Cognitive flexibility and its relation with forecasting:
the Ukrainian crise as a case study

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Abstract

Title: Decision-making process: does cognitive flexibility enhance forecasting abilities?
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Does cognitive flexibility enhance forecasting abilities? Cognitive flexibility "is the human ability to adapt the cognitive processing strategies to face new and unexpected conditions in the environment" (Cañas, 2006, p. 296), and has already been proven to have a positive impact on decision-making (Cañas et al., 2003; Laureiro-Martínez et al., 2009; Laureiro-Martínez & Brusoni, 2018). I focused my research on forecasting abilities, using the war in Ukraine as a study case. Participants had to first test their flexibility with the Cognitive Flexibility scale (Martin & Rubin, 1995) and then answer forecasting questions about the war. The sample consisted of 95 valid answers. The results of my analysis showed no correlation between cognitive flexibility and forecasting abilities. Nevertheless, I highlight several limitations of my work, which explain why these results should not be considered a definitive answer to this study's question and why researchers should further explore this topic. Previous researchers have shown the advantages brought by cognitive flexibility, and I emphasize the importance of continuing to study this matter, in order to be able to teach, foster and enhance cognitive flexibility to reach a competitive advantage – if indeed these advantages are eventually proved.

Keywords: cognitive flexibility, forecasting abilities, decision-making.

Título: Processo de tomada de decisão: a flexibilidade cognitiva aumenta as capacidades de previsão?

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A flexibilidade cognitiva aumenta as capacidades de previsão? A flexibilidade cognitiva "é a capacidade humana de adaptar as estratégias de processamento cognitivo para enfrentar condições novas e inesperadas no ambiente" (Cañas, 2006, p. 296) e já foi provado que tem um impacto positivo na tomada de decisões (Cañas et al., 2003; Laureiro-Martínez et al., 2009; Laureiro-Martínez & Brusoni, 2018). Concentrei a minha investigação na capacidade de previsão, utilizando a guerra na Ucrânia como caso de estudo. Os participantes tiveram primeiro de testar a sua flexibilidade através de uma escala de flexibilidade cognitiva (Martin & Rubin, 1995) e depois responderam a perguntas de previsão sobre a guerra. A amostra consistiu em 95 respostas válidas. Os resultados da minha análise não mostraram qualquer correlação entre a flexibilidade cognitiva e as capacidades de previsão. No entanto, destaco várias limitações do meu trabalho que explicam porque é que estes resultados não devem ser utilizados como uma resposta definitiva à pergunta deste estudo e porque é que os investigadores devem continuar a explorar este tópico. A investigação anterior mostra as vantagens trazidas pela flexibilidade cognitiva, e sublinho a importância de continuar a estudar este assunto de modo a poder ensinar, fomentar e melhorar a flexibilidade cognitiva para alcançar uma vantagem competitiva - se de facto estas vantagens acabem por ser provadas.

Palavras-chave: flexibilidade cognitiva, capacidades de previsão, tomada de decisão.

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1. Introduction

Volatile. Unsettling. Unpredictable. Three key characteristics of our current business environment. After 1945, global institutions and a globally interconnected economy were created to promote multi-level cooperation. For decades, we thought, we hoped, that those would be the safeguards of our economies, of peace, and would foster a virtuous circle of growth and of positive geopolitical development (Lawless, 2019).

Yet, it has become clear that economic institutions are not enough to safeguard us form extreme upheavals anymore. More than ever, companies are facing potent forces of disruption. Uncertainty is present at every level: economic, political, legal, moral, as well as at the level of consumers' attitudes and public opinion. This is "unprecedent in modern memory" (Finn et al., 2020). The upheavals have become even more difficult and complex because of the social networks and the press that amplify their impacts. Indexes of uncertainty such as the Economic Policy Uncertainty Index and the World Uncertainty Index point to the same conclusion: uncertainty has significantly increased in the last decade (Ahir, Bloom, & Furceri, 2018). This reality led me to study the link between cognitive flexibility and how competent our leaders and future leaders are at apprehending and preparing for those disruptions.

Cognitive Flexibility (CF) may be apprehended as the ease with which one develops appropriate responses, views or perspectives to a new environmental stimuli (Scott, 1962), and has largely been studied under the spectrum of decision making (Cañas et al., 2003; Laureiro-Martínez et al., 2009; Laureiro-Martínez & Brusoni, 2018). CF has been shown to be impactful in many aspects of decision-making, as it gives one the ability to consider a multitude of alternatives, to easily adapt to any change in the environment, to deconstruct complexity and to expand awareness (Martin & Rubin, 1995; Mental Health Daily, 2015). Yet, whether CF impacts one's ability to foresee and navigate uncertainty remain a topic that has been scarcely addressed in scientific literature.

In the past two years, we all have faced uncertainty; for some, more than ever before. We have faced a number of crises. The COVID crisis, and now the war in Europe, forced each one of us to adapt, be creative, and resilient. Brown and collaborators (2021), rightly highlighted that the circumstances we are facing now are unique in many ways: the degree of daily changes over a

long period of time is extreme, whereas previously, companies facing corporate crisis saw uncertainty mainly limited to a short period of time. Furthermore, companies and management systems experience many difficulties addressing information instability, which is our reality nowadays.

What CF permits is to apply and adapt our knowledge appropriately in a novel situation. In these uncertain times, where such skills are increasingly needed, I have chosen to study the following question:

Is there a relationship between high cognitive flexibility and forecasting abilities?

Scientists and researchers have largely examined CF under the spectrum of decision-making or problem solving, but rarely has the impact of CF on forecasting and anticipation been studied. Yet, it would not be surprising to observe a positive correlation between those two notions. This is the reason why I will see if the following hypothesis can be proved right: does high cognitive flexibility positively impact forecasting abilities? If confirmed, it would suggest that people in positions where forecasting is important, such as managers or future managers, can hone their ability to tackle sudden geo-political complexities and upheaval through continuously fostering their CF. This, in turn, would stimulate research on how best to promote CF as a broad, overarching competence.

My thesis will have the following structure: Firstly, I will give an overview of the way we think, considering several important concepts, including cognitive flexibility, and how we plan ahead, focusing, amongst other concepts, on forecasting. This review will aim to understand to what extent those concepts have already been studied and to consider their impact on the business world. Secondly, I will cover the methodology I applied to my thesis. This part will refer to the construction of my survey in two sections: 1) a scale – the cognitive flexibility scale (Martin & Rubin, 1995) – used to determine where each participant stands on a scale from cognitively rigid to flexible, 2) and the forecasting questions. Thirdly, I will analyze my results. Finally, I will draw conclusions and lessons from my survey.

2. Literature review

2.1. The way we think

Dualist theories of reasoning

Researchers have proposed that humans have two different thinking processes: system 1 and system 2 – also called type 1 processing and type 2 processing, both leading to entirely different types of responses.

System 1 is a near-instantaneous process and includes instinctive behaviors: preparing the same breakfast every morning is a result of this mode of thinking; recognizing your best friend's face when entering a room also involves the system 1. This unstructured system is characterized by emotional, unconscious, automatic, and quick answers to a certain issue (Osman, 2004). In other words, we perceive certain stimuli, and we act on them automatically. This way of processing information has the advantage of requiring very little energy but has the disadvantage of resulting in approximate and non-rational results (Toplak et al., 2014). We, humans, share system 1 with animals (Evans, 2003).

On the other hand, system 2 is distinctively human. This system is slower and requires more effort than system 1. System 2 permits abstract and hypothetical reasoning, unachievable by system 1. Resolving the following math problem, $\sin \alpha \pm \sin \beta = 2 \sin \frac{1}{2}(\alpha \pm \beta) \cos \frac{1}{2}(\alpha \mp \beta)$, falls under system 2. This kind of thinking requires drawing on past experiences, the construction of mental models, or the simulation of novel, future, possibilities. Its critical function is to "override Type 1 processing" (Toplak et al., 2014, p. 2).

