and .016) (Table 4). Thus, Hypothesis 3 was supported.

Table 1. Comparison of measurement models.

Model	No. of factors[a]	χ^2	d.f.	$\Delta\chi^2$	CFI	TLI	RMSEA
Baseline model	6 factors: Com, Rou, FCR, LGO, SSC, Cre	749.88	445		.92	.91	.06
Alternative 1	5 factors: Com, (Rou + FCR), LGO, SSC, Cre	1053.64	450	303.76**	.84	.82	.07
Alternative 2	5 factors: (Com + Rou), FCR, LGO, SSC, Cre	1100.05	450	350.17**	.83	.80	.08
Alternative 3	4 factors: (Com + Rou + FCR), LGO, SSC, Cre	1192.22	454	442.30**	.80	.77	.08
Alternative 4	3 factors: (Com + Rou + FCR + LGO), SSC, Cre	1358.61	457	608.73**	.75	.72	.09
Alternative 5	2 factors: (Com + Rou + FCR + LGO + SSC), Cre	1803.82	459	1053.94***	.63	.57	.11

[a]Com = Job complexity; Rou = Routinization; FCR = Free cognitive resources; LGO = Learning goal orientation, SSC = Supervisor support for creativity, Cre = Creativity.
d.f.: degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation. ** $p < .01$, *** $p < .001$.

Mediation moderated by supervisor support for creativity

Hypothesis 4 identified supervisor support for creativity as a moderator of the relationship between routinization and creativity mediated by free cognitive resources. The HLM results confirmed that the interaction between free cognitive resources and supervisor support for creativity was a significant, positive predictor of creativity ($\gamma = .22$, $p < .05$; see Model 5, Table 3). As shown in the simple slope analysis results in Figure 3, the relationship between free cognitive resources and creativity was positive when supervisor support for creativity was high ($b = .33$, $p < .001$), but not different from zero when supervisor support was low ($b = –.11$, ns). Meanwhile, as indicated in Table 4, the conditional indirect effects of routinization on creativity through free cognitive resources was significant and positive when supervisor support was high (conditional indirect effect = .07, 95% CI of .015 and .140), but non-significant when it was low (conditional indirect effect = –.01, 95% CI of –.071 and .024). Therefore, the present analysis confirmed Hypothesis 4.

Post-hoc analysis

We conducted two sets of post-hoc analyses to further examine the robustness of the present findings. First, we tested whether findings may change when control variables were excluded in the multilevel equations, in accordance with the recommendation regarding the treatment of control variables (Becker, 2005; Bernerth and Aguinis, 2016). Without control variables, the overall results were unchanged, except that the moderating effect of learning goal orientation on the relationship between free cognitive resources and creativity became statistically non-significant. However, when all control variables or just job complexity was excluded from the equation,

Table 2. Means, standard deviations and correlations among study variables.

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Age	32.22	7.88											
2. Gender	.31	.46	−.42***										
3. Education	2.11	1.00	.27***	−.19**									
4. Tenure	4.26	6.86	.58***	−.27***	.06								
5. Job types	.44	.50	−.31***	.22**	−.53***	−.16*							
6. Hierarchical positions	1.69	.87	.64***	−.40***	.42***	.32***	−.46***						
7. Job complexity	4.50	.59	.29***	−.29***	.09	.25***	−.17*	.31***					
8. Routinization	4.38	.84	.07	−.05	.01	.13	−.09	.03	−.17*				
9. Free cognitive resources	4.35	.79	.10	−.03	.09	.04	−.15*	.09	.16*	.19**			
10. Learning goal orientation	4.68	.88	.14*	−.19**	.19**	.11	−.21**	.21**	.55***	.15*	.26***		
11. Supervisor support for creativity	4.56	.89	.05	−.06	.17*	.11	−.17*	.13	.39***	.09	.03	.37***	
12. Creativity	4.39	1.08	.31***	−.34***	.40***	.16*	−.36***	.32***	.37***	.16*	.26***	.44***	.21**

N = 198; SD = standard deviation. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3. Results of hierarchical linear modeling.

