ACTION SCHEMAS:

UNDERSTANDING THE SOCIAL-COGNITIVE SKILLS OF DEAF ADULTS THROUGH ACTION-BASED UNITS OF COGNITION

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BOĞAZİÇİ UNIVERSITY

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DECLARATION OF ORIGINALITY

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- I am the sole author of this thesis and that I have fully acknowledged and documented in my thesis all sources of ideas and words, including digital resources, which have been produced or published by another person or institution;
- this thesis contains no material that has been submitted or accepted for a degree or diploma in any other educational institution;
- this is a true copy of the thesis approved by my advisor and thesis committee at Boğaziçi University, including final revisions required by them.

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ABSTRACT

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This thesis aims to apply action-based theoretical approaches to cognition to the empirical literature on the development of social-cognitive skills like mindreading through characterizing conceptual tools that can help interpret empirical findings. The first chapter looks at the empirical literatures on mindreading development, especially in relation to language development, as well as the arguments of action-based theoretical approaches to cognition in general. The second chapter presents an original empirical study conducted with an uneducated deaf population who did not have access to conventionalized language during development and can present an interesting case of adults without mentalistic vocabulary. The findings generally support the literature that many uneducated adults, both deaf and hearing, have difficulties with passing the false belief test, and partially support the role of language in this development. The rest of the thesis aims to characterize conceptual tools that can be used to reinterpret such findings within an action-based framework. Chapter three defines the notion of "action schemas" as interactive and anticipative processes that can be applied in a general way across cognition and are especially powerful in modeling development. Chapter four reinterprets empirical findings presented in chapter two as well as other related findings in the literature through the lens of action schemas. Overall, it is argued that conceptual tools like action schemas can be beneficial for reinterpreting empirical findings within an action-based framework, which can then provide novel accounts of developmental processes.

ÖZET

Eylem Şemaları:
Sağır Yetişkinlerin Sosyal-Bilişsel Becerilerini
Eylem-Odaklı Bilişsel Birimlerle Anlamak

Bu tez eylem-odaklı teorik yaklaşımları, eylem-odaklı kavramsal araçlar tanımlayarak zihin okuma gibi sosyal-bilişsel becerilerin gelişimini anlamak için kullanmayı amaçlamaktadır. Birinci bölümde zihin okuma gelişimine ve özellikle bu gelişimin dil gelişimiyle olan bağlantısı hakkındaki deneysel literatüre ve ayrıca eylem-odaklı teorik yaklaşımların genel argümanlarına bakılmaktadır. İkinci bölüm, gelişim sürecinde sistemleşmiş bir dile erişimleri olmadıkları için başka insanların zihinsel durumlarına refere edebilecek kelime dağarcığına sahip olmayabilecek eğitimsiz bir sağır topluluğuyla yapılan orijinal bir deneysel çalışmayı sunmaktadır. Bu çalışma hem sağır hem işiten yetişkinlerin "yanlış inanış" testini kolaylıkla geçememesi bulgusunu desteklemiştir. Ayrıca bu testin geçilebilmesinde dilin rolünü de kısmen desteklemiştir. Tezin geriye kalanı bu gibi bulguları eylem-odaklı bir bağlam içerisinde yeniden yorumlamaya yarayabilecek kavramlar tanımlamaya odaklanmıştır. Üçüncü bölüm "eylem şemaları" kavramını bilişsel süreçleri modellemeye yarayabilecek etkileşimsel ve antisipatif süreçler olarak tanımlar. Bu tanım bütün bilişsel süreçlere uygulanabilir ve özellikle gelişimsel süreçleri modellemekte güçlüdür. Dördüncü bölüm ikinci bölümde sunulan deneysel bulguları ve literatürdeki benzer bulguları eylem şemalarını kullanarak yeniden yorumlar. Sonuç olarak, eylem şemaları gibi kavramsal araçlar deneysel bulguları eylem-odaklı bir yaklaşım içerisinde yeniden yorumlamak için faydalı olabilir ve bu da gelişimsel süreçler hakkında yeni yaklaşımlar geliştirmeye yarayabilir.

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To those with the courage to defend their theses despite all,

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CHAPTER 1

THE LITERATURE ON MINDREADING, ALTERNATIVE APPROACHES, AND RELATIONSHIP WITH LANGUAGE

This thesis is about how cognitive skills can be scientifically approached within an action-based framework, focusing on an especially complex one: mindreading. Mindreading refers to our capacity to understand and interact with other people based on their own perspectives and anticipations of the world, which might be different from ours. Mindreading is more often referred to as "theory of mind" and is more narrowly defined as the capacity to "attribute mental states" to others, which might differ from our own (Wellman, Cross, & Watson, 2001; Ratcliffe, 2007). While these two definitions seem interchangeable, the main point of this thesis will be that emphasizing the skilled and anticipatory nature of mental activities as ways of interacting with the environment makes an important difference for empirical investigation, both in terms of methodology and interpretation.

In this first chapter, I will start by providing a literature review on mindreading focusing on its measurement, the prominent theories, and related developments that take place around the same age. I will then go on to review alternative, action-based approaches to cognition such as embodied cognition approaches (Varela, Thompson, & Rosch, 1991; Chemero, 2011) and interactivism (Bickhard, 2009; 2020) and their takes on mindreading (Ratcliffe, 2007; Campbell & Bickhard, 1986). In the final part of the chapter, I will focus on empirical findings on mindreading in relation to language, especially focusing on the curious studies with both deaf and hearing adults which suggest that passing the false belief test may not be as trivial as it might seem for many adults. The findings from this literature,

supported by our empirical observations detailed in chapter two, will help to show how an action-based framework can make a difference for empirical investigations in the later chapters.

The second chapter will detail an empirical study conducted with a community of deaf adults using a newly emerging sign language. This is a community living in an isolated village in the mountainous regions of Southern Turkey, where deafness is prevalent due to congenital diseases and the deaf population has had very little, if any access to established sign languages used in Turkey such as Turkish Sign Language (Ergin, 2017). As a result, the deaf community has been developing a system of signing with relatively little external linguistic influence. It was therefore possible that, similar to first cohort signers of Nicaraguan Sign Language (which is another emerging sign language) the signers may not have mentalistic vocabulary (i.e., words like *know*, *think*, *believe* etc., Pyers & Senghas, 2009). This provides a rare opportunity to observe the role of language on the mindreading skills of adults. We tested both deaf and hearing adults with similarly minimal education experience with two false belief tests and a language elicitation task and hypothesized that hearing adults with mentalistic vocabulary would outperform deaf adults without mentalistic vocabulary, while not performing at the ceiling level themselves. This study will support prior findings that false belief tests are not trivial even for socially skilled adults, and partially support the role of language for thinking about others.

The third chapter will be a break from the mindreading literature. Here, I will attempt to define a notion of "action schemas" inspired by (but not necessarily identical to) the notion of schema used by Piaget (1952; Ginsburg & Opper, 1988) and the interactivist model of dynamic representation (Bickhard, 2020). Very

generally, a schema is a repeatable process flow constituted by the interaction between the organism and its environment. It encompasses various mental capacities like those of motor behavior, emotion, and perception, and is a simple and useful way to view skilled actions of an organism as it is interacting with its environment, as well as understand the development of these skills. Such a notion perhaps fits best within the interactivist framework (described in chapter one), and my attempt is to try to shape it as a concept that will help put interactivist, action-based insight into scientific practice by providing a way to interpret experimental findings, whether one accepts the interactivist framework as a whole or not. This will be a general definition applicable to any mental activity.

In the fourth and last chapter, I will apply the generally defined concept of schema to mindreading to show that its use can make a significant difference for empirical research and help make sense of findings with adults. I will argue that such a notion captures the development of mindreading better than the computational framework does and that it helps us better approach what false belief tests really measure. This difference in approach to the false belief test can help us account for the curious results we replicated with both deaf and hearing adults, who seem to show poor performance in the false belief tests despite successfully interacting with other people in their daily lives. I will account for what might be happening during a false belief test in contrast to daily social interactions using schemas. This interpretation will not counter the robust finding that children start passing the false belief test around age four (Wellman et al., 2001), but will enable us to view what kind of shift might be happening, as well as how language may relate to this shift in a different way.

1.1 Theories and associated developments of mindreading

1.1.1 The false belief test and the ghost of behaviorism

Although I will try to use the term “mindreading” throughout this thesis to emphasize its skill-like nature, the more common and original term that refers to our understanding of others is “theory of mind” (Doherty, 2008). The first use of this term is from a study by Premack and Woodruff (1978) titled “Does the chimpanzee have a theory of mind?”. Premack and Woodruff already define theory of mind as the ability to understand the mental states of others that are otherwise unobservable and allow us to make predictions about their behaviors. Their methodology is based on showing chimpanzees videos of a human agent struggling with various problems such as trying to reach an object or being cold due to a non-functioning heater. After viewing these videos, chimpanzees were shown several photographs, one of which showed a solution to the problem in the video. The chimpanzees' choice of the correct photograph is taken as indicating that they do indeed understand the unobservable mental states of the agent, such as his goal or desire for warmth. The three responses to this article by Dennett (1978), Bennett (1978), and Harman (1978) are often shown as the origin of the false belief test (Doherty, 2008), which, since its first application by Wimmer and Perner (1983), has been the paradigm test for assessing theory of mind (Wellman et al., 2001).

These responses emphasize the need for a more comprehensive test to measure the chimpanzee’s social understanding and I will look more closely at Dennett’s motivations for this emphasis. His emphasis on the need for a test that assesses false belief to show theory of mind is widely known, but his reasons for it are even more interesting and possibly overlooked. About Premack and Woodruff’s findings, he says that “[p]resumably behaviorists would have to claim to be

unimpressed" (p. 568) because the chimpanzees' behavior can be redescribed by the behaviorist by simple associative learning, rather than chimpanzees' mentalistic theories about other agents. This is an interpretation that, although Dennett himself is unsympathetic to, needs to be argued against by another design that shows that the observer can understand others' beliefs even when they contradict with the current state of the world known to the observer and this situation is a novel one that the observer could not have learned by "mere" associations. It is very informative that this suggestion, that resulted in the creation of the change of location false belief test, is motivated by the need to argue against associationist interpretations. Of course, it can simply be seen as good science to take account of alternative interpretations, however, there is more going on. There seems to be a "ghost of behaviorism" haunting cognitive research, pushing for an experimental paradigm that only takes the most complex or developmentally complete form of a skill as its measurable and valid form and threatening to disregard any associatively explicable forms. The answer to the behaviorist's threat by focusing on complex forms of skills that have to be undeniably mentalistic, implicitly separates the associative processes from the presumed cognitive core of the skill. Associations within or habituations to certain contexts become "mere" associations that can be explained away by the behaviorist and are distinguished from the more "central" processes, which come be viewed as what the skill really is, where competence lies as distinct from performance (Chomsky, 1965). When such a separation occurs, it is very difficult to understand genuine development and daily use of complex skills by skilled agents. I will explain why this is so in later chapters when proposing that more dynamic concepts like schemas can help bridge that gap between central and associative processes and suggest that associations do not have to be "mere" associations.

