

# The Nature and Role of Cognitive Agility

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## SAŽETAK

**Ključne riječi:** adaptivnost, kognitivna agilnost, donošenje odluka u dinamičnom okruženju, ljudska izvedba, trening u motosportu

Kognitivna agilnost je slabo istražen formativni konstrukt za kojeg se pretpostavlja da uključuje niz konstrukata poput kognitivne fleksibilnosti, usmjerene pažnje i otvorenosti za iskustva. U ovom se članku kognitivna agilnost sagledava kroz prizmu svoje formativnosti i konstrukata koji ju sačinjavaju, kao i kroz potencijalno zanemarene elemente koje bi tek valjalo istražiti. Nadalje, rad se bavi i drugim kognitivnim konstruktima, poput kognitivne adaptabilnosti, čije su kognitivne strukture i karakteristike slične onima koje se pripisuju kognitivnoj agilnosti, ali su sami konstrukti zasebno opisani i definirani. Predlažemo i dublje istraživanje uloge osobnog iskustva u kontekstu razvoja kognitivne agilnosti. Naposljetku, raspravlja se o praktičnoj iskoristivosti ovoga konstrukta, odnosno korištenju treninga kognitivne agilnosti u praktične svrhe. U radu se razmatraju dosadašnja saznanja o kognitivnoj agilnosti iz područja primijenjene psihologije u vojnom kontekstu te kako se mogu primijeniti na razvoj treninga kognitivne agilnosti u nekim drugim primijenjenim sferama, kao što je profesionalni motosport.

## ABSTRACT

**Keywords:** adaptability, cognitive agility, dynamic decision making, human performance, motorsport training

Cognitive agility is an underresearched, formative cognitive construct that is believed to include other cognitive constructs, namely, cognitive flexibility, focused attention, and openness to experience. In this article, the construct of cognitive agility is explored through the lenses of its formativity, as well as potentially overlooked elements of the construct that are yet to be researched in the future. We also discuss other cognitive constructs, such as cognitive adaptability, whose cognitive structure and characteristics are like those of cognitive agility, yet they are defined and described as separate constructs. Furthermore, we propose an in-depth investigation of the role of personal experience in the context of one's cognitive agility development. Finally, since the construct itself belongs to the domains of human performance and development, we discuss practical uses of cognitive agility training. The paper addresses past research results applied in a military setting in the context of establishing training and development programs for cognitive agility as well as possibilities of such developments in other areas of human activity, such as professional motorsport.

## INTRODUCTION

Unlike most topics covered in review papers, cognitive agility is not a construct defined by a conclusive or a holistic definition, neither in psychological nor cognitive science literature. One possible reason for that is that, although the construct itself falls into the sphere of cognitive psychology, most of the research that has been done is in the field of organizational psychology. Furthermore, there is a lack of interdisciplinarity in relation to the subject that could be an unhelpful obstacle when defining such a broad construct. One other reason for the lack of an agreed upon definition is that there are many constructs that are in nature - and description - similar to cognitive agility, such as focused attention, cognitive flexibility and cognitive openness. Because of this, the question of the necessity to introduce a new construct arises, as well as the question whether cognitive agility even is a construct on its own. But to conduct research, the constructs of interest need to be concisely defined in a straightforward manner, hence the importance of defining cognitive agility properly and entirely as a construct in its own right.

Cognitive agility is a construct described by Hutton and Turner (2019, para. 7) as “the emergent product of an individual’s capacity to apply various knowledge, skills and abilities, and attitude, required to make rapid assessments, judgments and decisions for relative competitive advantage in anticipation of or in response to changes in the situation or recognition of one’s own cognitive limitations.” In simpler, more practical terms, it is the ability to juggle information and various input while reacting in an efficient, potentially optimal way, as fast as possible, in any given environment.

One extremely specific, but very well-rounded description of cognitive agility use is driving a Formula 1 car, where drivers constantly shift between new pieces of information, performing motoric reactions and having to do it all very quickly, while competing at the highest level in motorsport and driving at high speeds. The definition offered by Hutton and Turner (2009, para. 7) is an upgrade to a rather vague and limiting definition offered by Good (2009, p.15) that describes cognitive agility as “an emergent cognitive ability necessary for adaptive performance within a single real-time dynamic context” as well as a “specific cognitive ability that leads to increased performance in a context that requires a series of individual adaptations.” While both previously mentioned definitions are loosely based around the notion that cognitive agility is an extension of adaptability - the capacity to make appropriate responses to changed or changing situations - a definition proposed by Hutton and Turner (2019) gives clear insight in the operationalization of cognitive agility and allows for a less abstract understanding of the construct.

