

The Psychology of Novelty-Seeking, Creativity and Innovation: Neurocognitive Aspects Within a Work-Psychological Perspective

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Curiosity is, in great and generous minds, the first passion and the last.

Samuel Johnson, 1751

Why are some people constantly on the move towards something new, while others feel comfortable with what there is? What motivates us to seek for the new? What helps us in finding it? What leads us to transform what we find into a product that is visible to others and expose us to their judgement? Research in psychology holds fascinating insights concerning the above questions. Surprisingly, neurocognitive and neuropsychological insights that could lead to a better understanding of the processes of novelty-seeking and novelty-finding, have received little attention in the creativity and innovation literature. Especially for those working in professions where the generation of the new is the core business, it would be highly relevant to know more about those biological parameters of novelty generation and especially how they make human beings behave in professional environments. Such knowledge can not only improve human resource management in creative work settings, but also help creative professionals to better understand and manage themselves. The Novelty Generation Model (NGM) introduced in this article offers a new perspective.

A key feature of finding something new and being creative is the ability to think in ways that differ from established lines of thought, for instance by associating previously unrelated elements with each other. From a neuropsychological point of view, highly novelty-seeking individuals and above-average novelty-finders can be identified by particular sets of neurocognitive traits and styles of thinking that also require specific work conditions. In this article, neurocognitive and neuropsychological findings that have remained unused in the creativity and innovation literature are given a place next to the personality and social psychological insights that are already established. Based hereupon, novelty-seeking, creativity and innovative performance are proposed as key components of the novelty generation process in a new model: the Novelty Generation Model (NGM). Specific motivational states, neurocognitive and personality traits as well as social environments affect the three related components of

novelty-seeking, creativity and innovative performance. Distinguishing between these components with their different inputs allows researchers and practitioners to identify more accurately the critical switches where dysfunctions may occur in the process of generating a novelty, dysfunctions that may not only be of psychological, but also economic consequence. Awareness of these potential dysfunctions can bring about far more fine-grained and adequate measures of support for each of these three processes in creative work settings.

The article concludes with practical applications that illustrate the value of the NGM and its related knowledge in professional environments.

Neurocognitive Aspects of the Novelty Generation Process

Within the genetic, neurocognitive and neuropsychological research fields there are a

number of potential starting points for opening up this body of knowledge for researchers and practitioners interested in a better understanding of the novelty generation process. First of all, it has been discovered that *novelty-seeking behaviour* is related to individual differences in specific neurotransmitter activity in the brain. It has been argued that the novelty-seeking personality is modulated by the transmission of the neurotransmitter dopamine (Cloninger, 1994). Specific genes determining this transmission (DRD4, DRD2-A2, SLC6A3-9) have been labelled 'novelty-seeking genes' (Benjamin et al., 1996; Ebstein et al., 1996; Lerman, et al., 1999; Prolo & Licinio, 2002). Highly novelty-seeking individuals are at a higher risk of falling prey to particular patterns of psychological dysfunctioning, most notably attention deficits and addictive behaviours (Cloninger et al., 1994) that may also influence their social interaction patterns in professional environments. The link between an individual's novelty-seeking personality and his/her creativity crucially depends on the degree to which an individual is a novelty-seeker, mainly related to the individual's dopamine levels, and requires the matching forms of support by those who seek to manage their creative process (Schweizer, 2004).

Being a 'creative genius' has been argued to emerge from configurations of multiple genes all interacting with each other (Lykken, McGue & Tellegen, 1992). Creativity can be seen as a particular kind of response style (MacKinnon, 1962) and activities of problem-seeking, problem-finding and problem-solving (Getzels & Csikszentmihaly, 1975; Kasperson, 1978). Research on creative cognition can best 'identify traditional areas in cognitive psychology and cognitive science that could be explored in a more creative way, such as mental imagery, concept formation, categorization, memory retrieval, analogical reasoning, and problem-solving' (Finke, Ward & Smith, 1992, p. 189). In order to find something new, focused attention is necessary, but also the defocusing of attention: creative thinking involves intuitive leaps, which are facilitated by states of unfocused relaxation, low levels of cortical and frontal-lobe activation and more right than left hemisphere activation (Martindale, 1999). Also, associative capabilities (Mednick, 1962), especially between remotely associated items, have long been identified as a key cognitive marker of creativity. Latent inhibition (LI) is another key to creative cognition: low latent inhibition, referring to a tendency to have – put simply – many things on your mind at the same time, is linked with higher creative achievement (Carson, Peterson & Higgins, 2003). Low LI

individuals continuously experience a higher number of stimuli simultaneously because they ignore less than those with average or high LI scores. This may also related to the concept of lateral thinking suggested as an aspect of creativity, that is, seeing things broadly and from various perspectives (DeBono, 1992).

