

*Flexibility, development, and grounded cognition*

**Habilitation thesis**

**Abstract**

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"And I hope that when you put the book down,  
you will perhaps be able to imagine that you, too,  
are a strange loop."

(D. Hofstadter, *I Am a Strange Loop*, 2007, p. xix)

Strange loops are we humans. How should we proceed in order to understand ourselves? The endeavors outlined in this thesis, both past and future, try to achieve this: to understand how we develop to become the flexible creatures that we are. In the present thesis I will first present what I have achieved this far and then outline the future investigations I envisage, with the hope that they can become the support for becoming a coordinator of young researchers who will choose this path too. My research interests are centered on two main topics, cognitive flexibility and grounded cognition, both under the larger umbrella of human development.

In the first part, I present my academic path since my PhD (2006) in which I have investigated flexible categorization in preschool children. While acknowledging multiple factors that influence children's performance in flexible categorization tasks (i.e., in which one object can be put in several appropriate categories), I also encountered the predominant view in the literature that equates cognitive flexibility with set-shifting in the executive functions literature. Because the flexibility of other cognitive processes like language or categorization was not termed as cognitive flexibility per se, a huge puzzle opened before my eyes: what is cognitive flexibility? As a consequence I started analyzing the multiple views that were out there about cognitive flexibility (like set-shifting, the flexibility of various processes, the trait of openness to experience, or a measure in creativity tests) and over the years I have developed a theory of cognitive flexibility as being a property of the cognitive system (Ionescu, 2012) and a part of the variability-stability-flexibility chain (Ionescu, 2017a).

At first, I have investigated the relationship between performance in flexible categorization tasks and set-shifting tasks in preschool children. One interesting observation was that while they could categorize flexibly in certain circumstances already at 4 years of age, they were able to shift attention efficiently only after the age of 5. In the categorization task the focus is on grouping several items together based on a certain categorization criterion, while in the shifting task the focus is on switching back and forth between dimensions for the same stimuli. Nevertheless, the first expectation was to have similar results. As the results were dissimilar, I started varying several elements in the categorization task to understand what made it so different. The only variation that produced significant results was that of the type of instructions or questions used in the task, an element that will lead as we will see below to a connection with the grounded cognition approach.

Experimentation with set-shifting and categorization have led me to the theoretical pondering about the possible mechanisms that foster flexibility. The natural solution was to conceive cognitive flexibility as a consequence of multiple interacting mechanisms on the way to finding a solution. After all these interactions work well, flexibility emerges as the system's property. My developmental background helped me look at this bigger picture not only from the point of view of the various approaches about cognitive flexibility, but also from the point of view of the developmental path of multiple processes and mechanisms where we can observe the passage from trial-and-error to knowing and then to adaptive behavior. I termed these phases variability – stability – flexibility (VSF, Ionescu, 2017a). Several lines of investigation were set, like comparing flexibility in multiple domains or using the eye tracker methodology to investigate polysemous word understanding, in order to track the passage from one state to another. It may well be the case that if flexibility is a hard to catch property before it manifests itself, all we can develop is the readiness for flexibility and context sensitivity. In the following paper in 2019 I have tried to analyze how we can adapt instruction to the VSF pattern of developing children. This analysis also stressed the need to differentiate between variability and flexibility as two different kinds of instability of the system.

While the journey of understanding flexibility showed me the immense role of context, on a parallel track I encountered in the developmental literature the ideas of embodiment and embeddedness. The embodied cognition approach caught my attention fully especially because in very young infants the interplay between external and internal is so obviously important for

development, as stated already in the theory of Piaget. But once I started to search in more depth it soon became obvious that the body stays important all along in ontogeny not just in the first few years of life. For example, representations stay multimodal that is they are to be found in the brain's sensorimotor areas that were active when they were first learned. Furthermore, cognition is also dependent in every moment on the external world too (e.g., contextual cues), not just on the brain and the body, which takes us to the idea of grounded cognition. In several papers and experiments the principles of grounded cognition were analyzed (Ionescu & Ilie, 2018) and we showed for example that language development in children is dependent on the enactment of new words. Moreover, in several book I started to regard these principles as guidelines for designing activities for children that will foster their development (Ionescu, 2014, 2022a).

Summing up the first part, when looking back I find circles or loops, all going around the ideas of representation, flexibility, and development. The loops then go up in a spiral and stress the link between our internal worlds in our bodies and the external world. These are all loops that develop gradually and that sometimes look like fractals or in other words: "might lead to a fractal-like view (Mandelbrot, 1983) of development and learning: The recursive reoccurrence of the VSF states might be a key to understanding the nature of learning and development." (Ionescu, 2019, p. 22).

In all the above mentioned endeavors I have constantly worked with students, from the undergraduate level to the doctoral level, in the Developmental Psychology Lab where I have coordinated a subgroup, which is lately called Flexibility and Grounded Cognition. Over the years it was always my aim to teach students how to perform sound research, not to hurry the results, and to critically analyze the concepts they want to investigate. From concept analysis to data analysis and publication, I have always tried to engage students in learning by doing with a focus on performing research, research ethics, and the aim of developing knowledge.

The second part of the thesis presents the future avenues. The most important aim I have for the following years is to prove my theory about flexibility. This entails two major elements. On the one hand, it is the issue of how the internal mechanisms and the context interact to give rise to flexibility. On the other hand, it is the problem of three versus two states of the system. Several experimental lines are presented with the most innovative one focused on a new mechanism for flexibility, namely twisting, in other words turning knowledge over and over until a new solution is found (Ionescu, 2022b). As one world renowned conductor, Gustavo Dudamel,

nicely expressed in a recent interview: “*you have to be flexible, to transform all the time, not to change*”! This transformation points mainly to twisting and not to shifting which means change. For sure shifting still remains an essential mechanism, as there are several mechanisms interacting, but some new ones may well be needed too. A corollary aim is to mentor students who will become researchers or practitioners. In research, the above mentioned future plans will offer opportunities to tackle the development of flexibility and the grounding of the cognitive system. In teaching, it is important for me to transfer to students the latest information in the domain together with the ability to critically analyze it so that they can use it in their practice.

And now we can go back to loops and to a shift (sic) in focus: “The big picture will become clear only when we focus on the brain’s large scale architecture, rather than doing even more fine-grained analyses of its building blocks” (Hofstadter, 2007, p. 27). Similarly, we may need to look at larger interactions to pinpoint what flexibility and cognition truly are, and how their development proceeds. And after the proofs will gather, thinking back to the quote that opened this thesis, maybe you, researcher, too, will conceive of being human as being grounded and of flexibility as being a property and part of the VSF chain.