Interestingly, even if we use them for different kinds of situations, the two systems are constantly vying for the control of our actions (Evans, 2003). The way things work could, theoretically, be described as follow: "system 1 proposes, system 2 disposes" (Holt, 2011). Yet, in his book *"Thinking, Fast and Slow"*, Kahneman highlights the true nature of system 2: system 2 is lazy and tires easily. Thus, more often than not our rational system gives up and adopts the easy answer given by system 1. This phenomenon has been described as ego depletion by researchers, and it refers "to a temporary reduction in the self's capacity or

willingness to engage in volitional action (including controlling the environment, controlling the self, making choices, and initiating action)" (Baumeister et al., 1998, p. 1253). In other words, we prefer to use system 1 for a quick answer, than to take the time to ponder the correct answer using our second system. (Toplak et al., 2014)

In the last decade, these notions have been explored through several theories or tests, the most popular being by far the cognitive reflection test. This test, developed by Shane Frederick in 2005, has been defined by the author as "the ability or disposition to resist reporting the response that first come to mind" (Frederick, 2005, p. 35). In other words, Frederick is here considering one's ability to suppress intuitive responses, that are incorrect, and the aptitude one has to reflect so as to reach the correct answer (Toplak et al., 2014). The CRT is therefore used to measure the ability to resist going along with the system 1.

The original CRT from Frederick consists of a 3-item questions, each offering strong, intuitive but incorrect answers. Getting the right solution requires to carefully analyze and/or reject the first idea that comes to mind. Although the three questions[1] of the CRT are not complicated, results of studies have shown that participants tend to perform poorly. In 2005, when Frederick published the scores of the CRT, only 17% of the 3428 respondents got three out of three correct answers (Frederick, 2005, p. 29). This type of results is consistent from what we know about the dual-process theory. The low score on the CRT highlights the facts that "rapidly accessible intuitive responses typically dominate reasoning (…) to conserve mental resources (and time)" (Pennycook et al., 2016, p. 341) and that humans make decisions based intuitive heuristics.

Researchers have correlated performing at the CRT with various measures: performance on ability measures, relationship to risk, conservatism, and so on (Frederick, 2005; Pennycook et al., 2012; Szaszi et al., 2017). It has also been shown that participants with high scores are less likely to exhibit biases in judgments and decisions (Campitelli & Gerrans, 2014) and shared a greater tendency to avoid decision biases (Szaszi et al., 2017; Toplak et al., 2011, 2014). Sophisticated strategic behaviors - such as finding the Nash equilibrium in diverse game, have also been positively correlated to high scores at the CRT (Brañas-Garza et al., 2019).

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[1] Over time, more questions have been added to the test, as the public was getting more and more familiar with the test. (Toplak et al., 2014; Thomson & Oppenheimer, 2016)

The reason I focused on the CRT is because both the CRT and CF are individual measurements of thinking - albeit of different properties of thinking. Yet, the CRT benefits from a much greater recognition than CF, as suggested by its frequent use and the number of publications, and research. This further supports the importance of studying more the concept of cognitive flexibility.

Cognitive flexibility

In our complex and fast-changing world, where multitasking is more required than ever, cognitive flexibility (CF) is primordial (Eshet-Alkalai, 2004). As defined by Cañas, "cognitive flexibility is the human ability to adapt the cognitive processing strategies to face new and unexpected conditions in the environment" (Cañas, 2006, p. 296).

This notion, core to cognitive-control function[2] (Braem & Egner, 2018), defines the ability to switch our knowledge and thinking from one subject or dimension to another (Ionescu, 2012). Yet, due to a lack of consensus on a definition, cognitive flexibility can hardly be limited to that switching notion. Researchers have over the years broadened the definition to include other concepts, which gives a vast, and sometime messy spectrum to that notion[3] (Dennis & Vander Wal, 2010; Ionescu, 2012). Amongst others, creativity and imagination, adaptability, being able to translate knowledge into different contexts, and the capacity to adopt different perspectives have been added in the notion of CF (Dondi et al., 2021). This capacity to adopt different perspectives can also be called open-mindedness (Price et al., 2015). Open-mindedness can be characterized by one's inclination to consider "a variety of intellectual perspectives, values, attitudes, opinions, or beliefs, even those that contradict the individual's prior opinion" (Price et al., 2015, p. 1). Researchers consider that one's level of open-mindedness is not stable, as it may differ across situations or domains (i.e., one might be open to considering various points of view on politics but not on religion). This notion is central for CF, since being able to perceive multiple perspectives and integrate them into one's judgments plays a substantial role in CF (Moor and Malinowski, 2009, cited by Sinnott et al., 2020).

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[2] "Refers to a family of top-down mental processes (…). There is general agreement that there are three core cognitive control function: inhibition and interference control (…), working memory (…) and cognitive flexibility" (Diamond, 2013, p. 136)

[3] See appendix 1 for a collection of different definitions of the concept.

CF, by nature, is embedded in system 2, in complex behaviors and reasoning. Indeed, it results from conscious and deliberated reasoning (Laureiro-Martínez & Brusoni, 2018).

For many years, several tasks and tests have been devised to study CF. Two of the most famous tasks are the Stroop task and the Wisconsin card sorting task. Both tests are mainly evaluating the shifting capacities of the participants (Rende, 2000). The Stroop task, developed in 1935, is based on the Stroop Color-Word Test and pairs conflicting stimuli simultaneously (i.e., a name of a color is printed on a paper of a different color; Stroop, 1935). During the Wisconsin card sorting task, participants are expected to accurately sort response cards based on a rule previously given to them through feedback (Rende, 2000). Though interesting, both tasks bear significant limitations. The main issue is that they have originally been developed for clinical use; therefore, their usage on mentally healthy participants is not recommended, since participants might lose interested due to the easiness of the tasks (Laureiro-Martínez & Brusoni, 2018). Another tool, the cognitive flexibility inventory (CFI) was developed in 2010 as part of a study on depression to assess which parts of cognitive flexibility enable individuals to appropriately respond adaptively to stressful life events (Dennis & Vander Wal, 2010). The focus on medical conditions of the CFI, and the other limitations of both the Stroop task and the Wisconsin card sorting task, led me to choose the cognitive flexibility scale (Martin & Rubin, 1995).

An interesting reason to study cognitive flexibility is that, rather than being solely innate, CF can be acquired and implies a learning process (Cañas et al., 2006). To foster CF, Cañas suggests training programs based on knowledge representation and attentional processes. Indeed, being cognitively flexible leads to diverse benefits, and, amongst other, it helps "producing diverse ideas, considering response alternatives, and modifying plans and behavior in order to manage changing circumstances and long-term goals" (Rende, 2000, p. 122). This finding makes it even more necessary to study CF in-depth, to understand how individuals and companies can harness the advantages of flexibility.

On the other hand, cognitive inflexible behaviors can be very damaging as they are utterly ineffective. Cognitive inflexibility can be illustrated when facing new conditions, "actions that have shown to be effective in previous situations are insistently carried out in new situations where they are ineffective" (José J. Cañas, 2006, p. 296).

As previously said, according to Cañas (José J. Cañas, 2006), CF depends on attentional processes and knowledge representation. As they are key to CF, both concepts deserve to be covered with more detail.

Attentional processes

Cognitive flexibility heavily depends on the awareness and recognition of new or unfamiliar features in an environment. Attention to the surroundings is therefore primordial. Kotler and collaborators (2016) define attention as "the allocation of mental processing capacity to a stimulus"[4] (Kotler et al., 2016, p. 197). We are all subjected to a varied number of stimuli and pieces of information, but individuals do not react the same way to similar stimuli. Amongst others, past experiences, personal characteristics, and the personal, social, and cultural environment play an important role in how one seizes and interprets the received data (Coelho do Vale, 2021). It is therefore also important to acknowledge mental mechanisms that could affect the way one perceives new stimuli. In his book *Marketing Management*, Kotler identifies three of these: selective attention, selective distortion, selective retention.

The first type, selective attention refers "to the differential processing of simultaneous sources of information. In nature these sources are internal (memory and knowledge) as well as external (environmental objects and events)" (Johnston & Dark, 1986, p. 44). We are all subjected to selective distortion, the second type of mechanism, which "causes the individual to distort the information received in order to make it more consistent with his or her beliefs"[5] (Kotler et al., 2016, p. 197). Finally, the third type, selective retention, refers to the phenomenon that causes an individual to retain only part of the information he or she perceives.

Closely linked to those attentional mechanisms – which are important to acknowledge and address, it is crucial to avoid automatic responses (Cañas et al., 2006). This is where attention has a big role to play. Indeed, automatic responses to a stimulus weakens the attention to changes in the environment, and, therefore, leads to less appropriate responses (Cañas et al., 2006). Thus, adding attention checks when evaluating CF is important to reduce the impact of automatic answers. Researchers have advanced that some attitudes, linked with objects or

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[4] Translated from French.
[5] Translated from French.

stimuli, are so accessible in memory that they become active upon simply being presented with the said object (Fazio et al., 1986). We can therefore understand that the main risk with automation and routine responses is to give quick, yet inappropriate responses. Moreover, even when our behavioral decisions are made as a result of the information currently active and relevant in our memory, it is still of paramount importance to constantly update the information we gather from our environment(Chen & Bargh, 1999). This regular assessment requires "a high level of attentional control, where the individual accesses the new situation and plans the action to be taken"(Cañas et al., 2003, p. 483).

