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Innovation search dynamics in new domains: An exploratory study of academic founders' search for funding in the biotechnology industry

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ABSTRACT

Previous studies have emphasized the role of experience in shaping the mental models and theories that guide search, but offered minimal insight into how individuals navigate domains for which their experience provides no problem-relevant schemata. To explore how search unfolds in such new domains (ND), we study first time academic founders' quest for early-stage funding, a critical step in the innovation process. We observe that these founders differentially recombine institutional, intellectual, social, and spatial facets of their OD (academic research) knowledge to search in the ND (funding a nascent business venture). We identify four distinctive recombinative patterns of OD knowledge facets, and propose that these are associated with differences in the founders' orientation to the ND, a reflection of their agenda for, and intellectual and affective engagement with the entrepreneurial endeavor in general and particularly their search for funding. We propose that ND orientation influences how individuals rely upon OD knowledge facets to anchor and filter their ND search. We extend the literature on innovation search dynamics by concurrently addressing how individuals recombine OD knowledge in a ND search and proposing ND orientation as a reason why individuals might do so differentially. (192)
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1. Introduction

Search is integral to innovation – it leads to the discovery of problems worth solving and to the development of useful solutions (Nelson and Winter, 1982; Shane and Venkatraman, 2000; Fleming, 2001; Katila and Ahuja, 2002). Firms undertake a great deal of innovation search and, accordingly, scholars have studied patterns in organizational search (Levinthal and March, 1993; Bhardwaj et al., 2006; Lopez-Vega et al., 2016). However, organizational search also reflects how individuals look for and make sense of information (Shane, 2000; Arthur, 2007), and search at the individual level has been less studied (Maggitti et al., 2013).

Useful models that describe how entrepreneurs search for opportunities have been developed (e.g. Fiet, 2007), but they have not specifically attended to the challenge of navigating new domains for which experience has not produced problem-relevant schemata (Gruber et al., 2013). Rather, most studies of innovation or entrepreneurial search at the individual level have elaborated the advantages of experience – e.g. for pattern recognition to identify new opportunities (Venkataraman, 1997; Baron, 2006, 2007). The process of how search unfolds in order to navigate new domains during the innovation process may not unfold in the same way that entrepreneurial opportunity identification or inventive search does (Gavetti and Rivkin, 2007; Benner and Tripsas, 2012).

Studies show that entrepreneurial search based on prior experience tends to be more successful (Shane, 2000; Baron, 2006) and that domain expertise improves inventive search (Arthur, 2007). In addition, several recent studies on innovation and recombinant search have shown that 'old' knowledge can be recombined in search to produce novel outcomes (e.g., Nerkar, 2003; Messeni Petruzzelli et al., 2012; Messeni Petruzzelli and Savino, 2014, 2015; Savino et al., 2015). In this vein, Maggitti et al. (2013) describe inventive search at the individual level as an iterative process of casting for information, sometimes in distant technological and scientific domains. However, none of this work explains what facets of OD knowledge are used or how they might facilitate ND search. Nor does prior work explain why individuals might differentially rely on the various facets of OD knowledge.

This study seeks to fill this gap in our understanding of search, which seems critical in light of the rapid growth of scientific knowledge, technological change, and globalization - forces that increasingly shift industrial, professional, and occupational boundaries and place individuals in situations where they need to solve problems for which experience has

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not prepared them. Addressing this gap in the innovation search literature responds to the call for scholars to consider multiple aspects of search simultaneously (Appio et al., 2016).

To understand new domain search at the individual level, we study how first time founders recombine different facets of old domain knowledge from academic research to navigate the new domain of entrepreneurship. We extend our understanding of innovation search dynamics by revealing salient differences in how individuals search a new domain, identifying distinctive patterns of ND search, and proposing orientation to the ND as an explanation for the different recombinative patterns in ND search that we observe.

We use a grounded theory approach as few theoretical precedents for studying this type of search exist (Glaser and Strauss, 1967). Using inductive thematic analysis, which involved building up from first order codes that were grounded in our field data to higher order abstract categories and looking for relations between them (Miles and Huberman, 1994; Boyatzis, 1998), we discern patterns in how first time founders rely on their "old domain" (OD) academic knowledge contexts to anchor and filter their search for funding in the "new" (ND) entrepreneurial domain.

We use the term 'old domain' (OD) to describe the disciplinary and professional context in which an individual has a notable degree of expertise, which in this study refers to academic research in the life sciences. It is in this domain that our founders honed their problem-solving skills, acquired social ties, and assimilated cultural norms (Knorr-Cetina, 1999). Merton (1996) describes the dominant norms associated with the domain of science "as being primarily a disinterested search for truth and only secondarily as a means of earning a livelihood" (p.303–304). By contrast, ND problems pertain to assuring commercial success in the entrepreneurial realm. Our founders began their search for funding with no experience in the entrepreneurial domain, but with significant ties to their old domain in the form of mental models, relationships with colleagues, and institutional connections.

