



The emergence of absorptive capacity through micro–macro level interactions



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ABSTRACT

A firm's absorptive capacity involves two dimensions: horizontal and vertical. The horizontal dimension refers to a dynamic interplay between internal and external environments of the firm, which is extensively covered in the absorptive capacity research. However, the literature ignores vertical dimension involving individual-organization interactions. Scant knowledge is available about the mechanisms through which absorptive capacity emerges as an organizational learning capability. This study reviews the seminal works of Cohen and Levinthal and finds that the stickiness of knowledge, the multiple antecedents of absorptive capacity and their interactions are explicitly addressed therein, but are insufficiently problematized in subsequent research. Drawing on the knowledge-based view of the firm and the micro-foundations lens of organizational capabilities, the present study re-conceptualizes absorptive capacity as a set of three sequentially linked learning processes where individual and organizational antecedents interact, and explains how value recognition, assimilation and application capabilities emerge as organizational (macro) level phenomena.

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1. Introduction

More than 25 years have passed since Cohen and Levinthal (1989, 1990, 1994) coined the term “absorptive capacity” and defined it as the “ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends” (1990, p. 128). Since then, a substantial number of conceptual and empirical studies have contributed to the understanding of how firms acquire and use new external knowledge for gaining and sustaining a competitive advantage (e.g. Lane, Koka, & Pathak, 2006; Lane & Lubatkin, 1998; Szulanski, 1996; Van Den Bosch, Volberda, & De Boer, 1999; Zahra & George, 2002). The rationale behind such high scholarly interest in absorptive capacity lies in high potential of this construct to link organizational knowledge, learning and performance (Ahuja & Katila, 2001; Cockburn & Henderson, 1998; Kostopoulos, Papalexandris, Papachroni, & Ioannou, 2011; Lane & Lubatkin, 1998; Lane, Salk, & Lyles, 2001; Tsai, 2001). Despite this, research on absorptive capacity has been conceptually and methodologically underdeveloped, with the core construct suffering from reification (Easterby-Smith, Graça, Antonacopoulou, & Ferdinand, 2008; Lane et al., 2006; Volberda, Foss, & Lyles, 2010). This reification has resulted in limited explanations of the actual mechanisms through which absorptive capacity emerges as an organizational learning capability (Tortoriello,

2015; Volberda et al., 2010). In particular, although Cohen and Levinthal (1990, p. 131–135) explicitly argued that an organization's absorptive capacity has both individual and organizational antecedents, only limited attention has been given to their dynamic interplay in knowledge identification, assimilation and commercial application processes. Current absorptive capacity frameworks tend to be based on either “macro” (top-down) or “micro” (bottom-up) level theorizing, and only few models combine multiple levels (e.g., Lane et al., 2006).

Omitting the multi-level antecedents and their interactions in the absorptive capacity research is problematic for at least three reasons. First, from a practical point of view, it is firm employees, who search, identify and select valuable knowledge, assimilate and exploit the new knowledge in products and services. However, they do so by playing specific organizational roles, in a particular strategic and organizational context. Firm managers are routinely concerned about how to achieve the best “fit” between individual absorptive capacities and the firm's external environment for new knowledge (Lewin, Massini, & Peeters, 2011; Van Den Bosch et al., 1999). Organizational form and governance mechanisms influence how employees interact with the external environment, how they communicate and integrate new knowledge within and across subunits, and what types of innovations they bring onto the market (Lane et al., 2001; Roberts, 2015; Van Den Bosch et al., 1999).

Second, from a theoretical perspective, overlooking the actions and interactions of multi-level antecedents does not only overlook the underlying logics of Cohen and Levinthal's (1990) theorizing, but also suggests that organizations follow a certain “algorithmic matching process” (Lane et al., 2006, p. 854) where investments of an amount X

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into absorptive capacity Y enable a firm to learn Z . However, what creates a firm's competitive advantage out of knowledge is the unique and valuable ways of combining and applying it (Grant, 1996). That uniqueness arises from diverse experiences and mental models of individuals and combinative capabilities of the firm (Kogut & Zander, 1992) that jointly determine the scanning of external environment, the integration and exploitation of new external knowledge in products, services and organizational processes (Gooderham, Minbaeva, & Pedersen, 2011; Jones, 2006). Third, neglecting a multi-level construct of absorptive capacity limits the understanding of how learning and innovation processes emerge and evolve over time in organizations. Even if absorptive capacity starts with an individual, some of its aspects are “distinctly organizational” (Cohen & Levinthal, 1990, p. 131), and tensions in individual-organization interaction may vary at different stages of the knowledge absorption process (Lane et al., 2006). A better understanding of these complex interactions may shed new light on how firms develop and use their absorptive capacities to generate innovations.

The goal of this study is to explain the emergence of a firm-level absorptive capacity from the actions and interactions of individual and organizational antecedents. Implied in this study is an assumption that individual and organizational processes of learning are fundamentally different and involve tension in interaction (Crossan, Lane, & White, 1999; Spender, 1996; Weick & Westley, 1996), and that a better understanding of absorptive capacity is obtainable by conceptualizing it as a multi-level phenomenon (Kozlowski & Klein, 2000). Through the adoption of micro-foundations lens on organizational capabilities (Abell, Felin, & Foss, 2008) and Coleman's (1990) “bathtub” model, the paper explicates linkages between individual and organizational (or group level) attributes at each stage of the absorptive capacity process. This study contributes to organizational learning and innovation research by explaining how a firm strategy, structure and processes, and individual absorptive capacities of its members shape the development of knowledge identification, assimilation and application capabilities.