Practice in a given task reinforces automatic answers. According to the situation at hand, and the experience one has of it, Rasmussen (1983) differentiates various levels of performance: 1) skill-based level – such as riding a bike, drinking, leading to an automatic answer, 2) rule-based level – for situations in which one can use one's experiences, 3) knowledge-based level – described by Cañas and collaborators., (2003) as novel situations, in which the individual has no pertinent rules to rely on, and needs to plan a different response. The first two generate higher automatic responses, while to third one asks for an analysis of both the environment and the objective of the action (Rasmussen, 1983).

What is important to highlight here is that to perform in CF, one must constantly update oneself, one's perception of the information or the environment, as well as one's reaction to it. As we will see in the next section, knowledge can also be updated, so as to unlock new ways of achieving objectives.

Knowledge representation

According to Spiro and collaborators (2009), "cognitive flexibility is dependent upon having a diversified repertoire of ways of thinking about a conceptual topic". Knowledge representation can be considered the way "people represent their knowledge about a task and the possible strategies in which to engage with it*" (José J. Cañas, 2006, p. 296). It is crucial that what has been learned can be modified, transferred in various situations, and applied according to new parameters. Researchers have found that multiple knowledge representations are not only useful in better understanding complex individual concepts, but they also provide a more complete understanding, foster abilities, and enhance the performance in processing different situations (Spiro et al., 1988).

To prevent cognitive rigidity – or inflexibility, one needs to avoid several knowledge representations biases, such as: oversimplification of complex and irregular structure, context-independent conceptual representation, overreliance on precompiled knowledge structure, and rigid compartmentalization of knowledge components (Spiro et al., 1988).

With this knowledge on the way we think, and a few concepts to ponder on when considering our thinking process, I will now study the second important part of my question: the way we plan. In this part, I will not only write about forecasting but also about some components of such decision-making actions: risk (v. uncertainty) and the structure of problem (well-defined v. ill-defined).

2.2. The way we plan ahead

Decision making under uncertainty

The distinction between risk and uncertainty is central for our understanding of decision making, as well as for the study that will be subsequently detailed.

In a decision involving risk, one knows "the probabilities of all outcomes for all alternatives (…) this makes it possible to calculate the only correct, or optimal response" (Volz & Gigerenzer, 2012, p. 1). Gambling, for example, fits this definition. In these situations, risk can be evaluated, and there are no unknowns on the alternatives, the consequences, or the probabilities. Optimal decisions under risk derive from solving implicit mathematical models representing the issue according to the interests, objectives, and priorities of the decision-maker (Merigó, 2015).

On the other hand, when considering decision making under uncertainty, "probabilities cannot be expressed with any mathematical precision, neither in frequencies nor in propensities" (Volz & Gigerenzer, 2012, p. 1). This means that under uncertainty, some of the relevant information is unknown and incomputable. Everyone must therefore "rely on their own subjective probabilities of outcomes" (Sarin & Wieland, 2016, p. 3). Those situations are the ones we face most of the time: which road to take to go to work, what are the prognostics about a certain

situation, whom to marry, where to go in holidays, and so on. In order not to be paralyzed, our brains use strategies and rely on heuristics cues to take the decision that seems the best one (Volz & Gigerenzer, 2012).

Heuristics, closely linked to system 1, are used every day to reduce the effort needed to solve a problem. Relying on heuristics allows one to "1) examine fewer cues, 2) reduce the effort of retrieving cue values, 3) simplify the weighting of cues, 4) integrate less information, and 5) examine fewer alternatives" (Gigerenzer & Gaissmaier, 2011, p. 454).

Unfortunately, most of the time when facing geopolitical questions, decision-makers cannot be aware of all possible alternatives or outcomes. Geopolitical forecasting involves unknown, and therefore uncertainty. Understanding the distinction between risk and uncertainty, and considering the intricacies of a situation, provide a better grasp of the issues at stake and the difficulties they present to decision-makers.

Ill-defined problems

Theories on problem-solving have been developed for decades. Various aspects of problem-solving have been studied, and, at first, it seemed that to reach an effective solution, domain expertise was crucial. Although being knowledgeable is important in the problem-solving process, the problem's structure has been identified as an important constraint (Nickerson, 1991; Voss and Post, 1988 cited by Schraw and collaborators, 1995).

The structure of a problem can fall within two distinct frameworks: it can be well-defined or ill-defined – also called well or ill-structured problems. Well-defined problems are problems where "all the elements necessary for a solution are knowable and known, and there is an effective procedure for solving it" (Kitchener, 1983, p. 224). Finding a solution to those problems can be relatively straightforward when applying "a fixed number of concepts, rules, and principles" (The Clay Hill, 2015). On the other hand, ill-defined problems are more complex by nature, cannot be solved following a procedure, and do not have guaranteed or obvious solutions (Schraw et al., 1995). An ill-structured problem is characterized by the number of unknown elements it contains. The initial and final states are unknown, the number of solutions is almost limitless, the dependence on the context is strong. With this type of problems, expertise "cannot guarantee a correct or absolute solution" (Kitchener, 1983, p. 225).

Knowing about this distinction between those two types of problems is interesting because most of the problems we face in our daily life are ill-structured, as forecasting generally is. Furthermore, it has been confirmed, through hypothesis testing, that cognitive flexibility has a positive effect on the performing of an ill-structured task, by being able to provide better evaluations and answers to a problem (Laureiro-Martínez & Brusoni, 2018).

Forecasting

Forecasting is making assumptions on what will happen in the future, considering what is known from the present and from the past. Forecasting is used as a decision-making tool, as well as a planning tool (Corporate Finance Institute, 2022). It is widely used to foresee demand, market shares, or market trends. In every company, forecasting plays an essential part in all key area of business management (Makridakis Spyros & Wheelwright Steven C., 1977). The practice of forecasting should be central, to the same extent as intelligence gathering, for every company.

Nevertheless, many companies are still struggling to properly apprehend geopolitical events or indeed cultural trends and events, how there are going to unfold, and what their consequences are likely to be (Dehn & Everington, 2020).

This is even truer since the emergence of social media. Indeed, social media have shaped the way consumers learn and interact with certain situations and have forced companies to deal with crisis differently than hitherto. Those interactive platforms have brought new dimensions to contemporary crisis: content, information, or disinformation, are spreading wider and faster than ever – amplifying protest, exacerbating emotional reactions, and highlighting conflicting opinions (Oberiri Destiny & Elif, 2019).

Even if forecasting can be done in different ways, two major methods can be distinguished: qualitative or quantitative methods. Quantitative forecasting is based on data; it is a mathematical and statistical process relying on objective information, thus demanding less cognitive flexibility than the qualitative method, which seldomly relies on data but rather on heuristic cues, past experiences, judgments, and knowledge, among others. Both methods can be used conjointly or separately, according to the available data or the question raised, as they have complementary strengths and weaknesses (Caniato et al., 2011). Forecasting studies have

shown that a combination of methods improves accuracy in comparison with a single method (Blattberg & Hoch, 1990).

Blattberg & Hoch (1990) have argued that using forecasting models (quantitative methods based on databased) affords many advantages: no biases, no emotions, immunity to social pressures, etc. Yet, models only "know" what they have been programmed or taught to know. Thus, these models are ill-suited to evaluate variables that are impossible to measure objectively, as they are quite rigid and do not adapt easily to changing conditions. Consequently, it is not surprising that their research highlights the importance of combining of the two methods – quantitative and qualitative, to improve forecast quality and accuracy.

In the last few years, the positive relation between super-forecasters and cognitive flexibility has been established (Mellers et al., 2015; Vari-Lavoisier, 2021). To establish that link, Mellers and collaborators have engaged their sample during two years in forecasting tournaments focused on geopolitics questions. They used various tests, including the Cognitive Reflection test, the Raven's Advanced Progressive Matrices, or the Shipley-2 Abstraction test, to evaluate the cognitive abilities (amongst other the cognitive flexibility variable was studied), and style of each participant. In this study, the link between open-mindedness and CF has been found (Mellers et al., 2015), which only confirms what Moor and Malinowski (2009) had stated: open-mindedness is key for being cognitively flexible.