But what exactly is the change of location false belief test? As first applied by Wimmer and Perner (1983) with children, it involves observing an event taking place between two characters. The child is introduced to these characters (which are usually dolls) by the experimenter as, for example, Maxi and his mother. Maxi puts a bar of chocolate in an enclosed location, like a blue cupboard and leaves the room. While he is away, his mother takes the chocolate from the blue cupboard and puts it in a green one and also leaves the room. Maxi comes back to the room and the experimenter tells the child that Maxi is hungry and wants some chocolate. Then she asks the child "where will Maxi look for the chocolate?". To pass the test the child needs to answer with the blue one, which is where Maxi left it and believes it is there despite this belief not corresponding to its true location, which is known by the child. The child is also asked a control question after the test question: "where is the chocolate really?", to make sure that a correct answer is attributable to an understanding of Maxi's mental state rather than memory problems.[1]

After Wimmer and Perner, many different forms of the test have been developed where different events take place instead of the change-of-location event described here, such as the unexpected contents event developed by Hogrefe, Wimmer and Perner (1986). In this version children are shown a candy box which is normally expected to contain candies, but, unbeknownst to the children, contains pencils instead. Children are asked what is inside the box and are expected to answer with candies. They are then asked to open the box and see that it in fact contains pencils. Then another person comes into the room, and children are asked what she will say about what is in the box. To pass the test, children should answer with

[1] In the original study, Wimmer and Perner also require the child to provide a coherent explanation of why Maxi will search the chocolate in the blue cupboard, but this control does not seem to have become a standard part of the false belief test as will later be used by others.

"candies" since the new person does not know that it contains pencils instead. Interestingly, when asked "what did you think was in the box before you opened it", the children who cannot correctly answer what another person would think also fail, and say they knew it was pencils all along (Gopnik & Astington, 1988). After years of research and attempts to make the test simpler in various ways (such as emphasizing deception, Chandler, Fritz, & Hala, 1989; or increasing the salience of the absence of the protagonist during the event, Mitchell & Lacohée, 1991), a meta-analysis by Wellman et al. (2001) concluded that children are not able to pass the test before the age of four, regardless of the form of the test, showing that false belief tests are capturing a robust developmental phenomenon about understanding others.

1.1.2 Associated developments and metarepresentation

Various other skills are found to accompany or be precursors to this shift in false belief understanding around age four.[2] Tomasello (1999), for example, describes joint attentional capacities of infants which develop around 9 months of age as crucial skills that precede false belief understanding. In a joint attentional setting, the infant attends to an object simultaneously with another person (e.g., her mother) and follows not only the object but the attention of her companion by shifting her gaze between the object and her mother. The infant can learn to point to the object to show it to her mother and start engaging in joint attention. This shared attentional context with another person provides the backdrop not only for learning about the objects (such as what it is called, Tomasello, 2003) but also learning about other human beings. What others can or cannot attend to or visually engage in becomes important

[2] One of the most important of these developments is language, but I will skip it here to describe the relevant research in greater detail in the final section of this chapter. Note that I am also skipping many other related developments (such as executive function, Frye, Zelazo, & Palfai, 1995) in order to focus on findings that will be redescribed with schemas in chapter four.

to be able to engage in joint attention and developing such understanding of others seems crucial for understanding how false beliefs may form. For example, understanding where people are looking at or attending to can be used to understand what they are seeing or knowing, which may differ from what the child can see or know at a certain point and can be used by 2-year-olds to interpret their actions (Moll & Tomasello, 2006).

Another developmental shift that seems to be related to false belief understanding around age 4 is that of understanding objects as having more than one identity (or characteristics that can hint at multiple identities). The appearance-reality distinction is one example of this (Flavell, Flavell, & Green, 1983). In one version of the appearance-reality test, measuring whether children can make this distinction, a deceptive object, such as a sponge that looks like a rock, is shown to them. After investigating the object by touching (and realizing it is a sponge) children are asked "what is this object really and truly?" and also "what does it look like?". Children who cannot pass the test give the same response to both questions, apparently unable to realize something can look like another thing that it actually is not. Children start being able to pass this task around age four when they also start passing the false belief test.

Another related test focuses on the identities of symbolic objects such as photographs, maps or scale models of rooms (DeLoache, 2004; 2011). According to this research, through development, children come to understand and use objects like photographs or scale models to find out about the objects they represent, like the actual room or the photographed object itself. In the scale model task (DeLoache, 1989), the experimenter shows the child a scale model of a room and explains in detail how it corresponds to or represents the room itself. She then hides a toy inside

the model, and says it is in the same place in the room as it is in the model and asks the child to find it in the room. Children are able to use this information in the model to find the toy in the actual room only around age three. DeLoache explains this developmental shift as children's emerging capacity to use "dual representations" in order to gain "representational insight" into the symbolic nature of these objects (where dual representations are necessary but not sufficient for representational insights). The scale model needs to be represented not only as an object in itself, but also as representing another object other than itself, and it is this dual characteristic that young children have difficulty with before age three, according to DeLoache.

A final relevant, object-oriented precursor skill to false belief understanding that I would like to mention is pretend play (Leslie, 1987). Pretend play is a form of play that emerges around 18 to 24 months of age and includes not merely using objects or toys within their proper functions as in reality-oriented play but engaging in "as-if" actions where objects are pretended to be other objects than they actually are (e.g., pretending that a banana is a telephone), or using imaginary objects as if they are really there (e.g., pretending to eat soup from an empty bowl). Here, children seem to start making a distinction between the real identities of objects and their pretend identities as used in the play, which, according to Leslie (1987), has a crucial role in later theory of mind development.

What relates these developments to each other and to mindreading, according to the accounts described above, is a focus on "metarepresentation". A metarepresentation is a representation about a representation (Pylyshyn, 1978), and according to Leslie (1987), this is what needs to be achieved to pass the false belief test, since the child needs to "represent" how the other person "represents" the event, for example as the candy box containing candies rather than the pencils it actually

contains. This is similar to how Flavell et al. (1983) approach the appearance-reality task as children understanding the sponge with its dual characteristics (as being one thing in reality while looking like another thing) and how DeLoache (2004) uses the notion of dual representation as enabling children to understand symbolic artifacts, as being one thing in themselves and "representing" another thing. Leslie (1987) provides a detailed model of how pretend play is a manifestation of developing metarepresentational skills, since it allows for a kind of representation that is decoupled from reality (i.e., the pretend identity of the object), which later becomes central to understanding how others may hold such representations that diverge from reality, i.e., are false.

I will dive deeper into the metarepresentational theory on all of these tests and especially the false belief test in greater detail in the fourth chapter, where I will describe similar "meta" processes (inspired by the interactivist account of reflection described in section 1.2.2) using action schemas, and the potential role of language in these meta processes. This will be an opportunity to show how applying more action-based versions of similar insights about the "meta" level nature of these developments can make a significant difference for interpreting the empirical findings. For now, notice that the concept of representation is being used in these theories to describe the central, non-associatively-explicable mental processes, and that development consists of being able to use new kinds of more complex representations that describe more complex entities, such as those with dual characteristics like objects with deceptive appearances and people with false representations.

1.1.3 Theories of mindreading and nativism

The metarepresentational approach can be placed under a larger group of theories called “theory theory” (Doherty, 2008; Gopnik & Wellman, 1992). According to theory theory, understanding false beliefs requires that the child has theoretical knowledge about how other people form beliefs about the world, and that these beliefs can be false. According to the version defended by Gopnik and Wellman (1992), the child constructs a theory through development that is very much similar to how scientific theories develop, that is by forming hypotheses and testing them against the world, although they do not have to be in the technical and explicit form that scientists use. Based on the child’s theory about how beliefs are formed (depending on what events people saw, for example) they are able to attribute the correct beliefs to them. An alternative theory to the theory theory is that of simulation theory (Goldman, 1992; Gordon, 1986). According to simulation theory, it is not necessary for children to possess a complex theoretical structure that details how people form beliefs. Instead, they can simply assume that other people will have the same belief they themselves would have if they were in their place. In other words, they can simulate the other person’s belief state by inputting what they observed the other person experienced to their own mechanism of producing beliefs about the world, which will output the beliefs the other person now must possess.

A question that can be distinguished from how exactly the child is attributing a mental state to someone else (whether by having a theory of persons or simulating their experiences) is whether this capacity is innately specified (Ratcliffe, 2007, p. 16). For example, Baron-Cohen (1995) takes on a modular approach, where mature mindreading is a result of the combination of three evolutionarily designed modules: an “intentionality detector”, an “eye-direction detector” and a “shared attention

mechanism". Modules, in this account, are very specific mechanisms designed by natural selection to process certain kinds of inputs in an innately specified, efficient but non-flexible and domain specific way (Buller, 2006; Ratcliffe, 2007). Baron-Cohen (2000) suggests that autism is a result of a malfunction in this mechanism, and the specificity of this disorder is suggested to strengthen the idea that mindreading is enabled by a dissociable, singular mechanism like a module.