The structure of this paper is as follows. First, the study reviews seminal works of Cohen and Levinthal (1989, 1990, 1994) and places particular emphasis on conceptualizations of knowledge, the role of individuals and their interactions in the creation of firm's absorptive capacity. Second, a critical review of the subsequent absorptive capacity research is provided, where micro-level issues are addressed. Third, drawing on a multi-level paradigm in organizational research and the micro-foundations view of organizational capabilities, this paper provides a new conceptualization of absorptive capacity and offers seven propositions for empirical examination.

2. A Critical Review Of Absorptive Capacity Literature

2.1. Micro-Foundations of Absorptive Capacity in Cohen and Levinthal's Research

A review of the foundational articles by Cohen and Levinthal (1989, 1990, 1994) shows that the authors problematize the nature of organizational knowledge, address the multi-levelness of absorptive capacity construct and present it explicitly as a learning process. Although the micro-foundations view of absorptive capacity does not constitute the core of Cohen and Levinthal's work, their underlying assumptions about knowledge and learning in organizations confirm its high research potential.

First, Cohen and Levinthal (1989, 1990) explicitly argue that firm's absorptive capacity is a function of cognitive abilities and the intensity of effort of its individual members. Learning is cumulative, and the ability to recognize value, assimilate and exploit new external knowledge depends on individuals' prior related knowledge and the diversity of experience. Researchers maintain that firm employees do not equally experience or interpret new external knowledge. Quite the contrary, individuals possess diverse cognitive structures, and their absorptive capacities also depend on the degree to which they can process

knowledge throughout the firm. More specifically, individuals need to build awareness about “who knows what, who can help with what problem, and who can exploit it” (Cohen & Levinthal, 1990, 133), which implies that organizational knowledge is distributed in nature (Tsoukas, 1996). The role of an organization is to develop decision-making structures and networks of intra-firm relationships through which individual absorptive capacities can be leveraged and deployed (Tortoriello, 2015). Cohen and Levinthal (1990) also emphasize that individuals' prior related knowledge encompasses various domains that complement each other (such as research and development (R&D), product design, manufacturing and marketing knowledge). Complementary knowledge enables individuals to make new associations and linkages, and they make those linkages within a particular strategic context and through interactions with organizational structure, culture and knowledge management routines. Furthermore, Cohen and Levinthal (1989, 1990, 1994) address problems associated with the tacit nature of knowledge (Grant, 1996; Kogut & Zander, 1992). The authors maintain that knowledge about how innovation processes take place are firm specific and, therefore, cannot be bought and quickly integrated into another firm (Cohen & Levinthal, 1990).

Second, Cohen and Levinthal (1990, p. 131) consider firm's absorptive capacity as a multi-level construct – as a function of mental models and learning behaviors of its individual members and involving “distinctly organizational” aspects. In their view, individuals assess the value of new external knowledge, relate new knowledge to what they already know and creatively use it in new products, services and organizational processes. However, a firm's absorptive capacity is not resident in any single individual, nor is it an aggregate of individual absorptive capacities. Rather, it depends on the “links across a mosaic of individual capabilities” (Cohen & Levinthal, 1990, p. 133). The “linking” processes are embedded in combinative capabilities of the firm (Kogut & Zander, 1992). Coordination, systems and socialization capabilities enable firms and their business units to synthesize and apply the newly acquired knowledge (Jansen, Van Den Bosch, & Volberda, 2005; Roberts, 2015). As Lane et al. (2006) observed later, these organizational antecedents determine how efficiently and effectively individuals acquire and use new external knowledge to commercial ends.

Third, although Cohen and Levinthal (1989, 1990, 1994) use R&D spending as a proxy for absorptive capacity, they explicitly define it as a set of sequentially linked, complementary learning processes. The authors maintain that through R&D activities a firm develops a particular breadth and depth of its knowledge base and the speed of learning (Cohen & Levinthal, 1989). Over time, the firm develops communication structures and decision-making processes that facilitate (or inhibit) the knowledge sharing among firm employees (Cohen & Levinthal, 1990). The outcome of knowledge sharing and assimilation processes is a renewed “collective scheme” across organizational units (Lane et al., 2006), which leads to combinations of newly acquired technological and market knowledge (Lenox & King, 2004). Through these knowledge linkages, a firm becomes adept at forecasting new market trends, identifying new applications and incorporating newly acquired knowledge into its operations (Cohen & Levinthal, 1990, 1994).

