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COMBINING VERSUS TRANSFORMING KNOWLEDGE? A COMPARISON OF THE VOLUME AND NOVELTY OF NEW IDEAS

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INTRODUCTION

Scholarly understanding of the origins of variation in individual ideas in organizations is currently rather limited. We, for example, have little systematic understanding of in which respects individuals' new ideas may differ (George, 2007; Unsworth, 2000) and the extent to which such differences may occur across both people and time. In addition, we know little about the respective roles of knowledge and contextual stimuli as critical information processing counterparts in corporate ideation (March & Simon, 1958, Simon, 1947, 1979).

Integrating technological search and organisational creativity literatures, we theorize divergence in the information processing antecedents of the *novelty* and *volume* of individuals' new ideas in corporations. We jointly consider the roles of (a) individual knowledge and (b) individual exposure to contextual stimuli to account for variance in individuals' 'idea set novelty' and 'idea set volume' (Hill & Birkinshaw, 2010) – where idea sets refer to the stock of new ideas a person has accessible in memory at a given time.

Using questionnaire data from 388 employees of three multinationals (validated against supervisory assessments), we find that individuals' *knowledge profiles* prove more critical to their idea set volume, while the *stimuli* to which they are exposed proved crucial to their idea set novelty. Furthermore - countering the dominant assumption of a single 'recombinant search' process in technological search literature - distinctive knowledge processes appear to account for differences in the novelty of ideation. Overall, the study aims to shed further light on the sources of systematic variation in individual ideas within corporations.

THEORY AND HYPOTHESES

A crucial proposition ties together our hypotheses, namely: distinctive knowledge processes underlie the generation of many ideas versus highly novel ideas by individuals. Technological search literature has relied on inferred processes of recombinatory search (Fleming, 2001) to account for organisational innovation. Recombinatory search entails "new inventions emerge[ing] from the recombination or 'mixing and matching' of existing elements of knowledge" (Ahuja et al., 2008: 65). However, processes going beyond the mere combination of 'pieces' of knowledge might be at play in the generation of highly novel ideas. Indeed, a number of psychological theories of creativity (e.g. Guilford, 1950, 1967; Kaufmann, 2004; Kirton, 1976; Koestler, 1964), contend that different levels (or types) of creative thinking occur. According to such theorists, improvements within existing frameworks are thought to characterize less radical forms of creativity. A more fluid, transformative form of information processing (Mumford and Gustafson, 1988), where the outcome is substantially more novel than its constituent parts, may characterize more radical forms of creativity.

We contend that combinatory knowledge processes may describe the former type of individual ideation and hence account for the generation of many – but not necessarily highly novel – ideas in corporate settings. However, the principal knowledge process accounting for highly novel individual ideas is likely to go beyond knowledge combination to incorporate the transformation of knowledge. Stated more formally, we propose that:

***P1:** Knowledge combination processes account primarily for an individual's volume of ideas (idea set volume), while knowledge transformation processes principally underlie the novelty of their ideas (idea set novelty).*

Knowledge Profile versus Exposure to Stimuli

Are individuals' knowledge profiles and the workplace stimuli they encounter associated equally with knowledge combination and knowledge transformation processes - and thereby with the volume versus novelty of ideas they generate? Our contention is that they are not.

Multiple literatures indicate that an individual's knowledge base will impact the ideas he or she generates. Within creativity literature (e.g. Amabile & colleagues, 1996, 1988), it is "universally acknowledged that one must have knowledge of a field if one hopes to produce something novel within it" (Weisberg, 1999: 226). The bounded nature of human rationality implies that existing individual schemata shape selective attention to and processing of stimuli (Fiske & Taylor, 1991; March & Simon, 1958; Ocasio, 1997). Existing knowledge, as a critical constituent of individual's schemata, thus provides a key platform for interaction with new experiences (Corbett, 2007). The firm-level concept of absorptive capacity represents a useful analogue to the role played by individual prior knowledge in idea generation: existing knowledge provides a necessary foundation for the assimilation and processing of new information by individuals (Cohen & Levinthal, 1990; Zahra & George, 2002).