Neurocognitive characteristics of creative processes are highly under-researched but gradually gaining ground in brain research (Schweizer et al., 2006). Understanding such neurocognitive parameters in the creative process means learning more about why people behave the way they behave and how one can best deal with them when it comes to dysfunctional behaviours in the work environment. The application of such knowledge to human resource management is a new stream of creativity research at the borders of the organizational sciences, neuropsychology and cognitive neuroscience. Crossing these interdisciplinary borders forms a major challenge.

Personality and Social Psychological Views on Creativity and Innovation

How can the above type of knowledge be linked to personality psychology and social psychological insights that have a more established place in the creativity literature? Personality traits that are widely accepted as supporting creativity are, for instance, judgemental autonomy, self-confidence, risk-taking, non-conformity, independence and a critical attitude towards norms (Amabile, 1983a; Eysenck, 1993; Feist, 1998; Kasof, 1995; MacKinnon, 1965). But there is also some research in the personality literature related to novelty and curiosity that comes closer to the neurocognitive tendencies discussed above. For instance, Berlyne in the 1960s distinguished various types of novelty and different forms of exploratory behaviour, as well as *diversive curiosity*, which includes the seeking of novelty or complexity driven by a state of boredom, and *epistemic curiosity*, defined as driven by the need to resolve uncertainty concerning perceptual or symbolic representation (Berlyne, 1960). In the 1970s, Pearson developed his so-called novelty-experiencing scales (NES) around the construct *tendency towards novelty* as a behaviour of approaching novelty contrary to avoiding novelty (Pearson, 1970). In the 1990s a concept called novelty-seeking is included in the Temperament and Character Inventory (TCI), where *novelty-seeking* is defined as a temperament factor that is 'viewed as a heritable bias in the activation or initiation of behavior such as frequent

exploratory activity in response to novelty' which belongs to 'automatic, pre-conceptual responses to perceptual stimuli presumably reflecting heritable biases in information processing' (Cloninger, Svrakic & Przybeck, 1993, p. 977). Similar, and related to Cloninger's novelty-seeking scale, are Zuckerman's sensation-seeking scale (Zuckerman & Cloninger, 1996) and the Openness to Experience dimension in Costa and McCrae's Five Factor Model (Costa & McCrae, 1992). Within Zuckerman's *sensation seeking* trait two dimensions are of particular interest: *experience seeking* (ES), referring to 'the seeking of novel sensations and experiences through the mind and senses, as in arousing music, art, and travel, and through social nonconformity, as in association with groups on the fringes of conventional society (e.g. artists)' and *boredom susceptibility* (BS), which 'represents an intolerance for repetitive experience of any kind, including routine work, and boring people' (Zuckerman, 1994, pp. 27–32). In the NEO-PI-R (a measure of Costa and McCrae's five-factor model of personality) individuals scoring high on the 'openness to experience' factor have been assigned personality facets such as curious, creative, original and imaginative (Costa & McCrae, 1992). Items included in this openness dimension are 'values intellectual matters', 'rebellious', 'non-conforming' versus the non-openness end of the continuum including 'sex-role stereotyped behaviour', 'favours conservative values', 'uncomfortable with complexities', 'judges in conventional terms' (p. 657). Openness has been found to be related to trait creativity (McCrae, 1987), creative personality (Feist, 1999), creative achievement (King, Walker & Broyles, 1996) and cultural innovation (McCrae, 1996). Also similar to novelty seeking is the construct 'need for cognition' (NC) (Cacioppo & Petty, 1982). Individuals scoring high on the need for cognition 'naturally tend to seek, acquire, think about, and reflect back on information to make sense of stimuli, relationships, and events in their world' – whereas those scoring low on need for cognition are 'more likely to rely on others (e.g. celebrities and experts), cognitive heuristics, or social comparison processes' (Cacioppo et al., 1996, p. 198).

