International Journal of Lifelong Education

ISSN: 0260-1370 (Print) 1464-519X (Online) Journal homepage: http://www.tandfonline.com/loi/tled20

Linking complex problem solving to opportunity identification competence within the context of entrepreneurship

Yvette Baggen, Jakob Mainert, Thomas Lans, Harm J. A. Biemans, Samuel Greiff & Martin Mulder

To cite this article: Yvette Baggen, Jakob Mainert, Thomas Lans, Harm J. A. Biemans, Samuel Greiff & Martin Mulder (2015) Linking complex problem solving to opportunity identification competence within the context of entrepreneurship, International Journal of Lifelong Education, 34:4, 412-429, DOI: 10.1080/02601370.2015.1060029

To link to this article: http://dx.doi.org/10.1080/02601370.2015.1060029

Published online: 24 Sep 2015.

INT. J. OF LIFELONG EDUCATION, 2015
VOL. 34, NO. 4, 412–429, http://dx.doi.org/10.1080/02601370.2015.1060029

Linking complex problem solving to opportunity identification competence within the context of entrepreneurship

YVETTE BAGGEN[a], JAKOB MAINERT[b], THOMAS LANS[a], HARM J. A. BIEMANS[a], SAMUEL GREIFF[b] and MARTIN MULDER[a]
[a]Wageningen University, The Netherlands; [b]University of Luxembourg, Luxembourg

Today's working life is increasingly characterized by entrepreneurial challenges. Entrepreneurial challenges start at an individual level with the identification of entrepreneurial opportunities, which is acknowledged as one of the key competencies for lifelong learning. Since the identification of entrepreneurial opportunities relies heavily on the opportunity identification competence (OIC) of individuals, understanding the meaning of OIC is relevant. Until now, OIC has been explored in the young entrepreneurship research field. However, entrepreneurship researchers until now have not fully explored OIC. According to several authors, the research on complex problem solving (CPS) in the cognitive research field might contribute to understanding OIC. In this paper, we review the link between OIC and CPS by comparing the cognitive and entrepreneurship research fields. We argue that those who excel in identifying opportunities share core characteristics with high-level complex problem-solvers. We propose to conduct empirical research in the future to investigate the relation between OIC and CPS within a work context in order to gain more insight into OIC. We believe that the cognitive research field contributes to the entrepreneurship research field and provides a deeper understanding of the initial steps of the entrepreneurial process.

Keywords: entrepreneurship; opportunity identification competence; complex problem solving; innovation

Correspondence: Education and Competence Studies, Wageningen University, P.O. Box 8130, 6700 EW Wageningen, The Netherlands. Email: yvette.baggen@wur.nl
Yvette Baggen is a PhD candidate at Education and Competence Studies, Wageningen University. She has a background in educational sciences. Her research interest is the importance of human capital for organizational learning and innovation. In her research project, she looks at the relationships between opportunity identification competence of employees, organizational learning and the innovative performance of organizations.
Jakob Mainert is a research assistant and PhD candidate at University of Luxembourg since September 2013. He is member of the psychometricians' team responsible for the assessment of complex problem solving skills, led by ATTRACT research fellow Dr Samuel Greiff. His research interests are cognitive abilities and their relationship to occupational performance and innovation on the individual, group and organizational level. Furthermore he is interested in cognitive and strategic skill trainings and organizational stocks and flows of learning.

> ... most importantly, an inquiry into entrepreneurial opportunity has the potential to unlock one of the greatest intellectual puzzles of our time, namely the creation of new value in society. (Sarasvathy, Drew, Velamuri, & Venkataraman, 2010, p. 94)

In today's society, facing entrepreneurial challenges has become part of everyday working life. From 2000 until 2011, the number of independent professionals in Europe has increased by almost 100% (Rapelli, 2012). According to the Global Entrepreneurship Monitor, almost one out of ten adults (18–64 years old) in Europe was in 2013 involved in the process of starting or already running a new business (Amores & Bosma, 2014). Also, daily work at more mature organizations is increasingly spiced with entrepreneurial challenges: a trend is discernible towards twenty-first-century tasks that require innovation, more autonomy, and a decrease of routines (Autor, Levy, & Murnane, 2003; Hornsby, Kuratko, Shepherd, & Bott, 2009). In addition, the European Commission has set out entrepreneurship as one of the key competencies necessary for lifelong learning (European Parliament and the Council of the European Union [EC], 2006). In order to start up new ventures, innovate within existing companies or to adapt flexibly as worker to a rapidly changing world, individuals need to be able to identify high-potential entrepreneurial opportunities, which is a topic in the conceptual heart of the scientific field of entrepreneurship (Shane & Venkataraman, 2000).

It is assumed that those who are able to identify entrepreneurial opportunities can contribute significantly to personal, professional and/or business development (EC, 2006; Ireland, Hitt, Camp, & Sexton, 2001). Pursuing entrepreneurial opportunities may lead to different activities and outcomes, such as independent entrepreneurship (e.g. start-ups, social enterprises), innovation, strategic renewal, internal or external venturing, and so on (see for a classification of entrepreneurship, intrapreneurship and innovation, Sharma & Chrisman, 2007). Nonetheless, the road from initial idea to realization is far

Thomas Lans, PhD, is an assistant professor at Education and Competence Studies, Wageningen University. His research interests include entrepreneurship education and (situated) entrepreneurial learning. From 2012 to 2015, he is one of the work package leaders in the European LLLight'in'Europe FP7 research programme, in which the relationships between learning situations (and their interactions), and learning and innovative performance in the food industry are studied. Furthermore, he coordinates the master track entrepreneurship and is actively involved in entrepreneurship awareness and acceleration programmes.

Harm J. A. Biemans, PhD, is associate professor at the Education and Competence Studies group of Wageningen University in the Netherlands. He has a background in educational psychology. He carried out and supervised many projects in different domains, such as learning and instruction, competence-based education and training, professional development and organizational learning.

Samuel Greiff, is research group leader principal investigator, and ATTRACT-fellow at University of Luxembourg. He holds a PhD in cognitive and experimental psychology from the University of Heidelberg (passed with distinction) and has studied at Marburg University and Heidelberg University, Germany and at the University of Bergen, Norway. Samuel has been awarded several national and international research funds by the German Ministry of Education and Research and by the European Union, is currently fellow in the Luxembourg research programme of excellency; has published articles in national and international scientific journals and books; and has an extensive record of conference contributions and invited talks.