2.2. Micro-Foundations of Absorptive Capacity in Subsequent Research

In contrast to the foundational works by Cohen and Levinthal (1989, 1990, 1994), in subsequent research absorptive capacity is typically viewed as a firm—or a business unit-level construct (with several notable exceptions, e.g. Chang, Gong, & Peng, 2012; Easterby-Smith et al., 2008; Jones, 2006; Matusik & Healey, 2005; Reinholt, Pedersen, & Foss, 2011). A lack of attention to the role of individuals has led to the perceptions of absorptive capacity as a certain “algorithmic matching process” (Lane et al., 2006, p. 854): developments of X amount of absorptive capacity in Y enable a firm to learn Z (Ahuja & Katila, 2001; Mowery, Oxley, & Silverman, 1996; Stock, Greis, & Fischer, 2001; Tsai, 2001). Several recent studies have witnessed that organizational

learning from the external environment is a much more complex process, involving individual actions and their social interactions (Easterby-Smith et al., 2008; Hotho, Saka-Helmhout, & Becker-Ritterspach, 2012; Robertson, Casali, & Jacobson, 2012; Tortoriello, 2015). Even if absorptive capacity starts with an individual, a primary concern has been to understand how absorptive capacity emerges as an organizational capability (Tortoriello, 2015; Volberda et al., 2010). However, scant knowledge exists about how individual and organizational absorptive capacities interact (Lane et al., 2006). For example, current research provides little explanation about how firm strategy affects the abilities and motivations of its individual members to identify, assimilate and apply valuable knowledge to commercial ends, and how these individual learning behaviors "translate" into firm-level processes and routines.

The reasons behind this insufficient treatment of absorptive capacity as a multi-level construct may be attributed to limited research attention to knowledge stickiness (Szulanski, 1996; Von Hippel, 1994). The concepts of knowledge (the "know-how") and information (the "know-what") are often used interchangeably in the absorptive capacity literature (Lane & Lubatkin, 1998; Todorova & Durisin, 2007; Van Den Bosch et al., 1999; Zahra & George, 2002). Accordingly, fundamental axiological differences between tacit and explicit knowledge are neglected (Kogut & Zander, 1992). Whereas "information" (explicit knowledge) implies knowing *what* something means and can be codified in records of the past, assessed on a sequential basis and transmitted with no loss of integrity (Kogut & Zander, 1992), tacit knowledge implies knowing *how* to do something and is highly immobile (Jensen & Szulanski, 2004). Knowledge is accumulated in the minds of individuals, acquired and refined by practice and embedded in a specific organizational context (Kogut & Zander, 1992; Nelson & Winter, 1982). Tacit knowledge cannot be "captured" or "converted" but only manifested in human action (Tsoukas, 1996, 2003) and can be better described as a skilled process of *knowing* (Brown & Duguid, 1998; Penrose, 1959; Polanyi, 1966; Spender, 1996). Following this line of thought, organizational knowledge is situated – it is embedded and invested in practice, resides in complex interactions among firm employees (Spender, 1996) and reflects the institutional environment in which it was created and used (Kostova & Zaheer, 1999).

Organizational knowledge is also distributed in nature. The knowledge-based view scholars (Grant, 1996; Nonaka, 1994; Spender, 1996) consider firms as distributed knowledge systems consisting of various domains and skills that await being connected and integrated rather than articulated and formulated (Tsoukas, 2003). Factual knowledge of specific circumstances, of a certain time and place is incomplete, continuously reconfiguring and dispersed. As a result, no single mind can specify in advance the relevance of knowledge or the timing and context of its use (Tsoukas, 1996). Given that organizational knowledge generates "inherent uncertainty" as to what causal connections between the actions and outcomes are (Lippman & Rumelt, 1982; Reed & De Fillippi, 1990; Simonin, 1999), a firm's absorptive capacity is not an automatic aggregation of individual absorptive capacities but rather a set of unique interactions of organizational strategy, structure and culture as well as individual motivations and abilities to absorb new external knowledge (Lane et al., 2006).

Furthermore, absorptive capacity researchers tend to oversee a distinction between individual and collective forms of knowledge creation (Spender, 1996). Nor do they problematize a continuous tension in individual-organization interaction alongside each phase of the absorptive capacity process. A research focus is given on knowledge stocks at the expense of knowledge flows (with exceptions, e.g., Lane et al., 2006). Individual expertise is largely perceived as an asset that is easily convertible into a collective good through human resource management practices (Lane & Lubatkin, 1998; Lane et al., 2001), shared organizational goals and knowledge governance mechanisms (Gupta & Govindarajan, 2000; Todorova & Durisin, 2007; Van Den Bosch et al., 1999; Zahra & George, 2002). However, collective knowledge is not

consciously known by individuals nor is it easy to articulate – it is embedded in complex organizational routines, social relationships, collectively shared norms and values of the firm (Chakravarthy, Mcevely, Doz, & Rau, 2003; Nelson & Winter, 1982; Spender, 1996; Zander & Kogut, 1995). Organizations are not the collections of rational agents and systems of applied knowledge bundles that can be "shuffled" around. Rather, they are systems of knowledge creation and use, and their members are malleable human beings whose sense of self is influenced by the organization's evolving identity (Spender, 1996).

To summarize, the role of tacit, situated and distributed knowledge is not sufficiently problematized in the absorptive capacity research, and multiple antecedents to knowledge creation and use are not addressed adequately. In this way, the current body of research deviates from Cohen and Levinthal's (1989, 1990) work (see Table 1) and calls for the improved micro-level understanding of how a firm-level absorptive capacity arises.