Certainly, these arguments suggest, notwithstanding recognized limits (e.g. expert processing biases; Baron, 1998; Ericsson & Lehman, 1996), that greater depth and breadth of knowledge may aid the development of more novel ideas. However, the key mechanisms identified of directing attention and enabling absorption of stimuli (or facilitating connections to existing knowledge in memory) are more closely concerned with an individual's capacity to generate a high volume of connections between knowledge elements, than with the degree of novelty of such connections. In contrast, we posit that individuals' exposure to incoming stimuli plays a crucial role in influencing the novelty of their ideas.

To make this argument, we turn to technological search literature. The central finding of technological search studies is that more 'distant' search is associated with increased instances of firm-level innovation (Ahuja et al., 2008; Li et al., 2013). Distant search, typically conceived in terms of breadth of exposure across domains (e.g. across technological, company, geographic and temporal domains), extends the range of information available to an agent. Although little acknowledged within technological search literature (see Li et al., 2013, for an exception), exposure to more distant contextual stimuli does not, however, merely extend the volume of potential informational input for ideation. It also impacts the nature of individual attention to and processing of information. Unfamiliar, distant and diverse terrains are more likely to contain novel, salient and vivid stimuli (Li et al., 2013). Such stimuli, according to selective attention theory (Fiske & Taylor, 1991; Ocasio, 1997), are in turn more likely to capture individuals' attention. Notwithstanding recognized constraints on information processing (Simon, 1997), such stimuli are both more likely to be noticed and to engage attention over a prolonged period. These

attentional and processing potentialities of expansive contextual stimuli provide them with, we contend, a key role in influencing the novelty of a person's new ideas. Accordingly:

***H1:** Individual knowledge is more strongly associated with the volume of ideas generated by an individual than with the novelty of their ideas.*

***H2:** An individual's profile of exposure to stimuli is more strongly associated with the novelty than the volume of their ideas.*

Knowledge Processes in Ideation

The final step in setting our arguments is to more rigorously associate heightened exposure to stimuli with the likelihood that an individual will engage in transformative (rather than recombinative) ideation processes. To do so, we introduce the notion of information equivocality from information processing and sense-making literatures.

Information equivocality refers to signals that carry a multiplicity of meanings (Weick, 1979). Information equivocality is well suited to triggering transformative thought processes, given the heightened vividness and salience of equivocal stimuli (Fiske & Taylor, 1991; Huber & Daft, 1987). These encourage more extensive sense-making, incorporating higher levels of dissonance reduction (Festinger, 1957). Individuals in companies are most likely to encounter equivocal information when exposed to broad and deep stimuli which, in turn, thus carry the potential for producing highly novel creative outputs. While equivocality-induced transformative processing is closely associated with the novelty of an individual's ideas, the volume of their ideas does not rely critically on such information processing. Instead, recombinant search suffices via the combination or reconfiguration of existing components, or the direct application of existing combinations to a new context. Accordingly:

***H3:** Equivocality mediates more strongly between exposure to stimuli and the novelty of individuals' ideas, than between (a) their exposure to stimuli and their idea set volume, and (b) their knowledge profile and their idea set novelty and volume.*

METHODOLOGY

The research consisted of three phases (reported in greater depth in Hill & Birkinshaw, 2010): the first phase comprised exploratory interviews with 20 employees in a multinational FMCG company; the second phase consisted of collecting self-report, questionnaire data from 388 employees in three multinationals; and the third phase involved 12-month case studies of 22 employees from two of the companies that had participated in the survey. All participants were 'knowledge workers', fulfilling either professional or managerial roles in their organizations.

The analyses reported here draw on the self-reported questionnaire data. Self-reported data was deemed most appropriate given the cognitive and intra-personal nature (particularly, for ideas at early stages of development) of individuals' idea sets. However, in an effort to establish convergent validity (especially for more observable features of ideas and later idea progression stages) supervisory assessments were also sourced from one of the participating companies. Eighty-nine percent (34) of supervisors responded, covering 88 percent (75) of individual respondents to the principal questionnaire from that company. Overall, these ratings provide a moderate degree of corroboration for the self-reported dependent variable measures.