Martin Mulder is professor and head of the chair group of Education and Competence Studies at Wageningen University in the Netherlands, and a specialist in competence theory and research. He was (key-note) speaker at international conferences in Europe, Northern and Latin America, Asia and Africa and published over 400 articles, chapters and books with his co-workers on training, human resource development, competence development and educational research (see also www.mmulder.nl).

from straightforward. For instance, figures from the Netherlands show that about 2.5% of all Dutch horticulture companies introduce innovations truly new for the country (Pannekoek, van Kooten, Kemp, & Omta, 2005), and for those who start, many do not even become real business owners (i.e. they drop out before they have been in business for three-and-a-half-years) (Amores & Bosma, 2014). Similarly, from a large company perspective, Stevens and Burley (2003) estimated that out of 3000 raw ideas, only one will eventually become a commercial success. Thus, getting more insight into the initial steps in this process and necessary competence, referred to here as opportunity identification, seems to be necessary from a practical point of view.

From a theoretical point of view, studying entrepreneurial behaviour—and more specifically its defining initial stage, the identification of entrepreneurial opportunities—has become prominent in entrepreneurship literature, and has opened up the door for examining entrepreneurship in different contexts (e.g. new ventures and existing organizations) as well as among different target groups (e.g. intrapreneurs, small business owners, nascent entrepreneurs, ordinary people), and relating it to learning and development issues (Dimov, 2007b; Dutta & Crossan, 2005). Entrepreneurial opportunities come into being by way of a process of social construction: ideas and beliefs about the experiential world come together and the resulting actions enable the creation of a future good or service (Wood & McKinley, 2010). The identification of entrepreneurial opportunities starts at the individual level, and therefore relies heavily on individual capabilities (Du Chatenier, Verstegen, Biemans, Mulder, & Omta, 2010; Reid & de Brentani, 2004).

Research on opportunity identification shows that individuals have different capabilities in identifying opportunities. To explain those differences, some authors refer to differences in divergent thinking skills (i.e. generation of multiple, novel and original ideas) (Ward, 2004). Also, personal characteristics, such as self-efficacy, are mentioned as factors that explain variance of opportunity identification competence (OIC) (Rauch & Frese, 2007). As an attempt to gain more systematic insight into opportunity identification and its underlying process, it is suggested in more recent entrepreneurship literature that differences in OIC are the result of a complex interplay between cognitive and other psychological processes that individuals employ in their entrepreneurial endeavours (Hsieh, Nickerson, & Zenger, 2007). Along these lines of inquiry are those who suggest that opportunity identification needs key efforts, which are comparable to complex problem solving (CPS) (Nickerson & Zenger, 2004). To start, Hsieh et al. (2007) argue that the initial steps of entrepreneurship are influenced by cognitive search for strategies to solve a complex problem. Stevenson and Jarillo (1990) argue that individuals need to accumulate knowledge that 'assists in problem solving' (p. 23) to deal with entrepreneurial challenges. Besides, having to establish a new means–end relationship, individuals have to identify, define and structure novel solutions to open-ended problems (Shane, 2000). However, the role of CPS in opportunity identification is not elaborated upon thoroughly yet.

To summarize, individual OIC is assumed to play a key role in dealing with entrepreneurial challenges which have become prominent in our daily working lives. Although attempts have been made to explain differences in OIC among individuals, more systematic, integrative studies are called for (e.g. Hsieh et al., 2007). Since the literature indicates linkages between OIC and CPS, we aim to

integrate the entrepreneurship and cognitive research fields in this conceptual paper to gain deeper insight specifically into the relation between CPS and OIC. The main question is as follows: *To what extent is OIC related to CPS on a conceptual level?* We aspire to elaborate from a theoretical point of view on the exact role CPS plays in entrepreneurial tasks, in particular opportunity identification. Research on CPS can contribute to the understanding of OIC as psychological research has already proven that CPS is a relevant, reliable and valid predictor of academic achievement, and results of several studies provide support for an understanding of CPS as a transversal skill that yields substantial relations to performance in educational contexts (Fischer, Greiff, & Funke, 2012; Wüstenberg, Greiff, & Funke, 2012). Moreover, CPS is considered to be a twenty-first-century skill and efforts targeting twenty-first century skills from a lifelong learning perspective have been gaining increased attention (Autor et al., 2003; OECD, 2010). Requiring more insight into opportunity identification, representing the initial steps of entrepreneurship, is needed since it has repeatedly been claimed that (sense of) entrepreneurship is a key competence in the context of lifelong learning (EC, 2006). In short, by elaborating on the role of CPS as a defining element of entrepreneurship, namely OIC, this review contributes to the special issue on CPS and lifelong learning by integrating two research fields and focusing on the connection of CPS to individuals' ability to identify opportunities.

In this conceptual paper, the research roots, process models and assessments of OIC and CPS will first be discussed separately. Thereafter, we explore the ties and distinctions between OIC and CPS, and elaborate how the cognitive research field could contribute to the entrepreneurial research field. To conclude, we put forward a future research agenda.

Entrepreneurial opportunities

Within the entrepreneurship research field, the research roots of entrepreneurial opportunities and the process leading towards identification and exploitation are approached as either objective or subjective (Renko, Shrader, & Simon, 2012). The position one chooses distinctly defines the competence domain necessary for this process. Accordingly, we next present an elaboration of the objective and subjective approach. In addition, we argue our position within this debate.

Followers of the objective approach argue that opportunities exist out there, meaning that opportunities exist in the economic environment as objective entities (Companys & McMullen, 2007; Renko et al., 2012). Disequilibrium on the labour market and competition are sources for opportunities as they emerge from inefficiencies in complex webs of markets, networks and technologies (Kirzner, 1997). Several characteristics of an individual influence opportunity identification and exploitation, including social networks, personality traits, and prior knowledge (Kirzner, 1997; Wang, Ellinger, & Wu, 2013). Moreover, every individual is driven by a certain degree of entrepreneurial alertness. Alert individuals are motivated and able to perceive the market correctly; to recognize the driving forces and crucial factors that influence the market; and hereby to recognize opportunities as they emerge when the existing goods and services are no longer sufficient.

Adherents of the subjective view argue that opportunities are subjective constructs, which cannot be discovered as assumed in the objective definition.

Instead, according to this view, opportunities are created or identified by individuals (Sarasvathy et al., 2010; Wood & McKinley, 2010). Social cultural practices and social situatedness enable the identification of opportunities (Fletcher, 2006; Wood & McKinley, 2010).

Opportunities can thus be objective or subjective by definition, depending on the underlying view: an opportunity can either be discovered in the economic environment or created by an individual in interaction with his/her social environment. Fletcher (2006) states that models based on the objective view help us to identify factors that characterize the identification and exploitation of opportunities, such as the influence of prior knowledge and entrepreneurial alertness. However, these models do not provide much guidance in explaining *how* people enact opportunities in a certain manner and time in relation to their context. Adherents of the subjective view do provide a thorough understanding of the complexity and the social nature of opportunities (Fletcher, 2006). They stress that it is the entrepreneur or intrapreneur who constructs opportunities in interaction with his or her environment.