2.3. Complex choices: the case of the Ukrainian war

If we consider the war between Ukraine and Russia and its manyfold consequences as a prime example of many similar situations - where political or geopolitical events suddenly and significantly disrupt previously establish economic and business patterns, one question can encapsulate the conundrum companies are facing during the war: in the absence of formal legal obligations, should they stay or should they leave the Russian market?

While some companies have voluntarily suspended their operations in Russia (e.g., PayPal, Richemont, Ford, Kering) or closed them down (e.g., Netflix, Volkswagen, Accenture, KPMG),

others have decided to stay and continue their business (e.g., Leroy Merlin, Auchan, Alibaba, Qatar Airways; Yale School of Business of Management, 2022)[6].

Leaving the Russian market, like staying, raises legal, ethical, logistical, organizational issues (Edgecliffe-Johnson et al., 2022; Weaver & Edgecliffe-Johnson, 2022). We will see some examples next.

First, since the beginning of this war, some companies have argued that they have an obligation toward the Russian population, as well as towards their employees. Finding a balance between not punishing Russian consumers and employees and responding to the growing pressure coming from western countries and consumers to leave the market is complex.

Second, on March 10th, 2022, Mr. Putin threatened foreign companies exiting Russia with a seizure of their assets. For companies with physical assets in Russia, the threat is even more acute than for others. Industrial facilities are not the only asset at risk. Foreign firms also face risks associated with their digital assets, and the direct threat of cyber-retaliation.

Third, with the growing list of people and entities sanctioned by western governments, finding potential buyers has become harder than before. Additionally, now that various Russian banks were pushed out of the SWIFT system, transferring sales proceeds has become more complicated.

Fourth, for companies suspending their activities in Russia, several questions arise: when could they come back? Under which social, legal, moral, or political circumstances could companies legitimately decide to enter the Russian market again? Would they be welcome, or would their local reputation have suffered too much?

Experts are advising companies on how to deal with those questions. Yet, the answers must ultimately come from their senior executive and their boards. It has been demonstrated that speed and quality of decision are closely linked to a company performance (Aminov et al., 2019). Therefore, investing in sound forecasting makes even more sense; by giving beforehand a range of possible outcomes to deciders, they will be able to speed the decision-making.

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[6] Information collected on August 2022. Since then, the situation might have evolved.

In this new context, a solid knowledge of the industry, in-depth analysis, forecasting, and geopolitical understanding are as essential as ethical and emotional intelligence (Amaral, 2021). The war in Ukraine is a striking example of a broader reality that companies must face when there is a contradiction between the conduct of business and geopolitical upheavals: defining the rules to follow in such a situation. The Ukrainian case highlights that we need to think in depth about the education and training of our leaders and future leaders. It is essential that our managers be trained to consider all relevant facts in order to adequately respond to such unsettling situations.

It seems clear that these issues have not been sufficiently anticipated by both our countries and some of our companies. This is illustrated by our collective dependence on a hostile country, and now we are paying the price. Yet, despite its obvious negative outcomes, this war presents itself as a great opportunity to test my hypothesis: is high cognitive flexibility positively associated with forecasting abilities, and address my research question - is there a relationship between cognitive flexibility and forecasting abilities?

3. Method

In this chapter, I will consider the different technical points of my thesis. I will first give an overview of the participants – and their demographic characteristics; then I will describe the procedures I employed during the entire time of my work; and finally, I will be referring to the main variables, the tools I used and their limitations.

3.1. Participants

I aimed to collect (minimum) 80 answers for this study. The closing date of the survey was set for April 25th. That date was chosen to give to every participant a relatively equal chance on the forecasting questions. Indeed, answering closer to the deadline could give to the participants a clearer idea of the situations, and, therefore, a more accurate forecast. On that date, a total of 139 participants had started the survey, 44 did not finish answering all the questions and were excluded from the analysis. At the end, I could work with 95 valid answers. The final sample consisted of 44 men and 49 women; two participants decided not to state their gender. In terms

of age, two groups formed most of the sample: 36.8% were between 20 and 30, while 28.4% were between 51 to 60. Though there was no strict quota, I aimed at having a fair balance between participants aged between 20 and 40 – I will refer to this age group as "leaders of tomorrow", participants aged between 41 and 60 – they will be referred to as "leaders of today". At the end of the survey, all the participants fell into one of these two categories: 47 participants qualified as "future leaders" and 48 as "leaders of today".

All participants were European residents or citizens, mostly coming from Belgium (50 participants, i.e., 52.63%) and Germany (25 participants, i.e., 26.32%). Other nationalities included, amongst other: Portugal – 3.16% and France - 9.87%. Concerning their occupation, 41.1% of the participants were employed by a company, 30.5% were self-employed and 14.7% were students. Other groups included retired persons (10.5%) and unemployed persons (3.2%).

Participants were all volunteers and did not receive any reward or counterpart of any kind. The respondents were recruited through diverse channels: 1) social media – Facebook, 2) Católica's master students - recruited via WhatsApp, 3) professional and future professionals from my network, recruited through direct request.

3.2. Procedure

In order to better follow this part, one might wish to have a look at the survey itself[7].

Before starting to answer questions in my survey, participants read a consent form and a few lines explaining the objective of the survey (i.e., studying the relationship between individual characteristics and the capacity to forecast the future). After reading and accepting the informed consent form, participants were asked to undertake a three part-survey, which consisted of 31 questions. I used Qualtrics, an online survey tool to design the survey and collect answers.

The first part of the survey focused on assessing participants' cognitive flexibility. To do so, I used the cognitive flexibility scale on the form of a Likert table, developed in 1995 by Martin and Rubin. The scale covers the three components of CF identified by the researchers in their paper: "1) awareness that in any given situation there are options and alternatives available, 2) willingness to be flexible and adapt to the situation, and 3) self-efficacy in being flexible"

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[7] See appendix 2 for the entire survey.

(Martin & Rubin, 1995, p. 623). Each component was reflected in one or more of the 12 statements of the scale. Although the authors integrate many components in the scale, the scale has a single score and no subscales. Here is an illustration of the statements participants encountered: for the first component: "I can communicate an idea in many different ways", for the second: "I am willing to work at creative solutions to problems", and for the third: "I have the self-confidence necessary to try different ways of behaving" (Martin & Rubin, 1995, p. 624). Participants were instructed to tick the appropriate box – in a six-point scale, from "strongly disagree" to "strongly agree", on the statements dealing with their beliefs and assessment about their own behavior.

Once this part was over, participants were notified of the objectives of the second part of my survey, focused on forecasting (i.e., understand how one perceives the evolution of the Russian-Ukrainian war and its impact). This part consisted of 15 forecasting questions regarding the Ukrainian war and how participants were perceiving the situation to evolve. Those questions can be divided in four categories: 1) the situation on the field – "On April 30th, is the city of Odessa going to be occupied by Russia?", 2) general diplomacy and sanctions - "On April 30th, is Russia going to be entirely excluded from the SWIFT system?", 3) companies, citizens, and consumers – "Is the Chinese group Lenovo going to stop its commercial activities in Russia entirely by April 30th?", 4) economies and stock exchange – "On April 8th, 1€ is exchanged for 84.3173 Russian rubles. Do you think that, on April 30th at 00:00 UTC, 1€ will be exchanged for fewer rubles?". All questions in this section were of a yes or no format.

Finally, the third part of my survey covered the demographics. Participants were first asked to indicate in which age range they were in (from – 20 to 61+, by blocks of 10 years). Then I considered their gender and gave four options (male, female, other, prefer not to mention). I also asked participants about their nationalities. Finally, I questioned them about their occupation. Here, they could choose between six options: self-employed, employed by a company, job-seeking, unemployed, student, retired.

3.3. Materials

In the context of this thesis, and as previously mentioned, I analyzed cognitive flexibility and forecasting ability, and their potential correlation.

Predictor variable: cognitive flexibility

The instrument I chose to measure CF was the cognitive flexibility scale, developed in 1995 by Martin and Rubin to measure participants' cognitive flexibility. Martin and Rubin have modelled the CF scale as a Likert scale, consisting of 12 items – on a 6-point scale measuring participants' agreement with each statement (Martin & Rubin, 1995). All statements were rated according to the answer given – that is, answering "strongly disagree" would yield 1 point, while answering "strongly agree" would give 6 points. Four out of the 12 statements had to be reversely coded. The use of reverse-coded statements is important to verify participant's attention and reduce response bias (Field, 2013).

When creating this scale, the authors did two surveys and in both found high reliabilities, with a Cronbach's α of 0.76 and 0.77.