Variable	FCR	Creativity			
	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	4.16***	3.47***	3.48***	3.44***	3.30***
Age	.01	.02	.02	.02	.02
Gender	.10	−.23	−.25	−.25	−.25
Education	.01	.35***	.35***	.33***	.33***
Tenure	−.01	−.01	−.01	−.01	−.01
Job types	−.17	−.20	−.17	−.16	−.17
Hierarchical positions	−.02	−.13	−.13	−.12	−.12
Job complexity	.10	.45***	.43***	.27*	.24
Routinization	.14*	.05	.03	.05	.06
Free cognitive resources (FCR)			.21*	.17*	.11
Learning goal orientation (LGO)				.23**	.20*
Supervisor support for creativity (SSC)				−.04	−.06
FCR × LGO					.19*
FCR × SSC					.22*
Pseudo *R* squared	.02	.25	.28	.31	.36

$N = 198$. * $p < .05$, ** $p < .01$, *** $p < .001$.

routinization exhibited a statistically significant main effect on creativity ($\gamma = .15$, $p < .05$).

Second, we tested two plausible alternative relationships among constructs in our model. One possibility is that free cognitive resources from the task may facilitate the routinization of one's work, which in turn, affects creativity. This reverse causality model exhibited no significant mediation, and moderated mediation effects. Another possibility is that learning goal orientation may promote routinization to generate slack resources that can be utilized for skill improvement and creative endeavors. Our follow-up analyses invalidated the possibility that learning goal orientation improved creativity by enhancing routinization or free cognitive resources.

Third, although we employed the three-dimensional measure based on SWAT to evaluate free cognitive resources, the most direct and straightforward measure may be the time load dimension because it indicates the extent to which employees cannot spare any time, and experience continuous overlapping demands during their daily performance, thereby depriving any extra cognitive capacity from them. Thus, we performed the same HLM analyses for testing the hypotheses by using the single item representing the time load dimension for free cognitive resources. The results based on this single-item measure showed the same patterns as those based on the three-item scale of free cognitive resources, except for the non-significant moderating effect of supervisor support for creativity on the relationship between free cognitive resources and creativity (results are available upon request). All other direct and indirect effect patterns were unchanged, further confirming the robustness of the current findings.

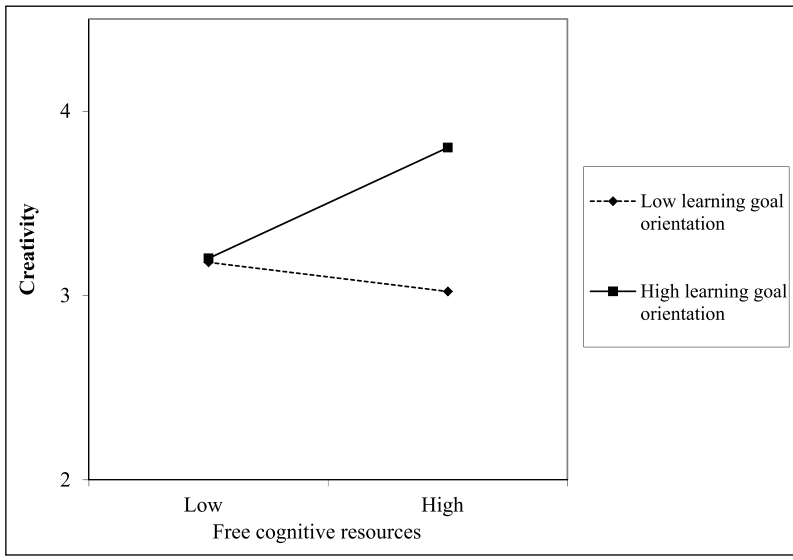

Figure 2. Interaction of free cognitive resources and learning goal orientation on creativity.

Discussion

This study challenges the prevailing assumption that routinization is detrimental to creativity in organizations because challenging and complex jobs favor the generation of creative ideas. Expanding the previous finding that routinization can actually improve creativity (Ohly et al., 2006), we elaborate on the routinization–creativity relationship by examining the underlying mechanism accounting for this relationship and its boundary conditions. The present conceptual and empirical analysis demonstrates that routinization promotes creativity through free cognitive resources, which can be invested to creative and non-routine issues. In addition, the indirect effect of routinization on creativity through free cognitive resources motivates employees to deploy extra resources to creative problem-solving. The following section will discuss the current study's implications, limitations and directions for future research.

Theoretical implications

Research on task characteristics that enhance workplace creativity has largely focused on challenging, complex and broadly defined jobs (Grant and Parker, 2009; Oldham and Cummings, 1996). Therefore, routinization is often regarded as a job characteristic that stifles creative thinking (Anderson et al., 2004). When job complexity and routinization are simultaneously considered to predict employee creativity (see Table 3), only job complexity is revealed as a significant predictor, confirming the prevailing view based on the job design literature (Hackman and Oldham, 1980; Oldham and Cummings, 1996). However, when job complexity is excluded in the equation, routinization also

Table 4. Bootstrapped moderated mediation results.

