Nature based Solutions for flood risks: what insights do the social representations of experts provide?

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Abstract

In the context of intensification of flood risks, NbS propose an interesting approach to conciliate population's protection and biodiversity. While this recently emerging concept has been the subject of numerous studies, there is still little work on this issue in social sciences. However, it is essential to understand the social representations of NbS in order to help authorities to overcome possible barriers to implementing more NbS projects for flood risk. As the opinions of experts eventually diffuse and come to shape the representations of the general public we decided to explore the social representation of NbS of flood risk experts. We interviewed 19 actors who can be divided into two groups: theorists and practitioners. These interviews were transcribed and analyzed using textual statistics and a qualitative analysis grid, in order to identify the main lines of discourse and how social representations are organized. Combining the two techniques is rather rare, but proves to be fruitful. The main findings of this work are that the social representations of the two groups of experts diverge and that the concept of NbS and the solutions it encompasses do not seem to represent the same social reality. The lack of collaboration between institutions and field actors is a major obstacle to the implementation of NbS projects. Finally, the social representations of the two groups of experts have a common basis which seems to be centered on cognitive biases such as the need to control risk and natural ecosystems, and the culture of civil engineering. Moreover, the results suggest that the expression "NbS" is not well suited to all actors.

1 Introduction

One of the major challenges of the Anthropocene era is undoubtedly human adaptation to climate change. The latter has impacts on many phenomena and in particular on the frequency and intensity of extreme climatic events such as floods [1]. In France, flooding is the leading natural hazard [2]. To protect exposed populations, many solutions, both structural and non-structural, exist and are implemented in the field. In addition to civil engineering infrastructures (dikes, flood control dams, etc.), which are very well developed in France, the concept of nature-based solutions to flooding has emerged.

Nature-based solutions (NBS) propose adaptation strategies to address current climate challenges [3] of which flooding is one. NbS are defined as "actions to protect, sustainably manage, and restore

natural or modified ecosystems to directly address societal challenges in an efficient and adaptive manner, while ensuring human well-being and producing biodiversity benefits" [4]. There are a huge number of NbS that can mitigate the impact of flooding such as green roofs or rain parks. A rain park is an urban park in which a portion is designed to receive water during a flood; by capturing some of the runoff, it limits flooding while avoiding the need for concrete constructions. The risk of flooding is higher in urban areas where urbanization and soil sealing are drastically increasing [5], which can lead to greater runoff, thus aggravating the risk of urban flooding [6]. So-called "gray" solutions such as levees, which are traditionally used in Western cities, no longer always have the capacity to keep pace with the increasing rate of stormwater [7] [8]. Moreover, these "gray" solutions usually only address the sole objective of protection where NbS can be multifunctional. Indeed, they contribute to the adaptation to climate issues, as well as to biodiversity and human well-being, while providing an effective response to the protection of populations from flood risk [9] [10]. Several territories have already experimented with the use of NbS for flood risk management; these examples are documented and reviewed in the literature[11] [12]. Examples include re-meandering to restore the original course of a stream to dissipate its energy or vegetating the slopes of a basin to reduce and slowdown runoff.

In France and internationally, various institutions have adopted the NbS concept [13] [14]. It has been adopted by the European Commission in its "Horizon 2020" research program to promote the development of NbS in urban areas. Although this recently emerging concept has been the subject of various studies [15], as yet little work on this issue has been done in the humanities and social sciences. However, we believe that these disciplines, starting with social psychology, could shed new light on this concept. Indeed, social representations are at the center of the processes that allow us to understand how social knowledge is constructed around a new object [16] and this seems to constitute a relevant framework to study NbS.

1. Nature-based solutions and social representations

a. How are NBS an object of social representation?

The theory of social representations conceptualizes common sense knowledge that is composed of ideas, values and symbolic associations [17]. These representations are formulated socially and used within social groups to understand a new phenomenon [18]. To identify a social representation is thus to first study what individuals think about an object, how they use it and why they express it in such a way in the formulation of their common reality [19].

Nature as a social object of representation has been studied extensively. Serge Moscovici himself, in his essay on the history of nature, describes it as organic, cybernetic or mechanistic. These different representations are involved in the very social construction of nature [20] and are synchronous, distinct and interdependent. Each of them is intrinsically linked to a particular sense of identity, a mode of knowledge and a mode of relation to nature [21]. This polysemy of nature has been described at length by Descola [22], who explains that "nature" is a Western concept invented to differentiate human culture from the rest of living beings. Close to the term nature, the notion of environment is very broad and is also used in many contexts [23]. The very definition of environment leaves much room for interpretation: indeed, Sauvé [24] described six representations of the environment: the environment as a resource, a problem, a place to live, a biosphere, a community project and as nature. These six paradigmatic conceptions are at the heart of a singular representation of the environment [25]: they are complementary and coexist [24]. Some authors invoke a utilitarian vision opposed to an ecological vision of the environment [26] [27] [28]. We believe that these visions build a common ideological basis for a set of social representations of other environmental objects.