From the pool of social psychological theories, social influence, social comparison and social judgement research provide good tools for an in-depth approach to the social aspects of the novelty generation process. First of all, novelty-seeking and creative activities can be influenced by the social environment in which they take place. Individuals can be socially influenced by cues perceived in the environment that either support (so-called promotion

cues) or interfere (so-called prevention cues) with an individual's likelihood to be creative (Friedman & Förster, 2000, 2001). Parents with higher educational status may act as promoters by providing 'environmental contributions to their child's intellectual ability and also may encourage exploratory, socially stimulating behaviors' (Raine et al., 2002). Exposure to creative role-models supports creative individuals in their development (Bandura, 1977; Simonton, 1975). Social comparison is one way for an individual to find his or her way in the creative process. However, it is not only individuals who compare themselves to others, but also those who see the products of their creative process compare them to others. So second, social comparison and judgement processes are also key for being attributed the label 'creative'. Marcel Duchamp presented a urinal to the world and it became a famous artwork, because the art world at some point recognized the novelty in its presentation. Individuals can display novelty-seeking and creative behaviour, but only the judgement by others may label the results from this behaviour as new, that is: 'innovative'. It is a long-established idea in the psychological literature that the judgement of knowledgeable others such as experts, peers or supervisors are key in assessing the value of an individual's contribution (Getzels & Csikszentmihaly, 1975; MacKinnon, 1962). How such judgement processes are managed in real decision-making processes in the creative industries has been explored, for instance in the context of Hollywood pitch meetings: here decision-makers judged the creative potential of applicants by matching individuals with creative and uncreative prototypes. How the applicants matched with the decision-makers themselves also played an important role (Elsbach & Kramer, 2003).

Clearly, an innovation is not 'something new', but more appropriately referred to as 'something that is *judged as new*', thus a label resulting from a social comparison and judgement process – a label that can disappear from the product again, for instance if it enters another environment in which social judges do not consider this product as new. What role do neurocognitive aspects have in this social judgment process? Whether such judgements are intrinsically motivated in the sense that judges do really perceive novel stimuli in a product or whether it is extrinsically motivated by the social desirability or obligation felt by judges to 'declare a product an innovation or non-innovation' are two very different situations. After all, this process also requires the ability to perceive novelty and distinguish it from non-novelty, an ability that requires

similar neurocognitive markers as discussed, but this time on the side of those who pass the judgement about a potentially novel product.

Introducing the *Novelty Generation Model (NGM)* on Novelty-Seeking, Creativity and Innovative Performance

People can seek for novelties for a whole lifetime but may never come to find something that is new to the world. Equally, people can engage in productive activities, but only rarely create a really new product. The subtle difference between 'producing' and 'producing something novel' remains one of the trickiest moments in understanding the concept of creativity. Various types of creative contributions have been discussed, and surprisingly also 'replication' has been included as a type of creativity that refers to the effort of keeping something as it is (Sternberg & Ben-Zeev, 2001, pp. 290–291; Sternberg, Kaufman & Pretz, 2004). Of course, replication is also an act of producing something, but one may wonder whether it really deserves to be included as a type of creativity – after all, it is similar to imitation, the absolute opposite of producing something novel. In scientific contexts such a wide view of creativity leads to major theoretical and methodological problems. Maybe also for this reason, some prefer more narrow definitions in which they emphasize that creativity is marked by the generation of novelty (Mandler, 1995). In this sense, other types of creativity classified by Sternberg and colleagues well deserve the label 'creativity', because they meet that novelty condition: for instance 'redefinition' (looking at a field from a new point of view), 'advance forward incrementation' (the attempt to move a field beyond a point where others are ready to go), and 'redirection' (the attempt to move a field towards a new and different direction).

On two things we can probably all agree considering the above literature review. One is that there are different components that make up the entire process of novelty generation and creativity is only one of them. The second is that it is often not made clear in the literature to which of the different components of the novelty generation process the point of discussion relates. For example: it was found that the shyer and lower in self-esteem a child was, the lower its 'creativity' (Kemple, David & Wang, 1996). However, the specific switches in which the shyness actually interfered in their research were not specified. The child may well have been creative but its shyness

may have interfered with what follows the creative process, namely the process of achieving innovative performance that would require the child's ability to present its creative products to the social environment and obtain recognition for it.