Two rounds of pilot questionnaire development and testing preceded the administration of the survey. Full sampling occurred of professional and managerial individuals across different levels, functions and countries of participating divisions within the three companies. The companies are major publicly-held multinationals in the milk products, household products, and pharmaceutical sectors. The multiphase contact process closely followed that advocated by Dillman (2000), attaining an overall response rate of 55 percent.

Measures

Further details of all measures are available from the author. The dependent variables were measured using Hill and Birkinshaw's (2010) multi-item measures for the volume and novelty of individual idea sets. These measures were designed to facilitate a fine-grained, field-based assessment of the range of new ideas considered by individuals at a point in time.

Dependent variables. *Idea set novelty* comprises four reflective items examining the extent to which respondents viewed their ideas as novel, indicated by terms such as 'frame-breaking', 'unconventional' and 'visionary' ($\alpha = .85$). *Idea set volume* examines the quantity of ideas a person is considering at a given time along an inventory of seven developmental stages through which ideas may progress (c.f. Dimov, 2007). For each stage, respondents estimated the number of ideas they had considered or worked on over the previous six month period ($\alpha = .83$). For both measures, CFA indicated an excellent fit of the data to a single-factor model.

Independent variables. *Broad knowledge* was measured via five items examining the number of functional areas, companies, industries, countries and (of their current company) divisions an individual had worked in. These items acted as formative indicators (Podsakoff et al., 2005) for the diversity of individuals' work experiences. *Deep knowledge* comprises the mean value of the following (formative) ratios: (1) number of functional areas worked in over total years working, (2) number of companies worked in over total years working, (3) number of industry sectors worked in over total years working, (4) number of countries worked in (for a minimum of one month in succession) over total years working, and (5) number of divisions within the current company worked in over total years employed by that company.

Broad exposure to stimuli examines individual exposure to the following categories of work stimuli: geographic stimuli (stimuli in other countries), industry stimuli (exposure to people and issues in other industries), internal company stimuli (exposure to issues and people in other units of the company), external stimuli (contact with customers, suppliers, industry associations, etc.), functional breadth (the extent to which a job crosses disciplinary boundaries), and breadth of personal interests. Exposure within each category was measured by a set of reflective indicators (each possessing adequate psychometric properties), which were then aggregated into an overall measure of a formative nature. *Deep exposure to stimuli* was measured by two formative items examining the degree of specialisation in individuals' work roles. *Equivocality* was measured via four reflective items examining perceived informational ambiguity (Daft & Lengel, 1986; Daft & Macintosh, 1981; Dennis & Kinney, 1998; Weick, 1979). CFA indicated an excellent fit of the data to a single-factor model ($\alpha = .68$).

Control variables. Alongside company dummies, organizational level factors controlled for were performance management and social organization context (Gibson & Birkinshaw, 2004), and company support for innovation. Individual level factors controlled for were tenure (job/company/entire career), independent and corporate entrepreneurial experience, gender,

functional area, geographic location, educational level, seniority, and individual creativity (using Gough's, 1979, Creative Personality Scale).

Checks for Common Method Bias

A number of steps were taken to evaluate and reduce the influence of common method variance (CMV) in the study. First, in order to assess potential concerns associated with single-informant data (Venkatraman & Grant, 1986), supervisors of participating employees in one of the companies were surveyed on their reports' idea characteristics. This provided corroboration for the self-reported dependent variables. Second, we sought to minimise the impact of common method bias through placing the independent and dependent measures some distance apart in the questionnaire, and employing a variety of response formats (Podsakoff et al., 2012).

Ultimately, however, we were restricted in the extent to which we could obtain multi-source data by the intra-personal nature of the phenomenon being investigated. Consequently, we also undertook post-hoc statistical checks for CMV. Specifically, we subjected the data to a Harman (1976) one-factor test, finding seven components (explaining 63 percent of the variance) with eigenvalues greater than 1.00. If common method bias were a serious problem, one factor accounting for most of the covariance should have emerged. Finally, the complex patterns of our findings, which include quadratic effects, contribute confidence that common method bias is unlikely to play a significant role in our analyses (Siemsen, Roth, & Oliviera, 2010).