Independent variable	Mediator	Dependent variable	Moderator	Moderator level	Conditional indirect effect	Product of coefficients			Bootstrapping bias-corrected 95% confidence interval	
						SE	z	*P*	Lower	Upper
Routinization	Free cognitive resources	Creativity	Learning goal orientation	Lo (Mean – 1SD)	−.018	.022	−.82	ns	−.077	.016
				Mean	**.026**	**.017**	**1.53**	**< .01**	**.006**	**.068**
				Hi (Mean + 1 SD)	**.071**	**.030**	**2.37**	**< .01**	**.011**	**.146**
			Supervisory support for creativity	Lo (Mean – 1SD)	−.013	.023	−.57	ns	−.071	.024
				Mean	**.028**	**.015**	**1.87**	**< .01**	**.005**	**.076**
				Hi (Mean + 1SD)	**.069**	**.035**	**1.97**	**< .01**	**.015**	**.140**

Bootstrap sample size = 1,000. Coefficients in bold indicate significant mediation. SE = standard error; *P* = probability; ns = not significant; SD = standard deviation.

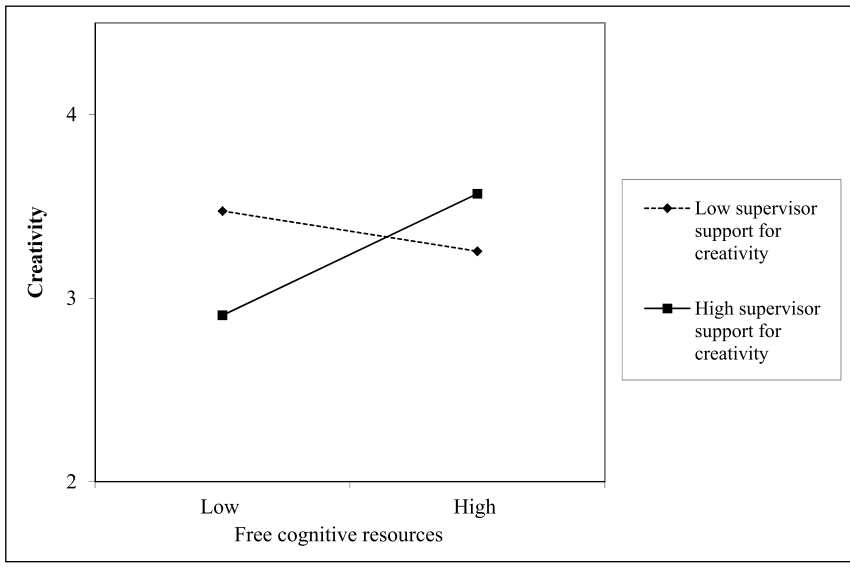

Figure 3. Interaction of free cognitive resources and supervisor support for creativity on creativity.

exerts a significant positive effect on creativity. Furthermore, unlike the non-significant mediated and moderated mediation effects of job complexity, routinization exhibits a significant indirect effect on creativity through free cognitive resources. Such an effect is moderated by learning goal orientation and supervisor support for creativity. Compared with the direct motivational potential of job complexity toward creativity, the effect of routinization on creativity is slightly nuanced because it involves the activation of the intervening mechanism and depends on boundary contingencies. This disparity between job complexity and routinization parallels the contrasting effects of intrinsic motivation and extrinsic rewards. Relative to the direct effect of intrinsic motivation on creativity, extrinsic rewards tend to constitute a neutral or even negative predictor of creativity, but become a positive predictor when it activates a certain psychological state (e.g. performance pressure) under certain conditions (e.g. rewards contingent on creative performance) (Byron and Khazanchi, 2012).

Routinized activities can be the source of stability or inertia because they can establish a repetitive and well-established pattern that is executed in a uniform manner over time (Becker, 2005). These unchanging preset patterns of actions may limit the organizational repertoire of activities, thereby serving as the antithesis of flexibility and change (Feldman, 2000). However, routinized task behaviors also represent automaticity in performing tasks, which are executed subconsciously. As tasks become automated, minimal conscious processing and attention are required to complete them, allowing individuals to conserve mental resources and mitigating the burden of their daily duties by creating shortcuts in completing those regular tasks. The present results demonstrate that the benefit of routinization toward creativity is realized through the generation of free cognitive

resources. This study advances the understanding of the rationale and mechanism through which routinization can be considered functional to creativity in organizational settings.