Related to these nativist theories, research with infants as young as 18-months purportedly shows an "implicit theory of mind" that can be observed much earlier than what is measured by the standard false belief test (Onishi & Baillargeon, 2005), which is taken to support that mindreading is an innate capacity. Measuring the implicit theory of mind relies on observing simpler responses from infants instead of asking a question about a person's beliefs as it is the case in the standard false belief tests. These measures include the "violation-of-expectation paradigm" and "anticipatory looking paradigm", both of which allow the infant to observe a traditional false belief event such as a change of location, and measures infants' looking behavior (either in surprise to the observed person not possessing a false belief when she should or in anticipation of where she should look based on an understanding of false belief, Dörrenberg, Rakoczy, & Liszkowsky, 2018). While 18-month-old infants are claimed to pass such tests and show signs of understanding others' false beliefs, these findings are highly controversial due to problems with both replication and interpretation. For example, several studies published in a special issue of the journal Cognitive Development dedicated to replicating these implicit tests report failures in replicating the findings as well as findings being accounted by adding control conditions (Sabbagh & Paulus, 2018; Dörrenberg et al., 2018; Powell, Hobbs, Bardis, Carey, & Saxe, 2018; Burnside, Ruel, Azar, & Poulin-

Dubois, 2018). On the other hand, Allen and Bickhard (2013) suggest that arguments for nativism depend on a rich interpretation of the data that can be accounted for by simpler explanations. I will also suggest, following their arguments, that the notion of innateness can be put into flesh in a much better way by action-based notions like schemas, in the third chapter. For now, notice that the notion of implicitness in these studies means that the highly complex conceptual skill of mindreading is already there in very young infants, but is masked by "performance factors" like the complexity and need for language in the traditional false belief tests. In other words, implicit means a skill somehow already exists without necessarily being used in social interactions, which is their main use in adult life. I will compare this meaning of implicitness with its use in the interactivist framework in section 1.2.2 (Campbell & Bickhard, 1986; Allen & Bickhard, 2018).

1.2 Alternative approaches to cognition and mindreading: embodied cognition and interactivism

Whether they see mindreading as enabled by the development of metarepresentation, as resulting from a theoretical understanding or a simulation mechanism, or as being innate or acquired, all these perspectives described above share some assumptions. These include assuming that the mental states of others are non-perceivable and require interpretation, focusing on observations of other people rather than skilled interaction with them, and that mindreading involves attributing mental states to others and this is what happens when we interact with people throughout our lives (Ratcliffe, 2007). But perhaps more centrally, they all take place within the computational paradigm where mental processes are computations on representations that take inputs from the environment and output behaviors, where the input and

output processes are separated from the more important central processes involved in the manipulation of representations (Shapiro, 2011); a perspective that is visible in the development of the false belief tests in response to worries of behaviorist explanations as described above. In this section I will summarize some critical approaches to this framework that also have different takes on mindreading.

1.2.1. Embodied cognition approaches

One such approach with increasing popularity is the embodied cognition approach named after Varela, Thompson and Rosch's (1991) book titled *The Embodied Mind: Cognitive Science and the Human Experience*, which can serve as an umbrella term to place several perspectives sharing similar insights (Shapiro, 2011; Clark, 2011). Taking inspiration from both phenomenological philosophy and Buddhism, Varela et al. emphasize that the world within which a living organism exists is dependent on its own constitutive processes, which the authors refer to as the organism "enacting" its environment (and their specific approach is referred to as "enactivism"). For example, a bacterium that needs sugar to reproduce its own constituting parts and processes will be sensitive to the sugar in its environment, which will define the world within which it lives and acts. This self-production of one's parts, called "autopoiesis", is suggested to be what defines living beings, and enactivists suggest that these biological processes are a much better model for understanding cognition than the computer analogy that is the basis of computationalism (Thompson, 2007).

With a similar perspective to the enactivists, Van Gelder (1995) emphasizes the dynamic nature of cognition as an alternative to computation. Instead of taking an input from the environment to be computationally manipulated, Van Gelder argues that there is a "coupling" relationship between the organism and the environment

where mental processes are continuously engaged with external cues, changing in real-time with the world, leaving no need for representations as explanatory tools. Instead of representations, Van Gelder suggests, mathematical tools provided by dynamical systems theory should be used to model the agent-environment relationship.

Chemero (2011), while agreeing with Van Gelder about the usefulness of dynamical systems theory as a modeling tool, argues that a dynamical description by itself is not enough. While it is a very powerful prediction tool, it still needs a "guide to discovery" to help produce new concepts and hypotheses for scientific investigation (for a critique of this approach, see Erdin, 2020). Chemero suggests Gibson's (1979) ecological approach to perception as fulfilling this need. Gibson, focusing on human vision, developed an ecological approach that shares many insights with other action-based approaches, such as getting rid of representations and noting the organism-dependence of the environment. According to Gibson, the environment consists of "affordances" that refer to action possibilities that the environment presents to the organism. What the affordances are in an environment depends on the capacities of the organism that perceives them. For example, a cup of water affords holding and drinking to humans who are skilled at manual manipulation, while it may not do so for an animal without an opposable thumb. Cognition, in this framework, consists of "picking up" of these affordances directly from the environment, without the meditation of representations, putting a great emphasis on the continuity between perception and action. This action orientation is also exemplified by Gibson's point that the visual system includes not just the eyes and the visual systems in the brain, but also the musculoskeletal system that moves the organism, which is what seeing is for, i.e., the movement of the organism in an

environment. This active nature of perception is also emphasized by O'Regan and Noë (2001; Noë, 2004) who argue that perceiving itself should be seen as an action instead of a passive receiving process, and the complete sensorimotor cycle needs to be seen as a whole.

I should note here that this is a very brief summary of a large literature composed of loosely associated perspectives without a single unifying theory of action-based cognition, and there are many disagreements among these perspectives (such as the potential role of representations in explanations, Clark, 2011). However, we can note that all these theories generally converge on their critique of computationalism, their emphasis on the interactive, action- and agent-oriented nature of cognition, and in their aim to close the gaps that computationalism opens between different types of mental processes like those between action and perception or between higher and lower forms of cognition.

How have such insights been adopted to mindreading research? As mentioned in the beginning of this section, the observational focus in computational research has been replaced by a focus on interaction and "intersubjectivity". Gallagher (2001) focuses on what he calls "primary intersubjectivity" which refers to direct interactions with others, especially with the primary caretaker throughout infancy. These are skills developed in interaction with another person to form a "second-person perspective", in contrast to observing people from a third-personal, observational standpoint. It is due to these interactive skills that we come to possess the full skillset observed at age four. Notice that this is similar to Tomasello's (1999) point about how joint interaction in infancy is what provides the context for mindreading skills to develop. However, in contrast to Tomasello who still views developed mindreading as a representational and interpretive skill, Gallagher

emphasizes the continuity of early skills with more developed ones, which do not lose their intersubjective, second-personal character in their mature forms. Similarly, Krueger (2012) argues that the "beliefs" of other people are not necessarily unobservable like the computational theories claim. A lot of our gestures and facial expressions indicate rich emotional and cognitive experiences, which are often directly observable by other people, and are even constitutive of those emotions. The motor aspect of happiness, like a smile, is not a distinguishable, mere motor output of some internal state, but is constitutive of what it means to be happy. Ratcliffe (2007), while also challenging the non-observability of mental states and emphasizing the role of social interactions, argues against the assumption that mindreading, defined as attribution of mental states to others, is ubiquitous in daily life. He claims that in daily interactions with other people, it is unnecessary to constantly speculate about mental states and make predictions about them, since we can simply follow social scripts that specify what to do or anticipate in many familiar situations. Ordering food at a restaurant or talking to a teacher at school already provides a rich context that constrains our actions and expectations, without the need for constant mental state ascription. It is our learned skills of navigating these environments that underlie many of our interpersonal skills. Notice how this emphasis on practically learned skills sounds a lot like the fearsome behaviorists that Dennett (1978) was warning about, since these skills seem to be amenable to being explained away by "mere" associations. Also notice, however, that these authors are not trying to explain anything away, or reduce them to associations, but are trying to develop a perspective that unifies what have been assumed as distinct central and peripheral processes. This already shows that taking peripheral processes seriously may not be as dangerous as might be thought in understanding complex cognitive skills.

1.2.2 Interactivism

Another alternative approach to the computational perspective on cognition is interactivism, developed by Bickhard during the same time, but independently, with the early enactive approach (Bickhard, 2009; 2016; 2020). I opted to describe this account separately rather than putting it under the umbrella of embodied cognition since it has some significant divergences and is a single unified theoretical framework (although it shares many insights with the embodied approaches) and also because the notion of schemas I will elaborate on in the third chapter will be most consistent with this framework. Before moving on to the notion of reflection that explains developed mindreading skills in this framework, I will briefly sketch interactivism in its general form and its theory of representation. Note that this really is a brief sketch aimed to provide some background for later discussions rather than a full account or defense of the framework.

One shared aspect of interactivism with other embodied approaches is the focus on the dynamic aspect of cognition. However, this seems to take on a greater role in interactivism, which has the central goal of accounting for mental phenomena as situated in a more general process metaphysics; while, for enactivism, phenomenology seems to take on a greater role (Varela et al., 1991; Thompson, 2007). Here, it is important not only that the mind is inherently active and dynamic, but the whole of nature is constituted by processes rather than substances, making the interactivist model of mind part of a process metaphysics of nature (Seibt, 2022). According to interactivism (Bickhard, 2020), it is only in such a framework that genuine emergence is possible, which is necessary to account for mental phenomena

and normativity in nature.[3] Bickhard (2020), similar to enactivism, presents a detailed picture of how a single cellular living being can emerge within self-maintaining chemical processes, but unlike the enactivist account, he emphasizes the role of far-from-equilibrium thermodynamic conditions instead of the production of component parts (as is the case in autopoiesis, Varela et al., 1991). The second law of thermodynamics dictates that entropy should increase in time in closed systems, and this corresponds to complex structures being dissolved for a more homogenous distribution of energy (Prigogine & Stengers, 1984). For a living being, dissolving complex structures means death, and it has to fight against the increase of entropy to remain alive. A living being can do this since it is an open system and, by constantly receiving energy from its environment, it can preserve its complex structure and keep itself in a far-from-equilibrium state. This makes the interactions of the organism with its environment normative relative to its far-from-equilibrium state since they enable its continued existence, and it is at this point that normativity emerges in nature (Bickhard, 2020). As living beings grow more complex through evolutionary processes (which also have emerged with living beings), their interactions with the environment also grow more complex and flexible. Bickhard (2020) describes an "evolutionary ratchet" that describes different sorts of interactions that develop in this process, each building upon the previous one. These are interactive knowing, learning, emotion, and reflective consciousness, which allow for increased flexibility in interactions with the environment and interactivism aims to account for the "whole person" by accounting for all these aspects together and unifying mental life in a single process-based framework.

[3] However, it is not necessary to share this assumption with interactivism to switch to an action-based approach to cognition through schemas, as long as one accepts that biological phenomena are best explained as processes (Nicholson & Dupre, 2018).