Like nature and the environment, the term NbS is polysemous and cannot be defined in a simple and univocal way. We consider it as a new technical-scientific object [29] that evokes different conceptions in individuals. It is a term that triggers debate: it can be praised as much for its qualities [4] as criticized for the vagueness caused by its definition [8] [30] and the lack of evidence by example that accompanies its principle [31] [32]. Moreover, the observation we can make today is

that NbS remain relatively unknown to the general public. The media and institutions that speak about NbS describe them as innovative, embodying high environmental values and whose co-benefits could revolutionize the current approach to flood risk [4] [14].

However, several obstacles to their implementation are cited in the literature. The first barrier relates to the persistence of a culture that favors gray infrastructure [33] [34]. This culture drives institutions to invest in projects equivalent to those they already know, even though NbS alternatives exist and are known. The actors involved prefer the certainty of a solution they have already encountered and that is easily replicable. A second obstacle concerns the definition of the concept, which remains poorly understood by actors [35][36]: few decision- makers clearly identify actions that can be qualified as NbS. In addition, the lack of evidence by example of the effectiveness of NbS is also an major barrier [37]. Finally, a third constraint is linked to the fact that implementing NbS requires advanced knowledge of the local environment in terms of both the natural ecosystems and the human organizations with which they interact [38] [39]. This lack of knowledge about natural ecosystems is a major barrier. The literature identifies other obstacles that are land-related, economic or technical.

The social psychology of the environment can propose an original analysis centered on the meaning given to this technical-scientific concept by individuals who work with it. In this study, we decided to interview flood risk experts in order to explore their social representations of NbS, in a context where knowledge about them is still lacking, even on the part of flood risk experts [15]. This new understanding could provide keys to the implementation of NbS in the field and help remove some of the obstacles previously identified.

b. Social representation of experts

As described previously, social representations are common sense knowledge [17]. It is therefore appropriate to clarify here why we have used this theory to analyze expert representations, which we might want to contrast in a rather binary way: scientific and rational knowledge versus profane

and irrational knowledge. However, the border between these two currents of thought can be porous [40].

The difficulties of apprehending new objects based on scientific findings is quite common [41] [16]. It concerns the general public but can also involve experts themselves. In this article, we focus on exploring social thinking around NbS. Social thought is a perspective in which objective reality is not considered to exist: all reality is represented, i.e. appropriated by individuals and groups [42]. Social thought thus refers to a set of cognitive systems that constitute the tool for reading the interpretation of the world [43]. It is in this context that we wish to explore the representations that experts may have of the social object of NbS.

In social representation theory, it is assumed that the opinions of experts eventually diffuse and come to shape the representations of the general public [44]. It is interesting to study the social representations of experts for this reason. However, the social representations of experts are not uniform [44]. Since we wanted to scan the broadest and most representative spectrum of actors in terms of professions, we interviewed fieldworkers and policymakers in addition to researchers. The interviewees can be divided into two groups: theorists and practitioners. Theorists are institutional and/or scientific actors, who are not necessarily close to the field (e.g., researchers). The practitioners are the technical actors in the field (e.g., river basin coordinators). Our hypothesis is that belonging to one or the other group will vary the SR of NbS. We decided to conduct a separate analysis between these two groups.

2. Method

a. Participants

Regarding recruitment, we contacted the participants by e-mail. To determine who were experts, we were able to base ourselves on their writings for scientists and on their positions in associations or unions for practitioners. We indicated to those who agreed that their participation was anonymous.

We interviewed 19 participants who are all flood risk experts. The panel of participants was composed of 12 women and 7 men who all have a specific area of expertise with respect to flood risk. The panel was composed of 9 practitioners and 10 theorists. Our independent variable (IV) was membership in one of the two groups (theorist or practitioner). The participants were listed in chronological order of interview and their occupations are reported in the following table (Table 1). The interviews lasted an average of 41 minutes and 28 seconds. In all, 13 hours and 8 minutes of recordings were retranscribed in order to be analyzed as closely as possible to the discourse.

Table 1. Participants' description

Participants	Variable	Profession	Gender
P1	practitioner	In charge of aquatic environment management and flood prevention (GEMAPI), flood risk prevention association	F
P2	practitioner	Animator, River Syndicate	M
P3	practitioner	Operation officer, River Syndicate	F
P4	practitioner	Regional coordinator, French Office for Biodiversity (OFB)	M
T1	theorist	Researcher in urban planning	F
T2	theorist	Researcher in vegetal engineering	M
T3	theorist	Research teacher in civil engineering	M
T4	theorist	Director of an Social and Environmental Psychology (SEP) research office	F
P5	practitioner	Wetland manager, Geographer	F
T5	theorist	Researcher in coastal development	M
T6	theorist	Researcher in hydrogeology	F
P6	practitioner	Works engineer, river syndicate	F
T7	theorist	Project manager, OFB	F
T8	theorist	Regional coordinator, OFB	F
T9	theorist	Researcher in environmental sciences	M
P7	practitioner	Director of development and territorial management, EP Bassin	M
P8	practitioner	Animator, OFB	F
T10	theorist	Deputy director, flood risk prevention association	F
P9	Praticien	Head of the GEMAPI mission	F

b. Materials : semi-structured interviews

An interview situation, through the psycho-social gaze "translates into a ternary reading of facts and relationships" said Moscovici [17]. We conducted semi-structured interviews with an interview grid adapted to both field and institutional actors (see appendices). This grid goes from the general to the

specific and asks questions about the entire creation of an NbS, from its design project to its long-term maintenance following its implementation. The first question concerns what the term NbS evokes for the interviewee, these evocations being frequently used to describe the themes of social representations [45].