Our analysis also revealed that routinization and the resulting free cognitive resources enhance employee creativity because of the presence of favorable individual and contextual boundary conditions. In particular, the free cognitive resources of employees are invested in creative efforts when they have learning goal orientation and when their supervisors provide support for creativity (Figures 2 and 3). Investing extra cognitive resources to creative processes requires the voluntary intention of employees to explore fresh alternatives and the presence of environmental encouragement to spur their creative efforts (Kim et al., 2010; Zhang and Bartol, 2010). By demonstrating the moderating roles of individual and social characteristics that enable routinization to promote creativity, the present study emphasizes an alternative theoretical account on the effect of job properties on employee outcomes. Unlike the direct motivational potential of job complexity toward task behavior, routinization provides additional resources or energy that can be channeled to different behavioral directions depending on individual and contextual motivational drivers (Quinn et al., 2012). This distinct process of resource generation followed by motivational channeling may be further elaborated by exploring underlying mechanisms and contingencies that connect routinization to creativity and innovation in organizations.

These findings may appear paradoxical in suggesting that routinization conserves the cognitive resources of individuals to enable them to cope with non-routine events and think divergently. Although performing routinized tasks presents potential risks and shortcomings, continuous challenges and cognitively taxing complex jobs often reduce individual creativity (Byron et al, 2010). Our analysis on the interaction between free cognitive resources and supervisor support for creativity from a different direction demonstrated that the effect of supervisor support for creativity on employee creativity was significant and negative when free cognitive resources were low ($b = –.28$, $p < .05$) but became non-significant when free cognitive resources were high ($b = .16$, ns). We posit that organizational support and encouragement of creativity may backfire and produce unintended negative effects in employees without any free cognitive resources who may regard such support as a source of additional burden and stress. Job design theories also suggest that simple, repetitive and unchallenging jobs are demotivating, and employees may feel that their tasks are insignificant, thereby reducing their intrinsic motivation and creativity (Anderson et al., 2004; Oldham and Cummings, 1996). Thus, for routinization to become beneficial for creativity, it should not come at the expense of significance and challenges from the task. In fact, both Ohly et al. (2006) and the present study confirm that routinization and job complexity are only weakly related ($r = –.09$, ns and $r = –.17$, $p < .05$). Therefore, routinization can be attained among workers with challenging and complex tasks through careful job design interventions.

Practical implications

This study provides important implications for managers. Several organizations known for innovative products (e.g. 3M and Google) emphasize the importance of motivating employees to think differently by taking a respite from their day-to-day business. Instead

of inundating employees with fully engaging and complex tasks under time pressure, these organizations provide workers with time for reflective thinking or incubation, which is essential for creativity (Elsbach and Hargadon, 2006; Sonnentag et al., 2010). Thus, creativity is promoted by free cognitive resources, which can be generated by various organizational interventions, including routinization, regular breaks, sabbatical leaves or special time allowance for personal exploration of non-routine task issues. Hence, managers must be tolerant of these alternative pathways toward creativity because employees who engage in reflection and incubation (e.g. those who take free time from work to think alone or stare out the window) may appear inefficient and inactive compared with fully engaged and hardworking employees.

Given the present findings, managers may also consider the recommendation of Elsbach and Hargadon (2006) regarding a new framework of workday design to enhance the creativity of chronically overworked employees. Job design for overstretched professionals should focus on workdays, in which scheduled periods of low cognitive difficulty and less pressing work should be integrated. These periods of work require limited concentrated attention, thereby enabling a person's mind to drift regularly to non-task-related thoughts (Jett and George, 2003). In the context of the current results, managers should consider the role of reflection-in-action needed for creativity that oscillates between involvement and detachment, where detachment is supported by time or intensive attention away from the cognitively demanding work tasks (Sonnentag et al., 2010).

Managers should also be conscious of facilitating conditions that allow routinization to contribute toward creativity. For example, managers can allow task routinization and additional time away from daily hassles for employees with high levels of learning goal orientation, because such employees tend to invest additional cognitive resources to task-related problem-solving. Managers should likewise explicitly convey that they advocate creativity and motivate employees to spend cognitive slack toward generating creative solutions. Thus, to foster workplace creativity, managers must initiate interventions to create a work environment that channels additional cognitive resources to creative engagement.

