Chapter 2
A Pragmatist Theory of Innovation

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Abstract In this chapter, I develop theoretical foundations for practice-based innovation from the *embodied cognition* school of thought in cognitive science and from the *pragmatist* line of thought in philosophy. From it, I derive the notion of *cognitive distance*. I use the resulting insights to discuss the well-known notions of *absorptive capacity* and *exploitation* and *exploration* from the innovation literature, and the way in which exploitation and exploration are connected. In the analysis I model practice in terms of the notion of a *script*. Cognitive difference ('distance') complicates but also enriches collaboration, and this positive effect is related to the notion of bridging *structural holes*. Among other things, the analysis yields an underpinning of the idea that application is not just a result of research but also a basis for ideas for research, in two-way traffic between theory and practice, and between research and application. The analysis also has implications for innovation policy, in particular for the currently popular principle of *focus and mass*.

2.1 Introduction

In innovation, what is, and what should be, the relation between theory and practice, between science and industry? In the traditional 'linear view' of innovation, science is autonomous and its results are carried into application in business. Since the 1990s, the innovation literature has shifted to a non-linear view, according to which a variety of factors, including not only science and technology but also design, marketing, organisation, training, and entrepreneurship, are parts of a wider innovation system in which feedback also travels from practice to theory, and there

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should be feedback from industry to academia. While this is the 'espoused theory', the actual 'theory in use' often still is one of a linear science and technology push. I propose that one reason for this is that our basic, tacit notions of knowledge favour the linear view, and that for a proper grasp of the non-linear view, we need to reconsider those basic notions.

We talk a lot about the 'knowledge economy', and in innovation, knowledge is central. We should, then, know what we are talking about, and rather than reinventing wheels, let us employ the insights from cognitive science that are available. The problem is that there are different schools of thought in cognition. I opt for the 'embodied cognition' school. I will show that it has deeper roots in philosophy, in the school of American Pragmatism. Hence I call my theory of innovation a pragmatist theory. The crux of it is that action is constitutive of knowledge, that ideas get transformed in their application, which leads to new ideas. The term *application* suggests that what is applied remains what it was, like brushing paint on a surface, while in fact application entails integration with other ideas and transformation of those ideas, depending on the conditions of application. Knowledge and the goals of action shift through action to the extent that one encounters obstacles and novel opportunities. An apt term for such form of action is the anthropologist Levy-Strauss' term *bricolage* (the French term used for 'do it yourself', which also has the connotation of 'muddling through'). This is a key feature of innovative, Schumpeterian entrepreneurship.

After sketching the fundamental ideas, I will use them to discuss and develop a number of concepts that play a role in innovation management and innovation policy.

2.2 Embodied Cognition

The embodied cognition school, in the work of Damasio (1995, 2003) and Lakoff and Johnson (1999), rejects the Cartesian separation of body and mind in the recognition of how cognition is rooted in largely unconscious bodily processes of perception, feelings, and emotions. As a result, cognition is a wide concept, including knowledge as well as feelings and normative evaluations.

The roots of cognition in the body and feelings allow the theory to connect with neural science and with social psychology. In neural science, it connects with the work of Edelman (1987, 1992), who proposed a 'neural Darwinism' where neural structures develop in analogy to evolution, with variety generation via connections between existing structures and selection via reinforcement of structures that generate conduct that is experienced as successful.

In social psychology, embodied cognition connects with the notion of mental framing and with decision heuristics, in which unconscious psychological mechanisms, emotions, and rational evaluation mix (see e.g. Bazerman 1998). Decision heuristics can be interpreted as making sense from a perspective of evolutionary psychology. While they may be substantively irrational by the standards of economic logic, taking into account survival conditions that require rapid perception,

interpretation, and response to opportunities and threats, they are adaptive and in that sense procedurally rational.

Cognition and action are situated. People develop repertoires of mental frames, forms of perception, and dispositions to interpretation, judgment, and action, and how selections and combinations from those repertoires are made depends on the situation. From the situation, people adopt cues that trigger mental frames and are assimilated into them to make sense. In this process, people attribute characteristics to situations and people according to mental schemas even when those are not observed. This yields prejudice, but is also functional in fast response and the use of experience.