The semi-structured interview was defined by Savoie-Zajc [46] as: "a data collection technique that contributes to the development of knowledge favoring qualitative and interpretive approaches pertaining in particular to paradigms. It is a discourse by theme whose order can differ according to the interviewee, whose inference will be moderated and which will contain certain obligatory points of passage." This methodology makes it possible to focus the interview on the specific themes to be addressed but also to give the interviewee freedom of speech to develop his or her discourse.

c. Procedure

Two types of analysis were carried out jointly: a thematic analysis and a lexico-metric analysis. Thematic analysis [47] consists in cutting up and grouping the speakers' interests, i.e. recurrent speech, into categories. This discursive examination of the aspects addressed makes it possible to classify them into themes and sub-themes. In brief, it is a matter of gradually answering the general question: "What is fundamental in this speech?" [48].

In the second step, we conducted a lexicometric analysis of the corpus of interviews using the Iramuteq software [49]. This allowed us to highlight quantitative results in terms of frequency by analyzing similarities. This method is part of data analysis techniques based on the idea of association [50]. It is based on graph theory and highlights the common and differentiated elements of a textual corpus according to different variables [51]. Here, the two variables were technicians (V1) and practitioners (V2).

3. Results of the similarity analysis: from common ground to disparities

a. Common basis of representation

The similarity analysis [50], highlighted the common aspects and differences between the two groups of experts: theorists vs. practitioners (Table 1). The following graph shows the use of terms according to the category of actor. In the center are grouped the terms that were most cited by the participants and the further away the words are, the less they were mentioned ("NbS " was pronounced 457 times versus 28 times for "farmer"). The thickness of the lines varies according to whether the words were uttered together (thick line) or separately (thinner line).

Fig 1. Which term is used by which group of experts? The blue word are mentioned by the theorists and the red word by the practioners. The black word are the common basis of the social representation.

The gap between the concept and the field is widened by its very definition, which is perceived as broad and vague by five experts, both theoreticians and practitioners: "it's vast, in fact, it's vast" (GEMAPI project manager, trade union); "from the moment you are going to say a use of something that is natural, I would say that you can qualify it as an NbS?" (researcher in hydrogeology). Two of them went so far as to describe the concept as difficult to apply: "the communities that really do what the IUCN definition says, there aren't that many [...] if we want to apply the whole IUCN definition to the letter, it becomes complicated to really find what fits in [...] it's quite restrictive" (director of a flood risk association); "It's hard to grasp the concept, to apply it in an operational way" (EP basin manager). This aspect is in line with the literature: the definition of the concept remains poorly understood by the actors [35][36]. The lack of evidence by example is mentioned by four experts: "I am waiting for concrete operations of nature-based solutions" (GEMAPI Mission Officer); "what is needed now is feedback" (SDL'E researcher). This also aligns with the literature [37]. Paradoxically, NbS techniques are portrayed as "old" by nine experts who detail NbS as "rustic" or "rudimentary" solutions (or other term) and have been used in the field for decades. The experts seemed to differentiate between the recent concept promoted by international institutions and the long-proven techniques it contains. All in all, many decision-makers appreciated this concept, but this was not necessarily the case for local residents: "I think that some decision-makers like this concept,

but the local population has a hard time understanding and accepting it" (wetland manager). The opposition of the inhabitants as well as their preconceptions were cited by six experts: "a rather strong opposition of these farmers [...] it was really a psychological barrier for the farmers who were really against it and took a hostile stand against the principle" (in charge of GEMAPI, river syndicate); "the major oppositions in the territory between the inhabitants and the managers of the natural environment" (in charge of operation, river syndicate); "this concept generates a lot of conflict [...] there are quite a lot of demonstrations" (in charge of a wetland). These aspects are opposed to the desire to involve the inhabitants in the projects. Moreover, three experts stated that it was impossible to calm conflicts and that they are obliged to expropriate: "In the long run, it will be done, but it will be painful" (works engineer, river union); "The only solution for the moment is to expropriate" (facilitator, OFB); "once the project is declared to be in the public interest, that is what justifies the right to expropriate" (works engineer, river union). This way of proceeding is the antithesis of thecommunity participation strongly encouraged by the institutions that support the NbS concept. This discrepancy reflects difficulties in articulating this participatory concept, which is not easy to implement [51] and requires scientific rigor [52]. By focusing on the NbS object, the humanities and social sciences could provide adapted expertise and promote a more appeased approach. This appeasement would also be beneficial for the experts themselves. Six of them told us about oppositions between experts or institutions: "I don't think they tell you the same thing because they work for nature, that's their primary objective" (operation manager, river syndicate about environmental researchers); "they don't trust each other [...], they don't trust each other between elected officials, in fact they have the impression that they won't be the ones to decide" (coordinator, river syndicate).