3. Theory Development: The Emergence Of Absorptive Capacity As An Organizational Learning Capability

In the following section, the micro-foundations view of strategic organization (Abell et al., 2008; Felin & Foss, 2005, 2011; Felin, Foss, Heimeriks, & Madsen, 2012; Foss, 2006; Lane et al., 2006; Lepak, Smith, & Taylor, 2007; Lewin et al., 2011; Subramaniam & Youndt, 2005) and Coleman's framework, more specifically, are used to explain *how* absorptive capacity emerges as an organizational capability to recognize the value of, assimilate and apply new external knowledge to commercial ends (see Fig. 1). The underlying assumption of this paper is that organizational phenomena are multi-level in nature (Kozlowski & Klein, 2000), implying that firm's absorptive capacity is subject to actions and interactions of "micro" and "macro" level antecedents.

Coleman's framework extends the "macro-macro" linkage explanations (arrow 4) by theorizing the emergence of social outcomes through interconnected "macro-micro" (arrow 1), "micro-micro" (arrow 2) and "micro-macro" linkages (arrow 3). Felin and Foss (2005) suggest that utilizing this framework can raise critical questions as to the origins of macro-level phenomena, such as organizational capabilities and routines that are often treated as independent variables determining variation in outcomes (e.g., firm performance). However, systemic performance differences among firms are not driven by efficiency differences that are ascribed to collective constructs, but rather emerge through interactions with the micro-level processes, such as individual abilities and motivations to act and interact (Felin & Foss, 2005).

To develop the arguments further, this paper employs Lane et al. (2006) theoretical framework of absorptive capacity processes and draws on scholarly discussions within the knowledge-based view of the firm (Grant, 1996; Kogut & Zander, 1992; Spender, 1996). According to Spender (1996), a firm is a dynamic knowledge-based activity system in which tacit and explicit forms of knowledge, at individual and collective levels, interact to produce knowledge outcomes. Following this line of thought, organization is not a collection of rational agents and systems of applied knowledge bundles, but rather a system of knowledge creation and use where individual and organizational attributes of absorptive capacity interact.

3.1. Recognition of Value as Exploratory Learning

To Cohen and Levinthal (1990), a firm's ability to recognize value of new external knowledge is a function of prior related knowledge and the intensity of effort of its individual members. An organization's absorptive capacity, however, does not only depend on individual absorptive capacities, but also on the external environment of the firm and the firm's interface with it (Cohen & Levinthal, 1994; Lewin et al., 2011; Van Den Bosch et al., 1999). Valuation, as such, is a cognitive act during which individuals use their automatic skills, hunches and intuitions as well as facts about their firm's strategy and its external

Table 1
Micro-Foundations of Absorptive Capacity in Cohen and Levinthal (1989, 1990, 1994) and Subsequent Research.

Micro-foundations of AC ¹	Cohen and Levinthal (1989, 1990, 1994)	Subsequent AC research ²	
Nature of knowledge	Problematicized: • Organizational knowledge is tacit, situated and distributed. • Individual and collective forms of knowledge co-exist in the organization.	Not problematicized: • Overly focus on 'quantity' (extent/stock) of organizational knowledge. • Organizational knowledge seen as aggregate of individual knowledge.	See: Ahuja and Katila (2001); Jansen et al. (2005); Lane and Lubatkin (1998); Mowery et al. (1996); Tsai (2001); Van Den Bosch et al. (1999); Zahra and George (2002).
Role of individuals	Addressed: • Firm's AC is dependent on ACs of its individual members. • Learning behaviors of individuals constitute cognition, motivation, action, and social interaction.	Under-researched: • Overly focus on organizational- level AC, i.e., a firm's past experience, formal governance mechanisms, such as structure, routines, HRM practices, and informal mechanisms. • Few studies on individual antecedents (e.g. Minbaeva et al., 2015; Matusik & Healey, 2005; Jones, 2006; Tortoriello, 2015).	See: Gupta and Govindarajan (2000); Jansen et al. (2005); Lane et al. (2001); Szulanski (1996); Todorova and Durisin (2007); Zahra and George (2002)
Learning processes	Addressed: • AC is a set of sequentially interlinked learning processes (i.e., recognition of value, assimilation, and commercial application of new external knowledge). • Learning processes are emergent and involve interaction across levels.	Under-researched (with exceptions, e.g., Jones, 2006; Lane et al., 2006; Easterby-Smith et al., 2008): • Overly focus on knowledge content rather than process. • AC perceived as a static organizational resource.	See: Ahuja and Katila (2001); Cockburn and Henderson (1998); Jansen et al. (2005); Mowery et al. (1996); Tsai (2001); Zahra and George (2002).
Individual-organization interaction	Addressed: • The multi-levelled nature of AC construct is acknowledged: micro vs. macro level ACs. • Linkages between micro and macro levels of AC are addressed though not developed further.	Addressed/modestly developed: • Mostly conceptual/review papers.	See: Lane et al. (2006); Volberda et al. (2010).

¹ AC - absorptive capacity.

² Selective (most seminal) AC publications, based on AC review articles (Lane et al., 2006; Todorova & Durisin, 2007; Volberda et al., 2010).

environment (Crossan et al., 1999; Spender, 1996). Tacit (“automatic”) and explicit (“conscious”) forms of individual knowledge interact in the value recognition phase of absorptive capacity (Spender, 1996). This interaction implies that individuals identify value of new external knowledge in a particular strategic context of the firm. Individuals search and judge the value of new external knowledge within areas of science and technology that are relevant to the firm and in the pursuit of firm strategic goals that are known to them (Lane et al., 2006).