Specifically, we observe that, in 'where and how' innovation search in ND occurs, these first-time founders rely on search mechanisms that recombine social, spatial, intellectual, and institutional facets of their OD academic knowledge to make their ND search for funding tractable. Spatial and intellectual contexts anchor ND search to familiar information sources and problem solving heuristics, while social and institutional contexts provide criteria and processes for filtering alternative solutions. We also found that founders evinced distinctive orientations to the ND, which we describe as being primarily focused on the technology, the venture, their role as founder, or the societal good their technology could provide. These orientations were associated with distinctive combinations of the OD knowledge facets describing how and where they searched for funding. Our inductive approach takes into consideration multiple aspects of 'where' and 'how' individuals search, allowing us to empirically develop a new theory for innovation search in a ND. We summarize our theory, which is elaborated on page 48 (Table B.4).

2. Theoretical background

Search is broadly defined as a "goal oriented process of information gathering and problem solving" (Cyert and March, 1963, p. 121). The search process unfolds differently, according to whether it is initiated by the need to solve a specific problem, or is better characterized as a solution seeking a problem to solve (Cyert and March, 1963; Cohen et al., 1972). Much of the research on search emphasizes that it tends to be local, that is, solutions are sought in the neighborhood of prior success (Levinthal and March, 1981). Theories of entrepreneurial search emphasize that search is anchored by what has previously worked and that beliefs formed through experience are used to filter candidate solutions and to select among viable search paths (Boeker, 1988; Shane, 2000; Baron, 2006).

However, knowledge gained through learning by doing and trial and error also enables individuals to move from inductive, experiential search, to forward looking, cognitive search which is based on theories or simplified cognitive representations of the world (Gavetti and Levinthal, 2000). Individuals who lack relevant domain experience can solve problems through trial and error, but with little insight regarding where to look or how to select among possible solutions they may run up against the limits of time and cognitive capacity (Cyert and March, 1963; Gavetti and Levinthal, 2000). How do individuals make an ND innovation search tractable?

There is precedence in the search literature for how 'old' knowledge shapes the search for novelty in organizations (e.g., Katila and Ahuja, 2002; Nerkar, 2003; Messeni Petruzzelli et al., 2012; Messeni Petruzzelli and Savino, 2014, 2015; Savino et al., 2015). Based on this prior literature, we began with the assumption that lacking relevant experience, individuals bring old domain (OD) ways of knowing, shaped by the disciplinary, professional, regional, organizational, and interpersonal contexts in which they have been embedded, to their ND innovation search (e.g., Wenger, 1998). In this study, the OD refers to academic research in the life sciences, where our first time founders honed their problem-solving skills, acquired social ties, and assimilated cultural norms (Knorr-Cetina, 1999). This study complements the more common observation that novelty is produced through recombinant knowledge in innovation search (Martini et al., 2015), by exploring how various facets of OD knowledge are recombined to navigate or guide the innovation search in an entirely novel domain.

Through our literature review, we identified four different facets of OD knowledge that could be applied in a ND innovation search. First is the Intellectual facet of OD knowledge, which is the way people come to learn is influenced by their disciplinary training and their professions. Disciplines have distinct styles of reasoning, reflecting their phenomenological interests and orientation toward certain practical problems (Kuhn, 1962). This knowledge might be applied automatically in a new domain, or semi-consciously if an individual recognizes similarities between old and new domain problems (Thagard, 1996). By supplying templates to structure search, old domain intellectual contexts might enable individuals to learn about new problem domains faster. Second, the Institutional facet of OD Knowledge, reflects the fact that disciplines and professions impart not only problem solving tools but also norms and values that define what good solutions look like and designate certain signals of competence and quality as legitimate (Merton, 1968; Wenger, 1998). Like cognitive structures, they are deeply ingrained, often constituting a key element of a person's identity, and hence will likely be applied beyond the domain in which they are acquired (Jain et al., 2009). By limiting the range of choices considered legitimate, old domain norms and values might make navigating a new domain tractable. A third is the Social Facet of OD Knowledge. Search is often a social process; there is evidence to show that new ventures can often times rely on their social ties with intermediaries like service vendors (e.g. Zhang and Li, 2010), venture capitalists (e.g., Busenitz et al., 2005), to reduce search costs in their innovation search. Thus, OD social knowledge facets might accelerate and enrich new domain search. Finally, a fourth Spatial facet of OD Knowledge, reflects literature that suggests that geographic proximity reduces coordination costs and enables richer face to face communication (e.g., Stuart and Sorenson, 2003). New domain search might also be guided by knowledge that is held locally in the sense that it is common to the social networks, institutions, and communities of practice within the geographically co-localized region (Saxenian, 1994), such as local incubators (e.g., Clarysse et al., 2005) by way of example. Through each of these mechanisms, the geographic region in which old domain experience was accumulated can shape OD knowledge facets and thereby influence how individuals search in new domains.

We examined how first time academic founders used these four OD knowledge facets in their initial search for funding, to establish a new business venture in the biotechnology field. Funding was a major

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