Despite the opposition between theorists and technicians, their objectives are indeed the same. The analysis of similarities reveals that they are situated around the terms "climate change" and "protect". The two ambitions of NbS are to protect populations from flooding by responding to the challenge of climate change and to biodiversity issues. Climate change mitigation through NbS is thus

198 linked to the capacity of ecosystems to capture and store carbon [53]. This same institution lists the
199 areas concerned by an NbS project for water-related risks [54] such as land use planning, agriculture
200 and the climate. The social issues addressed by the SHS are largely absent from this inventory. Other
201 sources have recently taken up these issues [55]. Their contributions in terms of conflict
202 management, environmental behavior and risk awareness would be invaluable.

203 b. What distinguishes theorist and practitioner

204 This analysis reveals that the term "NbS" was exclusively used by theorists during the interview. NbS
205 would therefore be a rather conceptual term that is not used in the field. This result is in line with
206 our thematic analysis in which seven participants describe the term NbS as conceptual and scientific,
207 which is not present in the field: "I find that there is really a distinction between the organizations
208 that drive this concept [...] and the local level, which is a little out of step and needs to be informed
209 and understand what is being proposed with this concept of NbS " (GEMAPI officer, association); "the
210 people who are more in the field do not communicate at all on this subject" (wetland manager).
211 Moreover, six participants added that when talking about NbS, their discourse must be adapted
212 according to the interlocutor, and that this term is not appropriate for all audiences: "depending on
213 the profession, we do not call things by the same name " (researcher in hydrology). The term NbS is
214 not unifying and not necessarily understandable for all stakeholders, particularly those in the field.

215 Second, the similarity analysis highlights the fact that the term "dike" is used primarily by
216 practitioners. This element further widens the gap between concept and field. In fact, the institutions
217 and scientists who support the NbS concept, such as the IUCN or the OFB, propose a sort of
218 alternative to gray solutions. Without pitting gray solutions against nature-based ones, dikes as such
219 are not present in the definition of NbS. However, the practitioners mentioned dikes a lot in their
220 speeches, explaining that we could not do without this engineering in France: "Today, cities like Arles
221 or Avignon would not exist without dikes" (works engineer, river union). Indeed, five actors, both
222 practitioners and theoreticians, defined NbS as complementary to the so-called gray solutions: "we

are not going to think of a total substitution but of a link between these two practices" (researcher in urban planning).

Finally, we note that most of the terms related to the "field" are taken from the practitioners' speech such as "territory", "farmers", "inhabitant", "population" and "local". These terms were very frequent in the speech of the practitioners and concerned a large part of their discourse. For them, the inhabitants and local populations in general represent as much the people to be protected from the risk, as individuals who need to be convinced about the projects to see the light of day. They even represent actors that it would be interesting to involve directly in the NbS projects: "For me, the inhabitants should participate [in monitoring the works]" (OFB regional facilitator); " NbS [...] imply much greater participation from local populations" (SDL'E researcher). In addition, the words "funding," "policy," and "landowner" highlight problems encountered in field implementations of NbS projects such as lack of funding, difficulties related to local policy decisions that do not favor NbS, or the refusal of landowners to give up their land. In fact, many of the NbS projects cited by the experts involve land negotiations with local farmers. Close to the previous words on the similarity chart, the term "complicated" was also used by the practitioners. Presumably, it describes the complications of implementing NbS projects on the ground, but also the fact that it is complicated for non-specialized inhabitants and actors to understand the term NbS.

By carrying out an even more rigorously qualitative analysis, we explored in greater depth the obstacles to the implementation of NbS and the philosophical divergences they imply.

4. Results of the thematic analysis: from obstacles to cognitive biases

a. Risk culture

The thematic analysis carried out on all the discourses highlighted several major themes that can be broken down into several sub-themes. The first theme revealed that the participants' social representations were very much centered on cognitive barriers and biases.

Fig 2. Identified barriers and their consequences. Four barriers to NbS identified are reprensented at the top of the figure. They are linked to their commom consequences.

The first barrier echoes the persistence of a culture favorable to gray infrastructure [33] [34] that would leave no room for NbS projects. Three experts told us of a cultural bias of perceived protection from residents that was maintained by the habituation of engineering projects to protect them from flooding. A researcher in environmental science gave us the following discourse: "there is a cultural bias that makes people feel protected behind a civil engineering work" "the impression of protection". For him, we are not “genuinely” protected by dikes. Civil engineering infrastructures can therefore be perceived as invulnerable and guaranteeing safety [56]. Furthermore, a project manager from the OFB stated that "when we build a dike we feel protected and therefore we increase vulnerability by building schools and hospitals behind the dike. For her, this cultural bias would indirectly lead to increased vulnerability. Indeed, the construction of a levee can sometimes increase vulnerability by amplifying the number of vulnerable buildings in a flood zone [57] or by increasing the speed and rise in the water level near the levees in the event of a breach or overflow [58]. Parker [59] and Sauri-Pujol [60] even spoke of an "escalator effect": in addition to the technological risk caused by the potential failure of a dike, the latter unduly authorizes urbanization behind it and this proves to be an essential risk factor. Here, the impression of protection reduces risk culture and increases vulnerability. On the other hand, a person in charge of operations in a river syndicate expressed that "there is even a somewhat general demand from the population to say reinforce everything, raise everything, we want more protection. It is therefore a real demand from the population to reinforce dikes and build more structures because that is what makes them feel safe. In addition, two other participants mentioned old and ineffective dikes: "we have dikes that are unreliable" (works engineer, river union) and "they are collapsing, they are completely dead" (leader, river union). In spite of this, a firm demand from the population was expressed to keep these dikes that no longer protected them in their current state. This desire to keep ineffective dikes reflects a potentially weak risk culture.