If we had a model that distinguished creativity from innovative performance as different components of the novelty generation process, those above effects of shyness could better be located and understood. Various components and phases of creativity have been distinguished in the literature before, for example, the phase of *preparation* when individuals direct their attention to a particular topic and gather information within themselves and their environment; followed by an *incubation* phase in which conscious work stops and attention is directed to other things, while unconsciously the creative process continues; then the *illumination*, the moment when new insight suddenly comes to mind; and lastly the *verification* phase, in which logical and rational thought comes in again to turn the new insight into something apparent to others (Wallas, 1926). Similarly, it was suggested that creativity can be

best conceptualized as a syndrome involving a number of elements: (a) the processes underlying the individual's capacity to generate new ideas or understandings, (b) the characteristics of the individual facilitating process operation, (c) the characteristics of the individual facilitating the translation of these ideas into action, (d) The attributes of the situation conditioning the individual's willingness to engage in creative behavior, and (e) the attributes of the situation influencing evaluation of the individual's productive efforts' (Mumford & Gustafson, 1988, p. 28)

The question is: does this last element about the evaluation by the social environment really belong under the header of the creative process as such? Is this not a factor belonging to the achievement of innovative performance rather than creativity? The term 'creativity' may have been overstretched in recent decades.

It solves some theoretical and methodological problems to model the novelty generation process as a whole and make clear conceptual distinctions between the seeking for novelties, followed by the finding of a novelty and transforming it into a product visible to others, and finally innovative performance, which stands for the social recognition that the producer of a novelty can receive in this world. Such a model would for instance account for scenarios in which a highly novelty-seeking individ-

ual may create comparatively few novel products, or s/he may create novel products but still end up with a low innovative performance record. Where in the entire process of generating a novelty can the individual become stuck?

The Novelty Generation Model (NGM) (Figure 1) can help to gain more insights on such key functions and dysfunctions in the process of generating something new (Schweizer, 2004). In this conceptual model I present the process of novelty-seeking as the first component in the onset of the whole novelty generation process, followed by creativity as a second component consisting of two main processes: *novelty-finding* and *production of the novelty*, which in turn is followed by innovative performance, in which a product is presented to a wider social environment. Within the NGM's notion of creativity, novelty-finding occurs when an individual has the neurocognitive traits that allow him or her for instance to come up with unusual combinations, an ability detected by creativity tests such as the RAT (Remote Associates Test) or 'Unusual uses of objects' tests like the 'brick test'. Following this process component, an individual may decide to transform novel insights/findings into observable products

and we may say that someone has been 'creative', which in turn is the necessary condition for the following process component: a novelty entering the process for innovative performance. This final component in the process of generating a novelty – innovative performance – depends on the individual's interaction with the social environment in which the novelty is presented. Here, *co-operativeness*, a factor in the TCI assumes a central role, just as *extraversion* and *sociability* in the Five-Factor-Model help in presenting one's products to a social environment. The willingness and the ability to interact with the environment to get a product socially judged and recognized as novel supports the achievement of innovative performance. History teaches the main difference between creativity and innovative performance: those with the great ideas have not necessarily received the social recognition for it; often the recognition has been harvested by others who were able to convince the environment about those ideas. And still others may not have sought for something novel, but have found something novel by chance and done something with it. Or innovative performance may have been assigned to products that are not novel at all. These examples are to emphasize: the process of novelty generation is not

