

Work-related curiosity positively predicts worker innovation

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1184

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Abstract

Purpose – The purpose of this paper is to investigate the relationship between individual work-related curiosity and worker innovation and to test the mediating role of worker divergent thinking.

Design/methodology/approach – In all, 480 participants, holding 188 different jobs, filled in a validated work-related curiosity scale and indicated their job title. Job requirements in terms of divergent thinking and innovation – derived from the Online Information Network (O*NET) database – were used as proxies for divergent thinking and innovation skills.

Findings – Results indicated that individual work-related curiosity was a positive predictor of worker innovation and that worker divergent thinking mediated this relationship.

Research limitations/implications – Individual work-related curiosity supports exploratory skills which support in turn innovation skills.

Practical implications – Managers could use individual work-related curiosity as a predictor of innovation skills when recruiting, training and guiding employees.

Originality/value – This study is the first to show an association between individual work-related curiosity and innovation skills across more than 150 different jobs.

Keywords Innovation, Individual psychology, Divergent thinking, Work-related curiosity
Paper type Research paper

Popular opinion and scientific research are ambivalent towards curiosity. As an individual characteristic it is sometimes perceived as a positive trait, associated with intrinsic motivation that individuals should develop, and sometimes perceived as a negative trait that might lead to undesirable outcomes (Loewenstein, 1994). Curiosity is, for example, recognized as an antecedent of scientific discoveries (Simonton, 2012) and is usually considered as a tendency that should be reinforced by educators (Goodwin, 2014). On the other hand, curiosity has been shown to predict behaviour disorders such as substance abuse or certain types of anti-social behaviours (Green, 1990). Recent investigations, however, have shown that epistemic curiosity should be rehabilitated on the work floor as it is a positive predictor of job performance (Mussel *et al.*, 2012; Mussel, 2013).

Considering that curiosity is a drive that can be fostered (Goodwin, 2014), research on the relationship between curiosity and job performance is very relevant for vocational counselling or recruitment purposes. The present study focusses on a specific aspect of job performance, namely, innovativeness. Innovation is essential for the survival of companies, and the relationship between individual work-related curiosity and innovation skills has not been extensively investigated before. We hypothesize that work-related curiosity supports basic cognitive skills, such as divergent thinking skills, which in turn strengthen the ability to carry out innovative tasks.



Curiosity and innovation

Innovation can be defined as the development and implementation of creative and useful ideas within an organization (Scott and Bruce, 1994). In general, several factors are thought to interact and contribute to innovation: individual, leader, work group and climate factors. Much research has emphasized the importance of an innovative climate (Kanter, 1988), but the individual level factor has been relatively little studied (Zwick *et al.*, 2015). The general understanding about innovation in organisations is that it is a response to some kind of dissatisfaction, tension or external stress. At an individual level, encountering a problem may thus stimulate the search for new solutions to improve their condition, which can lead to innovation (March and Simon, 1958). Research, however, shows that a recurrent problem in organisations is that innovation is often postponed, up until the point that there is a crisis (Van de Ven, 1986). Probably, this is partly due to the fact that in organisations people often adapt to gradually worsening situations and perceive relatively late that their condition has deteriorated (Helson, 1948).

However, according to Dewett (2007) and Walsh and Nagaoka (2009) inventive performance is more driven by intrinsic task motivation, than by extrinsic (pecuniary) motivation. Curiosity, i.e. the “desire to know” is perhaps the core of this intrinsic motivation (Schiefele *et al.*, 1992), because it directs effort towards exploration, and allows to link cues of novelty with opportunities to learn, grow and innovate (Kashdan *et al.*, 2004). As such, more curious people may look for new ideas and solutions, well before the situation has deteriorated to a crisis level, simply because they are intrinsically curious about understanding and acquiring new knowledge and skills.

Previous work on curiosity showed that new comers in organizations scoring high on curiosity adapt quicker (Harrison *et al.*, 2011), because they are strong information seekers and they are more eager to learn from socialization on the work floor (Reio and Wiswell, 2000). Mussel *et al.* (2012) developed and validated a measurement of work-related epistemic curiosity and showed that curiosity at work was a positive predictor of conscientiousness, peer and self-ratings of job performance, and of status in terms of career success.