Consequently, identification of value of new external knowledge is not automatic but fostered by the firm, in a sense that firm strategy determines the scope of the search process, the criteria for valuable knowledge and the intensity of effort among individuals to search for that knowledge. Given a biased nature of individual learning (March, 1991), valuation of new external knowledge needs to be nurtured continuously and directed in order to fulfill company needs. The ability to judge a potential value of new external knowledge implies that people recognize change in the task environment of the firm. Hence, they identify value of new external knowledge in the context of search strategy of the focal firm. Firm strategy conditions individual search

behavior; that is, it determines which areas of knowledge are valuable and which are not, and how distant and intensive the search processes have to be (see Fig. 2, arrow 1). Firm strategy encompasses a vision and mission statement, short- and long-term goals and the road maps towards achieving these goals (Mintzberg, Ahlstrand, & Lampel, 1998), and includes (in a broad sense) competitive, corporate (business unit) and functional strategy dimensions.

Drawing on the above, a firm’s “capacity to recognize and understand new external knowledge” emerges as the outcome of firm strategy that determines individuals’ engagement in exploratory learning behavior.

“Exploratory learning” is driven by the ability and motivation to act and interact or refrain from action (see Fig. 2, arrow 2). Motivational dispositions and abilities are individual in nature and, therefore, the outcomes of exploratory learning may differ between firm employees. In turn, in the context of absorptive capacity, exploratory learning behaviors reflect the breadth, depth and speed of exploratory search by firm employees at a given point of time (see Fig. 2, arrow 3). These behaviours reflect the extent to which individuals use different skills

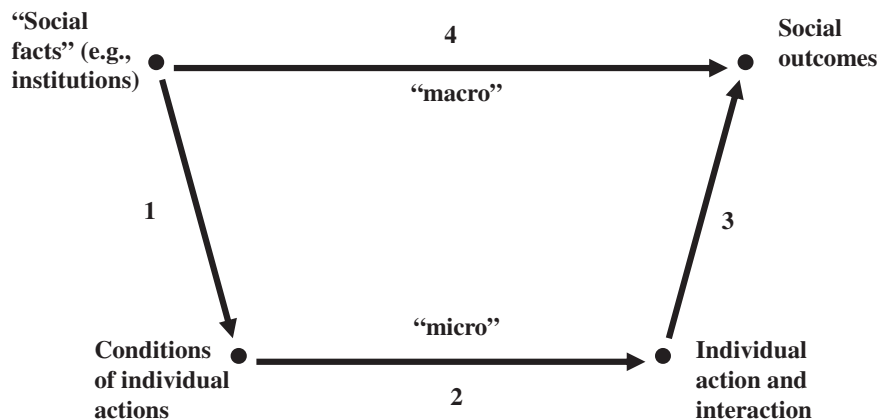


Fig. 1. The Coleman Framework.

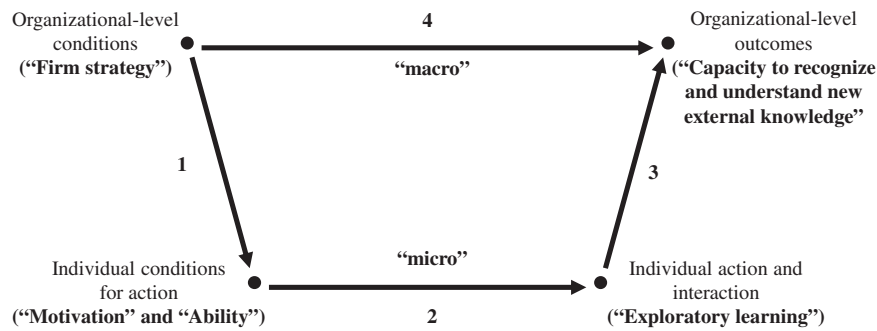


Fig. 2. The Firm's Capacity to Recognize the Value of New External Knowledge.

in multiple areas of expertise, the extent to which those different skills are mastered thoroughly and completely and the pace at which they are mastered (Zahra, Ireland, & Hitt, 2000). The extent and intensity of an individual's effort to identify and acquire valuable external knowledge are not determined by R&D investments in the firm's knowledge base, but are facilitated or constrained by the strategic course of the focal firm. Two propositions address these micro–macro level interactions:

Proposition 1. Firm strategy affects individuals' ability and motivation to recognize value of new external knowledge that, ultimately, determine their engagement in exploratory learning (Fig. 2, arrows 1 and 2).

Proposition 2. Value recognition capability of the firm emerges as a function of individuals' ability and motivation to recognize value of new external knowledge through exploratory learning (Fig. 2, arrows 2 and 3).

3.2. Assimilation as Transformative Learning

Following Cohen and Levinthal (1990), absorptive capacity can be leveraged through linking individual capabilities. These linkages are critical when individuals share their insights about valuable external knowledge for the firm that need to be assimilated. Given a high degree of tacitness, situatedness and distributedness of organizational knowledge (Brown & Duguid, 2001; Tsoukas, 1996; Zander & Kogut, 1995), integrating it across and within organizational units is a challenging task. Interestingly, the "character and distribution of expertise within the organization" was emphasized by Cohen and Levinthal (1990, p. 132), but was largely ignored in subsequent absorptive capacity research. Instead, researchers conceptualized assimilation and transformation capacities as cognitive processes and engaged in the debate about whether they constituted subsequent or alternative learning processes (Todorova & Durisin, 2007).