An important aspect to note here is that unlike many of the embodied approaches, interactivism accepts the existence of representations, although they are defined differently than those in computationalism. Bickhard (2020) describes the commonly used computational notion of representations as "encodings" of external things, where the external environment (or the represented aspect of the environment) is reproduced within the mind in a transduced form. A result of such a definition as internal encoding is that transduced encodings are now dependent on another agent inside the mind (called a "homunculus") to interpret, since the encoding only carries the object from the outside to inside of the mind without providing a model of what constitutes the dynamic interaction between the organism and the environment. As such, how the homunculus perceives the encoded representation still remains unexplained.[4] This creates a problem of an infinite regress (since the homunculus itself would need another homunculus to represent that representation, ad infinitum), a point also made by Gibson (1979). While encoded representations have two parts, that of the mental representation in the mind and the external, represented environment, interactivist representations have three parts, allowing for them to account for the possibility of error in representing (and the organism detectability of that error that allows learning), which is the central function that the notion of representation is supposed to explain, according to Bickhard (2020). In addition to the external part (i.e., what is represented), the interactivist model of representation divides the internal representation into two parts: "contact" and "content". The contact is between the organism and the environment, which amounts to a simple differentiation (such as a neuron firing upon

[4] If one argues that the transduced representation is manipulated upon and outputs a behavior without a need for a homunculus, other forms of the problem emerge such as the symbol grounding problem (Harnad, 1990) or the Chinese room problem (Searle, 1980).

detecting a certain shape). But for this representing to have truth value and the anticipatory aspect necessary for such truth value, there needs to be another process in the organism for which this contact is functional, or in other words, that anticipates some possibility on the basis of this kind of contact, and provides the representation with its content. What a differentiation in the environment means for an organism, i.e., its content, equals how it makes use of that differentiation in other processes. Since this content is given by another process that anticipates a certain contact, the process can fail when the anticipated contact (or the differentiations indicated by the contact) does not occur, and hence possibility of error, or misrepresentation emerges. Notice that representation here is not a static entity residing in the mind but a process of representing (Erdin & Bickhard, 2018). I will build upon this processual and anticipatory notion of representing the environment while defining schemas and suggest that focusing on a larger coherent flow of action (i.e., the schema) rather than an individuated representation will be more useful when trying to understand the details of skilled mental processes and showing how the models of these processes can differ from computational models.

Interactivism has a detailed positive model of development which accounts for the developmental shift indicated by success on the false belief test at age four. Campbell and Bickhard (1986) detail this developmental model that they call the "knowing levels model". In this model, children develop through levels of knowing, a process similar to Piaget's (1970; Ginsburg & Opper, 1988) stage theory of development (although it has divergences, especially in rejecting the structural notion of stages, Bickhard, 1988). While the exact timing of progression from one level to the next is not fixed, each level builds on the previous one and hence the order of levels is invariant, and no level can be skipped. This progression, again similar to

Piaget, is domain general (Allen & Bickhard, 2018; Allen, Çelik, & Bickhard, 2021). However, there is an interesting tension between domain generality and specificity (or a different take on what it means to be domain general or specific than for the computational account). While one skill may have progressed from one level to the next, and this is enabled by the acquisitions of a domain general skill, another skill that has not been put into practice is not automatically updated and can remain at the previous level. So, it is possible that there can be domain specific progressions in certain skills that are practiced more than others. Any skill itself needs to be actively used to progress, a result of their conceptions as entities that are not independently and passively residing in the mind but consist of their individuated occurrences, which is a result of their processual nature.

The separate skill that enables such progression is the Piagetian concept of "reflective abstraction" (or reflection for short). This capacity in itself is thought to mature relatively independently (hence, in a sense, innately) and allow for the construction of mental processes that interact not with the world, but with the mental processes that interact with the world themselves. With the emergence of reflection, the mind can now interact with its own processes and come to know what was implicit in those first level processes and make use of that implicit knowledge (with the help of a language-like system, as will be mentioned shortly). Unlike the notion of implicitness used by Onishi and Baillargeon (2005) as explained in section 1.1.3, this kind of implicitness does not refer to the existence of a capacity that is masked by performance factors. What is implicit in an interaction is not encoded in the mind itself, but it is a quality of the first level interaction organization that can be reflected upon when the capacity for reflection arises. It can be implicit in the interaction of an infant with her mother, for example, that the mother is responsive to the infant. But

this quality of the interaction is not explicitly represented by the infant, who is only engaging in certain interactions that anticipate the learned responses (which happen to assume responsiveness from the mother). But since the infant is not representing this quality as opposed to other possibilities of interaction (where the anticipated response may not occur, say, with an unresponsive mother), they are not explicit. Even if the anticipations fail, they can remain as failures that produce variations in behavior and learning of new interactions, still without necessarily being reflected upon. But through reflection on these interactive flows later on, the infant can reach conclusions like “my mother was responsive” or “I am worth responding to”, without going through trial-and-error type of learning processes. These conclusions are based on the implicit properties of the organization of first level anticipatory interactions that were themselves not known by the infant before reflection.

Campbell and Bickhard (1986) point to the newly emerging abilities of children around age four as when the reflective capacities emerge as a result of maturation and skills come to be reflected upon and are advanced to further levels. So, performance change in false belief tests is a result of domain general change in the capacity to reflect, which allows for progression through knowing levels in different domains. Once progressed, children can now interact with others in ways that are more flexible than learned patterns of interaction by reflecting on what was implicit in those interactions. For example, even if the hints to where the person will look for the hidden object are indeed unobservable and not specified by learned interactions, the child can still correctly anticipate the mistaken action of an agent (which is viewed as the result of a false belief in the computational framework) if she has made explicit the implicit qualities of the first level interactions, such as the actions of people depending on their previous interactions. Note that the interactivist

explanation is different from the other embodied explanations, in that there really is a qualitative shift that allows for new kinds of interactions with other people that qualitatively differs from first level interactions (the latter of which resemble the "mere" associative explanations of behaviorists), but there is a specific model of the continuous relationship between the two levels (as one emerging from the other through reflection) rather than being cast aside as performance factors as is the case in computational approaches. Although the emergence of reflection resembles the metarepresentational approach in certain ways (in the meta quality of reflection), the process ontology, three-part definition of representation and the focus on dynamics sets it apart. In the fourth chapter I will try to cash out this reflective process in more detail using (meta)schemas and doing so will help us see how an action-based framework can make a difference when used to interpret empirical findings.

It is worth noting that the explanation of the age four transition based on reflection creates more room for the role of language in aiding not only the development of mindreading skills, but also for reflection in general. Campbell and Bickhard (1986) give "symbolic language (or some equivalent examinable system of representational indicators)" (p. 86) a necessary role in reflection, since this system serves as an indicator to the processes to be reflected upon as decoupled from the original process and allow for an interaction with the rest of the system. In order to be able to attempt at fleshing out this role for language in reflection using schemas in the fourth chapter (which I hope will make it easier to approach), let's look at the empirical literature on the developmental relation between mindreading and language in more detail in section 1.3, especially concerning the interesting case of deaf and/or uneducated adults. This will also be a preparation for the second chapter where one such empirical study will be presented. Note that section 1.3 and chapter two will be

a break from the focus on the more theoretical questions discussed so far in this chapter, which I will return to in chapters three and four. I will be focused on describing the empirical findings here rather than any theoretical issues, and will be more relaxed in using computationalist language in doing so (such as referring to beliefs as static entities in the mind). A closer look at empirical findings both within the literature and as presented in the study described in the second chapter will provide us with a concrete setting to approach how we might apply schemas to mindreading and what role we can give to language and reflection within it.

1.3 Research on mindreading and language

1.3.1 Mindreading and language in hearing and deaf children

Learning to understand and use language that refers to mental processes has been the focus of a lot of research trying to understand the developmental relationship between mindreading and language although observing this relationship has not always been very direct or easy. For example, research suggests that while children younger than four years of age are able to use phrases like “I think” or “I do not know”, which on the surface seems like they are referring to mental states, their use is very restricted and such phrases are not flexibly applied when, for example, understanding that someone had a false belief (de Villiers & de Villiers, 2014). Analyzing children’s use of such clauses between the ages of one and five, Diessel and Tomasello (2001) suggest that these are not bound by more general rules but are usage specific. A genuine understanding of these words seems to develop around age four when children start to pass false belief tests, after a period of increasing appreciation of mental references at age three (Wellman & Bartsch, 1994). Children’s performance in a “memory for complements” task where they described

events of people making mistakes resulting from false beliefs (de Villiers & Pyers, 2002) suggests that it is only after the ability to describe such events with mentalistic language is acquired can children pass the false belief test.

In addition to gaining the capacity to produce mentalistic language, having an environment where mental states are often the subject of conversation through early development is also seen as an aid to mindreading development. "Mind-mindedness" of mothers, which refers to mothers' more interpretive, mentally focused descriptions of events rather than relying on more concrete descriptions, is shown to be related to mindreading development in children (Dunn & Brophy, 2005; Meins & Fernyhough, 1999). Training studies also support the idea that the acquisition of mentalistic language is helpful for mindreading development. Lohmann and Tomasello (2003), for example, trained 3-year-old children using deceptive objects, and either with or without mentalistic language to complement the events. They find that children's performance in false belief tests improved most when the observation of deceptive events was accompanied by mentalistic language, and it did not improve by training in the false belief test without the accompanying language.

These findings with typically developing children suggest that acquiring language that refers to mentally complex events has a crucial, maybe even necessary role in the development of mindreading. However, in the course of typical development it is difficult to separate the effects of language and other maturational effects; it is possible that mindreading will develop in the same way whether or not it is accompanied by language, if only several years later. Research with congenitally deaf children hints at a way to better understand this developmental relationship. Studies suggest that deaf children born to hearing parents experience delays in language acquisition compared with the deaf children born to deaf parents; and this

delay is also reflected in mindreading development, resulting in difficulties sometimes being found as late as at age 15 (Russell et al., 1998; Peterson & Siegal, 1999). Further strengthening the role of language in mindreading development are studies with deaf adults who are not exposed to conventionalized linguistic systems, which can show us whether at some point mindreading skills may develop without the help of language through years of skilled social interaction.