Curiosity can be broadly defined as a drive for acquiring new knowledge and sensory experiences that can motivate exploratory behaviour (Berlyne, 1978; Loewenstein, 1994). Curiosity as an individual difference variable can thus be described as a desire for knowledge – either about relatively abstract concepts or ideas, or about concrete situations or objects – to develop new ideas and solve problems. Exploratory behaviours elicited by curiosity can be specific, aimed at understanding for example how a specific complex machinery works that one has never encountered before, or diversive. Diverse curiosity can result in exploration in the absence of complex and/or ambiguous stimuli (Litman and Spielberger, 2003). It can sometimes be the result of boredom or sensation seeking (Berlyne, 1978), but is probably also a trait associated with being curious about a wide range of topics (Zuckerman, 1994). A study conducted by Litman and Spielberger (2003), showed a moderate correlation of 0.56 between diverse and specific curiosity, suggesting two distinct dimensions that are components of one underlying epistemic curiosity dimension – i.e. a drive to “know” elicited by a gap in knowledge. Moreover, curiosity appeared to be largely independent from sensation seeking and anxiety.

Curiosity is related to need for cognition, intellectual engagement and openness for new ideas. Curious people intrinsically enjoy the process of discovery, learning and thinking (Mussel, 2010), and put persistent effort into controlling attention and

self-regulation to engage in complex thinking (Schmeichel *et al.*, 2003). Moreover, Pulakos *et al.* (2000) noted that curious individuals perceive change and novel situations as less stressful, and therefore adapt more quickly than less curious individuals.

In the present paper, we propose that curiosity is part of a disposition that energizes individuals towards an exploratory thinking and action mode (Harrison *et al.*, 2011; Kashdan and Silvia, 2009). Furthermore, we propose that this disposition in turn may be linked to innovative performance. Our reasoning rests on literature that links exploratory and associative thinking – i.e. divergent thinking – to creative performance (Lubart, 2001; Runco and Acar, 2012). Divergent thinking is the ability to generate many original and different ideas to a given problem, in an associative “horizontal” manner. In the literature divergent thinking has been associated with openness to new ideas, and curiosity (Vidler and Karan, 1975). However, whether work-related curiosity is associated with innovative performance has been little investigated until now. Nevertheless, ideas have been proposed in the literature that link innovative behaviour particularly to an intuitive problem solving style Scott and Bruce (1994) – a style characterized by a defocused and suggestive way of thinking, combining disparate domains of knowledge simultaneously (Koestler, 1967), which is found to be related to creative idea generation (Garfield *et al.*, 2001).

Taken together, if curiosity in essence is an intrinsic motivation to explore, curious individuals should be better divergent thinkers. This reasoning echoes with existing theories on the effect of non-cognitive factors on cognitive performance (Alberti and Witryol, 1994). Moreover, we argue that curiosity is not only related to intrinsic motivation and persistence in knowledge seeking (Kashdan and Fincham, 2002), but also facilitates innovative performance at work through this mechanism (Amabile, 2001).

Present study

Based on the above, in the current study we investigate whether there is a relationship between work-related curiosity and the ability to carry out innovative tasks, and we test the potentially mediating role of divergent thinking skills. Our hypotheses are:

H1. Work-related curiosity is positively related to worker innovation.

H2. Divergent thinking skills mediate the relationship between work-related curiosity and worker innovation.

Our aim is to test these hypotheses across several jobs in order to increase the generalizability of our results. Because creative behaviour is partly domain specific (Baer, 2014), it is difficult to assess innovativeness across different jobs using “generic” creativity measures. For some jobs, specific measures were designed, but, unfortunately, such measures do not exist for many other jobs. Furthermore, using job specific measures of innovativeness makes comparisons across jobs complicated as differences can be attributed either to differences between jobs or differences between assessment methods. To address these issues, we derived participants’ divergent thinking and innovation skills from the objective requirements of their current job. Our basic premise is that job requirements can be considered a proxy of worker skills, because individuals possessing stronger divergent thinking and innovation skills will be attracted to, selected for, and stay in jobs in which divergent thinking and innovation skills are required. Thus, we assume that individuals holding a job that requires high levels of divergent thinking and an innovative work style possess these skills to a greater degree than individuals in jobs requiring less divergent

thinking and innovation skills. Using such proxies to assess innovation skills allows us to test our hypothesis across various jobs for which specific innovation measures are still to be developed.

Method

Participants

For our study we combined two subsamples of participants. The first subsample of participants was recruited in an European equivalent of Amazon MTurk called Clickworker ($n = 572$). The second sub-sample was recruited online by university students as part of a research project ($n = 190$). Students and/or currently unemployed respondents were dropped from analyses. All participants took the survey online. The overall drop-out rate was 6 per cent. We implemented a test procedure inspired from Oppenheimer *et al.* (2009) to check for response inconsistencies. This procedure resulted in a drop 64 participants from the analyses who provided highly unreliable responses. The final sample included 482 participants (290 women) with a mean age of 34.91 years ($SD = 11.12$). Altogether, these participants represented 188 different jobs.