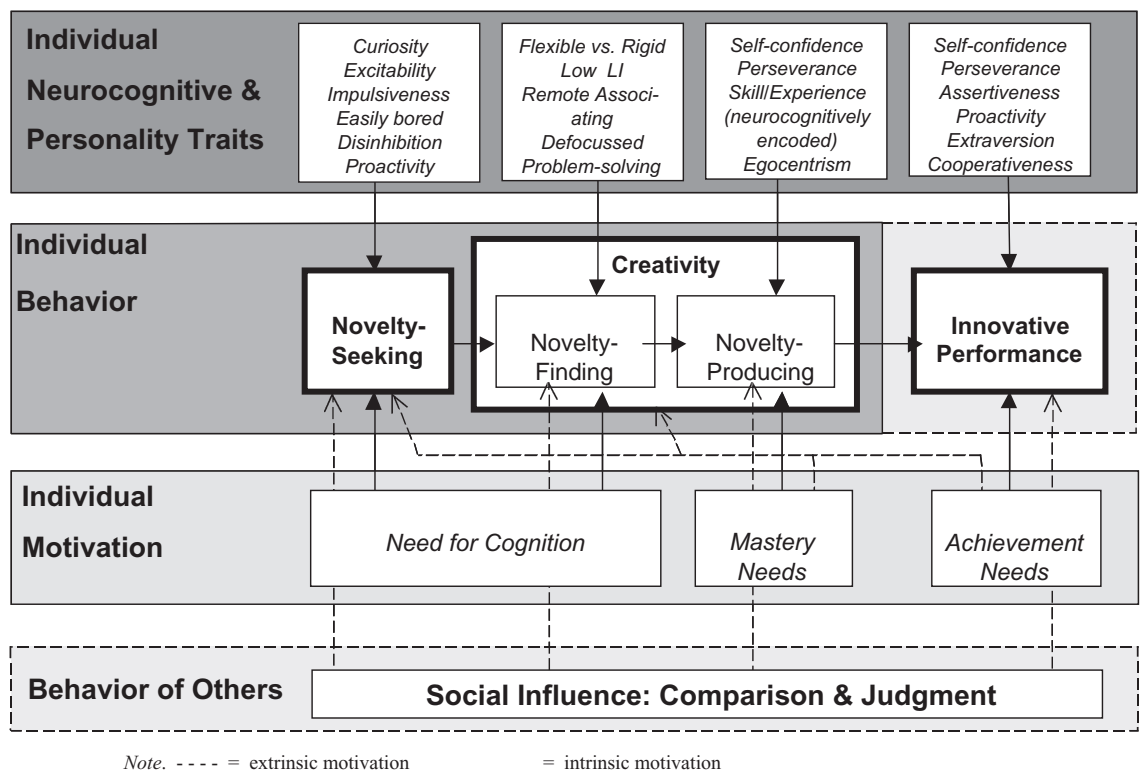


Figure 1. The Novelty Generation Model (NGM)

necessarily as linear as the NGM's ideal-typical framing of the novelty generation process depicts.

The NGM differs from the most widely accepted models suggested by Wallas (1926), Amabile (1983b) and Mumford and Gustafson (1988) in that it clearly treats creativity as only *one* component within the wider process of novelty generation, and it also pays attention to the neurocognitive/neuropsychological traits supporting it. In such an approach, relevant neurocognitive as well as personality traits can be clearly related to the different components. At the same time it becomes possible with the NGM to elaborate on the motivational inputs to each of the different sub-processes by indicating the different needs of the individual and also where they may work as either intrinsic or extrinsic motivators. For example, the NGM helps to visualize the problem that occurs when individuals seek and/or find novelties with motivations other than those of satisfying their needs for cognition: extrinsic motivators are at work then. This is for instance the case when achievement needs – which do function well as intrinsic motivators in achieving innovative performance – assume motivating roles in other components of the novelty generation process. And finally, the critical switches in the transition from novelty-seeking to novelty-finding and novelty-producing, and then to innovative performance become investigable on the basis of the NGM. For instance, the NGM allows for identifying individuals with extremely high novelty-seeking scores that can make them jump from idea to idea without finishing the phases of transforming the ideas into presentable products and dealing with the social judgement process. Extremely high novelty-seekers are neuropsychologically at risk of being highly distractible and having short attention spans. It has been argued that it is not the highly above-average novelty-seeking personality, but rather a personality marked by slightly above average novelty-seeking scores that provides the optimal basis for the novelty generation process (Schweizer, 2004). Clearly, more in-depth research is required to better understand the novelty-seeking and novelty-finding processes, their neurocognitive and neuropsychological correlates (also encoded in experience and skills) as well as their behavioural implications in the creative work process.

Practical Implications of the NGM for Creative Work Environments

The processes of novelty generation can occur in any occupational field, but in some profes-

sions they are essential: art, science, advertising or haute couture are good examples of fields where the generation of the new is the core business. In such settings the interaction between creative staff on the one hand and operational staff on the other often becomes a key management issue. This can also include interactions between departments or business units. R&D departments are an example of units to which the generation of novelties is central. But in departments and professions where novelty generation is not the essential task creativity also increasingly plays a role. Historically, the overall share of novelty generation processes across all professions was much smaller than it is in today's fast and competitive environments, where the generation of new contents, styles and designs has become an essential ingredient of the survival of firms.

The NGM is meant to represent the basis for a toolbox that can be used by two particular groups of professionals involved in the novelty generation process: first of all, those who directly operate in creative work environments; second, the group of individuals who take more facilitative roles, for instance as support staff for creative staff, or who are involved in personnel selection or human resource management in the widest sense. The first group directly involved in the novelty generation process may find the NGM and its related body of knowledge helpful for analysing their own novelty generation processes, for instance along the following sets of questions:

Where are my strengths and weaknesses within the whole process of generating a novelty: in the seeking of novelties? In finding them? In transforming my findings into products? How am I doing when it comes to finding public recognition for my products?