Outcome variable: forecasting abilities

To measure forecasting accuracy, I developed a questionnaire with 15 multiple-choices questions (e.g., "Is the group Belgian AB InBev (Leffe, Corona, Stella Artois) going to stop its commercial activities in Russia entirely by April 30th?" or "In 2021, the average level of the MOEX (Russian stock exchange index) over one year was 3637. On April 8th, the MOEX closed at 2592. Do you think that on April 30th at closing time, the MOEX will be valued below 2592?"). To each statement, participants were asked to answer yes or no, according to their prognosis of the probability of this event happening.

Once the deadline of April 30th reached, and to analyze the data, I recoded the variables and attributed to each of those statement points – one if the statement occurred to be true, zero if it happened to be wrong. Aside from the descriptive analysis that I did, I ran various regression analysis: a simple regression, without control variables, to estimate the relationship between CF and forecasting abilities, and one with three control variables: age, gender, and nationalities.

The following chapter will highlight the main results of the data anaysis to verify my hypothesis.

4. Results

In order to better understand my data set and to verify my hypothesis, I ran various tests. In this part, I will highlight the most interesting results of these tests. The analysis is also available in appendix 4.

4.1. Data preparation and cleaning

From a sample of 139 participants, 44 were excluded from the analysis for failing to answer all the questions. In the end, I could work with 95 valid answers.

Concerning the data preparation, four out of 12 questions in the CF scale were related to cognitive rigidity - leading to a reverse use of the scale. Therefore, before conducting any test, I reversed coded those statements (statements 2; 3; 5; 10). I also coded each forecasting statement individually, depending on the answer of the participants and its match with whether events had occurred. Thus, for each question, if the event occurred, I recoded "yes" answers with a score of one, and "no" with a score of zero. Contrariwise, I recoded "no" answers with one point when the event did not occur, and "yes" with zero points. This way, participants who answered "yes" to the following question: "On April 14th, oil was traded at 103.17\$. Do you think that on April 30th, oil will be exchanged below 103.17\$?" got zero points, and participants who answered "no" got one point. Finally, to gain a better understanding of the CF and forecasting result of the leaders of today and the leaders of tomorrow, I separated the different age groups into those two categories: with participants between 20 and 40 years old being coded as leaders of tomorrow and those over 41 years as leaders of today.

4.2. Exploratory factor analysis & scale reliability

To analyze the structure of the cognitive flexibility scale, I used the principal component analysis (PCA) with Promax rotation. The Kaiser-Mayer-Olkin (KMO) index was 0.76, exceeding the recommended value of 0.6 (Kaiser, 1970), while Bartlett's Test of Sphericity (Barlett, 1954) reached statistical significance ($\chi^2 = 252.93$, $p < .001$), indicating that the collected data was suitable for factor analysis.

The results of the initial analysis revealed three factors with Eigenvalues explaining together 53% of the variance – those three factors explain respectively 28.80%, 15.37%, and 8.83% of the variance. The scree plot suggests a clear break after the third factor (Figure 1), suggesting also a potential three-factor solution for the scale.

Figure 1

Factor analysis and scale reliability, scree plot
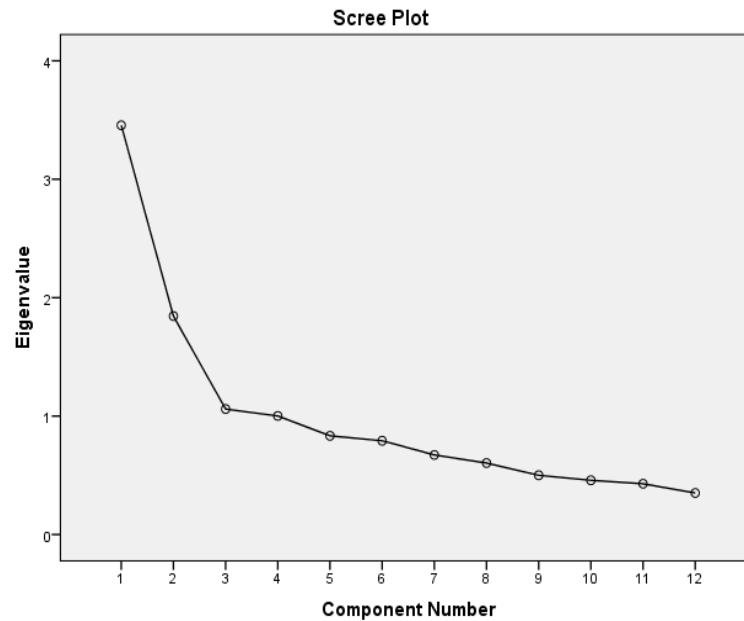
It is not surprising to find a three-factor solution (cfr. table 1). Indeed, as previously mentioned, Martin and Rubin (1995) defined and therefore assessed CF through three components: awareness of communication alternatives, willingness to adapt to the situation, and self-efficiency in being flexible. Six items (CQ1_4; CQ1_6; CQ1_7; CQ1_8; CQ1_9; CQ1_12,) are loaded on Factor 1, three items (RQ1_2; RQ1_3; RQ1_5) on Factor 2 and three items (CQ1_1; RQ1_10; CQ1_11) are loaded on Factor 3.

From here, we can compute the reliability of each factor using Cronbach's α. The results show that Factor 1 is above .70 (α = .790), thus in the acceptable range (Field, 2013). The second and third-factor reliability test was showing unreliability, α = 0.616, and α = 0.484 respectively. Interestingly, factor 1 and 3 show correlation (.343). To complete this analysis, I ran a reliability test of the entire scale, regrouping the factors in the initial single scale. Once again, the result was in the acceptable range, with α = 0.751.

Table 1

Factor analysis and scale reliability, factor loadings

Items	Factor 1	Factor 2	Factor 3
CQ1_4	.829		
CQ1_12	.717		
CQ1_9	.702		
CQ1_6	.697		
CQ1_8	.648		
CQ1_7	.487		
RQ1_2		.859	
RQ1_5		.729	
RQ1_3		.585	
CQ1_1			.777
RQ1_10			.640
RQ1_11			.592

In their work, Martin and Rubin (1995) do not clearly group the questions within the three dimensions, which could be potentially explained by the fact that one question could fall into various categories. Thus, and also due to the low reliability of some of the factors, I am myself not going to use the factors and instead am going to consider only the sum of all the 12 items.

4.3.   Descriptives

Cognitive flexibility

The descriptive analyses of the CF scores showed a mean (*M*) of 57.10 and a standard deviation (*SD*) of 5.99. The lowest score obtained was 41, and the highest score was 71. In terms of age, it seems that the leaders of tomorrow score higher in CF. Indeed, even if the difference between the means is not major (less than one point), their mean score was 57.63 (*SD* = 5.35), while the mean score of the leaders of today was 56.75 (*SD* = 6.66). Considering the nationalities, I will only focus on the two most represented nationalities: Belgian (*N* = 49) and German (*N* = 23). Germans show higher results in CF (*M*) = 58.78, (*SD* = 5.51), and that the mean of Belgian was 56.31 (*SD* = 6.65).

When creating the cognitive flexibility scale, Martin and Rubin (1995) conducted two surveys, the first one with 247 participants and the second one with 275. Although they did not disclose the difference between age, they did differentiate women and men, which can give us a comparison in terms of mean for our sample.

Martin & Rubin (1995)	Mean	Standard deviation
(First survey)		
Women	54.4	6.3
Men	53.4	7.4
(Second survey)		
Women	55.6	6.5
Men	54.1	6.9
My survey	Mean	Standard deviation
Women	57.73	4.80
Men	56.15	7.16

Forecasting tasks

Concerning the forecasting task (total of 15 questions), the data show a mean of 9.75 correct forecasts and a standard deviation of 1.74. The lowest score obtained was 5 correct forecasts, and the highest score was 13. In terms of age, both groups have really similar results. The leaders of tomorrow obtained an average score of 9.60 ($SD = 1.85$), while the mean score of the leaders of today was 9.90 ($SD = 1.64$). Considering only the score from the Belgian and German respondents, a test to compare means indicated that the mean of Germans in the forecasting task was 10.44 ($SD = 1.56$), and that the mean of Belgians was 9.66 ($SD = 1.67$).

Finally, the table in appendix 3 shows the percentage of participants who correctly answered each forecasting questions.

4.4.   Bivariate correlation

To uncover the relationship between all variables, cognitive flexibility, and forecasting, I ran a bivariate correlation analysis. At this point, the results showed that there was no significant correlation between cognitive flexibility and forecasting, $n(91\text{-}2) = r(89) = .05$, $p = .662$.