The second obstacle is the lack of risk culture. This was mentioned by nine participants: "Elected officials are also like the locals, they are not very sensitive if they have not experienced a recent flood", "knowledge of the risk, there is not much of it" (facilitator, river union); "every time we say to ourselves “how is it possible to have built in that place?” "I don’t think we are aware of this" (OFB project leader); "they [the communities] need to be informed about this" (GEMAPI officer, association). This lack of awareness is accompanied by a lack of knowledge of NbS that can lead to their rejection: "some cities, regarding development projects, refused to accept ditches or other solutions because they did not know what they were, they did not know how to manage them" (Civil engineering researcher); "we realized that the actors interviewed were not necessarily aware of the concept" (Manager, EP basin). These actors all agreed on the fact that acculturation would be essential: "The municipality must take charge of it and work on training agents, and also work to get agents to accept this kind of differentiated nature" (Director, research office), as much on the flood risk as on the NbS. In addition, two participants believed that awareness of NbS can lead to an acculturation of flood risk: " NbS to maintain a flood subsidence culture that was favorable to wetland species but which also allowed riparian populations to maintain their traditional flood subsidence culture that had been removed with the dam" (project manager, OFB); "it is still a term that allows for a better acculturation of both elected officials and citizens" (regional animator, OFB).

These first two obstacles highlight the fact that in certain cases civil engineering structures can increase vulnerability and do not help to improve risk culture. On the other hand, they help to reassure local residents through the fact these structures make human beings feel as if they cancontrol floods and therefore the risk.

b. Need for control: reassurance in the face of risk and climate change

The third obstacle relates to Climatoscepticism [61]. Three participants spoke of "denial" of the risks and of climate change (Director of a research office, wetland manager, river union operations manager). Another evoked the fear of consequences that leads to a taboo: "We know that they will

suffer from the rise in sea level but in fact it is too heavy" (Researcher in SDL'E) and the last one who spoke of a denial in another form: "a meeting with inhabitants where we hear that the rise in sea level does not exist" (in charge of operations, river union). This alteration of ecological awareness [62] is in line with the Dominant Social Paradigm: human beings need, in order to reassure themselves, to believe in the effectiveness of science in solving problems and that nature can be domesticated by human beings for their benefit [63].

The fourth and final obstacle, which also relates to this paradigm, concerns the need to control the ecosystem and risk. A researcher in coastal development evoked "a culture of control and domination of natural spaces. Also, the director of an engineering firm described "the need to control" nature. These anthropocentric beliefs unite in a libertarian conception of society ensuring that each individual has the right to do, especially with regard to nature, what they feel contributes most to their well-being [64]. Conversely, NbS propose a conception where humans would no longer be in control of their ecosystem and would no longer be in total control of the risks: "when we implement NbS we are not in control of the globality of the system we are touching but rather we will try to guide a system by developing an environment hoping that a biocenosis will develop there" (researcher in urban planning). This same researcher describes a "principled opposition to change the way we think" while the OFB project leader suggested a "paradigm shift". All of these elements refer to the New Environmental Paradigm [26]. This new worldview is based on three beliefs: the existence of ecological limits to growth, the importance of preserving ecological balance, and the rejection of anthropocentrism. This perspective suggests that by integrating these new beliefs, one is better able to listen to environmental issues such as those related to climate change.

c. New paradigm

In contrast to this position, many participants explained that "making more room for nature" was a key element in understanding NbS and the benefit it could bring to the field of risk management and society. Indeed, six participants, both theorists and practitioners, linked a broader conception of

nature to the concept of NbS. We can summarize this thinking in the following words: NbS thinking would be to leave more room for nature. Some experts express it directly in this way: "the idea is to let the sea in more" (researcher in SDL'E); "to give more space to water" (in charge of GEMAPI, an association); "to give space back to nature, to accept that the sea comes in" (researcher in coastal development). According to these experts, NbS are conceived and designed to leave more room for natural ecosystems: a positive overall idea that one could imagine being easily accepted by individuals. However, more precisely, this implies knowing how to incorporate one's needs into natural processes [65] and accepting to live with the hazard without trying to oppose it, leading to a form of diminished control. Indeed, one expert explained this concept by speaking of "we will give 300 hectares of land to the river and to nature" (works engineer, river union). This need for control will therefore be undermined with NbS and the individual will be forced to leave more room for risk, physically and cognitively, and thus live with risk. Moreover, the urban planning researcher spoke of this conception in the following terms: "instead of considering a river as a flow, we will consider it as a moving fluid loaded with particles that has its own life. These words echo Descola's work on nature conservation. The latter explained that for him, it is no longer a question of considering nature as a useful common good but of protecting it "in and for itself" [66]. Thus, an expert added: "If you have more vegetation near your home, you will have more insects [...]. Afterwards, is it serious? I think it's part of this whole awareness and acculturation process that has to do with the relationship that humans have with nature" (regional facilitator, OFB). NbS could also be a tool for acculturation to the fauna and flora by creating proximity.