1.3.2 Deaf adults without a conventionalized language

Deaf people, when not exposed to a conventionalized language system, such as when they are not part of a community of deaf individuals with whom they can interact and communicate only with their hearing family members with their idiosyncratic signing systems, are called “homesigners” (Goldin-Meadow, 2003). When multiple homesigners come together in a community such as a newly opening school for deaf children or when there are multiple deaf individuals who develop a signing system by interacting with each other isolated from more conventionalized systems (for example in a village); new sign languages may emerge and become more conventionalized and complex in time (Meir, Sandler, Padden, & Aronoff, 2010). Due to their lack of conventionalization in the early stages of emergence, these newly emerging sign languages (as well as the signing systems of individual homesigners) may not contain distinct words that refer to mental states such as *know* or *think*. This lack of a rich mentalistic vocabulary can provide a rare opportunity to see the relationship between mindreading and language skills of adults, at a much later age than when typically developing children are expected to pass false belief tests.

To test these interesting populations, Pyers and Senghas (2009) looked at signers of Nicaraguan Sign Language (NSL), an emerging sign language that has developed in a school for deaf children. They measured the mentalistic vocabularies of two cohorts of NSL signers using a mentalistic vocabulary elicitation task where signers described video clips showing people making mistakes about identities of objects, a task similar to the memory for complements task used with children (de Villiers & Pyers, 2002). Here the first cohort of NSL signers refers to the homesigners who came together in the school and their communication among each other is the starting point of NSL, while second cohort of signers refers to children who came to school later and found that there was already a system in development and had the chance to build upon it. The authors also applied a minimally linguistic false belief test using picture-based stories to eliminate difficulties that may be posed by language rather than actual difficulties with mindreading. They found that first cohort signers who are using a less developed version of the language almost never used mentalistic vocabulary in the elicitation task, while the second cohort signers did, and this difference was also reflected in mindreading performance as the second cohort signers outperformed first cohort signers. When the authors used the same measures two years later, they found that first cohort signers acquired mentalistic words from second cohort signers due to social interactions between cohorts, and their increased use of such words was also reflected in their improved performance in the false belief tests. It is worth noting that these signers are around their 20's, much older than typically developing children are when they begin to pass these tests, and the acquisition of vocabulary even at such a relatively old age seems to have had a significant impact.

Other research on adult homesigners (Gagne & Coppola, 2017) looked at simpler visual perspective taking skills thought to develop prior to a full-blown false belief understanding. They found that homesigners performed similarly to hearing adults without schooling experience and NSL signers with schooling experience in visual perspective taking tasks that required considering that objects might be viewed differently by others in different locations. However, both NSL signers and hearing participants outperformed homesigners in false belief tests, suggesting the critical role of language in passing the false belief test despite mastery over the relevant visual skills. Other research looking at signers of Iquitos, another emerging sign language (Gagne, Goico, Pyers, & Coppola, 2019), also supports the finding that earlier visual skills are independent of language, unlike false belief understanding that seems to require linguistic skills, no matter how many years of social experience an adult may have. A curious finding here is the role that education seems to have on false belief performance for adults, as it was found that unschooled, hearing Spanish speakers, while outperforming homesigners, do not perform at ceiling levels in false belief tests, and only around half of the participants pass the tests. The mindreading skills of unschooled hearing adults seem to require further investigation, especially considering that false belief understanding is assumed to develop around age four and is assumed to remain central in the complex social lives of adults according to computational approaches as described in section 1.1.

1.3.3 The current study

In the current study, that will be described in detail in the next chapter, we tested signers of an emerging sign language, Central Taurus Sign Language (CTSL) and hearing adults living in the same region who have similarly minimal schooling

experience,[5] in order to better understand the mindreading skills of adults independent of schooling experience. CTSL is a village sign language that has been developing in a remote village in Southern Turkey (Ergin, 2017). Due to the remote geography and lack of infrastructure in the region, the village has been largely isolated, and the relatively large deaf population (around 15 individuals living in or near the village as of 2021) have not had the opportunity to have contact with the deaf culture in Turkey and learn the widely used Turkish Sign Language. An important aspect of this community is its recency. It started emerging around 1970 and the first cohort of signers who created the language are still alive. Also due to CTSL being in its early stages of development, it is likely that it does not yet contain mentalistic words, which might provide an opportunity to see the mindreading skills of its signers who never learned these words. To uncover whether the language contains such words or whether these words (if any) are used by signers in appropriate situations, we used a mentalistic vocabulary elicitation task similar to the one used by Pyers and Senghas (2009). In addition, we tested participants using two minimally linguistic false belief tests, one based on video clips showing changes of location of object either seen or not seen by a protagonist, and an experiential test designed specifically for use with homesigners with minimal schooling (Pyers, 2004). The experiential test enables participants to experience false beliefs themselves before making predictions about the actions of another person.

In addition to testing the signers of CTSL, we also tested a hearing control group from similar educational and cultural backgrounds to serve as a control group. Since NSL is a community sign language composed of very large group of deaf people (already around 800 in 2004, Senghas, Kita, & Özyürek, 2004) with at least

[5] Although, unlike the deaf participants, most hearing participants completed the five years of mandatory education, see next chapter.

some access to schooling; CTSL, being a village sign language where people have very little access to schooling, provides an opportunity to compare two groups who have minimal schooling yet differ in their linguistic experience. Since the control groups in prior studies composed of unschooled hearing participants (e.g., Gagne & Coppola, 2017) were not tested in their mentalistic vocabulary use, it is not known how much mentalistic language production relates to false belief performance in these groups. It is possible that although these participants were native speakers of a highly conventionalized spoken language, they may not differ in their active use of mental vocabulary from the deaf group, which might account for their comparable performance in the false belief test. We opted to look into this possibility by also testing the hearing control group with the mentalistic vocabulary elicitation task. We hypothesized to find differences between the mentalistic vocabulary use between the deaf and hearing groups with hearing people using more mentalistic words than CTSL signers, and that this difference would be reflected in false belief performance where the hearing group outperform CTSL signers, while, importantly, still performing below the ceiling level. Due to the special nature of the population composed of only a handful individuals, it is inevitable that the test power will be very low. Still, taken together with other findings from the literature on adult mindreading described above and supplemented with observational anecdotes in the fourth chapter, the case of adults subjected to false belief tests will provide a useful background to see how action-based approaches and concepts can make a difference for interpreting empirical findings. But before that, let's look at the methodology and quantitative results from the study more closely in the second chapter.

CHAPTER 2

MINDREADING SKILLS OF DEAF ADULTS WITHOUT A CONVENTIONALIZED LANGUAGE

In this chapter, I will present the current study that tested the mindreading and language skills of minimally educated hearing adults and uneducated deaf signers for an emerging sign language. Following the findings in the literature (Pyers & Senghas, 2009; Gagne & Coppola, 2017) we hypothesized that hearing adults will produce more mental state words than signers of CTSL, and this would influence their false belief performance where they would outperform the deaf participants, although still not performing at ceiling. The performance below ceiling is a curious finding in this literature both for deaf and hearing adults who have well-functioning social lives and have been interacting successfully with other people throughout their lives. Such findings from this study and the larger literature will serve as an example to show how an action-based perspective on cognition using concepts like action schemas can make a difference in the interpretation of experimental results and tests like the false belief test, as I will discuss in the later chapters. In this chapter, I will first describe the method and results of the study and finish with a discussion of the immediate findings without going into the more general theoretical issues described.

2.1 Method

2.1.1 Participants

In total, we tested 13 deaf people (12 CTSL signers and one homesigner, nine females, M_{age} = 38.31, *SD* = 17.30), and 11 Turkish speakers (six females, M_{age} = 47.18, *SD* = 20.53).

However, this larger group is not very homogenous in terms of age and education. Both groups include two children, 7 and 9 years old in the deaf group, and 8 and 11 years old in the hearing group. Also, two hearing participants had extreme scores for years in education, with 14 and 11 years, with the nearest score being 8 years. One deaf participant had an extreme score with 12 years of education experience, the nearest score being 5 years. To keep the groups homogenous, these participants are not included in the analyses, leaving us with 10 deaf participants (nine CTSL signers and one homesigner, six females, M_{age} = 45.60, *SD* = 3.45), and seven Turkish speakers (five females, M_{age} = 53.71, *SD* = 3.88). The performance of excluded participants, i.e., deaf and hearing children, and more educated adults will be mentioned separately from the analyses when it is relevant. In addition to these participants, some have been excluded within different tasks or some tasks could not be completed due to time limitations. The included number of participants will therefore be repeated while describing the results of each task in the results section.

While the years of education is minimal for deaf participants (*M* = .50, *SD* = .50), most hearing participants had the 5-year elementary school experience mandated by the government (*M* = 4.71, *SD* = .89). This is a limitation since we aimed to have a control group matching the deaf group in terms of education. However, these 5 years of education is more than 40 years in the past for most hearing participants and is likely not to have had a big influence in their lives in the rural setting they lived most of their lives in, so I will omit the difference here while noting it as a non-ideal situation.

In terms of the setting within which participants live, seven of the 10 deaf participants are living in the remote mountain village where CTSL has originated or similar villages immediately neighboring it, while three of them have been living in a

slightly more urban setting (with a population around 60,000) for the last several years. In the hearing group, only two of the included participants could be tested in the same village due to time limitations in the field trip, and the remaining five of them are also living in a slightly more urban area (with a population of around 20,000). Again, this is not the ideal situation, yet the difference is omitted due to similar scores in mental language elicitation across participants (see results).

It is possible that the deaf group may not be homogenous in terms of a number of variables such as whether the signer has grown up around another signer more experienced than herself or has been exposed to spoken language when she was young. For example, one participant is not a signer of CTSL but is a homesigner and is the spouse of an omitted CTSL signer (due to her education experience), while a first cohort signer of CTSL has lost her hearing ability at age 8 and still has some level of proficiency over spoken Turkish. Despite any such differences, the deaf group has been analyzed as a whole due to their homogenous scores in the language elicitation test (as described in the results section), which is what is relevant for our hypotheses rather than any other linguistic capacity.