This paper argues that "assimilation" and "transformation" of knowledge are the transformative learning processes (Lane et al., 2006) during which individuals share and assimilate valuable external knowledge across "syntactic", "semantic" and "pragmatic" boundaries (Carlile, 2002, 2004). To manage complex knowledge boundaries, individuals use informal organizational routines and "ways of doing things", stories and shared systems of understanding as well as documented systems of rules, standard operating procedures and formalized routines (Crossan et al., 1999; Spender, 1996). In other words, tacit ("collective") and explicit ("objectified") forms of organizational knowledge interact in the assimilation phase of absorptive capacity (Spender, 1996). This interaction implies that organizational mechanisms associated with coordination, systems and socialization capabilities influence knowledge sharing behavior of firm employees (Jansen et al., 2005), and their effects may vary depending on the knowledge boundary. When a sufficient (commonly shared) syntax among individuals exists, the knowledge boundary proves to be "unproblematic", and the primary

concern of individuals is the extent of information processing across the boundary (Carlile, 2004). Provided that organizational mechanisms associated with systems capabilities (e.g., a highly routinized and formalized decision-making process) are developed in the firm (Jansen et al., 2005), communication and information systems suffice to facilitate information exchange among its individual members (Jansen et al., 2005; Szulanski, 1996).

However, a sufficiency requirement for a commonly shared syntax is highly problematic in organizations (Postrel, 2002). It is rather misleading to assume that a firm can easily move knowledge across boundaries without losing its integrity (Zander & Kogut, 1995). When sharing new external knowledge, interpretive differences emerge among individuals, dependencies are often questioned, and the meanings become ambiguous (Carlile, 2004). Given the above, the primary role of a firm is to mobilize its employees across different functional domains and to facilitate their interactions rather than increase the stock of relevant knowledge through R&D investments. Organizational mechanisms associated with coordination capabilities, such as cross-functional teams, job rotation and employee inclusion in decision-making (Jansen et al., 2005) may facilitate the sharing of knowledge across the boundaries. Novelty also creates different interests among employees that impede their willingness and ability to share, assess and assimilate each other's knowledge (Carlile, 2004). Under these circumstances, common interests are developed through a political process of negotiating, making trade-offs and, ultimately, transforming a "collective schema" of different organizational units (Lane et al., 2006). Organizational mechanisms associated with socialization capabilities (Van Wijk, Jansen, & Lyles, 2008), namely, the density and strength of social ties within and across subunits influence individual abilities and willingness to engage in these transformative learning processes (Easterby-Smith et al., 2008; Jones, 2006).

Drawing on the above, a firm's "capacity to assimilate valuable external knowledge" emerges as the outcome of coordination, systems and socialization capabilities that determine individual's ability and motivation to engage in transformative learning behavior (see Fig. 3, arrows 1 and 2).

A firm-level absorptive capacity depends on how well its structures, systems and social relations enable individuals to share new external knowledge (Cohen & Levinthal, 1990) and, consequently, transform their diverse interpretations and interests into a commonly shared knowledge for commercial use. The knowledge-sharing behaviors of individuals are not automatic, but need to be nurtured and facilitated by the firm (Foss, Laursen, & Pedersen, 2011), in the form of cross-functional interfaces, job rotation, boundary-spanning roles and other organizational mechanisms (Jansen et al., 2005). The degree of formalization and routinization influences the boundary-spanning behaviors of individual actors (i.e., their abilities and willingness to engage in "transfer", "translation" and "transformation" of newly acquired knowledge within and across organizational units) (see Fig. 3, arrows 1 and 2). Differences in assimilation capabilities among firms can also be explained by variation in social interaction patterns among firm

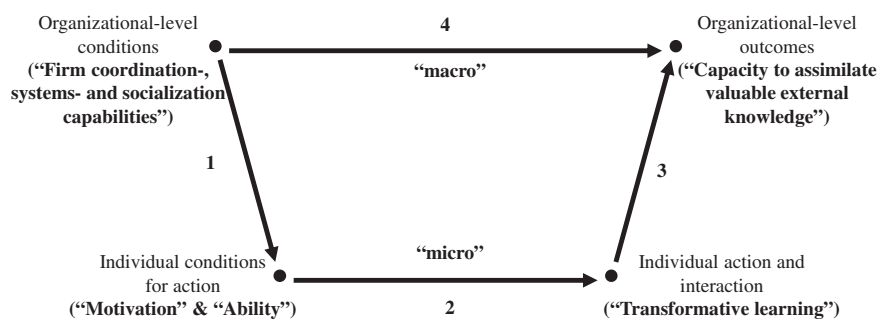


Fig. 3. The Firm's Capacity to Assimilate Newly Acquired Knowledge.

employees that influence their transformative learning behaviors (Hotho et al., 2012). More specifically, the degree of social cohesion among firm employees, the extent of social interactions among them and the diversity of interacting employees may explain how (i.e., in what manner) and how intensively and effectively individuals combine new and existing knowledge, allowing the latter to be used in new ways.