To measure attitudes toward nature, Dunlap and his colleagues created a scale (New Ecological Paradigm Scale) to assess the emergence of this thinking. According to this view, humans are part of the natural ecosystem: their very survival depends on the Earth's resources, in a delicate balance that human behavior can easily disrupt. This pro-environmental orientation is set to become dominant [64]. We believe that the rationale of NEP and the NbS concept are linked.

5. Discussion

a. From concept to the field

The gap between the concept of NbS and the projects carried out in the field seems to be significant. Practitioners, the people in the field who are at the heart of project implementation, do not use the term NbS. It is perceived as a theorist's concept, not adapted to the reality of the field. Although the techniques it encompasses are presented as old and known to all, no link seems to have been made between the NbS concept and the solutions it encompasses. This gap crystallizes in a strong opposition from the inhabitants who, according to some interviewees, may not understand and accept NbS projects on their territory. They do not always feel protected by NbS and perceive these projects as an admission of weakness on the part of the managers. It is as if this different approach to flood risk management was not designed to protect them. The theoreticians, those who are behind the NbS concept in France, do not always seem to be connected enough to the field to understand all the issues and the difficulties of implementation. However, the practitioners, who are strongly linked to the field, do not seem to succeed in communicating with the inhabitants and are ready to impose their projects. The broad and vague definition of the NbS concept [8] further widens this gap and misunderstandings between concrete implementation and conceptual theory.

b. Anchoring the terme NbS

In terms of social representations, we assume that this term has not gone beyond the scientific sphere. This would prove that it has not passed through the anchoring process described by Moscovici [67]. The theory of social representations, in seeking to explain the way in which individuals and groups give meaning to the objects of their social environment, is based on two essential processes. The first refers to a principle of cognitive coherence, while the second responds to a need to reduce uncertainty: these are objectification and anchoring [67]. Moscovici considered that the close articulation of these two mechanisms allows the emergence of consensual meanings within groups. The reduction of uncertainty is thus ensured by objectification. To synthesize it, we can say that it consists in transposing vague beliefs or information into certainties, so that these

elements no longer appear as the product of the cognitive activity of the person who holds them, but as the reflections of an objective external reality [68].

Anchoring is inserted in the continuity of objectification; it cannot be accomplished independently. It is a mechanism of categorizing and naming a new or unknown object that anchoring will come to make meaningful by integrating it into a familiar framework already shared within the social group [69]. Jodelet described the functional value of knowledge, used to interpret our environment [70]. Doise described the anchoring process as long and complex [71]. The first phase comprises attributing a meaning to the represented object by inscribing it in our system of values and standards. This is how the object is rooted in an existing field of meanings. Then comes the process of rooting in the pre-existing system of thought. Rooting refers to the notion of cognitive integration of the object in a frame of reference known to all. Through this rooting, the individual is no longer satisfied with objectifying the new element, but actually integrates it into their own cognitive and social thought system. Finally, the last phase is the process of instrumentalization in which the new element as it was at the beginning, i.e. an abstract concept and foreign to the social group, will gradually become usable and functional knowledge for the group, becoming an instrument making it possible for the group to understand and management its social environment. The fact of situating a new object in a frame of reference makes it possible to understand and master it [71].

We assume that the concept of NbS, as described to us in the interviews, has not yet gone beyond the scientific sphere, nor has it become embedded in a common language. It is not necessarily understood or mastered by all the experts. NbS will therefore likely have to go through this process of being extracted from the theoretical dialect and acquiring meaning in the eyes of a larger number of individuals and specifically non-specialists such as inhabitants and elected officials.

The social representations that experts have of the NbS object are multiple. They are largely centered around cognitive biases and the obstacles to the development of NbS. The persistence of a culture favorable to gray infrastructure and the need to control the ecosystem are of the order of

habit. In France, civil engineering structures are traditionally used to protect against flooding, and the arrival of NbS has weakened this mode. The lack of risk culture is a direct consequence of the two previous elements. Indeed, by no longer considering the flood risk as part of their environment or daily life, the individual will never be ready to adopt the appropriate behaviors or to take material provisions to mitigate the risk. This habit of reliance on civil engineering has led to the need to control the ecosystem and the risk. In terms of bias, this appeals to the illusion of control [72]. The individual does not want to live with the risk or change to this psychological comfort. Finally, some experts told us of a certain climatoscepticism observed among several inhabitants. Here again, it could be a matter of psychological comfort: it is more convenient not to consider water-related risks as impacting our living spaces. To understand the stakes of NbS and what they could contribute to the territories, it is necessary to consider these risks as realities.

We can say that the interviewees situated NbS in a more encompassing discourse and in relation to different, much larger social sets such as nature and climate change. Once again, social representations serve as a guide to understanding and mastering our daily environment, since they constitute a "contextualizing" rationale [43].

6. Limits

The limitations of our study are the small number of interviews conducted, which imposes a precautionary approach to the conclusions that can be drawn from them. This small number can be explained by the fact that we seemed to have satisfied the criterion of redundancy. We made this observation when the new interviews no longer allowed us to create new categories of thematic analysis and when many of the discourses seemed to paraphrase each other. Moreover, our results are consistent with a number of sources in the literature, leading us to believe that the richness of the discourses compensated for the small number of interviews.