As Dutta and Crossan (2005) argue, we agree that one 'needs to be able to reconcile or even to synthesize the apparently conflicting positions of the two ontological approaches' (p. 433). The objective and subjective view both seem to elaborate on different elements of the opportunity process. The objective view elaborates more on the cognitive side of the identification and exploitation of opportunities by focusing on valuable characteristics of the opportunity process, such as entrepreneurial alertness. The subjective view accounts for the situatedness and social complexity of opportunities, and hereby provides a deeper understanding of how opportunities come into being and develop over time. Therefore, elements of both views are used as inputs for this paper (Dutta & Crossan, 2005).

Elaborating the opportunity process

According to Wood and McKinley (2010), who espouse the subjective view in their article, the opportunity process, to which they refer to as the opportunity production process, consists of two phases: opportunity objectification and enactment of the opportunity.

The first phase concerns *opportunity objectification*. This phase encompasses a set of initial ideas in the mind of an individual, and the objectification of ideas into an opportunity. To come up with ideas, an individual continuously reflects upon the social world he or she lives in. As mentioned in the introduction of this manuscript, also factors such as prior knowledge or the creativity of an individual influence individuals' ability to come up with ideas (DeTienne & Chandler, 2004; Guilford, 1981). Divergent thinking capabilities, for instance, explain 7% of the variance in the number of generated business ideas and 16% of the originality of those ideas (Gielnik, Frese, Graf, & Kampschulte, 2011). To discover how good an idea is, an individual starts a process of sense-making: the individual shares the idea with peers such, as friends, family and other people, the individual trusts. As a result, abandonment or the objectification of an idea takes place (Dimov, 2007a; Wood & McKinley, 2010). Whether an idea gets abandoned or objectified depends on the trust the individual has in his or her peers and the agreement among peers about the potential of the idea. Once an idea is objectified, it no

longer exists solely in the mind of the individual: an opportunity has gained external status.

The second phase concerns the *enactment of the opportunity*. This phase includes the further development of an opportunity based on the acquisition of support amongst relevant stakeholders (Wood & McKinley, 2010). Relevant stakeholders are, for instance, investors or potential customers. In a process of intense dynamic interaction and negotiation with the stakeholders, the individual strives for a shared understanding of the opportunity. This might result in the objectification of the opportunity for the stakeholders and the further development of the idea into a new product, process, service or practice (Sarasvathy et al., 2010).

Based on the subjective process model, opportunity identification seems to be an important part of the opportunity objectification process. Opportunity enactments seems to go one step further when the opportunity is developed into concrete prototypes, plans, formats and so on. Based on the above-discussed theories, we define OIC as follows:

> The ability of individuals to identify ideas for new products, processes, practices or services in response to a particular pain, problem or new market need.

The process of identifying opportunities may eventually lead to the creation of new value, such as new products, processes, services or practices; in other words, it may lead to innovation.

Assessment of OIC

The first commonly used method to measure OIC is self-assessment (Chandler & Jansen, 1992). Although self-assessments are commonly used to explore OIC, the reliability and validity of self-assessments are doubtful: what people say they do might be different from their actual behaviour (Corbett, 2007; Wang et al., 2013). A more direct, alternative method to measure OIC is the investigation of the number and quality of ideas generated by individuals. For instance, DeTienne and Chandler (2004) asked participants to list the business opportunities they had observed during the last 24 h. However, the recall of opportunities identified in the past might be influenced by biases of recall and retrospection (Corbett, 2007). For this reason, Corbett (2007) asked respondents to sum up as many ideas as possible for a standardized problem case. The method of Corbett (2007) shares characteristics with a commonly used test of divergent thinking. In one of those tests, participants are asked to generate as many possible uses for, for instance, a brick and a newspaper that are different from the standard use (Guilford, 1981). Hence, the supporting role of creativity in the identification of opportunities is visible in these assessment methods.

CPS

The research roots leading to CPS are diverse. Therefore, in this section, we clarify its origins in science, definition, CPS assessments and involved cognitive processes.

Just like domain-specific approaches to CPS, our current research approach to CPS is founded in the European line of research (e.g. Dörner, 1986; Funke, 2001). We focus on domain-general and context-neutral aspects of problem solving as part of so-called transversal skills. CPS can be assessed in interactive, computer-based tests with individuals (e.g. Wüstenberg et al., 2012).This focus on CPS is in line with a more general and less domain-bound understanding of CPS for being able to adapt and innovate in response to new demands and changing circumstances(Binkley et al., 2012). CPS can thereby be considered an integral component of what Binkley and colleagues (2012) classified as twenty-first-century skills.

Research roots of CPS leading to a process model of CPS

Coming from the realm of cognitive science, CPS has its roots primarily in the research domains of human problem solving, decision-making and intelligence. These research domains help to grasp CPS and open gateways for the detection of linkages between CPS and OIC. *How* people process *what* information, make decisions and cognitively operate are the focus of this section.

Originally, Dörner (1976) describes problems as barriers between the given situation and the intended goal state. The barriers are due to a lack of knowledge about the functioning of a system. This lack of knowledge can either be deficient strategies of solutions or an ill-defined goal state (Dörner, 1976; Funke, 2003). For example, technical engineers in renewable energies are nowadays in demand every time an organization faces the encounter of complex and multidisciplinary issues in a rapidly developing field. More specifically, strategies of environment protection go hand in hand with the continuous development of new technology and its processing. A lack of knowledge about the functioning of only one component can be considered a barrier that makes ecological strategies deficient.

With regard to solving problems, Newell and Simon's (1972) theory of human problem solving is the most general conception and can be applied on problems of real-world complexity. According to these authors, the main components of problem solving are a *problem space* or internal representation of a solver, who does not immediately know what series of actions to perform, and the solver's search for a strategy to tackle the problem (i.e. overcome the barriers).In complex environments, such as the initial steps of entrepreneurship, where the distribution of information is not perfect across people (Kirzner, 1997), only those entrepreneurs who *do* possess relevant information within their problem space eventually know, what series of actions to perform to tackle problems around a future product. For example, advances in innovative technologies, such as fuel-efficient hybrid vehicles, enable the producer to release the product earlier on the market than competitors who lack relevant knowledge. In the last decade, this was seen in the sector of hybrid automobiles, which has long been dominated by only one brand that employed research and development teams of individuals with superior internal representations about how to overcome barriers of technological short-comings of previous hybrid prototypes.