Material

Main constructs. The ten-item Work-related Curiosity Scale (Mussel *et al.*, 2012) measures participants' subjective appreciations of their level of work-related curiosity (e.g. "I am eager to learn."). The scale has satisfactory psychometric properties and is unidimensional (Mussel *et al.*, 2012). Participants respond using a seven-point Likert scale from 1 (totally disagree) to 7 (totally agree). The observed internal consistency in our sample was satisfactory (Cronbach's $\alpha = 0.86$).

To determine participants' divergent thinking and innovation skills, we used the O*NET database. O*NET provides relevant and objective indicators of divergent thinking and innovation requirements of a wide range of jobs. O*NET is an initiative of the US Department of Labor, providing a dictionary of almost 1,000 occupational titles and a list of skills that are required from workers (Peterson *et al.*, 2001). Skill requirements are derived from ten to 15 job incumbents' ratings per occupation and an extensive literature review of several decades of research on predictors of job fit (Peterson *et al.*, 2001). The theoretical model for developing O*NET is inspired by Fleishman's work (Fleishman, 1982).

In the literature, interrater reliability of incumbents' ratings are reported to be satisfactory (intraclass correlation coefficients > 0.70) and consistent with empirical literature (Peterson *et al.*, 2001). O*NET is therefore a standard when it comes to objectively describing and characterizing jobs based on the skills and cognitive characteristics that they require from workers (Peterson *et al.*, 2001). O*NET has also become a very important instrument in the field of career management and vocational counselling and it has been used in many empirical studies (e.g. LaPolice *et al.*, 2008).

O*NET lists worker skills and their level of importance on a percentage scale – i.e. ranging from 0 to 100. Based on well established theorizing regarding the core processes in divergent thinking (Runco and Acar, 2012), using O*NET, we determined for each participant scores on ideational fluency, ideational originality and ideational flexibility required in their respective jobs. For each participant we also determined their innovation skills. Higher scores reflected stronger skills.

Control variables. To control for possible personality differences, we asked participants to take the ten-item personality inventory (TIPI, Gosling *et al.*, 2003).

The TIPI is a ten-item self-report questionnaire that explores the Big Five dimensions of personality with satisfactory psychometric properties (Gosling *et al.*, 2003) and is a good way to control for personality differences (Storme *et al.*, 2016).

Procedure

Data collection. All participants took the survey online. Participants first answered demographic questions, then took the work-related curiosity scale and finally the TIPI.

Data preparation. Participants who had an unclear job title (e.g. freelancer) were dropped from analyses because their occupation could not be matched with any of the O*NET job titles. Each of the 188 job titles was then coded independently by two researchers according to the O*NET job classification. The researchers then compared their classifications and reached an agreement for all the jobs that were not originally classified the same way. Lastly, we checked for extreme outliers for each variable, i.e. observations that were at more than five standard deviations from the average. Two participants who had extremely low scores on curiosity (five SD below the average) were removed from the analyses. No outliers were detected on the other variables. Finally, the main results of our statistical analysis were consistent across samples. Therefore, we report only the overall analyses.

Data analysis. We tested our mediation hypothesis using the framework of structural equation modelling (SEM, Schumacker and Lomax, 2004) and used the R package lavaan (Rosseel, 2012) to perform the analyses. SEM is a more precise test compared to using simple sum scores, because it corrects for unreliability of the measurements (Schumacker and Lomax, 2004). Regarding absolute model fit, we followed the recommendations of Schumacker and Lomax (2004) and used four statistical indices: the χ^2/df ratio (should be < 5), the comparative fit index (CFI should be > 0.90), the standardized root mean square residual (SRMR should be < 0.08) and the root mean square error of approximation (RMSEA should be < 0.09).

Results

Preliminary analyses

The correlation matrix of the main variables of interest and their descriptive statistics are reported in Table I. As hypothesized, work-related curiosity was positively correlated with the three indicators of worker divergent thinking: originality ($r=0.14$, $p < 0.01$), fluency ($r=0.14$, $p < 0.01$) and flexibility ($r=0.12$, $p < 0.01$).