4.5.   Hypothesis testing and regression analysis

To verify my hypothesis that high cognitive flexibility positively impacts forecasting abilities, I used a simple linear regression. The first regression was run without control variables and showed that cognitive flexibility accounted only for 0.2% of variability in forecasting. The following results were reached: $R^2 = .002$, showing that only 0.2% of the variation in forecasting could be explained by CF, $F(1, 89) = 0.19$, $p = .660$. As implied by the low percentage of variance explained, the first regression did not support the hypothesis as no significant impact from CF on forecasting was found, $\beta = .014$, $p =. 660$. As I had divided my forecasting task in four categories, I thought it would be interesting to not only have overall results but to consider each category separately. Table 4 shows those focused results.

Subsequently, I ran another regression, this time a multiple regression to assess the effect of cognitive flexibility on forecasting, after controlling for the influence of age, gender, and nationality. My three control variables were first entered into the model and explained 17.9% of the variance in forecasting. Cognitive flexibility was entered in the second step. When considering CF in the model, the total variance explained by the model was 18.3%, $F(5, 83) = 3.72$, $p < 0.004$.

Table 4

Results of the forecasting task divided by questions category

Independent variable	Dependent Variable	R^2	β	p
Cognitive flexibility	Situation on the field	.012	-.014	.306
	General diplomacy and sanctions	.011	.018	.333
	Companies, citizens, and consumers	.027	.024	.123
	Economies and stock exchange	.008	.014	.390

Cognitive flexibility explained an additional 0.4% of the variance in forecasting, after controlling for age, gender, and nationalities, R^2 change $= .004$, $F(1, 83) = 0.39$, $p = 0.53$. In the final model, cognitive flexibility did not have a significant effect on forecasting, $\beta = .02$, $p = 0.53$. Therefore, I rejected my hypothesis.

Table 5

Regression analysis, overview of the findings

Variable name	β	t	p
Female	-1.14	-3.23	0.002
What is your age?	0.13	1.17	0.246
Germany	1.35	2.68	0.009
Belgium	0.42	0.93	0.355
Cognitive Flexibility	0.02	0.63	0.532

Notes: (1) Men were defined as the reference category. (2) *Age* was treated as a continuous variable. (3) The reference/baseline category regarding Nationality is "*other*". "Other" consists of all nationalities except Germany and Belgium.

5. Discussion

After considering the results of the data analysis, several questions arise which may lead to a better understanding of the issue. Firstly, it is important to highlight the main findings. Secondly, I will consider their relevance, both academic and managerial. Finally, I will detail a few limitations faced throughout this master thesis and how those could be overcome in further research.

5.1. Research findings and main conclusion

As a result of the analysis of my data, I had the following findings no major difference in the cognitive flexibility between the two age groups (leaders of today, and leaders of tomorrow) was found. In terms of nationalities, considering only the two most represented nationalities,

results show that Germans had a higher cognitive flexibility mean than Belgian. Regarding the forecasting task, once again, no major difference was found between the two age groups. Germans showed higher results in the forecasting task. The bivariate correlation analysis presented no significant correlation between cognitive flexibility and forecasting. Finally, the regression analysis exhibited similar results: the first regression (without control variables) demonstrated that cognitive flexibility accounted only for 0.2% of variability in forecasting. After running the second regression, with three control variables – age, gender, nationalities, the total variance explained by the model was 18.3. Cognitive flexibility explained an additional 0.4% of the variance in forecasting, after controlling for age, gender, and nationalities. I therefore had to reject my hypothesis.

Although those results did not support my hypothesis, other studies have shown that a high level of cognitive flexibility is positively correlated with good decision-making and forecasting skills (Mellers et al., 2015). Moreover, the literature on cognitive flexibility has brought to light numerous components of cognitive flexibility that seem crucial to decision-making: the ability to adopt different perspectives, identify creative solutions, update mental representation, and so on (Ionescu, 2012; Laureiro-Martínez & Brusoni, 2018). As I realized the importance of CF, I became interested in understanding if it was possible to reach the same conclusion than Mellers and collaborators, using similar tasks (i.e., geopolitical forecasting questions), but with a different sample and a way shorter timeline (the tournament spread during years for Mellers et al. vs. one month for my survey). Our samples were different in many regards: mine was European (vs. American), 47.3% of my sample were men (vs. 83% for Meller et al.'s sample), there were no screening questions regarding the academic level and the political expertise of participants (vs. the requirement to have a "bachelor's degree or higher and completion of a battery of psychological and political knowledge tests"; Vari-Lavoisier, 2021, p. 103).

In the next section, I will highlight the limitations I faced, which could explain my results. I will also consider some paths to follow for future work. Although my work did not corroborate my hypothesis, this research on CF is nonetheless interesting and suggest the need for future studies, as much in terms of understanding CF as in terms of how to train and foster it.

5.2. <u>Limitations</u>

As previously said, despite non-significant results, everything in the literature review leads me to believe that not only is cognitive flexibility a crucial skill, but it can also lead to better decision-making and better forecasting. The question now is to understand and acknowledge the limitations of my work and consider them in order to be able to produce higher quality work in future research on this topic.

Firstly, with the hindsight I have now, I would consider building a stronger and more complete survey. Although considering only CF and forecasting made sense at the time, what I have learned is that CF is a complex skill, with deep roots in many other competencies. For example, it might have been interesting to measure the two systems of reasoning, to understand if the accuracy in forecasting answers were coming from system 1, and therefore intuitive, or from system 2, and therefore reasoned. If the accurate responses to the questions emanated from system 2, we can expect that a variety of information and scenarios are considered before any decision. Had it been possible, an understanding of the various sources of information and the scenarios the participants considered would have added extra focus to this study; such elements should usefully feature in any future research.

Secondly, regarding the measurement of CF, it is important to highlight that, despite the certain advantages provided by the scale I used (i.e., practical in the setting of my survey and easy-to-use), it entails various limitations: 1) social desirability bias and 2) the fact that such a scale relies on one introspective ability (Laureiro-Martínez & Brusoni, 2018). Because we are not equal in our capacity to perform introspection (Fleming et al., 2010), and given the heavy impact social desirability can have on surveys, it would be important to conduct further research on this subject with additional biases controls. As previously mentioned, other tests and tasks exist (e.g., the Stroop task, the Wisconsin Card Sorting Task, the CFI) and even if they do not bear the same limitations, they have others. In future research, to ensure better reliability, it would be crucial to also measure actual abilities, and not only self-perception (Laureiro-Martínez et al., 2009).

Concerning CF, I would also suggest adding education as a control variable. Indeed, in the sample of Mellers and collaborators (2015), participants needed to have a minimum of a bachelor and successfully pass a series of psychological and political knowledge tests to be part

of the study. Their sample was therefore way less heterogeneous than mine, at least as regards their political acumen. To know whether this plays a significant role on the CF score would be interesting.

Thirdly, as previously mentioned, the forecasting questions were all related to the Russian-Ukrainian war. The main limitation raised by this way to interrogate people is linked to their knowledge of the current geopolitical situation in Ukraine and its ramifications. This variable is a confounding variable that I have not analyzed. A simple question to ask people how informed they are about the matter might have given a sharper explanation to the results. Though it would have added substance to my work, this lack of prior preparation reflects the reality our managers often experience as they have to deal with this sort of situations, they do not know a lot about or are not prepared for. Yet, for further research, I would suggest either measuring previous knowledge, as just suggested, or building different questionnaires, with various forecasting subjects, to offer each participant the opportunity to choose a topic they would be more knowledgeable it.

Finally, coming more as a suggestion for further research, I would ponder the possibility to do an experimental study. The first purpose of an experimental study would be to see if cognitive flexibility and forecasting abilities vary under specific conditions. Those conditions could be having an imposed topic v. a chosen one, being alone v. being part of a group, with previous teaching on the topic v. without… All those scenarios could singularly impact the result of cognitive flexibility on members of the groups and their forecasting accuracy. Evaluating CF and forecasting under these conditions would also be a way to recreate conditions close to reality and therefore increase the realism of such a study. By highlighting the conditions under which flexibility increases and the best decisions are made, we would be able to propose an optimal decision framework to decision-makers. Such a study would arguably give the opportunity to analyze a large and interesting range of discrepancies between these conditions. The evaluation of CF and forecasting accuracy should occur after every task in order to observe the differences induced by these various conditions.