2.1.2 Materials and procedure

The data has been collected during a two-week field trip to a small village in the Southern region of Turkey and nearby towns with different levels of urbanization. For the deaf group, these measures often took place after two other experiments have been completed that are unrelated in terms of procedure and included participants viewing and describing two-three second videos with simple (non-mentalistic) events, while this was not often the case with hearing participants (see discussion section). Participants were always given a chance to rest for around 10 minutes

before the start of testing. The testing started with the experiential false belief test, followed by the video-based false belief test, followed by the mentalistic vocabulary elicitation task. I will not follow the testing order here in describing these to keep the experiential false belief to last, which is the most cumbersome to describe (and I expect, to read). All tasks have been applied by the same experimenter (i.e., the author), with the help of two research assistants, one taking notes of participant answers and the other acting as the confederate in the experiential false belief test. All procedures have been recorded through video cameras and participant answers have been double-checked by the author through the recordings.

2.1.2.1 Mentalistic vocabulary elicitation task

The purpose of this task is to check whether CTSL signers have a vocabulary that enables them to make references to mental states while signing, and to make sure that hearing participants use the relevant Turkish vocabulary so that we can be sure that deaf and hearing participants fall into two different groups in terms of their mentalistic vocabularies. To elicit mentalistic language, we followed the method used by Gale, de Villiers, de Villiers, and Pyers (1996), as reported in Pyers and Senghas (2009). Participants viewed six short video clips (approximately 30 seconds) taken from Charlie Chaplin films, as we knew from previous experience with the same participants that they enjoyed watching them and were able to follow the events, which might not be the case with less emotionally salient videos. Before finalizing the choice of six clips, nine clips were selected first and shown to a separate group of 17 deaf Turkish Sign Language signers and four uneducated Turkish speakers in a pilot study, who described the events after watching. The six clips that elicited the most mental words were selected for use in testing. Four of

these clips depicted people making mistakes (e.g., trying to eat a man's head, mistaking it for a cake) to elicit language referring to knowledge and belief states (e.g., *think, know*). The other two videos depicted people trying to accomplish a goal (e.g., trying to enter through a door) to elicit desire-state language (e.g., *want*). The videos were shown in two random orders to counterbalance any order effects.

Once the participants viewed the full clip, they were asked to describe what had happened, either in sign ("HERE WHAT HAPPEN TELL") or spoken Turkish ("what happened here, could you tell me?"). After they described what they had seen, the clip was shown again, this time pausing at the frame when the relevant action was happening (e.g., just as Charlie Chaplin is trying to use a spoon on the man's head, thinking it is a cake), and the experimenter asked the same question, this time pointing to the frozen frame showing the mistaken action. If no mentalistic vocabulary is elicited up to this point, the experimenter asked why the character was performing the specific action s/he was performing (e.g., "why is he spooning the man's head?" in Turkish, or "HE SPOON HEAD WHY?" in CTSL).[6] If the relevant vocabulary still was not elicited, the experimenter asked, after pointing to the character making the mistake on the screen, what the character is thinking. It is important to note, this last prompt was not given to the first four participants (three deaf) although it was part of the procedure described by Pyers and Senghas (2009), because we did not think there were clear signs with which we could ask this question in CTSL, and that it might confuse the participants. However, during testing we realized pointing to the head was an intelligible sign that deaf participants understood and decided to add it thereon (see discussion section).

[6] The experimenter has been extensively trained in these signs by a hearing native signer of CTSL.

All answers were videotaped and transcribed. The descriptions by CTSL signers were transcribed by the author, who had one year of experience of transcribing utterances by deaf people from various groups including CTSL. For CTSL signers, clear signs where participants point to their heads while explaining the relevant actions of the character were counted as mental state words, while words or imitations that described emotions, the sign "SEE", and immediate imitations of the sign "THINK" that the experimenter used in asking the last question were not counted. For the hearing group, words like *think, know, realize* were counted while emotion words or *see* were not. Because each participant was asked a different number of questions depending on whether they had used the word up to some point, and repetitions are difficult to decide on, each participant was given a score out of six, that shows how many videos elicited at least one mental word (see results section for different methods of scoring).

2.1.2.2 Video-based false belief test

Following previous research (e.g., Pyers & Senghas, 2009; Gagne & Coppola, 2017), we opted to use false belief assessments that depend on language as little as possible. A video-based false belief test was created based on the picture-based test used by Pyers and Senghas (2009). The picture version was not used because comprehending a narrative based on a sequence of pictures is a complex skill that requires familiarity with such narratives (Cohn, 2013), which our participants might lack. We shot six videos of change-of-location events (Wimmer & Perner, 1983) lasting about one minute, where a protagonist leaves an object at a closed location, and another character then moves the object to another location. Of the six videos seen by participants, three of them make up the false belief trials, where the protagonist does

not see the transfer, and three of them make up the true belief control trials, where the exact same event happens but the protagonist watches the other character as she changes the location of the object. These true belief control trials ensure that participants are not just selecting the tricky endings and are indeed taking into account the mental state of the protagonist. Each video has both a true belief and a false belief version, and half of the participants viewed one set of versions, and the other half the other versions, to make sure any difference in complexity of the stories is not a confound. In the false belief versions, the protagonist either leaves the room or turns her back while the transfer happens, and the event of leaving the room is randomly distributed across both false belief and true belief versions in order to eliminate its use as a cue for the correct answer (i.e., the protagonist also leaves the room and comes back in some videos after witnessing the change of location event). All videos have different actors playing the protagonist and different, culturally familiar objects are used in each video (such as a tablecloth, a bottle of cologne, etc.).

After viewing each video, the participant viewed two images showing the protagonist reaching for the two locations: one where the object has been moved, and the other where the object was first placed. Participants were asked "which comes next" in Turkish ("AFTER WHICH?" in CTSL) and if they seemed puzzled, were prompted with "where will s/he look", upon which all participants pointed to one of the pictures.

Before the test trials, participants also viewed four (later reduced to two) training trial videos to introduce them to the procedure. The first two trials showed simple events (e.g., drinking water from a glass) and two pictures, showing one possible (e.g., an empty cup) and one impossible (e.g., a cup still full of water) result of the event. These were aimed to introduce to the participant the procedure of

selecting the result following an event and the general procedure of selection. The next two training trials, again showing simple events (e.g., water spilling on a table from a falling glass) were aimed to show the participants that they should pick the immediate result of the events, rather than some eventual result (e.g., a picture showing the table being wiped with a cloth rather than one showing the table fully cleaned). However, these two latter training videos that showed two possible outcomes were removed after the first seven participants have been tested (one of whom was a Turkish speaker) because they seemed to confuse the participants who otherwise gave clear answers to test videos. Participants were given feedback during these training trials about their answers, and participants who gave wrong answers were corrected. Test videos were provided in two randomized orders and the position of the correct answers was randomized.

2.1.2.3 Experiential false belief test

The second false belief measure was the experiential false belief test designed by Pyers (2004), as detailed by Gagne and Coppola (2017). This task was created specifically for use with homesigners who may not have schooling experience and has minimal language demands. The test has two main phases: the experiential phase and the prediction phase. In the experiential phase, the participant experiences false beliefs herself as she goes through subsections of the task where she makes selections among different kinds of objects. Later, in the prediction phase (where the actual test trials take place), a confederate is brought in, who is a hearing resident of the village known to the participants and a native signer of CTSL. The participant is told that the confederate has never seen this task before, and sat next to the confederate, as the confederate went through the same procedure the participant did

in the experiential phase. Meanwhile, the participant is provided a laminated booklet showing pictures of the objects to be selected on each page and a marker; and asked to put a mark on the object the confederate will choose. The participant is asked not to show her markings to the confederate, and told "what will he choose? Mark it on the page" or "HE CHOOSE WHAT? MARK" in CTSL. The use of any mentalistic vocabulary by the experimenter was avoided during this test in order not to prime the participants who may not otherwise use such mentalistic words. The confederate waited for the participant to make her mark on the page and was told to go ahead with his choice afterwards. After the confederate made his pick, the participant was asked to show her prediction on the page, and it was compared with the choice of the confederate, where the experimenter asked "is it the same?" pointing to her selection and the object the confederate chose, making the sign for "SAME" in CTSL. If the prediction was correct, everyone cheered and clapped, and the participant was rewarded with a colored pencil, in order to emphasize the success conditions of the prediction procedure. To pass the test, the participant should make her selections based on the knowledge state of the confederate about the objects and realize that he will make the same mistakes that she did minutes ago.

The experiential and prediction phases each have three identical subsections: the sticker trials that serve as training, the appearance/reality trials, and the unexpected contents trials. The sticker section includes six questions. In half of them, the participants (or the confederate in the prediction phase) are shown three stickers and asked "which is best?". The three stickers are identical except that two of them are damaged and torn, and only one is in good condition, making the answer obvious: the best is the one in good condition. In the remaining three sticker trials the participant is shown two similar stickers, both in good condition, and asked the same

question. Here the choice is not obvious, and either can be chosen. The purpose of the sticker trials is to familiarize the participant with the selection procedure during the experiential phase, and with the prediction procedure in the prediction phase. The obvious choice trials show the participant that it is sometimes easy to guess what someone else will do, and the non-obvious choice trials show that sometimes it is difficult to make such a prediction. It was made sure that in the non-obvious choice trials, the confederate made both the same and different choices as the participant at least once to emphasize that others may have the same or different preferences from oneself.

The appearance/reality section included two questions: one test question where the mistake (either by the participant or by the confederate) is made, and a subsequent control question aimed to see if the correct answer is understood, similar to the memory control question in standard false belief tests (Wellman, et al., 2001). The participants are shown three plates containing one, three, and seven candies. Here, because pilot tests with unschooled hearing participants showed that participants tend to be modest and not choose the plate containing seven candies upon asking which is best, we modified the question and provided a more culturally relevant scenario to direct all participants to the same answer (i.e., the plate with the most candies). After putting the plates in front of the participants, the experimenter said “it’s [the religious] holiday, everyone is coming, you will give out candies. Which is best?”, or “HOLIDAY ALL COME GIVE CANDY WHICH GOOD?” in CTSL. All participants understood the question and made a choice afterwards. Unbeknownst to the participants, in the plate containing seven candies, which the question is intended to direct, the candies are glued to the plate. If the participant did not immediately pick that plate or picked an alternative, the experimenter prompted

with repeating the question, emphasizing the "ALL COME" part. After the participant chose the plate with seven candies, the experimenter told the participant to take one for herself, upon which the participant realized they were stuck. The experimenter then said "these are stuck, they are not good. Then, which is best?", upon which participants were expected to pick the plate with the second most candies. To pass the test in the prediction phase, the participant is required to realize that the confederate, who does not know that the candies are glued, will pick the plate with the most candies in the first question, making the same mistake she did in the experiential phase.