	M (SD)	2	3	4	5	6	7	8	9	10	11
1. Curiosity	57.56 (06.85)	0.14	0.14	0.12	0.14	0.10	0.23	0.07	0.28	0.21	0.39
2. Originality	43.14 (10.64)		0.96	0.74	0.97	0.76	0.06	0.00	-0.01	0.01	0.05
3. Fluency	43.50 (10.36)			0.78	0.98	0.75	0.08	-0.02	-0.01	0.01	0.02
4. Flexibility	46.04 (05.89)				0.85	0.46	0.01	-0.01	-0.01	0.04	-0.05
5. Total DT	44.23 (08.52)					0.73	0.06	-0.01	-0.01	0.02	0.02
6. Innovation	63.55 (12.98)						0.00	-0.02	-0.04	-0.03	0.07
7. Extroversion	08.24 (02.85)							0.16	0.23	0.22	0.34
8. Agreeableness	10.15 (02.02)								0.26	0.28	0.26
9. Conscientiousness	10.71 (02.27)									0.44	0.25
10. Emotional stability	09.48 (02.52)										0.22
11. Openness	10.69 (02.00)										

Table I.
Correlation matrix of
the main variables

Notes: $n = 480$. All bold correlation coefficients are significant at $p = 0.05$

Note that these three indicators of divergent thinking were strongly correlated to one another and strongly correlated with worker innovation (see Table I). Additionally, work-related curiosity was positively correlated with worker innovation ($r = 0.10, p < 0.05$).

Because of the strong correlations between the three indicators of worker divergent thinking (Cronbach's $\alpha = 0.91$), we computed a total worker divergent thinking score by averaging the three dimensions. This total divergent thinking score was positively and significantly correlated with work-related curiosity ($r = 0.14, p < 0.01$). The relationship between curiosity, worker divergent thinking and innovation were replicated with Big Five dimensions as control variables in multiple regression analyses. None of the dimensions of the TIPI predicted innovation or divergent thinking (all p 's > 0.10). Furthermore, controlling for personality traits did not change the relationships between work-related curiosity and worker divergent thinking ($\beta = 0.17, p < 0.05$) and worker innovation ($\beta = 0.11, p < 0.05$). Such results support *H1*.

Mediation analysis

To test our mediation hypothesis (*H2*), we used SEM. In this model, work-related curiosity was the independent variable; worker innovation was the dependent variable and worker divergent thinking was the mediator variable. We used lavaan to compute the direct, indirect and total effects (Rosseel, 2012). We followed Preacher and Hayes' (2008) recommendations to use bootstrapping to compute the confidence intervals for the estimate of the indirect effect.

The measurement model showed satisfactory fit ($\chi^2/df = 367.503/75 = 4.900$; CFI = 0.924; SRMR = 0.059; RMSEA = 0.085). Furthermore, all factor loadings were medium to large in magnitude. We concluded from this first analysis that the data was reflective of our theoretical expectations regarding the structural validity of the constructs under investigation.

We then estimated the structural model. Because the structural model is saturated, it has the same fit as the measurement model. Standardized estimates of the structural model are reported in Figure 1. The analysis yielded a significant total effect of curiosity on innovation ($\beta = 0.11, Z = 2.19, p < 0.05$). Consistent with our hypothesis, the results showed that curiosity was positively associated with divergent thinking ($\beta = 0.15, Z = 3.00, p < 0.01$). Moreover, results yielded a significant positive association between divergent thinking and innovation when controlling for curiosity ($\beta = 0.75, Z = 23.40, p < 0.001$).

Importantly, curiosity was not anymore a significant predictor of innovation when controlling for divergent thinking ($\beta = -0.00, Z = -0.14, p = 0.89$), indicating full mediation. To test the significance of the mediation we computed the bootstrap interval of the indirect effect of curiosity on innovation through divergent thinking ($\beta = 0.11, 95$ per cent bootstrap confidence interval [0.04; 0.17]). Because this interval does not include 0, we can conclude that the mediation was significant: the relationship between work-related curiosity and innovation can be fully explained by the mediating role of divergent thinking skills[1]. These results support *H2*.

Discussion

In the present study we hypothesized that a positive relationship between individual work-related curiosity and the ability to carry out innovative tasks at work can be explained by the fact that work related curiosity is associated with divergent thinking skills.