2.3 Pragmatism

Embodied cognition also connects with the American school of pragmatic philosophy of James, Peirce, Dewey, G.H. Mead and related, more contemporary philosophers, such as Hans Joas (1996). This reference to pragmatism is tricky, since in everyday language pragmatism is misleadingly seen as a shedding of principles and ideals in a muddling through with compromises. Philosophical pragmatism holds that cognition, in a wide sense that includes normative judgments and goals, occurs on the basis of mental dispositions and categories that are developed in interaction with the physical and especially the social environment. Intelligence is internalised practice. Questions of truth soon lead to questions of workability. There is a cycle of interaction between, on the one hand, cognition and language and, on the other, action, in which knowledge and meaning are applied (or better: exercised) in action and there run into limitations and novel challenges that lead to an adaptation or transformation of knowledge and meaning.

For an elaboration of that in an earlier (Nooteboom 2000) and a more recent work (Nooteboom 2009), I have been inspired by the ideas from the developmental psychologist Jean Piaget about how intelligence develops in children. The gist of it is that in the process of assimilating experience into existing cognitive structures (*assimilation*) in different stages, those structures are transformed (*accommodation*). An important element here is that in novel applications (*generalisation*), existing knowledge and competence are subjected to novel challenges and opportunities that yield new insights into the limitations of existing competence and yield inspiration as to how they may be overcome. In the face of failure, one first tries out different options from existing repertoires of competence (*differentiation*), and if that does not suffice, one adopts elements from practices in the novel context that appear to succeed where one's own practice fails (*reciprocation*). This yields hybrid structures of old and new elements that allow one to try out new elements without yet surrendering the basic design or architecture, and to see what elements have promise, to find where in the structure the obstacles lie to the full realisation of their potential, which gives hints as to where to make more radical, architectural change, in *accommodation*. This, I propose, yields a theory of discovery. It connects very well with the pragmatic principle of exploring while engaging in application.

The pragmatic perspective has important implications for notions of rationality, uncertainty, knowledge, learning, innovation, entrepreneurial behaviour, and innovation policy, which I will elaborate on in this chapter. The economic doctrine of rational choice of means to achieve pre-established goals according to given preferences is fundamentally misleading. According to pragmatism, goals, means, and action interact. We do have goals, preferences, and largely subconscious dispositions to action, but they are revised as the result of discovery of means and of results of actions, especially when action encounters problems or new opportunities are found. This happens especially in innovation, but on a lower scale also in ordinary life. The dynamics of cognition and action is not an add-on to statics as the base case; it is the base case. Situations and institutions not only condition goal achievement but also are constitutive of goals.

Entrepreneurs engage in what Levy-Strauss called *bricolage*. They do have some initial view of where they want to go, but on the way they shift targets as they encounter new problems and opportunities. This has important implications for innovation management and innovation policy, as I will discuss.

Since goals, intentions, perceptions, and meanings become determinate and shift in interaction with other people, action and cognition are inherently social, and the methodological individualism of economic theory fails fundamentally.

Embodied cognition and pragmatism explain why collaboration is important for innovation. To elaborate on this, I will next discuss the notions of absorptive capacity and cognitive distance.

2.4 Absorptive and Expressive Capacity

The well-known notion of absorptive capacity requires a conceptual widening to encompass the wider notion of cognition: not only the *competence* side of substantive understanding but also the *governance* side of insight and empathy with respect to styles of thought and action, motives, survival conditions of a partner firm, and moral views and predilections (Nooteboom 2004). On the organisational level, it includes ways of communication and knowledge sharing, organisational memory, and cultural features concerning views and attitudes towards the outside world, in organisational 'cognitive focus' (Nooteboom 2009).

Absorptive capacity refers to the receiver side in communication and needs to be complemented by expressive capacity on the sender side, in the ability to be clear, to explain and to give clever examples and metaphors that trigger understanding. Together, wider absorptive capacity and expressive capacity yield a wider notion of collaborative capacity. In connection with the earlier text, absorption equals *assimilation*.

In terms of the earlier analysis, interaction between people is a source of new knowledge, because the attempt to fit knowledge into the absorptive capacity of the partner may be seen as *generalisation*. Next, misfits, through misunderstanding, yield an incentive to 'put it differently', through *differentiation,* and there are

perceived needs and opportunities to try and fit elements of knowledge from the one into the cognitive framework of the other, through *reciprocation*, yielding novel combinations. The process of learning is enhanced because people can help each other to *assimilate, differentiate,* and *reciprocate*.