This paper distinguishes between tacit/explicit and individual/collective knowledge, and argues that the nature of knowledge acts as a boundary condition for the assimilation capability to emerge. The micro-macro level interactions in knowledge assimilation phase of absorptive capacity are determined by the knowledge context in which they appear. The nature of knowledge determines how individuals combine new and existing knowledge and, ultimately, how their assimilation capacities are linked to that of the firm or an organizational unit where they belong (see Fig. 3, arrow 3). When firm employees interact to assimilate new, explicit knowledge from different units, the new and existing knowledge tend to converge. Isomorphic pressures (Kozłowski & Klein, 2000) drive transformation of the collective schema of different subunits. In contrast, when individuals share tacit (individual or social) knowledge, compilation acts as the mechanism of transformative learning (ibid). In this process, individuals translate, combine and complement each other's knowledge, experiences and skills. Based on the above, this study offers three propositions for further examination:

Proposition 3. Organizational mechanisms associated with coordination, systems and socialization capabilities affect individuals' ability and motivation to assimilate valuable external knowledge that, ultimately, determine their engagement in transformative learning (Fig. 3, arrows 1 and 2).

Proposition 4. Assimilation capability of the firm emerges as a function of individuals' ability and motivation to assimilate valuable external knowledge through transformative learning (Fig. 3, arrows 2 and 3).

Proposition 5 a). In the context of explicit knowledge, transformative learning behaviors of individuals lead to assimilation capability of the firm through convergence (Fig. 3, arrow 3).

Proposition 5 b). In the context of tacit knowledge, transformative learning behaviors of individuals lead to assimilation capability of the firm through compilation (Fig. 3, arrow 3).

3.3. Application as Exploitative Learning

Following Cohen and Levinthal (1990), firms establish routines for applying new external knowledge to commercial ends (Van Den Bosch et al., 1999; Zahra & George, 2002). Essentially, knowledge exploitation is associated with combining valuable external knowledge with existing (e.g., market) knowledge of the firm and incorporating it in new products and services, new processes and organizational forms (Lenox & King, 2004; Tsai, 2001). Given that uncertainty in decision-making prevents managers from exclusively relying on standard

norms of rational behavior (Greve, 2003; Simon, 1991), exploitative learning primarily relies on the use of hunches, intuition and interpretation (tacit individual knowledge) (Greve & Taylor, 2000) and shared values and norms of behavior (tacit collective knowledge). In the knowledge exploitation phase of absorptive capacity, individuals convert tacit ("automatic" and "collective") forms of knowledge into more explicit ones ("conscious" and "objectified" knowledge), such as strategic plans and decisions, project teams and tasks or standard operating procedures (Spender, 1996). This interaction implies that firm strategy and organizational mechanisms associated with coordination, systems and socialization capabilities (Jansen et al., 2005) direct and ensure the effective use of new external knowledge by firm employees.

Based on the above, a firm's "capacity to apply valuable external knowledge to commercial ends" emerges as the outcome of firm strategy and its coordination, systems and socialization capabilities (see Fig. 4, arrows 1 and 2).

Firms may foster or inhibit knowledge exploitation behaviors of their individual members by setting the momentum, scope and speed of exploitation in the form of strategic goals and resource allocations. A firm strategy determines if exploitation opportunities are pursued, in which areas they are pursued and with what amount and intensity of resource allocations (Shane, 2000). In other words, it drives the intensity of effort on behalf of its individual members to use particular types of knowledge, for particular applications (see Fig. 4, arrow 1).

Organizational mechanisms associated with socialization capabilities, particularly, connectedness (the density of linkages) and socialization tactics (shared social experiences among firm employees) (Jansen et al., 2005) contribute to common codes of communication and dominant values that, in turn, may enhance or inhibit individuals' ability and motivation to leverage and convert knowledge to new commercial applications (Hansen, 1999) (see Fig. 4, arrow 1). Communication and information systems (Roberts, 2015) may also facilitate individual attempts to apply their technical knowledge to commercial ends since they increase an awareness of where relevant marketing (or other complementary) knowledge resides in a focal firm (Lenox & King, 2004). However, it is not the individuals but rather combinations and re-combinations of their complementary knowledge across R&D, design, manufacturing and marketing functions that determine the extent, scope and speed of knowledge exploitation in the firm. Those linkages can also be substantiated through high formalization and routinization (systems capabilities). The ultimate goal of organizational mechanisms is to expose individuals to diverse but complementary knowledge domains within the firm and facilitate the selection of commercially valuable knowledge (see Fig. 4, arrows 1 and 2). The diversity of individual learning behaviors is reduced through the use of combinative capabilities, which permit the effective application of new external knowledge to commercial ends (see Fig. 4, arrow 3). To explicate these micro-macro level interactions, this paper suggests the following:

Proposition 6. Firm strategy and organizational mechanisms associated with coordination, systems and socialization capabilities affect

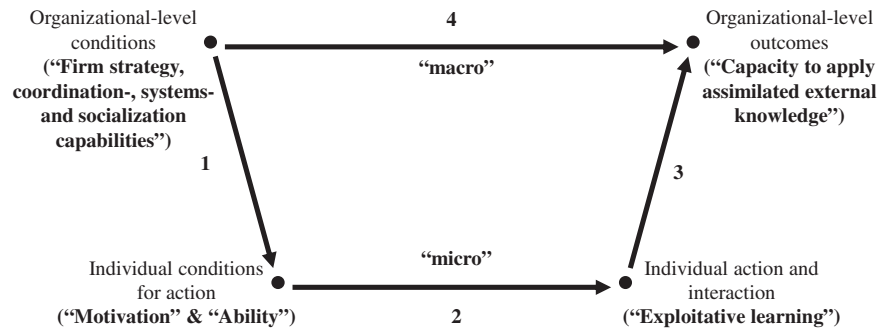


Fig. 4. The Firm's Capacity to Apply Newly Acquired Knowledge to Commercial Ends.

individuals' ability and motivation to apply valuable external knowledge to commercial ends that, ultimately, determine their engagement in exploitative learning (Fig. 4, arrows 1 and 2).