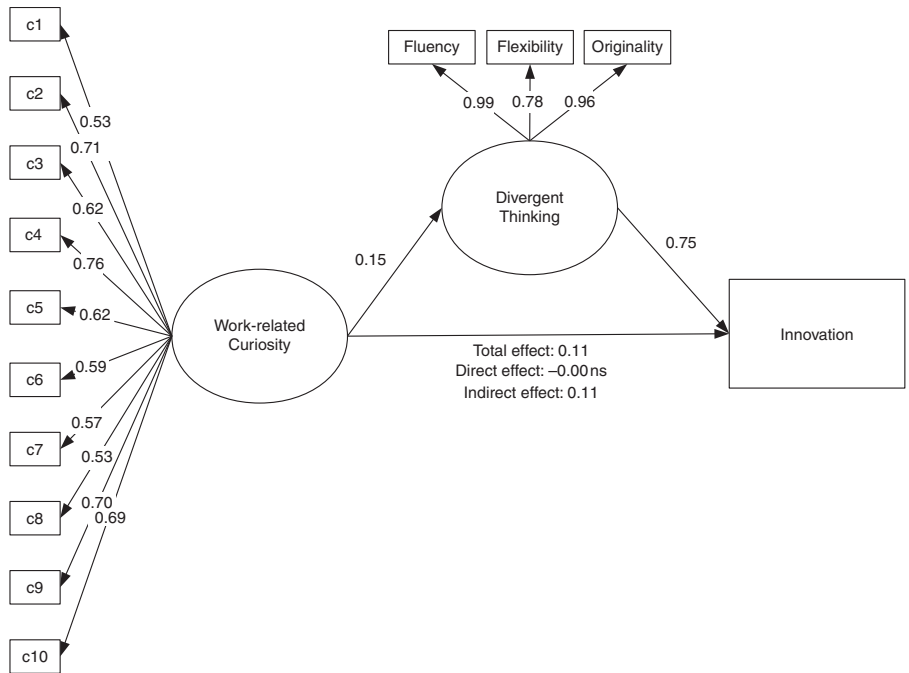


Figure 1.
Standardized
estimates of the
final model

Consistent with these expectations, our results showed that individual work-related curiosity is a positive predictor of worker innovation. This result is in line with theoretical expectations from other researchers (Mussel *et al.*, 2012; Mussel, 2013), and is consistent with recent work that paid attention to motivational antecedents of innovation at work (Madrid and Patterson, 2015).

Our results also revealed that the relationship between individual curiosity and worker innovation is mediated by worker divergent thinking. This is consistent with studies linking curiosity to exploration (Kashdan *et al.*, 2004), and exploration to creative potential and innovation (Runco and Acar, 2012). We conclude from the results that individuals with higher levels of curiosity are better divergent thinkers, which help them in turn to carry out innovative tasks.

Our study has strengths and limitations. One strength is that using worker requirements allowed us to test our hypothesis in 188 jobs which would have been impossible with direct measures as they would have required to design job specific measures of divergent thinking and innovation abilities. Another strength is that we assessed divergent thinking and innovation indirectly, through job requirements. This provides a strong test of our hypotheses. We can hypothesize that more direct measures of divergent thinking abilities such as job specific alternate uses tasks (Baer, 2014) and innovation abilities such as the Consensual Assessment Technique (Amabile, 1996; Storme *et al.*, 2014) would provide stronger correlations.

One limitation is that it is difficult to know from the design that we used if there is a causal relationship between curiosity, divergent thinking and innovation, as our study is correlational. An alternative explanation of our results could be that working innovatively fosters curiosity, hence the observed correlation. Using an experimental design to manipulate work-related curiosity could help better

understanding the nature of the relationship between curiosity, divergent thinking and innovation.

Our results provides further evidence on the importance of personality traits in creative behaviour in the workplace (Myszkowski *et al.*, 2015; Scratchley and Hakstian, 2001), which has strong practical implications in management, as it suggests that personnel innovativeness may be assessed indirectly through personality traits – here work-related curiosity. Indeed, when managers want to assess innovativeness, they face a major problem: creative behaviour is at least partly domain-specific (Baer, 2014), making the existence of a “generic” creativity measure rather impossible. The results of this study are straightforwardly useful for managers, who can find here evidence that using a measure of curiosity will help in the – albeit indirect – assessment of innovativeness, and that such is true across a wide array of 188 jobs.

Conclusion

Evidence-based practices in human resources management suggest that practitioners use the best available evidence when making recommendations. The present study has several practical implications for career counselling and potential development. Our results suggest that it is relevant to assess the level of curiosity of individuals who are interested in finding a position in which innovation is important because their level of curiosity can be a predictor of their job fit. Individuals with relatively low levels of work-related curiosity could be advised to try to develop it with appropriate methods. Moreover, our results shed light on how being curious is beneficial to innovative performance. Trainees could apply this in developing interventions aimed at fostering work-related curiosity with a special emphasis on the driving role of divergent thinking.

Note

1. We also performed the reversed mediation analysis with curiosity as the mediator variable. As expected, this analysis resulted in a non-significant indirect effect.

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