2.5 Cognitive Distance

Cognitive construction on the basis of interaction with other people entails 'crossing cognitive distance': different people develop different cognitive structures along different life paths in different environments, and to collaborate one must cross that distance. Cognitive distance arises between different people, organisations, and scientific disciplines as well as between theory and practice. Cognitive distance entails difference in cognition in the narrow sense of knowledge but also difference in moral perceptions and views. This combination of the intellectual and the moral has the implication for the study of firms that we should combine perspectives of competence and governance (Nooteboom 2004), while in the literature on firms, they run in largely separate streams, in on the one hand studies of competence, learning, innovation, and the like, and on the other hand studies of collaboration and its governance, as in transaction cost economics.

In economics and society, cognitive distance results in both a problem and an opportunity. The problem is that to the extent that cognitive distance is greater, people understand each other more or less imperfectly, have different normative views and inclinations, and have less empathy, less ability to imagine themselves in the position of the other, which all limit ability to collaborate. The positive side of cognitive distance is that it provides an opportunity for learning and innovation. Hence, cognitive distance can be too small to generate novelty or too large to utilise its opportunities.

This may be modelled as follows. If we model the decline, with cognitive distance, of ability to collaborate as a downward sloping straight line, the increase of novelty potential as an upward sloping straight line, and performance of innovation by interaction as the mathematical product of the two, the result is an inverted U-shaped parabola. This yields the notion of 'optimal cognitive distance'. With this term, I do not wish to suggest that the optimum can be calculated prior to choice of partners, but rather that it is approximated by trial and error.

The optimum depends on how radical the innovation involved in the interaction is. If we adopt the well-known distinction between exploitation, defined as improvements within a basic design, set of principles, or architecture, and exploration as the breaking of such frames, in exploitation the marginal disutility of lack of understanding and agreement (slope of the downward sloping line) is relatively high, and the marginal utility of novelty (slope of the upward sloping line) is lower than in exploration, resulting in a lower optimal distance.

The optimum is not fixed in time. It depends, in particular, on the ability to collaborate at any level of cognitive distance, and this may increase as a function

of the accumulation of knowledge and experience in collaboration. That may be modelled as an upward shift of the downward sloping line that represents ability to collaborate as a function of cognitive distance. This causes optimal distance and innovative performance to increase (Nooteboom 2000). This shows how the development of ability to collaborate with people who think differently yields economic advantage. The idea of optimal cognitive distance and its shift on the basis of experience is tested empirically (econometrically) in a study of innovation in inter-firm alliances (Nooteboom et al. 2007).

2.6 Structural Holes

Collaborative relationships can last too long, leading to a reduction of cognitive distance as a result of knowledge sharing, to the point that they no longer have anything new to tell each other if the relationship is exclusive, i.e. excludes collaboration with other parties on the same subject. Thus, there is also an optimal duration for such relationships: long enough to bring cognitive distance down to an optimal level, but not beyond that, to too little distance. However, this principle is broken when the relationship is not exclusive, when both sides of the relationship also engage in other, non-overlapping partnerships, whereby both sides are rejuvenated with new knowledge from mutually unconnected outside partners. This, in fact, reflects the well-known principle of 'bridging structural holes' (Burt 1992). There is innovative potential in building a connection between previously unconnected communities (leaving a 'structural hole' between them). In this case, long-lasting connections (via the bridge) can maintain innovative potential.

2.7 Exploration and Exploitation

A well-known notion in the innovation literature is that of exploration and exploitation (March 1991). Exploitation refers to improvements within basic logics, designs, or architectures, while exploration entails their change. The distinction is related to that of incremental and radical innovation. In terms of the theory of discovery: *generalisation* and *differentiation* are exploitative, while *reciprocation* and *accommodation* are exploratory.

One of the greatest challenges to organisations and management is to somehow combine exploitation and exploration. The first is needed to survive in the short term and the second to survive in the long term, so one should be engaged in both. Exploitation is based on exploration, and exploration must somehow be inspired from the experience of exploitation. But how does one combine exploitation, which presupposes a given basic design logic, given structures of practice, with a given distribution of functions and roles, a shared purpose and clear, established ideas and standards, with exploration, which entails their change, with shifting roles

and meanings? This reflects both the need for the link between innovation and practice and the difficulty of it.

The theory of discovery sketched above gives part of the answer. It shows how in exploitation, by moving to a new area of application (*generalisation*), one can keep on exploiting while nevertheless setting out on a path of exploration through the stages of *differentiation, reciprocation,* and *accommodation*.