FINDINGS

We tested the hypotheses using seemingly unrelated regression (SUR) (Zellner, 1962). SUR was chosen to allow for the possible correlation between the error terms in the models explaining idea set novelty and volume, and to enable joint tests of their coefficients. Mean VIF indices of around 1.50 were well below common thresholds (typically recommending values below 10) (Cohen et al., 2002), indicating that multicollinearity was not of significant concern.

H1 and H2 compare the relative impact of individuals' knowledge profiles and exposure to stimuli on their idea set characteristics. Post-hoc chi-squared tests examined differences in the coefficients of these independent variables across idea novelty and idea volume models. *H1*, positing that individual knowledge is more significantly associated with the volume than novelty of ideas generated, was partially supported. In respect of knowledge breadth, the coefficient for broad knowledge was marginally more significant for idea set volume than novelty (χ^2 diff, df (1) = 2.48, $p < .10$), and highly significantly so for the squared broad knowledge term (χ^2 diff, df (1) = 9.09, $p < .001$). No support was, however, provided for *H1* in respect of deep knowledge.

Support for *H2* was stronger, with both breadth and depth of exposure to stimuli being significantly more strongly associated with individuals' idea novelty than their volume. Specifically, the lower- and higher-order terms for broad exposure are more strongly associated with idea set novelty (χ^2 diff, df (1) = 20.08, $p < .001$; χ^2 diff, df (1) = 5.69, $p < .01$, respectively). Furthermore, deep exposure is significantly more strongly associated with idea set novelty (χ^2 diff, df (1) = 4.06, $p < .05$), while its squared term demonstrates a similar pattern of association, although at only marginal levels of significance (χ^2 diff, df (1) = 1.87, $p < .10$).

Finally, *Hypothesis 3* predicted that equivocality-reducing transformative thought processes would mediate most strongly between an individual's exposure to stimuli and their idea novelty. The absence of significant mediating relationships was anticipated between (a)

individuals' exposure to stimuli and their idea volume, and (b) their knowledge profile and their idea novelty and volume. These predictions were confirmed via both: (a) following the causal steps mediation procedures outlined by Baron and Kenny (1986); and (b) employing the Sobel (1982, 1986) product of coefficients test, as an alternative approach to the causal steps procedure given recent criticisms thereof (Hayes, 2011; MacKinnon et al., 2002; Shrout & Bolger, 2002).

DISCUSSION AND CONCLUSIONS

Our analyses indicate, uniquely we believe, that the novelty and volume of corporate individuals' ideas are impacted (in part at least) by different information processing antecedents and knowledge processes. To be specific, the data suggest that possessing a broad knowledge base is associated more closely with the volume of an individual's ideas than with their novelty, whilst exposure to broad and deep contextual stimuli are both more strongly related to idea novelty. In addition, distinctive processes of knowledge combination and (equivocality-triggered) knowledge transformation may account for more versus less innovative processes.

Our findings contribute to both technological search and organizational creativity literatures. To the former, we add to the very limited body of technology search literature seeking to understand the micro-level foundations of search in organizations (c.f. Li et al., 2013; Maggitti, Smith, & Katila, 2013). In particular, our findings challenge the long-held assumption within technological search literature of a unitary recombinant innovation process (Ahuja et al., 2008), and suggest that this stream's focus on firm-level commercialised innovations or patent counts may create boundary conditions to the generalizability of its findings. For organizational creativity literature, an important implication stems from the information-processing perspective (Simon, 1979, 1997) taken in the study and supported by its findings. While creativity scholars have typically focused on the motivational influences of contextual factors (George, 2007; Shalley & Gilson, 2004), this study evidences the role information-processing considerations may play in providing the raw material necessary for new ideas. And, to both literatures, we add the insight that the 'character' of contextual stimuli – specifically, the degree of equivocality embodied – is critical to the nature of individual ideas in corporate settings.

Finally, we hope that this study will spur other scholars to explore further the intriguing topic of the sources (and consequences) of variation in individuals' ideas in organizations – and to do so, in particular, in ways that seek more holistic conceptualizations of corporate contexts and more dimensionalized understandings of individual ideas.

REFERENCES AVAILABLE FROM THE AUTHOR