In this article, the proposed definitions of cognitive agility will be assessed, to assure the reliability and validity of future research that relates to the construct. Aside from defining the construct, a proposed model of cognitive agility as a formative construct will be explored. The article will also offer explanations as to why cognitive agility should be held as a separate construct from other, similar cognitive constructs, whose characteristics will be described later in the article.

## COGNITIVE AGILITY: A FORMATIVE CONSTRUCT

To dissect the information top to bottom, this paragraph will begin by commenting on a definition offered by Good (2009), a definition which involves cognitive adaptability, but through concepts that he uses to form and define the construct of cognitive agility. Good (2009, p.17) states that „adapting successfully within a real time dynamic task context requires that one flexibly operate, being both open and focused.“ Successful adaptation to a context, according to the definition, relies on the work, combination, and an appropriate balance between the three constructs that make up cognitive agility - focused attention, cognitive openness, and cognitive flexibility.

Focused attention, according to Good (2009), is the ability to differentiate between relevant and distracting stimuli. Furthermore, as Lustig (2001) described, focused attention can also be perceived as efficient inhibition of specifically selected, irrelevant information, when presented with a variety of information, both relevant and irrelevant. In other words, focused attention means being able to focus on and extract information that is marked relevant in a certain context, while suppressing the potential distracting information. It should be pointed out that there are different ways in which people manage attention - holding, selecting, focusing, etc., but highlighted here is focused attention, which is believed to be an extension of selected attention, the difference being the suppressing of unnecessary information within the focused attention (Kahneman & Treisman, 1984, per Good, 2009). The role of focused attention as an aspect of cognitive agility is to ensure that the information being processed is limited to necessity, so that the task-solving could be as efficient as possible.

The second construct of cognitive agility according to Good's model (2009) is cognitive openness, a term mostly mentioned in personality psychology, specifically the literature that covers the Big Five Personality Trait Measurements by Costa and McCrae (1992). The full term "Openness to Experience", constructed in a personality inventory, a questionnaire by Costa and McCrae (1992) is used to describe a personality trait that Costa (1992) has described as having a strong interest in experience for its own sake. Individuals who score highly on this facet have a tendency for seeking out newness, and are usually described by others as "imaginative, daring, independent and creative." The thought process behind including a personality trait into a cognitive construct stemmed from the characteristics of said personality trait correlating highly with some key behaviors. Some of the behaviors that seem to be a positive predisposition in developing higher than average cognitive agility are willingness to try new experiences and likeliness of proper adaptation to change (Blickle, 1996). What is also interesting here is the connection of openness to creativity, which numerous authors have made in the past, while also conceptualizing creativity in different forms. Whatever the conceptualization, the known common denominator between openness and creativity is the heightened ability for divergent thinking, which opens up paths to finding new solutions and coming up with novel ideas. Further linking openness, creativity, and cognitive agility are Veale et al. in their book

Creativity and the Agile Mind (2013), where they explain that the creative mind has different forms of mental agility. It is proposed that each form corresponds to a certain creative expression. Across all, there seems to be a common denominator in how the finished product is assessed by the outsiders (non-creators of the product) – the more effortless the process of creation appears, the more creative the object of creation will be assessed. In the book, Veale et al. (2013) offered an ambiguous, but a truly cognitive-centered definition of mental agility. Present in the definition is the involvement of cognitive flexibility, as well as the importance of expertise of creative minds, both of which are highlighted as important factors in cognitive agility, throughout this article.

According to Good's (2009) formative model, the last of the three concepts that constitute the construct of cognitive agility is cognitive flexibility. The most important feature of cognitive flexibility is that, in order for knowledge to be useful, "it has to be experienced, acquired, taught, organized, and mentally represented in different ways" (Hutton et al., 2017, p. 82). This is because, if the knowledge obtained is only limited to a situation in which it was learned, the re-use of this same knowledge will not be as efficient, or it may not be possible at all in different situations, and under different circumstances. In other words, cognitive flexibility has to do with different connections we create in order to better and more easily retrieve certain information, when, for example, learning rules to a new board game or studying for a practical exam. This is specifically why cognitive flexibility has been often used interchangeably with cognitive agility – a construct which will be explored in more depth later in the article.