Study limitations and directions for future research

Despite the important theoretical and practical implications of this study, it has several limitations that should be considered in identifying fruitful directions for future research. First, we cannot draw firm conclusions regarding the causal direction among study variables because of the cross-sectional nature of the study design. For example, free cognitive resources from the task may facilitate automaticity and routinization of one's work, which in turn, predicts creativity. Moreover, routinization and the acquisition of resulting free cognitive resources could be accomplished over a considerable period by accumulating practices and experiences (Morgan and Hancock, 2011). Thus, the benefits of routinization would only be realized over time with numerous practices, to the extent that the task becomes automatic. This temporal implication of routinization requires longitudinal or preferably field-experimental research designs for further empirical validation of the current conceptual framework.

Second, the present focus on learning goal orientation and supervisor support for creativity as moderating contingencies may have excluded other plausible and theoretically meaningful individual and contextual factors, thus leading to potential misspecification of the conceptual model. Future research should thus explore alternative explanations offered by other individual and contextual characteristics. For example, individuals with high growth need strength are less likely to interpret creativity as a risk or threat (Hackman and Oldham, 1980). Instead, they seek opportunities to extend their capabilities through their job, and persevere amid challenges, inconsistent findings and performance pressures (Shalley et al., 2009). Hence, similar to learning goal orientation, growth need strength may present a moderating function. Instead of supervisor support, a reflective climate that encourages members to discuss new ways of effective collaboration (Patterson et al., 2005) may urge employees to invest their spare cognitive resources to reflect on the team's objectives and processes and then adapt them to current or anticipated demands.

Finally, the present findings should be generalized with caution because the current sample involves technicians and engineers in five manufacturing companies. These task and organizational settings provide a favorable research context where task routinization is widely observed, thereby facilitating the detection of its effects on free cognitive resources and creativity. Future empirical studies must incorporate diverse task and organizational settings in which tasks are less structured and provide a relatively low base rate of routinization (e.g. new product design). In addition, the effect of routinization and free cognitive resources on creativity can take different forms in jobs that require radical product innovations (e.g. marketing, research and development). A consideration of different tasks and industrial contexts should further elaborate the role of routinization and free cognitive resources toward various types of creativity, such as radical or incremental ideas related to work processes or products.

In the context of re-emerging interest in job design, researchers have highlighted the need for further investigations on the conditions under which the same work design factors encourage rather than discourage creativity and other proactive behaviors (Grant and Parker, 2009). Similar to the ambivalent implications of complex and challenging jobs, routinized tasks may have both positive and negative implications for employee creativity; however, the prevailing perspective and assumption on routinization are more inclined toward underscoring the negative consequences instead of the benefits of routinization for creativity (Anderson et al., 2014; Sonenshein, 2016). Consistent with Ohly et al. (2006), the present study demonstrates the positive effect of routinization on creativity, and elaborates its underlying mechanisms involving free cognitive resources and its boundary conditions (i.e. learning goal orientation and supervisor support for creativity). Given the varying contributions of routinization toward creativity, additional conceptual and empirical efforts should be directed to developing a balanced perspective that integrates distinct paths toward creativity. Such paths could originate from various job design factors, including job complexity and routinization.

Note

1 Cognitive load theory defines free cognitive resources in terms of cognitive effort, which is a limited resource that can be allocated to a range of different activities, including on-task, off-task and self-regulation activities (Kanfer and Ackerman, 1989). Free cognitive resources

represent the difference between an individual's cognitive capacity in terms of working memory and information processing and the cognitive capacity necessary to complete assigned tasks (Brunken et al., 2003). If the difference between the total cognitive load and the processing capacity of the working memory approaches zero, then the individual experiences high cognitive load or overload. On the assumption that people can provide a numerical indication of their perceived mental burden, researchers developed valid and reliable instruments to assess cognitive load using multidimensional rating scale techniques (Paas et al., 1994). Of all the subjective techniques for assessing cognitive workload (e.g. VACP by Aldrich et al., 1989; W/Index by North and Riley, 1989), SWAT is the most widely accepted and standardized tool reported in the literature (Rubio et al., 2004). SWAT has also been validated by several physiological measures (Iqbal et al., 2004). Free cognitive resources refer to the available mental surplus experienced by individuals while performing their work task. Thus, we adopted the reverse-coded and averaged scores of the three dimensions of SWAT (time load, mental effort load and psychological stress load) as an indicator of free cognitive resources.

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