In the unexpected contents section, participants were provided with various objects and asked to match them with other objects across six questions. Before asking the first three questions, the experimenter showed the participants (or the confederate) an array of four objects: a glass, a candle, a lock, and a piece of paper. After positioning the array on the table, a target object is put in front of the participant. The first target object was a pen. The participant is asked "which of these [in the array] does this [the pen] go with?", or "THIS GOOD WHICH?" in CTSL, and proceeded to put the pen next to each object in the array with a questioning expression and repeating for each object "does it go with this, or this…" or "GOOD?" in CTSL. The expected answer is that the pen should go with the paper, and upon providing that answer the participant is invited to use the pen on the paper to emphasize the functionality. The second target object was a bottle of water, that should be matched with the glass. These first two questions were aimed to introduce the matching procedure to the participant and emphasize that the objects that can be used together should be selected. The third question is where the false belief occurs (and serves as the test trial in the prediction phase). The participant is shown a

matchbox, which, unbeknownst to the participant, contains a key instead of matches. The participant is expected to match the matchbox with the candle. Once she does so, she is invited to try and use it on the candle, whereupon she realizes it actually contained a key and should be matched with the lock. After the test trial, the first set of objects are taken away from the table and another array of objects is presented for the next three trials, the last of which serves as the control trial to see if the participant understood this correct matching and that she remembers there is in fact a key in the matchbox. The next array contains functionally equivalent objects to the first one: a mug, a cigarette, a different lock, and a notebook. The same target objects, which were never taken off the sight of the participant, are presented in the same order, where the pen is to be matched with the notebook and the bottle to be matched with the mug. In the last question, which serves as the memory control trial, the same matchbox is presented, which should now be matched with the lock, since the participant (or the confederate) knows that it contains a key instead of matches. The presentation order of the arrays and the appearance/reality and unexpected contents tests were counterbalanced across participants, and the presentation order of the arrays was reversed moving from the experiential phase to the prediction phase, in order to make sure participants were not simply repeating their own choices with specific objects during prediction.

To summarize, the whole experiential false belief test includes two false belief test questions in the prediction phase: one within the appearance/reality section and one within the unexpected contents section, where the participant needs to predict that the confederate will have the same false beliefs as she herself just had, rather than know the correct answer. In addition, there are control trials following both test trials in the prediction phase, and following the participant's own false

beliefs in the experiential phase, to make sure that the participant realizes what the correct answer really is (when she herself is answering in the experiential phase) and that she realizes that the confederate also realizes the correct answers after being fooled in the test trials (in the prediction phase). How the participants were excluded based on test-specific criteria will be described in the results section.

2.2 Results

The findings of the study are described here. It is important to note that we have low test power due to the small sample size (10 deaf and seven hearing participants) making the detection of significant differences between groups difficult. This is an unavoidable problem when working with rare naturalistic cases like signers of an emerging language who have little to no knowledge of mentalistic words. Here, I will nonetheless present inferential statistics but will go on to make some interpretations based on descriptive statistics while keeping in mind the previous findings from the literature with which these findings are largely in concert. More general theoretical interpretations presented in the later chapters will not be based on significant group differences based on language but on the failure of both hearing and deaf participants to show a ceiling effect in the false belief tests and observational anecdotes from those failures. My focus will be on speculating about how a language effect on mindreading may be theoretically approached at all, rather than defending a specific model and attempting to prove the existence of such an effect based on these findings.

2.2.1 Mentalistic vocabulary elicitation task

This task is completed by all participants included in the analyses (10 deaf and seven hearing participants), none of whom are excluded.[7] Before this, there were no findings concerning the mentalistic vocabularies of CTSL signers. Following the procedure in Pyers and Senghas (2009), two of the stimuli videos targeted the elicitation of desire words, while the other four targeted belief-related words like *think, believe*, etc. We had no specific hypothesis about the desire words but were surprised to find that CTSL did not have a clear sign for *want*, unlike NSL (Pyers & Senghas, 2009). This is an interesting finding since it is often assumed that desire and desire related language understanding develops earlier than "belief understanding" in ontogeny (Perner, Sprung, Zauner, & Haider, 2003; Repacholi & Gopnik, 1997; but also see Ruffman, Aitken, Wilson, Puri, & Taumoepeau, 2018 about replication problems with desire understanding before age 4). Some participants did seem to use the sign for "TAKE" in a more generalized form that may refer to desire states, but only two participants used this sign, and it is unclear what they meant by it. In contrast, all hearing participants used desire words like *want* or *try to* at least once. We did not analyze desire words further and they were not counted as mental words.

Participants were given a score out of 6 that refers to the number of videos about which they used a mentalistic word at least once. Although two of these videos were aimed at eliciting desire words, many participants used mentalistic words in describing them also, so they were included in the score. We found a clear difference between deaf and hearing groups, where all hearing participants scored either 4 or 5

[7] Due to a technical problem, the recording of one deaf participant was lost after the first four videos. She had produced only one mental word by that point, and her maximum score would be three, which does not impact the results in terms of significance. Therefore, her score is counted as one.

except one who scored 2 (M = 4.14, SD = .40), while deaf participants scored 0 or 1 except three who scored 3 (M = 1.10, SD = .43). A Mann-Whitney U test showed that this was a significant difference (U = 3, p = .001). The difference remains significant even if we count the total number of mental words uttered by participants across all videos, instead of giving a score out of 6.

It is also interesting to note that the 7-year-old deaf participant who was not included in the analyses because of her age used mental words for all videos, scoring a perfect 6, which is the highest of all participants including the hearing group. At the same time, her older sister who was 9 and also deaf, scored only 2. It is possible that the younger sister picked the mental word up from the prompt questions, or that she has learned the mental signs recently and is eager to use them.

2.2.2 Video-based false belief task

Due to time limitations during testing, nine deaf participants, and six hearing participants completed this task. Of these, two deaf participants have been excluded from analyses because one of them selected only the pictures on the right, and one gave unclear answers and did not seem to understand the task, leaving us with seven deaf and six hearing participants. Other participants who gave wrong answers to training trials but were corrected by the experimenter were included in the analyses.

Overall, the true belief control trials did not produce the results observed in previous studies (Pyers & Senghas, 2009), since not all participants passed them. We conducted Mann-Whitney U tests to see if there are any significant differences between groups in false belief and true belief scores (which show the number of correct answers out of three). There were no significant differences between groups neither for true belief (Mann-Whitney U = 10, p = .054) nor false belief scores

(Mann-Whitney $U = 13.50$, $p = .263$). While differences between groups are non-significant, the mean ranks for deaf participants are lower than hearing participants both for true belief scores ($M_{rank} = 5.43$ for deaf group and $M_{rank} = 8.83$ for hearing group) and false belief scores ($M_{rank} = 5.93$ for deaf group and $M_{rank} = 8.25$ for hearing group). If we interpret these descriptive results while ignoring the non-significant inferential results (as we might because of low test power) we can say that the hearing group performed better than the deaf group both in understanding true belief and false belief events. There does not appear to be any interaction between the effect of language group and video type (depicting true or false belief events), which means that false belief events do not put an additional burden on the deaf group compared to the hearing group (see Figure 1 showing the mean number of correct videos per group). Interestingly, the two deaf children not included in these analyses do seem to experience a more marked difference in difficulty between true belief and false belief videos, since both the 7-year-old and the 9-year-old passed all three true belief trials while failing all three false belief trials.

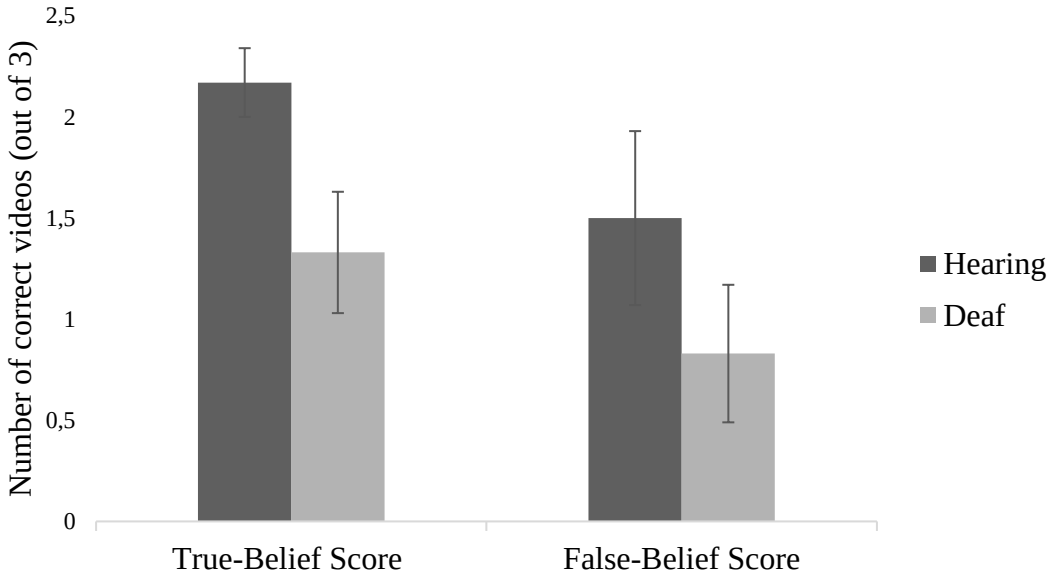

Figure 1. Mean scores for the video-based false belief test

2.2.3 Experiential false belief task

The task could not be completed with one deaf participant because he did not understand the object selection procedure. In addition, two deaf participants have also been excluded, one for having seen the task the day before testing and knew the correct answers to the false belief trials already, and another because she tried to show the confederate her marked answers, suggesting that she did not understand that she needed to predict the selections of the confederate. This left us with seven deaf and seven hearing participants. In addition, alternative task-specific exclusion criteria have been developed, as not all participants gave clear and consistently correct answers to the control questions. Two alternative criteria have been devised to make sure that the participant, after the false belief trials, understands that the correct answer is actually the non-obvious answer (i.e., the plate with three candies and the lock to be matched with a matchbox). Giving the "correct" wrong answer in the false belief prediction trials (predicting that the confederate will choose as if he knows the reality of the situation) is maintained in both criteria and giving wrong answers to the object matching familiarization trials are ignored (for example, some participants matched the pen with the glass, because they thought they could put the pen in the glass, which is not problematic for the purposes of the task). The first and more relaxed alternative that serves as an exclusion criterion is the following: the participant should give the correct answer in the control trial (after the false belief trial when s/he should realize the correct answer) either in the experiential phase or in the prediction phase. The more stringent criterion, on the other hand, holds that the participant should give the correct answer to the control question in the prediction phase, regardless of her answer in the experiential phase. In what follows, I will present the results based on the relaxed criterion as it might be enough to show

participants understand and remember the correct answers to questions even though they do not follow the change in the knowledge of the confederate, and because the pattern of results does not change whichever criterion is applied. The exclusions have been applied specifically to tests, and a participant who is excluded in the appearance/reality (A/R) test may be included in the unexpected contents (UC) test if she satisfies the criterion.