Once the problem-solver has chosen a strategy to select relevant information, this strategy can alter the initial problem space by uncovering new possible solutions and pathways of getting there or, on the downside, create unexpected

(sub-) problems. The latter case means the initial expectations about the problem structure are incorrect or incomplete (Dörner, 1989), and the interaction with the problem during the acquisition of knowledge discloses errors in the problem space (Funke, 2001).

The moments when the problem representation itself is challenged are called *corrective moments*. These corrective moments might portray roots for innovation. The Theory of Representational Change (Ohlsson, 1992) labels the trigger event of the corrective moments in the problem space impasse. It is a state in which the current internal problem representation is not sufficiently equipped with operators and information to solve the problem. An impasse provokes a change of the representation through an intensified search for information, a relaxation of constraints; in other words, removing restrictions and applying thinking outside the box, or a reinterpretation of the internal representation. *How* strategies are chosen and applied to *what* selection of information with regard to the limitations of human cognitive capacities is the topic of the next section.

The goal of each step during the process of solving a problem involves a decision for or against an action and its alternatives (Dörner, 1986). A variety of possible actions might occur at a later stage of the problem space, when strategies have been chosen and applied on a relevant selection of available information. At this point, the challenge lies more in configuring a parsimonious internal representation, which is considered a prerequisite for efficient decision-making (Klauer, 1993). For the creation of a parsimonious representation, constant changes to the selection of a vast amount of accessible information, relevant and irrelevant, have to be made. Only then the decision for an action in complex scenarios can be placed on solid ground.

Complex scenarios share features that distinguish them from problems in general as defined by Funke (2003). These features are the complexity of the structure, the dynamics of the system, the interconnections of the variables, the ambiguity of how to approach the task and the intransparency of the situation (Fischer et al., 2012).

At the stage of a parsimonious representation of a complex problem, the gateway to genuinely new and innovative solutions is wide open, but at the same time regulated by the limits set to human cognitive resources (Gigerenzer & Brighton, 2009). When the problem-solver resumes the exploration and acquires even more knowledge, a tension between the collection of information and need for its reduction is likely to occur. The problem-solver is in constant need of maintaining a parsimonious internal representation within the restrictions of his or her cognitive capacity. Distinguishing between goal-directed and irrelevant information is key to an efficiently composed problem space.

Newell and Simon (1972) suggest reducing complexity through an abstraction of the problem space and its later detailed retranslation in the situation at hand. This strategy illustrates how information is processed after only relevant information was selected for efficient problem solving.

Definition of CPS

Based on the previous section, we can say that complex problem situations are characterized by a combination of novelty, dynamics, intransparency and the need to engage in self-initiated learning behaviour (Warr & Bunce, 1995).

Buchner (in Frensch & Funke, 1995) gives this definition of CPS processes in the realm of cognitive science:

> The successful interaction with task environments that are dynamic (i.e. change as a function of user's intervention and/or as a function of time) and in which some, if not all, of the environment's regularities can only be revealed by successful exploration and integration of the information gained in that process. (Frensch & Funke, 1995, p. 14)

As a consequence, the relevant information needs to be actively generated in CPS tasks in order to successfully control a dynamic, previously unknown system. Building on Buchner (in Frensch & Funke, 1995), Greiff, Holt, and Funke (2013) describe the individual skill set required to solve a problem:

> Finding out how the system under question works (i.e. exploration: finding a strategy to build up knowledge; i.e. a representation) and trying to move toward a given goal (i.e. control: applying the acquired knowledge to reach a certain goal; i.e. to solve the problem). (Greiff et al., 2013, p. 77)

It follows that the two main processes are knowledge acquisition leading to a representation of the problem space (e.g. Klahr & Dunbar, 1988) and knowledge application, which, if appropriate, provides a solution of the problem (e.g. Novick & Bassok, 2005).

The process of CPS

Portraying CPS as (a) knowledge acquisition and (b) knowledge application (Leutner, Wirth, Klieme, & Funke, 2005) contributes to an understanding of CPS as a process (Fischer et al., 2012). This process usually starts in (a) knowledge acquisition, with (1) *information generation* in an intransparent situation with the most ecologically rational strategy at hand, continues with (2) *information reduction* in order to keep a set of relevant information, leading to an (3) actionable *internal representation*, which allows (b) knowledge application through (4) *decision-making* on the basis of an abstraction in the problem space and (5) an *evaluation* of the solution amongst many alternatives and against the backdrop of interfering and/or ill-defined goals (Fischer et al., 2012).

Assessment of CPS

The empirical realization of the process of CPS can be handled with the help of computer-based microworlds. The scenarios allow for the simulation of complex problems (e.g. Greiff, Wustenberg, & Funke, 2012) and have been constantly refined in the last decades. The most recent scenarios are based on multiple complex systems (Greiff et al., 2013). The multiple complex systems framework consists of an entire battery of relatively short CPS tasks with varying difficulties and semantics. MicroFIN is a representative for multiple complex systems (see

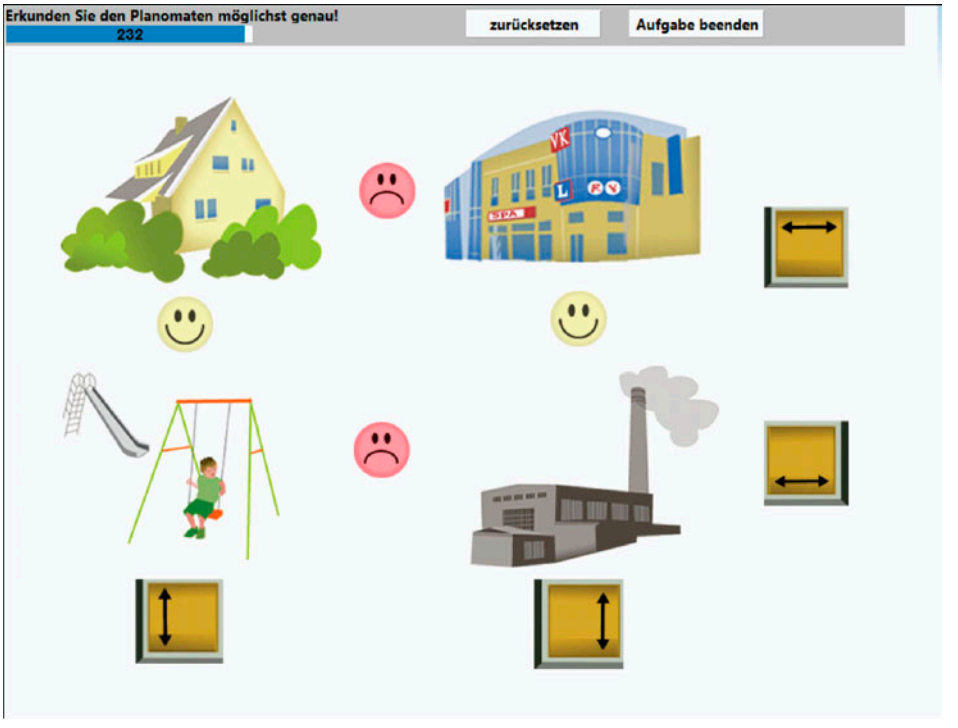

Figure 1. Screenshot of the MicroFIN item 'Planomat'. Problem-solvers have to balance the interests of various stakeholders in a city by way of alterations of the urban landscape. Along the bottom and the right side: the keys for altering the location of the interest groups. In principle, two stakeholders change places when triggered. On the right side: a city mall and a factory. On the left side: a family home and a playground. Between these stakeholders, smileys indicate the atmosphere. The problem-solver has to improve the atmosphere by finding an optimal set-up

figure 1 and Greiff et al., 2012). The following results were, without exception, assessed with the multiple complex systems approach.