Another limitation concerns an aspect of pure feasibility: we conducted these interviews by videoconference as most were done during a period of confinement related to the COVID19

pandemic. For the sake of consistency, all the interviews were conducted by videoconference, under the same conditions. Nevertheless, using a camera, interaction can be comparable to the onsite equivalent with the presence of nonverbal and social cues [73].

Another limiting aspect concerns the discourses of the inhabitants, which are reported by other actors who have themselves worked with the residents affected by the NbS they were implementing. These inhabitants are not directly represented in our study. We had to make this choice following a pre-test of our interview grid with a resident who showed that the term NbS was not adapted to address this type of population. The results of this pre-test were then confirmed by our study. We are now conducting a study exclusively focused on residents in order to address this limitation. Finally, as our study is limited to the French context, it would be interesting to study the social representations of NbS by experts from other countries, to establish whether there are similarities or disparities in terms of obstacles.

7. Conclusion

In this article, we focused on experts' social representations of Nature-based Solutions for flood risks. To do so, we interviewed 19 experts on flood risks and NFS. We analyzed their discourses using two methods: thematic and lexicographic. These analyses revealed a social representation centered on cognitive biases likely to constitute obstacles to the implementation of NbS. This concept suffers from a significant gap between the principles it embodies and the reality on the ground. The lack of knowledge of some decision-makers, the poor communication between actors as well as the lack of training does not allow the appropriation of the concept and leads to rejections not only by inhabitants but also by experts. The human and social sciences, and in particular the social psychology of the environment, can propose approaches to this concept to help overcome cognitive biases and promote the appropriation of the concept by the actors in the field. On the other hand, the term "nature-based solution" does not seem appropriate and does not manage to go beyond the scientific sphere, likewise for the anchoring process [67]. The considerable polysemy of the term

nature and the vague and broad aspect of its definition add to this gap. Thus, we consider that this term is inadequate for communicating with all the actors, especially non-specialists such as inhabitants. This is especially because experts seem to differentiate the concept from the techniques it contains. It is necessary, at present, to imagine a more appropriate common language that will allow everyone to know the stakes of NbS and the benefits they can contribute in terms of biodiversity and flood risk protection. The perspective of "leaving more room for nature" has led to the idea that the concept of NbS could be intimately linked to CIP design [26]. We even think that NbS could foster a pro-environmental attitude thanks to the acculturation they allow. Our task today is to understand the link between the rationale of NEP and the NbS concept. In the next part of our work, we will explore this link: Could a strong NEP attitude go hand in hand with an acceptance of NbS? To what extent could NbS foster a pro-environmental attitude through the acculturation they allow?