Can I get really excited about things? Do I get easily bored? Do I take pleasure in thinking about things in unusual ways? Can I step back from a problem and let its solution come up in me in a relaxed mode? Do I have a tendency to jump to new projects without finishing them? Do I feel confident about my own creativity? Do I like to present my ideas and my work in public or do I have a tendency to keep my ideas to myself?

What motivates me to generate novelties? Am I genuinely enthusiastic about my work? How important is it for me to produce something and see for myself that I can do it? To what degree am I concerned

with what others will think about it? How important is it for me to get the public recognition of others for it?

Where are the links in my novelty generation processes that could be improved? What kinds of training could help me to better handle myself in the critical switches of the process? Do I receive the social support I need for seeking and finding novelties, producing them and presenting them to others? Can I accept support from others at all? What are the main sources of support I draw on? Do I experience a sense of well-being in my work environment?

On the other hand, people who are indirectly involved in the novelty generation process, for instance those who manage creative staff, may also benefit from the NGM and its related knowledge. Most importantly, they can support those who are directly involved in the novelty generation process by creating awareness of dysfunctional switches in their work process and develop adequate support strategies with and for them. In order to further illustrate the managerial value of the NGM, some practical examples will be offered in the following. Some of these examples also indicate the direct benefit of neurocognitive and neuropsychological knowledge within creative work scenarios.

- *Creative staff selection.* Human resource managers still have a rather limited set of criteria for the decision-making process concerning the selection of new staff for creative positions. In particular, how to determine the specific role that new employees are the fittest to take within the entire novelty generation process is an important issue. Screening for the neurocognitive and personality markers that support work in the different components of the NGM can facilitate the decision-making process.
- *Training creative staff.* For existing staff an identification of the individuals' personality and neurocognitive strengths as well as deficits affecting the novelty generation process would be a worthwhile HRM policy.
- *Managing addictive behaviours in workplaces.* This issue is currently rising in importance, for instance in the context of internationally diffusing non-smoking policies in office spaces. From a neuropharmacological perspective the physical need for nicotine during the novelty generation process can be explained by its facilitative effect in deliberate and focused creative problem-solving (similar to caffeine). On the other side of the spectrum there is the consumption of alcohol to achieve a down-regulation of the prefrontal cortex and the relaxation that supports more spontaneous creative problem-solving. Alcohol abuse is also known to be widely spread in the creative professions. According to recent research in the neurosciences and neuropsychology, neural pathways can be trained in order to achieve effects that are able to substitute for the effects of the above-mentioned drugs. Stimulating the training and use of these alternatives during work hours could help employees maintain good productivity within a drug-wise restricted environment.
- *Detecting compensatory behaviours.* Weaknesses in one of the components of the novelty generation process are often compensated by excessive activity in the other components. Recognizing such compensatory behaviours can help re-directing the employee's energies into his/her deficient components.
- *Composition of work teams.* The value of composing teams in a way that optimally covers the different components of the novelty generation process can become particularly obvious in critical moments of the novelty generation process. A good example here is the case of a research team confronted with completely unexpected research results shortly before a deadline. Whereas neurocognitively more rigid team members can provide good structure to the overall process, they often respond less constructively in drastically changed situations and under extreme time-pressure. In contrast, team members with more flexible cognitive styles of thinking may be more able to shift between different cognitive sets, which makes them more likely to respond in a constructive way to the changed situation, seeking out new opportunities and thereby realizing creative potential in such disruptive situations. Joined in a team, different sets of capabilities further the novelty generation process at different points in time.
- *Handling employees' stress, fatigue and absence records.* Job dissatisfaction, stress or above-average absence records among creative staff can be symptoms of deeper-lying dissociations within the novelty generation process. Examples are: extremely novelty-seeking individuals who may experience strong limitations in their working environment wasting their novelty-seeking and creative energy; vice versa, individuals with a neurocognitive set-up that is less supportive for novelty-seeking and novelty-finding activities often draw mainly on extrinsic motivations such as social achievement. In professions in which creative out-

puts are part of the job definition this can cause excessive work pressure to the individual. The identification and dissolution of such distortions in the working process form an important part of managing the well-being and productivity of employees.