Now that I have considered the limitations, highlighted the importance of certain improvements for future studies, it is time to considerer the relevance – both academic and managerial, of the thesis.

5.3. Academic and managerial relevance

Despite the results obtained, considering cognitive flexibility and its general impacts is important. Indeed, CF encompasses many skills important to master and to foster either in academia, in business, and in fact in all endeavors, such as adaptability, creativity, perspective taking, among others. As mentioned in my introduction, uncertainty has increased in our time (according to the Economic Policy Uncertainty Index and the World Uncertainty Index). This not only impacts our society and its protagonists – companies, and authorities, but every one of us. The complexity and the ambiguity embedded in uncertainty lead to anxiety, lower performance, lower job commitment and satisfaction, stress, and so on (Potter, 2021). Such pervading uncertainty most probably affects the mental health of many; it thus has a negative impact on job satisfaction, on commitment to a task or an institution, and therefore on the performance of companies – and indeed on the well-being of our societies at large. As CF can counter these effects, continuing the research on the topic is ever more important.

Let us first consider the managerial relevance. The literature shows positive effect of CF for companies and the entire process of decision-making: for Laureiro-Martínez et al., (2009) it (CF) is a "fundamental determinant of the organizational ability to learn and (…) to adapt to environment changes" (p. 6); later Laureiro-Martínez & Brusoni (2018) highlight the positive impact of CF on performance, and showed that CF is "an important antecedent of effective individual decision-making" (p. 90). While this study has not proved the association between CF and forecasting abilities, the other positive impacts on companies and decision making have been demonstrated - such as performance, motivation, ability to adapt to environment changes. Henceforth, it is important for companies to consider CF in recruitment, in talent development, and when promoting or selecting a person to a managerial or leadership position. Scientific literature amply highlights the importance and advantages CF can bring to individuals and companies. This notion and all the skills it entails could be a real asset to fight the increasing uncertainty I previously mentioned. There appears to be nowadays not just more complexity but indeed more uncertainty (real or perceived) than yesteryear, and this trend may well continue, perhaps even accelerate (Finn et al., 2020). If that is indeed the case, and that cognitively flexible people can better tackle complexity and foresee its evolutions and future consequences, such people would prove a most precious asset for companies and institutions alike…

This importance does not only apply to recruitment or career development, but it also applies to the entire organization of a company. For years, companies have built processes. To improve efficiency, every layer of a company must follow guidelines and processes. It took such an important place that "business automation" is now part of any company's vocabulary. And, although this results in a lot of advantages (less time is wasted, fewer errors are committed, standard quality is insured), it leads to automatic answers. Yet, as previously mentioned, automatic answers are a danger, as they decrease attention to novel details and facts, increase inflexibility, and thus the risk of analytical or pragmatic (Fazio et al., 1986). Of course, people with high CF are not immune to abuses these intuition-promoting processes (viz., automation) can bring, even if they can counteract them better than others. I am not questioning the importance of automatic processes, just highlighting the strategic advantages of CF, which could be repressed under the excessively automation-driven processes.

Cognitive flexibility is not only important for companies in terms of leadership or to avoid the drawbacks of automation, but it can bring competitive advantage if properly implemented in the very functioning of the organization of the structure. One way to foster CF to reach a competitive advantage is through collaboration. Indeed, it has been found that cognitive flexibility abilities are best expressed collaboratively (Mellers et al., 2015). Therefore, to increase cognitive flexibility, it is crucial to rethink the way things are done or the way problems are tackled. A problem should not be addressed by one person alone, nor should it be by one department. Mellers and collaborators show the importance of building mechanisms allowing all relevant levels and departments to come together to analyze issues collectively and creatively, rather than leaving that to the hierarchy alone, to reach more creative solutions. Fostering cognitive flexibility inside a company is also possible through talent development - upskilling, flattening the organizational structure, and nurturing a culture where the expression of new ideas or where innovation is encouraged, to name only three options.

The academic relevance is no less important. Cognitive flexibility should not be the prerogative of the business world but of our entire societies, starting with academia. Indeed, fostering CF in companies can offer them a tactical advantage, but fostering it at an early age could give any society a permanent advantage, allowing them to better adapt and to apprehend complexity better.

The importance of CF, right from a young age, has already piqued the interested of several researchers: Peralbo-Uzquiano and collaborators (2020) have analyzed how digital game-based and gesture-games learning improved CF on children from three to six years old. Buttelmann & Karbach (2017) have identify various training methods based on task-switching and on the dimensional change card sort task that significantly improve CF among youth, across childhood and adolescence. Other researchers have focused on young adults and on older adults: in 2013, it had been discovered that real-time strategy video games could significantly improve CF on young adults (Glass et al., 2013), and in 2016, Müller and collaborators have shown that concentrative meditation led to an increase in CF.

What emerges from my research is that, although I could find a few studies showcasing tools to improve CF, there is still a lot to be researched. The question of how to improve and foster CF on healthy young or mid-life adults seems still to be under-researched and, knowing the importance of CF and the competitive advantage it can bring, the paucity of academic article on the subject is a real shortfall.

6. Conclusion

In sum, during this work, I have studied the impact of cognitive flexibility on forecasting abilities. My readings have convinced me the importance of cognitive flexibility as the benefits to be gained from being cognitively flexible are immense. Indeed, much previous research has established that cognitive flexibility has a major positive impact/influence on creativity, performance, adaptability, and so on. It is with this in mind that I explored the relationship between CF and forecasting abilities. Although the result of my analysis did not confirm a correlation between the two items, I have highlighted limitations that could explain the reasons for those results and suggested new procedures for future research. Following a thorough dive into the literature on the subject, it is clear to me that the field of cognitive flexibility is still under-explored and would deserve further consideration. Researchers should investigate how, at every layer of our societies, cognitive flexibility can be fostered, and enhanced, to address global challenges and to reach competitive, strategic, and political advantage.

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8. Appendix

Table of content

1.1. Broad definition of cognitive flexibility (Ionescu, 2012, p. 192)

Table 1

Overview of the different definition given to cognitive flexibility

Cognitive flexibility	Author(s)
(1) "One component of executive unction is cognitive flexibility, which refers to the ability to shift to different thoughts or actions depending on situational demands".	Geurts et al., 2009, p. 74
(2) "… the "shifting" between tasks and mental sets (also called "flexibility")".	Colzato et al., 2009, p. 226
(3) "...the ability to flexibly switch between different tasks, commonly termed set-shifting or cognitive flexibility".	Cragg & Chevalier, in press, p. 2
(4) "Cognitive flexibility, that is, the ability to flexibly switch perspectives, focus of attention, or response mappings"	Diamond, 2006, p. 70
(5) "… the Shifting Attention Test and the Stroop Test; both are measures of what neuropsychologists refer to as "cognitive flexibility" or "executive function""	Masley et al., 2009, p. 189
(6) "Flexibility refers to the ability to shift between responses and mental sets, and to generate alternative strategies" (italics in the original)	Bennett & Müller, 2010, p. 455
(7) "Cognitive flexibility, or the ability to consider simultaneously multiple conflicting representations of a single object or event (…)"	Jacques & Zelazo, 2005, p. 54
(8) "Cognitive flexibility, the ability to adapt goal-directed behavior in response to changing environmental demands (...)"	Garcia–Garcia, Barcelo, Clemente, & Escera, 2010, p. 754
(9) "Flexible cognition entails the dynamic activation and modification of cognitive processes in response to changing task demands"; "... flexibility is a higher-order (i.e., derivative) property of cognition."	Deak, 2003, p. 275; p. 276

(10) "The rest of this section explicates a few stereotypic properties of mental states: (.), embedding, intentionality, flexibility, and displacement".	Kockelman, 2012, p. 5
(11) "The dependent variable sof divergent thinking tasks, such as the Alternative Uses Task, are (…), flexibility (i.e., the number of different types or categories of ideas) (...)"	Dietrich & Kanso, 2010, p. 823
(12) "So the AUT assesses a cognitive flexibility measure connected to creative mechanisms involving verbal fluency and originality" (italics in the original)	Cretenet & Dru, 2009, p. 204
(13) "Flexibility is the ability to produce responses from a wide perspective"	Takeuchi et al., 2010, p. 12

1.2. Survey

Dear participant,

Thank you very much for taking the time to answer this survey! This should take less than 10 minutes.

This survey is conducted for research purposes as part of my master's thesis. My aim is to study the relationship between individual characteristics and the capacity to forecast the future.

Your participation is voluntary. I will not collect or store any personally identifiable information from you.