The computer-based microworlds, as exemplified in Figure 1, allow for detailed task analyses (e.g. the detection of an assumed two step-process of knowledge acquisition and knowledge application by analysing the pattern of interaction with the task).

Conceptual ties and distinctions

The elaboration on OIC and CPS puts several points of comparison forward. In order to disentangle the ties and distinctions between OIC and CPS on a conceptual level, these points of comparison will be discussed in separate sections. We will increasingly discuss on a more detailed level the ties and distinctions between OIC and CPS in the context of entrepreneurship: the common ground of problems and opportunities; goals of opportunity identification and CPS; ties

and distinctions between competence domain and skills; prerequisites of OIC; and process models of opportunities and CPS. To conclude, we will discuss to what degree the two different fields of research can contribute to one another.

What is the common ground between problems and opportunities?

In colloquial contexts, problems have a negative connotation. However, in the context of entrepreneurship, a problem is defined as a challenge. According to Mayer (2003), a problem occurs whenever a goal state needs to be achieved. A problem can start at any given state, and there is no routine strategy of solution available. Recall that *complex* problems are characterized by a complex structure, dynamics of the system, interconnection of variables, ambiguity of how to approach a task and intransparency of a situation (Fischer et al., 2012). Especially when it comes to *complex* problem solving, the barriers to reach an intended goal state are hard to overcome. Despite the complexity, entrepreneurs feel challenged by such situations and do not necessarily experience them as problems.

In summary, based on the definition of complex problems in light of the entrepreneurship research field, complex problems consist of a given situation, and a goal state with barriers in between. We argue that opportunities emerge at the moment that an individual identifies a complex problem situation as being an entrepreneurial challenge, and comes up with a solution to fill the gap between the given, complex situation and the desired goal state.

Comparison of the outcomes of the opportunity and problem solving processes

As mentioned before, opportunity identification starts when individuals come up with business ideas (Wood & McKinley, 2010). Some ideas objectify, after a process of evaluation, into an opportunity. Enactment of the opportunity might lead to new value creation: the successful exploitation of ideas into new products, processes, practices or services (Shane & Venkataraman, 2000).

Problem solving, in general, is directed towards making decisions and solving problems within the limits of cognitive capacities (Gigerenzer & Brighton, 2009). Referring to Dunbar (1998), we can say that problem solving is about the successful search of a strategy to make something work or control a system in an efficient way.

Although the opportunity and CPS models aspire somewhat different outcomes, they do share core principles. Sarasvathy et al. (2010) notice that 'we could model an entrepreneurial opportunity as a function, or a process or a set of decisions' (p. 79). Here, the overarching opportunity process shares the core principle of the problem solving process, as a set of decisions is necessary to accomplish the desired outcomes of both processes.

CPS is a skill, OIC a competence domain

Throughout this paper, CPS is defined as a skill and OIC as a competence domain. The relation between a skill and a competence domain will be discussed in this section.

An individual is competent when he or she acts responsibly and effectively based on given standards of performance. Although the concept remains subject of debate, recent notions of competencies define competencies as integrated clusters of knowledge, skills and attitudes functioning within a specific position and context (Mulder, 2014). OIC is clearly related to the entrepreneurial role of owner-managers or employees (e.g. next to their role as manager, leader, engineer or craftsmen). Moreover, research shows that sector-specific knowledge is extremely important in OIC (Shane, 2000). For instance, a builder is less prone to identify an opportunity in the food sector than a butcher.

CPS is positioned as a transversal, domain unspecific skill (i.e. a skill that spans multiple domains) (Wüstenberg et al., 2012). The main difference between CPS and OIC here is that in OIC, the knowledge and attitude component are a tangible part of the competence domain next to skills. For instance, domain-specific prior knowledge and self-efficacy (as an attitude) explain OIC in a significant degree (Wang et al., 2013).

What are prerequisites of OIC?

Now that we have discussed the roots of problems, goals of opportunity identification and CPS, and the difference between competence domains and skills, we are interested in the following question: What components of CPS trigger OIC?

Entrepreneurial alertness is an important motive of individuals for identifying opportunities. Recall from the section on OIC that individuals with high alertness identify opportunities quickly as they have a critical attitude towards the market environment, and are able to estimate accurately the potential of a situation (Gaglio & Katz, 2001). Wood and McKinley (2010) stress that it is necessary to build a shared understanding of the future in order to reach consensus with stakeholders. Also, Dimov (2007a) emphasizes that ideas begin as abstract representations of an imagined, future reality.

On the basis of the theory about entrepreneurial alertness, it is relevant to investigate what sources contribute to higher alertness. According to Funke (2001), problem-solvers actively acquire knowledge based on the assumption that information around them is incomplete or false (Dörner, 1989). Gaglio and Katz (2001) mention that 'an alertness schema includes a dynamic that induces scepticism about information perceived and that questions, if not challenges, the initial frame of reference' (p. 101). In accordance with the theories of OIC and CPS, alert individuals reveal a higher eagerness to challenge information. Therefore, we argue that the individuals who question whether information around them is incomplete or false have high entrepreneurial alertness. This suggests that effective problem-solvers and innovators share the ability to search for relevant, complete information, and that both have high alertness for the identification of opportunities.

Next to entrepreneurial alertness, there are also other factors that trigger OIC. For instance, the perception of industrial environmental opportunities relates to the opportunities for new product and technological innovation in the environment of an organization (Wang et al., 2013). Factors more closely related to the individual are, for instance, prior knowledge, social networks, self-efficacy, flexibility, risk-taking, need for achievement and locus of control (Rauch &

Frese, 2007). As the results of the research of Wang et al. (2013) show, the perception of industrial environmental opportunities, social networks, self-efficacy and prior knowledge explain 35% variance of OIC. OIC research should point out whether these factors explain OIC to a higher, lower or equal extent compared to CPS.