These were only a few practical examples indicating starting points for a managerial application of the NGM and the body of knowledge it represents. The examples also illustrate that the psychosocial chain of novelty-seeking, creativity and innovative performance is flexible to some degree, but also fragile. The social inability to manage the needs of potential novelty generators comes with high costs for all those involved. What is more, in a wider perspective, inestimable societal costs occur where investments disappear in innovation processes that are not sufficiently fed by novelty-seeking, finding and producing, but by a self-sustaining network of social judges acknowledging the production of a novelty even where there is none. A society as a whole is served best if occupational and organizational decisions in novelty-generating professions are informed by an in-depth knowledge of the psychological factors underlying the generation of the new. The above examples are also meant to draw attention to the need for theory-building and empirical testing concerning the critical switches of the novelty generation process discussed in this article. Lastly, it became obvious that the elaboration of the practical implications of neurocognitive and neuropsychological insights for both, managerial use on the one hand and self-knowledge of the creative staff themselves on the other, is still in its infancy and would certainly deserve more attention in creativity and innovation research. Hopefully this article has opened up this debate and provides impulses for future research into these particular work-psychological issues. Notably, these issues also hold the keys to understanding the unique pleasure that can be experienced during such creative research work.

References

- Amabile, T.M. (1983a) *The social psychology of creativity*. Springer-Verlag, New York.
- Amabile, T.M. (1983b) The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology*, 45, 357–76.
- Bandura, A. (1977) *Social learning theory*. Prentice, Englewood Cliffs.
- Benjamin, J., Li, L., Patterson, C., Greenberg, B.D., Murphy, D.L. and Hamer, D.H. (1996) Population and familial association between the D4 dopamine receptor gene and measures of Novelty Seeking. *Nature Genetics*, 12(3), 81–4.
- Berlyne, D.E. (1960) *Conflict, arousal, and curiosity*. McGraw-Hill Book Company, New York.
- Cacioppo, J.T. and Petty, R.E. (1982) The need for cognition. *Journal of Personality and Social Psychology*, 42, 116–31.
- Cacioppo, J.T., Petty, R.E., Feinstein, J.A., Blair, W. and Jarvis, G. (1996) Dispositional differences in cognitive motivation: The life and times of individuals varying in need for cognition. *Psychological Bulletin*, 119, 197–253.
- Carson, S.H., Peterson, J.B. and Higgins, D.M. (2003) Decreased Latent Inhibition is associated with increased creative achievement in high-functioning individuals. *Journal of Personality and Social Psychology*, 85(3), 499–506.
- Cloninger, C.R. (1994) Temperament and personality. *Current Opinion in Neurobiology*, 4, 266–73.
- Cloninger, C.R., Przybeck, T.R., Svrakic, D.M. and Wetzel, R.D. (1994) *Temperament and Character Inventory: A Guide to Its Development and Use*. Center for Psychobiology of Personality, Department of Psychiatry, Washington University St., Missouri.
- Cloninger, C.R., Svrakic, D.M. and Przybeck, T.R. (1993) A psychobiological model of temperament and character. *Archives of General Psychiatry*, 1993(50), 975–90.
- Costa, P.T. and McCrae, R.R. (1992) Four ways five factors are basic. *Personality and Individual Differences*, 13(6), 653–65.
- DeBono, K.G. (1992) *Serious creativity: Using the power of lateral thinking to create new ideas*. HarperCollins, New York.
- Ebstein, R.P., Novick, O., Umansky, R., et al. (1996) Dopamine D4 receptor (D4DR) exon III polymorphism associated with the personality trait of Novelty Seeking. *Nature Genetics*, 12(3), 78–80.
- Elsbach, K.D. and Kramer, R.M. (2003) Assessing creativity in Hollywood pitch meetings: Evidence for a dual-process model of creativity judgments. *Academy of Management Journal*, 46(3), 283–301.
- Eysenck, H.J. (1993) Creativity and personality: A theoretical perspective. *Psychological Inquiry*, 4, 147–78.
- Feist, G.J. (1998) A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review*, 2, 290–309.
- Feist, G.J. (1999) The influence of personality on artistic and scientific creativity. In R.J. Sternberg (ed.), *Handbook of Creativity*. Cambridge University Press, Cambridge.
- Finke, R.A., Ward, T.B. and Smith, S.M. (1992) *Creative Cognition. Theory, Research, and Applications*. MIT Press, Cambridge MA.
- Getzels, J.W. and Csikszentmihaly, M. (1975) From problem solving to problem finding. In Taylor, I.A. and Getzels, J.W. (eds), *Perspectives in Creativity*. Aldine, Chicago pp. 90–116.
- Kasof, J. (1995) Social determinants of creativity: Status expectations and the evaluation of original products. *Advances in Group Processes*, 12, 167–220.
- Kasperson, C.J. (1978) Psychology of the scientists: XXXVII. Scientific creativity: A relationship with