Proposition 7. Knowledge application capability of the firm emerges as a function of individuals' ability and motivation to apply valuable external knowledge to commercial ends through exploitative learning (Fig. 4, arrows 2 and 3).

4. Discussion

This paper examined a dynamic interplay between individual and organizational levels of absorptive capacity. A review of the absorptive capacity literature revealed that the intrinsic nature of organizational knowledge, the role of individuals and their social interactions have not been problematized sufficiently, and questions about how absorptive capacity emerges as an organizational capability were left unanswered. The present study addresses this as a limitation and conceptualizes absorptive capacity as a set of sequentially linked exploratory, transformative and exploitative learning processes in which individual and organizational antecedents interact.

A re-examination of the absorptive capacity concept brought several important findings. First, this study shows how firm strategy and organizational mechanisms associated with coordination, systems and socialization capabilities may facilitate or inhibit the engagement of its employees in value recognition, assimilation and commercial application processes of new external knowledge. Second, the study emphasizes that the nature of knowledge and learning processes may vary in the emergence of value recognition, assimilation and application capabilities of the firm and that the importance of individual and organizational antecedents is relative to each phase of the absorptive capacity process. Third, this paper finds that knowledge stickiness determines whether individual learning behaviors emerge into organizational routines through combination or aggregation mechanisms. In this way, it addresses the unresolved issues of the micro-foundations view of strategic organization (Barney & Felin, 2013; Vromen, 2010; Winter, 2013) and calls future research to validate the link between individual actions and organizational outcomes empirically for all three dimensions of absorptive capacity.

At the value recognition phase, the exploratory learning behaviors of firm employees are driven by their cognitive abilities and motivations to identify value of new external knowledge, and are purposeful acts of individuals to achieve strategic goals of the firm. The paper emphasizes that valuation, as such, is a purely individual act, yet it is pursued within a strategic context of the focal firm. Firm strategy determines which areas of knowledge are valuable and which are not, how and where to search for valuable knowledge, and for what purposes.

At the assimilation stage, new external knowledge is transformed into firm specific, collectively shared knowledge that is further embedded into the organizational structure, its culture and decision-making

processes. Organizational mechanisms associated with coordination, systems and socialization capabilities may facilitate or impede the transformative learning behaviors of firm employees. These mechanisms may expand or reduce the opportunities for individuals to manage complex knowledge boundaries, in the form of infrastructural quality for information exchange, the building of common knowledge and access to knowledge resources (Carlike, 2002, 2004). The nature of knowledge determines how individuals combine new and existing knowledge, and how their assimilation capacities are linked to that of the firm or an organizational unit to which they belong.

Finally, the commercial application of new external knowledge is a result of the exploitative learning behaviors of firm employees whose abilities and motivations to act and interact are determined by strategic goals, resource allocations and coordination, systems and socialization capabilities of the firm. The commercial application of knowledge is a process of making tacit knowledge more explicit and incorporating that knowledge into firm operations. For that, strategic choices, cross-functional interactions, information and communication systems, organizational routines and socialization practices are important.

There are, however, limitations to the present analysis that deserve particular attention. First, theoretical arguments are based on the review of several highly cited conceptual and empirical papers in the field of absorptive capacity that do not represent an exhaustive bibliometric analysis. Second, the aggregated outcome variables of absorptive capacity have not been addressed in this study as this was not its primary focus. Instead, the paper develops arguments of why a firm's absorptive capacity is not exclusively an aggregated, static and flat concept.

5. Conclusions

Drawing on the knowledge-based view of the firm and the micro-foundations view of strategy, the paper shows how tacit and explicit forms of knowledge interact at micro and macro levels for all three dimensions of absorptive capacity. In this way, it contributes with a framework for better understanding of how a firm-level absorptive capacity emerges as an organizational capability from actions and interactions of individual and organizational antecedents. The study explains how organizations set the direction, the efficiency and flexibility requirements for their individual members to identify, assimilate and exploit new external knowledge, and how they mobilize individuals for the creation of value recognition, assimilation and application capacities. Organization- and individual-level absorptive capacities interact in such a way that a firm strategy and a set of combinative capabilities determine the exploratory, transformative and exploitative learning behaviors of its individual members through its effects on cognitive abilities and motivations to act (and interact). This study shows that organizational antecedents of absorptive capacity act as opportunity sets for individuals to learn and innovate and are of relative importance to

their learning behaviors. Whereas a firm strategy determines the extent, flexibility and scope of exploratory and exploitative learning processes, organizational mechanisms associated with coordinative, systems and socialization capabilities are of primary importance for realization of transformative learning behaviors of firm employees.

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