Good's definition of mental agility provided at the beginning of this article seems narrow. Therefore, we will proceed by adding Hutton and Turner's (2019) thoughts on the constructs associated to cognitive agility. Among other things, they discuss an important new dimension into their view of cognitive agility, and that is "the value of experience and experiential learning in supporting the development of adaptive expertise (2019, para. 6). Researching the work on adaptive expertise, Hutton et al. (2017) found it worthy to highlight the importance of sole experience in the construct of cognitive agility, a concept which is not explicitly included in any of the models proposed by Good (2009). As can be understood from Hutton et al. (2017), the concept of adaptive expertise includes three scientific domains that were covered in their literature-synthesis: adaptivity, skilled performance, and skill development. Even though all three can be related back to focused attention, cognitive openness, and cognitive flexibility (and these constructs are indeed precursors and topics of interests in said areas), experience is an inevitable human factor that cannot be neglected when discussing cognitive agility. Just as each person has their own distinctive way of answering a personality questionnaire, and it is their way of answering that makes up what is called a personal equation, one's experience is a factor that could have an impact on how a person could react and adapt in a given situation. For this reason, cognitive agility, when discussed about in terms of models or in terms of its development, must include an individual aspect, not just a formula with generalized constructs for use.

## UNDERSTANDING THE DIFFERENCES BETWEEN CONSTRUCTS

It is often in the world of science that different authors give the same phenomenon different names. This is why the scientific community does not introduce new constructs easily, without much proof of it being a distinct, unique construct. In the case of cognitive agility, there are few widely recognized constructs similar in characteristics that, when examined in detail, have been found to be separate constructs from each other, and from cognitive agility, respectively. Two of these constructs, whose characteristics and relations to cognitive agility will be assessed below, are cognitive adaptability and cognitive flexibility.

To explain the relation, similarities, and differences between adaptability and cognitive agility, it is first crucial to understand the time frames in which their effects are present, specifically, how effects of adaptability are more prolonged and slower, while those of agility are more instant and in-the-moment because of their relation to context specificity. When talking about adaptability, we often mention the context of evolution, or any other long-term adjustment that has „a successful change in either cognition, behaviour or emotion in response to anticipated or actual environmental shifts“ (Good, 2009, p. 15). However, according to LePine (2000), there are different contexts, some of which are constantly changing environments, in which adaptability is defined by and relies on different factors and constant interaction. Gonzalez (2004) points out that adaptability can also be used when describing an adjustment to a real-time task, such as adapting to a new working environment, but again - over a certain period. Adaptability can also be viewed through people managing the ever-growing technological advancements, whose impact is present in everyday life; situations in which tasks are constantly changing and evolving are here and are often categorized as dynamic contexts (Good, 2009). According to Haynie (2005, p. 11), the definition of cognitive adaptability, is “performing effectively given an evolving and often novel context.” Even though this might be a consensus-worthy definition in regards to adaptability, when searching for a term that has now been coined as cognitive agility, Good (2009), realized that there is a key concept missing from the definition of cognitive adaptability, separating the two extremely similar cognitive constructs of adaptability and agility. What was missing from the previous definition was the need for specificity in contexts - the need to know about the individual switching in decision frameworks, as well as the speed of doing so. Agility, as a stand-alone term in sports sciences, is defined simply as the ability to change direction rapidly and accurately (Barrow & McGee, 1971; Johnson & Nelson, 1969; per Sheppard and Young, 2006). With that in mind, it is common sense that scientists would adopt and use the term agility in a context that, ultimately, describes the “sharpness and quickness“ of the brain as well as its abilities to switch from and to different tasks that are presented to it, and search for different ways to solving those tasks. Cognitive agility, unlike adaptability, has one key aspect to it, and that is speed - the need to optimize performance in the shortest possible time.

One other term that is close in use to adaptability, and possibly cog-

nitive agility, is cognitive flexibility. Sternberg (1985) defines cognitive flexibility as intelligently adapting to one's environment through various forms of shifting, restructuring, or expanding cognition. From this ambiguous definition, it seems as if being flexible in cognition would mean being able to, again, optimize performance based on situational needs by choosing the right path to task-solving. However, Cañas et al. (2003) showed in their experiment involving problem solving in changing environments that it is not only cognitive flexibility that we can rely on when task-solving, but rather a variety of cognitive mechanisms and its interaction with the human environment in which the dynamic tasks are being completed in. Based on the findings, it cannot only be cognitive flexibility that is a predictor of the process as a whole, in its optimal state. To conclude and define, cognitive flexibility allows one to use what they have learned, and in combination with focused attention, limiting distractions, and openness, discovering new ways of solving tasks, optimizing problem-solving in new, possibly unpredictable environments.