- information channels. *Psychological Reports*, 42, 691–4.
- Kemple, K.M., David, G.M. and Wang, Y. (1996) Preschoolers' creativity, shyness, and self-esteem. *Creativity Research Journal*, 9, 317–26.
- King, L., Walker, L. and Broyles, S. (1996) Creativity and the five-factor model. *Journal of Research in Personality*, 30, 189–203.
- Lerman, C., Audrain, J., Maln, D., et al. (1999) Evidence Suggesting the role of specific genetic factors in cigarette smoking. *Health Psychology*, 18(1).
- Lykken, D.T., McGue, M. and Tellegen, A. (1992) Genetic traits that may not run in families. *American Psychologist*, 47(12), 1565–77.
- MacKinnon, D.W. (1962) The nature and nurture of creative talent. *American Psychologist*, 17, 484–95.
- MacKinnon, D.W. (1965) Personality and the realization of creative potential. *American Psychologist*, 20, 273–81.
- Mandler, G. (1995) Origins and consequences of novelty. In Smith, S.M., Ward, T.B. and Finke, R.A. (eds), *The creative cognition approach*. MIT Press, Cambridge, MA.
- Martindale, C. (1999) Biological Bases of Creativity. In Sternberg, R.J. (ed.), *Handbook of Creativity*. Cambridge University Press, Cambridge pp. 137–52.
- McCrae, R.R. (1987) Creativity, divergent thinking, and openness to experience. *Journal of Personality and Social Psychology*, 52, 1258–63.
- McCrae, R.R. (1996) Social consequences of experiential openness. *Psychological Bulletin*, 120(3), 323–37.
- Mednick, S.A. (1962) The associative basis of the creative process. *Psychological Review*, 69, 220–32.
- Mumford, M.D. and Gustafson, S.B. (1988) Creativity syndrome: Integration, application, and innovation. *Psychological Bulletin*, 103, 27–43.
- Pearson, P.H. (1970) Relationships between global and specified measures of novelty-seeking. *Journal of Consulting and Clinical Psychology*, 34, 199–204.
- Prolo, P. and Licinio, J. (2002) DRD4 and novelty seeking. In Benjamin, J., Ebstein, R.P. Belmaker, R.H. (eds), *Molecular genetics and the human personality*. American Psychiatry Publishing, Washington, DC.
- Raine, A., Reynolds, C., Venables, P.H. and Mednick, S.A. (2002) Stimulation seeking and intelligence: A prospective longitudinal study. *Journal of Personality and Social Psychology*, 82(4), 663–74.
- Schweizer, T.S. (2004) *An Individual Psychology of Novelty-Seeking, Creativity and Innovation*. ERIM Ph.D. Series, Nr. 48.
- Schweizer, T.S., Deijen, J.B., Heslenfeld, D., Nieuwenhuis, S. and Talsma, D. (2006) Functional magnetic resonance imaging of brain activity during rigid versus creative thought processes in obsessive-compulsive patients. *Paper presented at the Cognitive Neuroscience Society Conference, San Francisco, CA, USA*.
- Simonton, D.K. (1975) Sociocultural context of individual creativity. *Journal of Personality and Social Psychology*, 32, 1119–33.
- Sternberg, R.J. and Ben-Zeev, T. (2001) *Complex Cognition*. Oxford University Press, New York.
- Sternberg, R.J., Kaufman, J.C. and Pretz, J.E. (2004) A propulsion model of creative leadership. *Creativity and Innovation Management*, 13(3), 145–53.
- Wallas, G. (1926) *The art of thought*. Jonathan Cape, London.
- Zuckerman, M. (1994) *Behavioral expressions and bio-social expressions of sensation seeking*. Cambridge University Press, Cambridge.
- Zuckerman, M. and Cloninger, C.R. (1996) Relationships between Cloninger's, Zuckerman's, and Eysenck's dimensions of personality. *Personality and Individual Differences*, 21, 283–5.

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