Ties and distinctions between the process models of opportunities and CPS

The first phase of the opportunity production process includes opportunity objectification; in a complex problem, the CPS process of knowledge acquisition enables problem solving. The opportunity process starts when an individual has an idea: an imagined, abstract representation of the future (Dimov, 2007a; Wood & McKinley, 2010). In CPS, the problem-solver builds an actionable problem space filled with relevant information through the ongoing acquisition of knowledge. We consider this actionable problem space to be a prerequisite for the development of the abstract representation of the future.

An important distinction between OIC and CPS is that in CPS, the problem situation and the desired goal state are given from the start (Dörner, 1976). However, opportunity objectification starts with a rudimentary idea (Dimov, 2007a). The further exploration of the idea might provide the set-up for a complex problem situation. This is only the case if the further exploration of the idea leads to any (complex) problems. If not, CPS is not involved in the opportunity process and does not predict individual's performance in major ways. However, if an idea provides the set-up for a complex problem situation, the hypothesis would be that further development of the idea into a genuine opportunity is influenced by CPS.

The second phase includes opportunity enactment and knowledge application. Recall that opportunity enactment means that an individual shares the opportunity with relevant stakeholders and negotiates about the potential of it in order to refine the opportunity (Wood & McKinley, 2010). From the perspective of the cognitive field, it is especially the corrective moments which explain the process of opportunity enactment. As mentioned before, corrective moments challenge the idea (or problem) representation of the problem-solver (Ohlsson, 1992). Corrective moments occur when new information contradicts the existing problem space. The individual might adjust the idea representation based on these corrective moments or, from an entrepreneurship perspective, based on the negotiation with relevant stakeholders.

Conclusion and future research agenda

To get the most out of newly emerging, flexible, adaptive work environments present in daily working life, individuals need to be able to identify high-potential opportunities. The 'ability to identify available opportunities' (EC, 2006, p. 17) is even acknowledged as one of the key competencies for lifelong learning. Since some authors suggest that CPS might contribute to a better understanding of opportunity identification (Hsieh et al., 2007; Stevenson & Jarillo, 1990), we elaborated on the relation between OIC and CPS from a conceptual point of view. The cognitive and entrepreneurship research fields show several conceptual

connections which lead us to the conclusion that CPS might explain variance of OIC, and hereby might contribute to a better understanding of the initial steps of entrepreneurship.

In summary, entrepreneurial problem-solvers feel challenged to overcome complex problems, which they experience as an entrepreneurial challenge. The outcome of the opportunity process (i.e. value creation) slightly differs from the outcome of the CPS process (i.e. solving a complex problem). Nonetheless, in both processes, individuals aim to find successful strategies and to make the right decisions (Dunbar, 1998; Sarasvathy et al., 2010). When considering CPS as a skill, and OIC as a competence domain, we argued that in OIC, the knowledge and attitude component are more tangibly present. Furthermore, effective problem-solvers, entrepreneurs and intrapreneurs seem to share a critical attitude towards their environment, an ability to search for complete information and a high alertness towards the identification of opportunities (Dörner, 1989; Kirzner, 1997). If the identification of a first, rudimentary idea provides the set-up for a complex problem situation, CPS is relevant for the further objectification of the idea into an opportunity and the development of the opportunity into a concrete prototype, plan, format and so on (i.e. opportunity enactment). In opportunity enactment, the opportunity process involves so many complex and ambiguous elements (Pannekoek et al., 2005) that CPS could play a role in many different aspects of entrepreneurship that are to be defined in future research. In conclusion, we believe that the entrepreneurship and cognitive literature can benefit from one another on a conceptual level, and that an empirical investigation of the relation between OIC and CPS could contribute to a more thorough understanding of the initial steps of the entrepreneurial process. This conclusion is in line with earlier research, in which the cognitive research field also offered concepts and techniques that enrich the entrepreneurship research field (Mitchell et al., 2002).

Our conceptual exploration leads us to the assumption that CPS might be a reliable predictor of OIC. Therefore, for future research, we recommend empirical exploration of the relation between OIC and CPS, and to which degree CPS can be regarded as a predictor of OIC. Since the CPS test has proven to be a valid, reliable assessment within an educational context, and there is no valid and reliable assessment available for OIC yet, employers could measure CPS and even gain an impression of the opportunity capabilities of employees. Although research on CPS was commonly focused on the school context, the first empirical evidence that CPS is relevant within the work context as well is presented by (amongst others) Danner and colleagues (2011), and Kersting (2001), who point out that CPS predicts supervisor performance ratings. If empirical research supports that CPS is a reliable predictor of OIC, the relevance of CPS tests within a work context becomes even clearer. Also, this would provide more solid ground for OIC and strengthen OIC as a unique competence domain. In addition, in order to develop a complete model of the initial steps of entrepreneurship, future empirical research should include prior knowledge and other variables that might explain variance in OIC, such as social networks, divergent thinking skills and personality traits (Kirzner, 1997). Those variables might have a moderating or even mediating effect on the relation between CPS and OIC.

For empirical research purposes, we suggest measuring OIC by confronting respondents with a problem case and asking them to enumerate as many ideas

as possible. This assessment is in line with the core principles of the subjective basis of OIC: individuals have to construct ideas in interaction with the environment (i.e. the problem case, compare Fletcher, 2006). When comparing OIC and CPS in future research, it is important to control for differences in assessment approach: the OIC assessment consists of authentic, entrepreneurial tasks, while the CPS assessment consists of tasks derived from daily life. To further advance the notion of entrepreneurial competencies, OIC could be linked to personal, professional and business outcomes, such as innovation or career success. Empirical research could be organized among professionals of several fields of expertise, such as students, self-employed people and workers. As a start, the relation between OIC and CPS could be explored among students as they are the professionals of the future.

In conclusion, we believe that CPS might predict OIC to a considerable degree. The empirical examination of this relation could contribute to a deeper understanding of the emergence of entrepreneurial opportunities within recently founded and more mature organizations; this is desirable because entrepreneurship is necessary for generating high-potential start-ups and for maintaining competitive advantage (Lumpkin & Dess, 1996). Moreover, we believe that CPS contributes to understanding how individuals can adapt to the transformations related to entrepreneurship at the workplace, as referred to in the explanation of this special issue. The notion of lifelong learning is closely related to the fast-changing work environment, in which being able to deal with entrepreneurial challenges has become a core task. The conclusion of this manuscript supports the belief that CPS plays a role in dealing with those entrepreneurial challenges, and therefore we would argue that an extension of the exploration of CPS from a lifelong learning perspective is highly relevant. In summary, our analysis of the research fields of OIC and CPS strives to contribute to solving one of the greatest intellectual puzzles of our time to create new value in our society (cf. Sarasvathy et al., 2010).