One other term that could possibly be compared to cognitive agility because of the similarities in their cognitive structures, is fluid reasoning. Bearing in mind Cattell's (1987) definition of fluid reasoning as "the capacity to think logically and solve problems in novel situations, independent of acquired knowledge", it is reasonable to draw comparisons between the two constructs. However, rather than equating the two, because of the formative nature of cognitive agility, it could be proposed that fluid reasoning is just one underlying factor of successful cognitive agility, one that relates to problem-solving and divergent thinking aspects of cognitive agility.

To summarize, cognitive agility can be viewed in relation to executive functioning due to the elements they share, such as are focused attention and flexibility. It is important to stress, however, that more research on the topic is needed before concrete conclusions about the relation can be drawn. Furthermore, when describing and analysing cognitive agility, it is necessary to set it apart from cognitive adaptability and cognitive flexibility - first, because of the similarity of the two constructs themselves (Good 2009), and second, in order to prevent confusion when describing cognitive processes constituting the construct of what is today known as cognitive agility.

## RESEARCH AND DEVELOPMENT

Before conducting research, there is a lot of discussion about operationalization of constructs - what are the externalizations of these constructs that can never be directly measured? This is especially challenging when a construct in question is something that has not been researched or measured before, at least not extensively. In their military-personnel-based research and article, Hutton and Turner (2019) discuss cognitive agility not as cognitive performance phenomenon, but rather in the context of cognitive work. While analysing cognitive work, they focused on the process and the planning that goes into decision-making as a whole, and not just on the output, skills, abilities, and cognitive functions as separate entities. Hutton and Turner (2019)

take into consideration all the concepts that fall under said construct of cognitive work - the “apparatus, resources and strategies“. Some of those include: detecting problems or anomalies, anticipating deviations from the expected (progress, behaviour, effects), assessing situations and making sense of conflicting, ambiguous, surprising information, explaining what and why the situation is as it is, generating alternative options, evaluating and choosing between alternatives, etc. Since the work of previously mentioned authors is closely involved with a practical field and not just theoretical knowledge, it is of no surprise that their examples are very precise and detailed, because they are able to envision the context in which the information gained will be used. In no way should creating theories and developing practical knowledge in a specific field, rather than in a generalized, global aspect of cognitive science, be viewed as a limitation. Moreover, gaining great insight in groups with extremely specific characteristics, such as military officials, could be of use in future research and development because of the replicability of the research, and for anyone working with other highly cohesive groups.

The pool of people eligible for research, training or development was described in strict and detailed guidelines, and research itself was done on homogeneous groups (military personnel, defence officers, etc.). Furthermore, even though said research does involve the development of training methods for improving cognitive agility of defence officers, it does offer a general template, or a reference for future applied research of development of cognitive agility and its training procedures. The factors that are believed to play a role in developing cognitive agility, according to Hutton and Turner (2019), are related to applying the acquired knowledge in a variety of fields - for example, human development in high performance athletes such as professional race car drivers. Some of these factors include experience, knowledge, self-awareness, mental models of how the world works, both proactivity and responsiveness, techniques for disciplined thinking and creative thinking. In fact, the above-mentioned factors perfectly overlap with the required prerequisites, skills, and abilities of a professional motorsport driver.

However, so far, very little research has been done on the aspects of the above-mentioned human development. Hence, there are very few tangible and applicable findings that could be applied and used in enhancing human performance. Irrespective of who may benefit from such findings - the 1% of population that is already demonstrating higher levels of cognitive agility, or those who would not mind improving their decision-making processes in everyday activities and working environment - more research needs to be done in order to have reliable reports and results on the characteristics of cognitive agility. Only when scientists understand the process can they begin to create development programs to try to improve skills and abilities. As of now, cognitive psychologists in the UK have been working with the military to research, learn and develop, then include appropriate adaptability and cognitive agility training in the defence’s regular training program. Aside from the constructs on which they base the training, as well as the factors that were decidedly crucial for successful cognitive agility, there is no public access to the training conducted within UK’s defence operations.