This sequence does not, however, solve the problem of how to combine exploitation and exploration at the same time and place. One solution to this is the well-known separation of production and R&D. The perennial problem there is that production people blame development people for not being conscious of problems and costs of production, while development people blame production people for being too conservative and missing out on new opportunities in the market or in technology. Exploration and exploitation require different mentalities that can be difficult to hold together in a single 'organisational focus'. A solution may then be to locate the two tasks in different organisations. We find this, for example, in the pharmaceutical industry, with small firms engaging in exploration and moving the outcomes on to exploitation in larger companies that can better deal with clinical testing and large-scale, efficient production and distribution.

In collaboration, optimal cognitive distance is greater for exploration, to generate more radically new 'novel combinations', than it is for exploitation, where the scope of novelty is less and the penalty for misfits and misunderstandings is larger. This was borne out in the empirical study of Nooteboom et al. (2007). There, exploration was defined and measured as innovation outside the technological profile of the firm and exploitation as inside it.

2.8 Scripts

The theory of discovery sketched earlier can be further clarified and made more tangible with the notion of scripts (Nooteboom 2000). A script is a graph of nodes connected by linkages. A script may be abstract, depicting the logical structure of an argument or theory in logical implication or causation. It may also represent a physical process, such as a production process, a service process, or a user process, with the nodes as component activities and the linkages indicating relations of succession in time and transfer of goods or information. These connections may indicate various forms of dependence (Thompson 1967): sequential dependence, where one activity feeds into the next; pooled interdependence, where different nodes derive inputs from a common source or contribute to a common output; or reciprocal interdependence, where they interact. Activities within nodes can themselves be represented as (sub)scripts, and the script as a whole may be inserted in a wider process (superscript). A classic example is a restaurant, with nodes of arrival, seating, ordering, serving, eating, paying, and leaving. The paying node may allow for alternatives of cash, check, debit card, or credit card, and each mode

of paying has its own subscript. The superscript is the higher system of supply to the shop, waste disposal, arrival, parking, and departure of customers, etc.

There are connected user and producer scripts. It is a well-known principle in marketing for producers to envisage the user scripts in which their product is to be inserted. Thus, a new device for a car is to be inserted in a driver script, a maintenance script, and a script for the production of the car. Acceptance of the innovation depends on how well it fits into existing user scripts. If the product requires an entirely new user script, its risk of rejection is high. If it does not fit into an efficient production script, then efficiency and cost are at risk.

Now the script concept can be used to clarify different concepts of innovation. Does the innovation entail a change in a single node or in the architecture of nodes? If it is a change of architecture, does it preserve existing nodes? An example is the innovation of a self-service restaurant from a service restaurant. With some internal changes, the nodes of arriving, seating, selecting food, ordering, eating, paying, and leaving are preserved, in the different order of arriving, selecting food, paying, seating, eating, and leaving. If the change concerns a single node, say the node for paying, does it change all alternatives or only one, such as abandoning payment by cheques due to the ubiquity of credit card ownership?

If the innovation changes a node, how wide are the repercussions for other nodes to maintain systemic integrity? Systems with many and densely and tightly connected nodes are more vulnerable to local change than a 'stand-alone' system with more-or-less isolated and weakly connected nodes. As a result, in a more loosely coupled, stand-alone system it is easier to combine exploration and exploitation within the same structure than in a densely, strongly coupled system. In the former, there is more room for local variation and experimentation without thereby jeopardising the integrity of the system.

The script notion can be used to clarify the theory of discovery, as follows. *Generalisation* now is insertion of a script into a new superscript. *Differentiation* is the selection of a new form of enacting a node from an existing repertoire (think again of the payment node in the restaurant script), or extension of such a repertoire. *Reciprocation* is adoption of a new node in an existing script. *Accommodation* is a re-arrangement of old and new nodes in a novel script. Exploitation preserves script structure, and exploration breaks it up.

2.9 3rd Spaces

In innovation policy, a hot topic is 'valorisation': how to put research to more productive use. Usually, the debate is limited to increasing the application of results from existing research or increasing the share of applied, contract research. The latter should not be taken too far, since fundamental research is of unpredictable value, and focusing only on short-term practical use would kill the goose that lays the golden eggs. However, from the present pragmatic perspective, application (exploitation) should also be a source of inspiration for fundamental research

(exploration). Application is just as much a test and source of inspiration as other empirical testing is.