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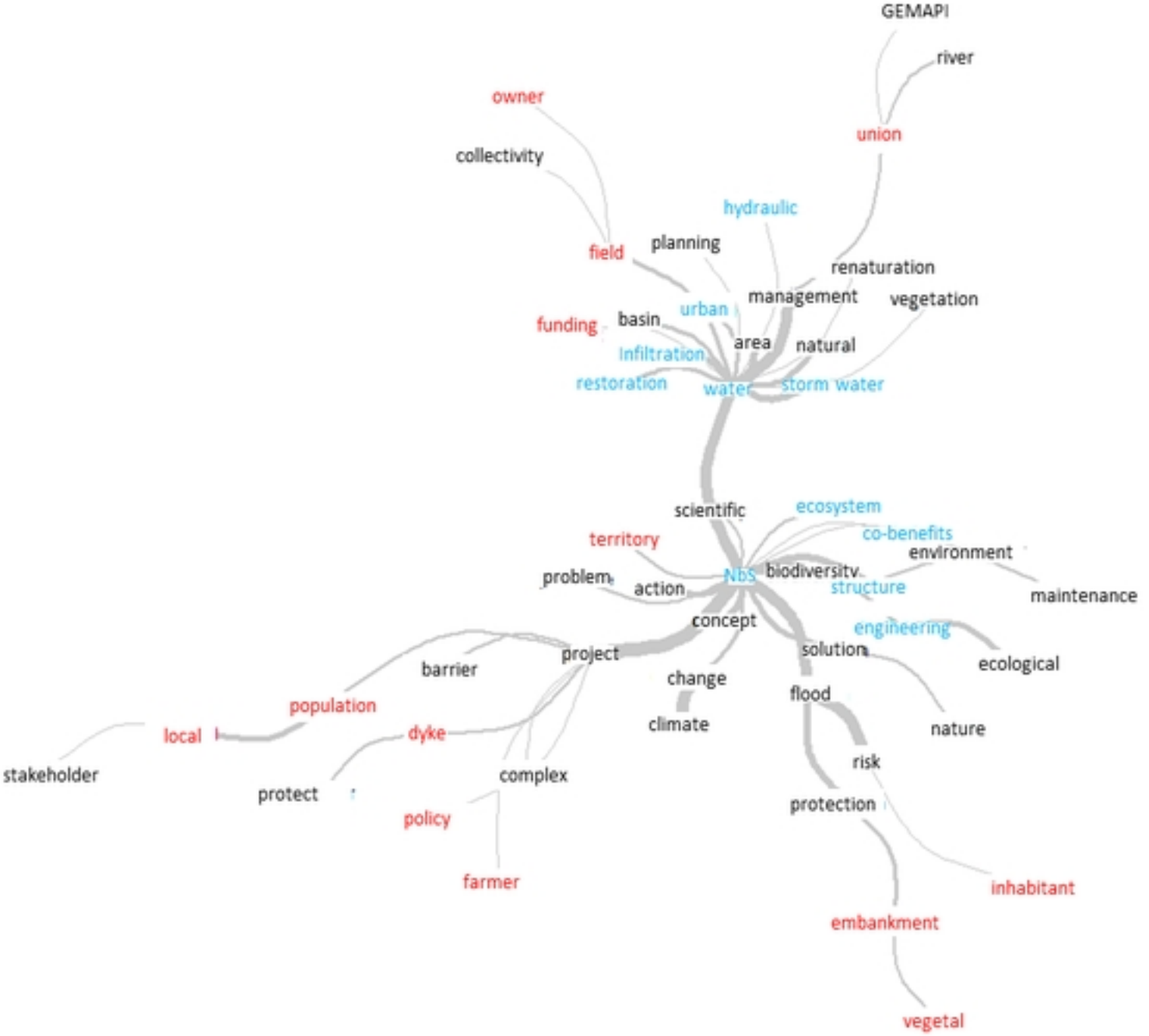
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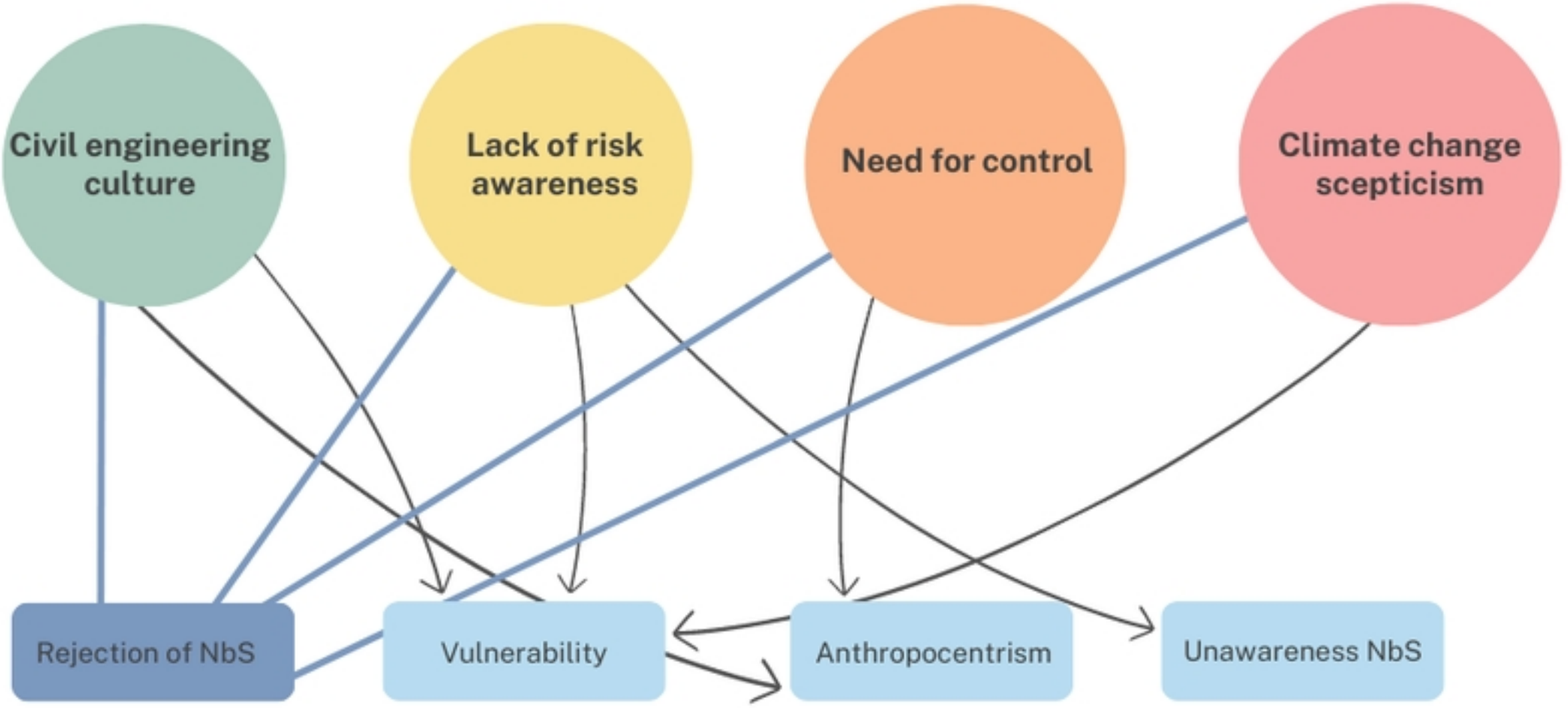
Figure


Civil engineering culture
Lack of risk awareness
Need for control
Climate change scepticism
Rejection of NbS
Vulnerability
Anthropocentrism
Unawareness NbS

Figure