The only popular, widespread, and proven-to-be-useful cognitive agility training that can be described today is that used by motorsport drivers.

## **COGNITIVE AGILITY TRAINING FOR MOTORSPORT DRIVERS**

Cognitive agility training is focused mostly on the physical and motor aspect of agility. For motorsport drivers it involves practicing motoric reactions and hand-eye coordination. The practice is frequently based on sports such as ping-pong or paddle (paddle tennis), throwing and catching tennis balls and the use of reaction training stations (BATAK). Since it is believed that motorsport drivers are extremely automated in what they do, most of their cognitive-based training involves reaction and coordination training. All of the aforementioned activities have the purpose of coordinating the movement of the hands with what the eye sees, in a quick reaction time. Activities can also be sound-based, forcing the drivers to rely on their audio-action connection, rather than the usual visual-action connection. The most specialized cognitive agility training among these would be the BATAK station, a web-like construction of light panels/buttons that switch on and off and must be pressed when lit up, as quickly as possible, to practice and measure reaction time and coordination. There are different versions of the activity, but all of them are based on rapidly pressing buttons that light up, under the “rules” set by the user, their trainer, etc.

Having in mind the incredibly high level of cognitive agility that motorsport drivers require while driving on the racetrack, it would be worth exploring the development of specific cognitive agility training methods for motorsport athletes, following the ideas, principles and work of Hutton and Turner (2019). It would also be crucial to collect data from professional motorsport trainers who work with cognitive agility practices, tools and activities daily, to gather information on what type of input and activity they believe is most useful for the drivers.

Finally, drivers should learn more about what their minds and bodies are going through while they are driving, and how their minds and bodies interact with their environment. They should undertake training that is focused on becoming aware of the cognitive load needed for driving race cars. They should be given plenty of opportunities to examine their driving-related cognitive workload and raise awareness of those situations that may have required quicker and/or more appropriate reactions or more effective verbalization of changes made in planning and tactics. Also, they should engage in activities that promote raising awareness of automated reactions.

If introduced, the cognitive agility training could be beneficial not just for the driver and their decision-making on the racetrack, but the whole team and their dynamics. It may improve precision of information and overall communication. Consequently, it may result in improvement of performance and team results. Cognitive agility-based training, in the context of motorsport athletes, goes beyond the usual simulation trainings and immersive experience drills. Rather, it aims at introducing novelty and creativity into the usual routine, creating space for openness, divergent thinking, and improvisation. In other words,



expert individuals should be given a chance to dive into the unexpected, and, at the same time, learn how to analyse situations and reactions that arise from the unexpected.

## CONCLUSION

Cognitive agility is a formative construct that consists of focused attention, cognitive openness, and cognitive flexibility, as defined by Good (2009). Albeit a good foundation, this is not the sole model that should be used to view cognitive agility in full, since it neglects, at least implicitly, the personal experience which people bring into every situation, while encountering new situations, learning similar or maybe even completely new tasks. Taking into account the importance of experience and expertise, as well as offering a more in-depth description of the construct, Hutton and Turner (2019) have taken a theoretical construct and transposed it in a real-life setting. They have made it applicable and user- and research-friendly, and given a prolonged, detailed definition on what cognitive agility entails. They have also provided some descriptions of aspects of cognitive agility that could be used as tools for future reference when creating material, methods and tasks for cognitive agility and development.

Psychologists have done considerable work in defining cognitive agility in their field, for their own use, in the domains of organizational psychology and cognitive psychology. The approach cognitive psychology has taken to explain the construct of cognitive agility has been concerned with individual human factors that could impact the construct, its expression in behaviour, as well as its development in practice. However, its complexity, especially in the area of applied human development, requires an interdisciplinary approach. It is self-evident that cognitive agility is a cognitive construct, but it is also socially situated, and it extends into a variety of environments that may determine how it should be examined. Thus, in we wish to make advances in investigating its complexity, we may need to take a different road and work on research designs combining the hexagon of cognitive science and sports sciences. In this way, we could tap into the domain of athletic performance (or any other human performance) in a more encompassing manner, that is, by investigating several relevant phenomena, from efficacy of team communication and collaboration to creativity, decision making and improvisation. To conclude, research and development of cognitive agility training in motorsport athletes and teams involved in motorsport should include research and training built around cognitive work, self-awareness and awareness and knowledge. Its complexity also requires emphasis on collaboration, divergent thinking, creative processes and innovation in addition to the existing focus on drills and automation.

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