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the FP-7 research project LLLight'in'Europe of the European Union [Grant number 290683].

References

Amores, J. E., & Bosma, N. (2014). *Global entrepreneurship monitor 2013 global report* [PDF]. Retrieved from http://www.gemconsortium.org/docs/3106/gem-2013-global-report

Autor, D. H., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *The Quarterly Journal of Economics, 118*, 1279–1333. doi:10.3386/w8337

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2012). Defining twenty-first century skills. In P. Griffin, B. McGaw, & E. Care (Eds.), *Assessment and teaching of 21st century skills* (pp. 17–66). Dordrecht: Springer, Netherlands.

Chandler, G. N., & Jansen, E. (1992). The founder's self-assessed competence and venture performance. *Journal of Business Venturing, 7*, 223–236. doi:10.1016/0883-9026(92)90028-P

Companys, Y. E., & McMullen, J. S. (2007). Strategic entrepreneurs at work: The nature, discovery, and exploitation of entrepreneurial opportunities. *Small Business Economics, 28*, 301–322. doi:10.1007/s11187-006-9034-x

Corbett, A. C. (2007). Learning asymmetries and the discovery of entrepreneurial opportunities. *Journal of Business Venturing, 22*, 97–118. doi:10.1016/j.jbusvent.2005.10.001

Danner, D., Hagemann, D., Holt, D. V., Hager, M., Schankin, A., Wüstenberg, S., & Funke, J. (2011). Measuring performance in dynamic decision making. *Journal of Individual Differences, 32*, 225–233. doi:10.1027/1614-0001/a000055

DeTienne, D. R., & Chandler, G. N. (2004). Opportunity identification and its role in the entrepreneurial classroom: A pedagogical approach and empirical test. *Academy of Management Learning and Education, 3*, 242–257. doi:10.5465/AMLE.2004.14242103

Dimov, D. (2007a). Beyond the single-person, single-insight attribution in understanding entrepreneurial opportunities. *Entrepreneurship Theory and Practice, 31*, 713–731. doi:10.1111/j.1540-6520.2007.00196.x

Dimov, D. (2007b). From opportunity insight to opportunity intention: The importance of person-situation learning match. *Entrepreneurship Theory and Practice, 31*, 561–583. doi:10.1111/j.1540-6520.2007.00188.x

Dörner, D. (1976). *Problemlösen als Informationsverarbeitung* [Problem solving as information processing]. Stuttgart: Kohlhammer.

Dörner, D. (1986). Diagnostik der operativen Intelligenz [Assessment of operative intelligence]. *Diagnostica, 32*, 290–308.

Dörner, D. (1989). *Die Logik des Misslingens. Strategisches Denken in komplexen Situationen* [Logic of failure. Strategic thinking in complex situations]. Hamburg: Rowohlt.

Du Chatenier, E., Verstegen, J. A. A. M., Biemans, H. J. A., Mulder, M., & Omta, O. S. W. F. (2010). Identification of competencies for professionals in open innovation teams. *R&D Management, 40*, 271–280. doi:10.1111/j.1467-9310.2010.00590.x

Dunbar, K. (1998). Problem solving. In W. Bechtel & G. Graham (Eds.), *A companion to cognitive science* (pp. 289–298). London: Blackwell.

Dutta, D. K., & Crossan, M. M. (2005). The nature of entrepreneurial opportunities: Understanding the process using the 4I organizational learning framework. *Entrepreneurship Theory and Practice, 29*, 425–449. doi:10.1111/j.1540-6520.2005.00092.x

European Parliament and the Council of the European Union. (2006). *Key competences for lifelong learning* (Report No. L394). Retrieved from *Official Journal of the European Union*, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006H0962&from=EN

Fischer, A., Greiff, S., & Funke, J. (2012). The process of solving complex problems. *The Journal of Problem Solving, 4*, 19–42. doi:10.7771/1932-6246.1118

Fletcher, D. E. (2006). Entrepreneurial processes and the social construction of opportunity. *Entrepreneurship & Regional Development, 18*, 421–440. doi:10.1080/08985620600861105

Frensch, P. A., & Funke, J. (Eds.). (1995). *Complex problem solving: The European perspective*. Hillsdale, NJ: L. Erlbaum Associates.

Funke, J. (2001). Dynamic systems as tools for analysing human judgement. *Thinking & Reasoning, 7*, 69–89. doi:10.1080/13546780042000046

Funke, J. (2003). *Problemlösendes Denken* [Problem solving thinking]. Stuttgart: Kohl- hammer.

Gaglio, C. M., & Katz, J. A. (2001). The psychological basis of opportunity identification: Entrepreneurial alertness. *Small Business Economics, 16*, 95–111. doi:10.1023/A:1011132102464

Gielnik, M. M., Frese, M., Graf, J. M., & Kampschulte, A. (2011). Creativity in the opportunity identification process and the moderating effect of diversity of information. *Journal of Business Venturing, 27*, 559–576. doi:10.1016/j.jbusvent.2011.10.003

Gigerenzer, G., & Brighton, H. (2009). Homo heuristicus: Why biased minds make better inferences. *Topics in Cognitive Science, 1*, 107–143. doi:10.1111/j.1756-8765.2008.01006.x

Greiff, S., Holt, D. V., & Funke, J. (2013). Perspectives on problem solving in educational assessment: Analytical, interactive, and collaborative problem solving. *Journal of Problem Solving, 5*, 71–91. Retrieved from http://cogprints.org/9041/

Greiff, S., Wustenberg, S., & Funke, J. (2012). Dynamic problem solving: A new assessment perspective. *Applied Psychological Measurement, 36*, 189–213. doi:10.1177/0146621612439620

Guilford, J. P. (1981). Factors that aid and hinder creativity. In J. C. Gowan, J. Khatena, & E. P. Torance (Eds.), *Creativity: Its educational implication* (pp. 106–123). Dubuque, IA: Kendall Hunt.