If you have any questions, please contact me at the following address: s-hrscunha@ucp.pt.
Best regards,

Hermine

<u>Question 1</u>

The following statements deal with your beliefs and feelings about your own behavior. Read each statement and respond by ticking the appropriate box.

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
I can communicate an idea in many different ways.	○	○	○	○	○	○
I avoid new and unusual situations.	○	○	○	○	○	○
I feel like I never get to make decisions.	○	○	○	○	○	○
I can find workable solutions to seemingly unsolvable problems.	○	○	○	○	○	○
	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
I seldom have choices when deciding how to behave.	○	○	○	○	○	○
I am willing to work at creative solutions to problems.	○	○	○	○	○	○
In a given situation, I am able to act appropriately.	○	○	○	○	○	○
My behavior is a result of conscious decisions that I make.	○	○	○	○	○	○
	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
I have many possible ways of behaving in any given situation.	○	○	○	○	○	○
I have difficulty using my knowledge on a given topic in real life situations.	○	○	○	○	○	○
I am willing to listen and consider alternatives for handling a problem.	○	○	○	○	○	○
I have the self-confidence necessary to try different ways of behaving.	○	○	○	○	○	○

Dear Participants,

The following questions are forecasting questions. I focused all the questions on the Ukrainian war. My aim to understand how you perceive the evolution of this war and its impact.

Situation on the field

<u>Question 2</u>

On April 30th, is the city of Odessa going to be occupied by Russia?
- o   Yes
- o   No

Question 3

From now to April 30th, is Russia going to use non-conventional weapons (chemical, biological, or nuclear in nature)?

- o Yes
- o No

Question 4

From now to April 30th, is the EU going to provide heavy offensive weapons to Ukraine (tanks, anti-ship missiles or artillery systems)?

- o Yes
- o No

Question 5

Is Russia going to withdraw its troops by April 30th to their position of before February 24th?

- o Yes
- o No

General diplomacy and sanctions

Question 6

On April 30th, is Russia going to be entirely excluded from the SWIFT system?

- o Yes
- o No

Question 7

From now to April 30th, will the Russians impose limits on their own food and fertilizer exports to Europe?

- o Yes
- o No

Question 8

On April 30th, will a European embargo be imposed on Russian gas and oil?

- o Yes
- o No

Question 9

From now to April 30th, will there be a compromise between Russia, Europe, and the US on the issue of paying for gas in rubles?

o Yes

o No

Companies, citizens, and consumers

Question 10

Is the group Mulliez (Leroy Merlin, Decathlon, Auchan) going to stop entirely its commercial activities in Russia by April 30th?

o Yes

o No

Question 11

Is the Belgian group AB InBev (Leffe, Corona, Stella Artois) going to stop entirely its commercial activities in Russia by April 30th?

o Yes

o No

Question 12

Is the Chinese group Lenovo going to stop its commercial activities in Russia entirely by April 30th?

o Yes

o No

Economies and stock exchange

Question 13

On April 8th, 1€ is exchanged for 84.3173 Russian rubles. Do you think that, on April 30th at 00:00UTC, 1€ will be exchanged for fewer rubles?

o Yes

Question 14

In 2021, the average level of the MOEX (Russian stock exchange index) over one year was 3637. On April 8th, the MOEX closed at 2592. Do you think that, on April 30th at closing time, the MOEX will be valued below 2592?

o Yes

o No

Question 15

On April 11th, wheat was traded at 10.52$. Do you think that on April 30th, wheat will be exchanged below 10.52$?

o Yes

o No

Question 16

On April 14th, oil was traded at 103.17$. Do you think that on April 30th, oil will be exchanged below 103.17$?

o Yes

o No

Dear Participants,

Please answer those last questions about yourself.

Thank you!

Question 17

What is your age?

o – 20 years old

o 20-30 years old

o 31-40 years old

o 41-50 years old

o 51-60 years old

o   61+

Question 18

What is your gender?

- o   Male

- o   Female

- o   Other

- o   Prefer not to say

Question 19

Please, specify where you are coming from.

- o   Portugal

- o   Germany

- o   Belgium

- o   Spain

- o   Italy

- o   France

- o   Other, please specify: _____

Question 20

What is your occupation?

- o   Self-employed

- o   Employed by a company

- o   Job seeking

- o   Unemployed

- o   Student

- o   Retired

Thank you for your time spent taking this survey.

Your response has been recorded.

1.3. Forecasting questions and correct answers

Table 2

Forecasting questions, overview of the answers

Questions	% of correct answers
<u>Situation on the field</u>	
On April 30th, is the city of Odessa going to be occupied by Russia?	75.79%
From now to April 30th, is Russia going to use non-conventional weapons (chemical, biological, or nuclear in nature)?	67.37%
From now to April 30th, is the EU going to provide heavy offensive weapons to Ukraine (tanks, anti-ship missiles or artillery systems)?	55.79%
Is Russia going to withdraw its troops by April 30th to their position of before February 24th?	92.63%
<u>General diplomacy and sanctions</u>	
On April 30th, will Russia be entirely excluded from the SWIFT system?	65.26%
From now to April 30th, will Russia impose limits on their own food and fertilizer exports to Europe?	49.47%
On April 30th, will a European embargo be imposed on Russian gas and oil?	80.00%
From now to April 30th, will there be a compromise between Russia, Europe, and the US on the issue of paying for gas in rubles?	69.47%
<u>Companies, citizens, and consumers</u>	
Is the French group Mulliez (Leroy Merlin, Decathlon, Auchan) going to stop its commercial activities in Russia entirely by April 30th?	71.58%

Questions	% of correct answers
Is the Belgian group AB InBev (Leffe, Corona, Stella Artois) going to stop its commercial activities in Russia entirely by April 30th?	30.53%
Is the Chinese group Lenovo going to stop its commercial activities in Russia entirely by April 30th?	95.29%

Economies and stock exchange

On April 8th, 1€ is exchanged for 84.3173 Russian rubles. Do you think that, on April 30th at 00:00UTC, 1€ will be exchanged for fewer rubles?	47.37%
In 2021, the average level of the MOEX (Russian stock exchange index) over one year was 3637. On April 8th, the MOEX closed at 2592. Do you think that, on April 30th at closing time, the MOEX will be valued below 2592?	78.95%
On April 11th, wheat was traded at 10.52$. Do you think that on April 30th, wheat will be exchanged below 10.52$?	84.21%
On April 14th, oil was traded at 103.17$. Do you think that on April 30th, oil will be exchanged below 103.17$?	82.11%

1.4. Complementary tables

Table 2

Survey sample size

Valid		Invalid		Total	
N	%	N	%	N	%
95	68.35	44	31.65	139	100

Table 3

Sample demographics

		N	Valid %
Gender	Female	49	51.6
	Male	44	46.3
	Prefer not to say	2	2.1
Age	< 20 years old	1	1.1
	20 – 30 years old	35	36.8
	31 – 40 years old	11	11.6
	41 – 50 years old	7	7.4
	51 – 60 years old	27	28.4
	61+ years old <	14	14.7
Nationality	Portuguese	3	3.2
	Germany	25	26.3
	Belgian	50	52.6
	Spanish	1	1.1
	Italy	1	1.1
	France	6	6.3
	Other	9	9.5
Employment status	Self-employed	29	30.5
	Employed by a company	39	41.1
	Unemployed	3	3.2
	Student	14	14.7
	Retired	10	10.5

Table 4

Sum forecasting x nationalities

Nationalities	Mean	N	Std. Deviation
Portuguese	8.00	3	3.61
Germany	10.44	25	1.56
Belgian	9.66	50	1.67
Spanish	8.00	1	-
Italy	7.00	1	-
France	10.50	6	1.64
Other	8.89	9	1.051.74
Total	9.7474	95	

Table 5

Cognitive flexibility x nationalities

Nationalities	CF Mean	N	Std. Deviation
Portuguese	60.50	3	3.54
Germany	58.78	25	5.51
Belgian	56.31	50	6.66
Spanish	50.00	1	-
Italy	59.00	1	-
France	57.83	6	4.79
Other	57.11	9	5.01
Total	57.10	95	6.00

Table 6

Sum forecasting x aged group

Age	Mean	N	Std. Deviation
Leaders of tomorrow	9.60	47	1.85
Leaders of today	9.81	48	1.64
Total	9.75	95	1.74

Table 7

Total cognitive flexibility x aged group

Age	Mean	N	Std. Deviation
Leaders of tomorrow	57.63	47	5.35
Leaders of today	56.75	48	6.66
Total	57.16	95	6.06