So, in a recent (2008) advisory report to the government, produced by the Dutch Scientific Council for Government Policy (WRR), we proposed the institution of so-called 'third spaces' (see Nooteboom and Stam 2008). These are actual or virtual spaces where applied scholars from university and R&D staff from industry meet to conduct joint projects, such as developing new ideas and developing and testing prototypes. Here, scientists from academia have an opportunity to test their ideas and developers from industry get some time off to reflect on how things may be done differently, away from the short-term pressures in their firms. Two conditions need to be met for this to work. First, this activity must be seen as legitimate and as contributing to an academic career, next to peer-reviewed scientific publications. Conversely, industry should see this as a legitimate activity of staff, which also contributes to their careers in industry, and should be willing to contribute to the funding.

This kind of activity may be seen to resemble what is done at state-supported technological institutes in between academia and industry, but there is one big difference. Third spaces engage in temporary, project-based activities, lasting, say, four months, after which participants disperse again to their home environments. This facilitates variety and turnover of people and ideas, and prevents institutionalisation where technological institutes, after a while, start to compete with both universities and industry and present a barrier between them rather than facilitating interaction between them.

2.10 Focus and Mass?

Makers of innovation policy are tempted by the logic of 'focus and mass'. The argument is as follows. A country cannot excel in every field and must therefore focus on what it is exceptionally good at ('focus'), in designated 'key areas'. Also, research and development in a certain field should be concentrated, to avoid wasteful competition where different researchers at different locations are studying the same field ('mass').

The problem with focus is that current excellence in a field is not necessarily indicative of success in the future. In innovation, future success is inherently unpredictable. If it were predictable, it would no longer be innovation. Also, the most radical innovations tend to be 'competence destroying', in 'creative destruction'. Precisely because one is currently successful, one can get locked into exploitation and fail to get out into exploration, which therefore is typically conducted by outsiders and newcomers. Also, innovation by novel combinations typically occurs across the boundaries of current fields rather than within them. And, finally, innovation occurs everywhere, in every industry, and cannot be seen as locked up in any existing industries. An example is retailing, which has exhibited radical innovation, mostly in the use of bar codes that has revolutionised distribution, marketing,

and product development. Yet no one would designate retailing as a 'key sector', because it is not 'sexy'.

The problem with mass is that different, competing approaches to a given field increase variety, and that is good for innovation. This insight is highlighted in an evolutionary approach to innovation, on the basis of the three basic principles of evolution: variety generation, selection, and dissemination. Policy makers tend to adhere to an 'intelligent design' view of innovation policy that, in this area, is as misguided as it is in biology. The favourable view of mass is also based, implicitly, on an argument of economy of scale. Admittedly, some minimum efficient scale of research does apply in some cases. For a laboratory with large and expensive machinery and instruments, with corresponding maintenance, one needs a sufficient number of researchers for efficient utilisation. But in some cases, that can be taken care of by scientists traveling to the facility from abroad, as in the case of observatories on faraway mountains for astronomers, and the huge particle accelerator in Geneva for nuclear physicists. Also, it is not the number of scholars doing certain research at a certain location that counts, but the number of researchers that they interact with, from various locations in the world.

I do admit that there is waste in the R&D system, but it is of a different source. It lies in the fact that people from different disciplines conduct research from different perspectives without taking cognisance of each other's insights. If people knowingly compete, that is good, in my view, but if they unknowingly duplicate, it is not good. Economists talk about trust, for example, while ignoring insights from sociology and social psychology, and talk about 'behavioural economics' while ignoring other behavioural sciences. This has nothing to do with lack of mass, but with myopia.

Such myopia is frustrating for policy, since policy makers cannot afford to focus on one perspective while the phenomena they have to deal with present themselves with all their perspectives. Specialisation is good, but integration of perspectives should also be part of science, and not left as a puzzle for policy makers.

2.11 Conclusion

The arguments for practice-based innovation are not only practical but also philosophical, epistemological. To some, *practice-based innovation* sounds pragmatic in the derogatory sense of ignoring foundations and principles, allowing for ignorance, incoherence, or even inconsistency. However, there is a more respectable notion of pragmatism as a line of thought in philosophy, which recognises that application is part of a learning process where ideas change in their application and yield new ideas, so that application is part of discovery. Not only usefulness but also discovery requires application, to provide the exploitation that inspires exploration, as one moves from one application to another.

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