Hornsby, J. S., Kuratko, D. F., Shepherd, D. A., & Bott, J. P. (2009). Managers' corporate entrepreneurial actions: Examining perception and position. *Journal of Business Venturing, 24*, 236–247. doi:10.1016/j.jbusvent.2008.03.002

Hsieh, C., Nickerson, J. A., & Zenger, T. R. (2007). Opportunity discovery, problem solving and a theory of the entrepreneurial firm. *Journal of Management Studies, 7*, 1255–1277. doi:10.1111/j.1467-6486.2007.00725.x

Ireland, R. D., Hitt, M. A., Camp, M., & Sexton, D. L. (2001). Integrating entrepreneurship and strategic management actions to create firm wealth. *Academic Management Perspective, 15*, 49–63. doi: 10.5465/AME.2001.4251393

Kersting, M. (2001). ZurKonstrukt- und Kriteriumsvalidität von Problemlö seszenarien anhand der Vorhersage von Vorgesetztenurteilen über die berufliche Bewährung [On construct and criterion validity of problem solving scenarios on the basis of the prediction of occupational success by supervisor ratings]. *Diagnostica, 47*, 67–76. doi:10.1026//0012-1924.47.2.67

Kirzner, I. M. (1997). Entrepreneurial discovery and the competitive market process: An austrian approach. *Journal of Economic Literature, 35*, 60–85. Retrieved from http://www.jstor.org.ezproxy.library.wur.nl/stable/2729693

Klahr, D., & Dunbar, K. (1988). Dual space search during scientific reasoning. *Cognitive Science, 12*, 1–48. doi:10.1016/0364-0213(88)90007-9

Klauer, K. C. (1993). *Belastung und entlastung beim problemlösen. Eine theorie des deklarativen veeinfachens* [Demand and release in problem solving. A theory of declarative simplification]. Göttingen: Hogrefe.

Leutner, D., Wirth, J., Klieme, E., & Funke, J. (2005). Ansätze zur Operationalisierung und deren Erprobung im Feldtestzu PISA 2000 [Attempts of operationalization and its proving in the field test of PISA 2010]. *Problemlösekompetenz von Schülerinnen und Schülern*, 21–36. Retrieved from http://archiv.ub.uni-heidelberg.de/volltextserver/8253/

Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *The Academy of Management Review, 21*, 135–172. doi:10.5465/AMR.1996.9602161568

Mayer, R. E. (2003). *Learning and instruction*. Upper Saddle River, NJ: Prentice Hall.

Mitchell, R. K., Busenitz, L., Lant, T., McDougall, P. P., Morse, E. A., & Smith, J. B. (2002). Toward a theory of entrepreneurial cognition: Rethinking the people side of entrepreneurship research. *Entrepreneurship Theory and Practice, 27*, 93–104. doi:10.1111/1540-8520.00001

Mulder, M. (2014). Conceptions of professional competence. In S. Billett, C. Harteis, & H. Gruber (Eds.), *International handbook on research into professional and practice-based learning* (pp. 107–137). Dordrecht: Springer.

Newell, A., & Simon, H. A. (1972). *Human problem solving*. Englewood Cliffs, NJ: Prentice-Hall.

Nickerson, J. A., & Zenger, T. R. (2004). A knowledge-based theory of the firm – The problem solving perspective. *Organization Science, 15*, 617–632. doi:10.1287/orsc.1040.0093

Novick, L. R., & Bassok, M. (2005). Problem solving. In K. J. Holyoak & R. G. Morrison (Eds.), *The Cambridge handbook of thinking and reasoning* (pp. 413–432). New York, NY: Cambridge University Press.

OECD. (2010). *PISA 2012 field trial problem solving framework*. Retrieved from http://www.oecd.org/pisa/pisaproducts/46962005.pdf

Ohlsson, S. (1992). Information-processing explanations of insight and related phenomena. In M. Keane & K. Gilhooly (Eds.), *Advances in the psychology of thinking* (pp. 1–44). London: Harvester Wheatsheaf.

Pannekoek, L., van Kooten, O., Kemp, R., & Omta, S. W. F. (2005). Entrepreneurial innovation in chains and networks in Dutch greenhouse horticulture. *Journal on Chain and Network Science, 5*, 39–50. doi:10.3920/JCNS2005.x053

Rapelli, S. (2012). *European i-pros: A study*. Retrieved from http://www.efip.org/?s=european+i-pros%3A+a+study

Rauch, A., & Frese, M. (2007). Let's put the person back into entrepreneurship research: A meta-analysis on the relationship between business owners' personality traits, business creation, and success. *European Journal of Work and Organizational Psychology, 16*, 353–385. doi:10.1080/13594320701595438

Reid, S. E., & de Brentani, U. (2004). The fuzzy front end of new product development for discontinuous innovations: A theoretical model. *Journal of Product Innovation Management, 21*, 170–184. doi:10.1111/j.0737-6782.2004.00068.x

Renko, M., Shrader, R. C., & Simon, M. (2012). Perception of entrepreneurial opportunity: A general framework. *Management Decision, 50*, 1233–1251. doi:10.1108/00251741211246987

Sarasvathy, S. D., Drew, N., Velamuri, S. R., & Venkataraman, S. (2010). Three views of entrepreneurial opportunity. In Z. J. Acs & D. B. Audretsch (Eds.), *Handbook of entrepreneurship research* (pp. 77–96). Boston, MA: Springer.

Shane, S. (2000). Prior knowledge and the discovery of entrepreneurial opportunities. *Organization Science*, 11, 448–469. Retrieved from http://dx.doi.org.ezproxy.library.wur.nl/10.1287/orsc.11.4.448.14602

Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *The Academy of Management Review, 25*, 217–226. doi:10.5465/AMR.2000.2791611

Sharma, P., & Chrisman, S. J. J. (2007). Toward a reconciliation of the definitional issues in the field of corporate entrepreneurship. In A. Cuervo, D. Ribeiro, & S. Roig (Eds.), *Entrepreneurship: Concepts, theory and perspective* (pp. 83–103). Berlin: Springer.

Stevens, G. A., & Burley, J. (2003). Piloting the rocket of radical innovation. *Research Technology Management, 46,* 16–25.
Stevenson, H. H., & Jarillo, J. C. (1990). A paradigm of entrepreneurship: Entrepreneurial management. *Strategic Management Journal, 11*, 17–27. doi:10.1007/978-3-540-48543-8_7
Wang, Y. L., Ellinger, A. D., & Wu, Y. C. J. (2013). Entrepreneurial opportunity recognition: An empirical study of R&D personnel. *Management Decision, 51*, 248–266. doi:10.1108/00251741311301803
Ward, T. B. (2004). Cognition, creativity, and entrepreneurship. *Journal of Business Venturing, 19*, 173–188. doi:10.1016/S0883-9026(03)00005-3
Warr, P., & Bunce, D. (1995). Trainee characteristics and the outcomes of open learning. *Personnel Psychology, 48*, 347–375. doi:10.1111/j.1744-6570.1995.tb01761.x
Wood, M. S., & McKinley, W. (2010). The production of entrepreneurial opportunity: A constructivist perspective. *Strategic Entrepreneurship Journal, 4*, 66–84. doi:10.1002/sej.83
Wüstenberg, S., Greiff, S., & Funke, J. (2012). Complex problem solving – More than reasoning? *Intelligence, 40*, 1–14. doi:10.1016/j.intell.2011.11.003