When we look at the A/R test with the relaxed criterion, we find that all remaining participants fulfill the criterion and that both groups perform exactly the same, two out of seven participants passing the test in each group. With the stringent criterion, two additional deaf participants are excluded, and the results remain non-significant ($X^2(1) = .11$, $p = 1$). In short, whatever exclusion criterion we use, we find that there is no significant difference between groups in the A/R test, while we see that at best, less than half of the participants have passed this test, also for the hearing group.

When we come to the UC test, on the other hand, some difference between groups seems to appear. Applying the relaxed criterion, five participants remain in each group, where three pass in the hearing group and none pass in the deaf group. However, this difference is non-significant based on a chi-square test ($X^2(1) = 4.29$, $p = .167$). Switching to the stringent criterion with this group, we are left with only four participants in the hearing group (two of whom pass the test) and just three in the deaf groups, none of whom pass, and results remain non-significant. In short, we find that the UC test is difficult for deaf participants, with none passing, and less so for the hearing group where around half of the participants pass.

In addition to the adult participants, the two children in both deaf and hearing groups were tested, and all four passed the control questions. Here both of the hearing children passed A/R and UC tests, and both deaf children failed the two tests.

2.3 Discussion

We hypothesized that there would be a significant difference between the mental vocabularies of deaf and hearing groups, and this difference would be reflected in false belief performances with the hearing group outperforming the deaf group while not performing at the ceiling level. These are partially supported by the results. First, we did find a significant difference between the mental word use between groups with the deaf group using mental words much less frequently. This is the first study testing the mentalistic vocabulary of CTSL signers and suggests that the signers are indeed capable of referring to mental states but do not do so as frequently as hearing Turkish speakers. Second, we did not see a performance at ceiling level in any of the false belief tests, with around half of the hearing participants succeeding in the experiential false belief tests and answering around half of the false belief questions correctly in the video-based false belief test. This is similar to the findings of Gagne and Coppola (2017) who tested hearing unschooled Spanish speakers and signers of NSL with the same experiential measure, where around half of the hearing participants passed the test.

Results are less clear when it comes to the effect of language on false belief performance. We did not find significant differences between groups for the video-based false belief test. Even if we look at the descriptive statistics and see that the hearing group is performing better in terms of correct answers, the difference is also there for true belief videos where participants do not need to understand the lack of

knowledge in the protagonist. So, the false belief situation does not seem to put an additional burden on deaf participants, making the attribution of any poorer performance on the difficulty with false belief somewhat difficult. For the A/R test within the experiential false belief test, we are again finding an exactly equal performance between groups, where two of seven participants pass in each group. This shows that people from both groups can indeed pass this test, but no language effect seems visible. In the UC test, we do find some difference between groups where around half of hearing participants pass and no deaf participant passes. Although this difference is not statistically significant, it is important to note the (unavoidably) low power of the study, and such a difference is worthy of note. This is similar to the findings of Gagne and Coppola (2017), who find that NSL signers have more difficulty with the UC test compared to the A/R test. It is possible that this difference is attributable to the complexity of the UC test which has four additional questions and a more complex object matching aspect in addition to the false belief aspect. It might be that the effect of language appears when the complexity of the task is increased.

There are several limitations and potential problems of the study worth noting. First, it is possible that the cognitive demands of the false belief measures might be too high, which might have influenced the deaf group disproportionately, since hearing participants have slightly more education experience, were fresher because this was the only test they went through, and tend to live in more urban places (see participants section). Some complexity can be found in the videos in the video false belief test (change of location events sometimes accompanied by the protagonist leaving the room) and in the prediction phase of the experiential false belief test where deaf participants were in the strange situation of making marks on a

page. For the video false belief test, this issue may be more problematic since we are not sure why exactly the participants who answered correctly did so, and results may reflect chance performance for both groups. But for the experiential test, we have at least some participants in both groups who pass the test and the control questions ensuring they know the correct answer and understood the prediction. As such, the test seems passable, and we are finding variance in performance rather than a floor effect. Although no deaf participant passed the UC test, some hearing participants did so, creating an interesting difference.

Another potentially problematic issue relates to the last prompt in the elicitation test where participants were asked what the character was thinking. One immediate problem is that this prompt was added after the first four participants were tested, three of whom were deaf (see methods section). This prompt may be priming the participants to use the mental word which is used by the experimenter in the later trials, and lack of use in the first three deaf participants may have affected the score of the group negatively. However, since the difference between hearing and deaf groups is very much marked, with all but one participant scoring 4 or 5 with no deaf participant scoring more than 3, this issue does not seem too problematic for the overall difference between groups.

Another limitation relates to the means of communication with participants. The experimenter was both a hearing person and a stranger to the local setting, which may have made it more difficult for deaf participants to communicate freely. Relatedly, although the confederate in the experiential false belief test was a local native signer of CTSL familiar to participants, he was not deaf, and it is possible that participants were more willing to attribute knowledge to him because of this, despite being told that he had never seen this before. Future studies testing the false belief

performance of unschooled deaf signers of emerging sign languages should aim to create culturally appropriate simple measures, use a hearing control group even more closely matching in education and cultural background, and have experimenters and confederates as familiar to participants as possible.

To conclude, we found that CTSL signers have access to mental vocabulary but do not use it as much as hearing Turkish speakers, who did actively use them in their descriptions during testing. Our findings are in concert with the literature where both hearing and deaf adults have been found to perform below ceiling level in false belief tests (Gagne & Coppola, 2017). They are less conclusive about possible group differences between people with and without mentalistic vocabulary (Pyers & Senghas, 2009). However, looking at descriptive results, some trend exists in the UC test, supporting prior findings. An interesting note is the case of the 7-year-old CTSL signer who used mental words for all videos yet failed all the false belief tests. It is possible that she simply overused a sign she recently learned and was primed by the experimenter's prompts with this sign but may also be an indication that the relationship between false belief performance and language may not be too direct. In the fourth chapter, I will return to interpreting these results, this time looking at specific participants and trying to understand why they are making the mistakes they do and what that might mean. I will not argue for the existence of the language effect, but rather try to picture how that effect may be modeled more specifically, within an action-based framework, and what this might add to the mainstream computational approaches. But before trying to understand mindreading, language, and the false belief test within such a framework in the fourth chapter, I will first aim to define a concept of "action schemas" in the next chapter. This will be a break from mindreading, as I will define this notion as applicable to any mental process and try

to characterize it very generally. The point of this is to have a simple, intuitive tool that will help us apply action-based insights (as especially found in the interactivist framework discussed in the first chapter) into experimental settings.

CHAPTER 3

ACTION SCHEMAS

This chapter will be a break from mindreading. Here, I will try to define an action-based notion that will (hopefully) be beneficial for applying action-based theoretical insights to empirical research practices. I called this notion "action schema", inspired by Piaget's use of the term, upon noticing how an action-based explanation is helping him to build a constructivist theory of development (Ginsburg & Opper, 1988; Piaget, 1952). However, I opt not to call these "Piagetian Action Schemas" directly, to avoid any historical burden that it might carry, especially considering Campbell and Bickhard's (1986, p. 56-57) criticism of the Piagetian notion. Also, such a notion perhaps fits best within the interactivist framework (Bickhard, 2009; 2020) as mentioned in the first chapter, so it might as well be called "Bickhardian action flows". Instead, going with action schemas, or simply schemas for short, seems more appropriate with my goals here.

Specifically, my goal is not to make an ontological claim about a new and interesting type of entity or process residing in the mind. Instead, I will begin with a definition that is as general as possible, and not controversial at all (i.e., simply an action or process that occurs in the world). What is more controversial, and where the challenge lies, is to develop this concept such that it will make a difference for researchers when it is used as the main unit of explanations of cognitive phenomena. This is akin to the notion of "affordance" as defined by Gibson (1979) and its usefulness. This simple notion that refers to action possibilities that an environment offers to an agent carries many insights of the Gibsonian theoretical framework, such as the central role of action, the agent-dependence of the environment, and the

overall relationality between organisms and their environments. Even if one is not well-versed in the Gibsonian theory and without using the notion in a strictly defined way, the skillful use of such a concept can provide many new possibilities for research across disciplines (Jamone et al., 2018). Similarly, my aim in defining the notion of schema will be that it should carry the insights from action-based approaches to cognition like embodied, and (especially) interactivist frameworks, such as the processual nature of cognition, the continuity of central and peripheral processes, and the centrality of interaction with an environment in cognition (Bickhard, 2009; Noë, 2004; Varela et al., 1991).

This chapter will provide a general characterization of schemas and their potential usefulness when accounting for mental phenomena. I will leave its application to experimental settings and findings related to mindreading to the next chapter. I will begin with a general definition of a schema as a process. Next, I will argue that schemas can help us approach development and surpass the nativist-empiricist dichotomy. Then, I will show their explanatory power by showing how various phenomena can be approached in terms of schemas, such as affordances, object representations, modules, among others. I will end by finding historical affinities with various approaches such as those defended by Dewey (1896), Piaget (1952), Tomasello (2003), and Jackendoff and Audring (2018).

3.1 Defining action schemas

To begin with, a schema is a repeatable and anticipative process of an organism interacting with its environment. Although it is possible to track these down to very basic processes (e.g., those constituting single-celled organisms), examples that are easiest to approach are highly skilled actions of complex organisms, such as the

forehand shot of a professional tennis player or my reaching to the cup on my desk and drinking the water in it. Although it looks a bit silly to compare the two, it is important to note that my water-drinking skills are comparable to the actions of professional athletes, since it took me a long while to master this skill, recognize the appropriate environments where I can do it, and conclude it successfully (almost) every time by quenching my thirst. That I mastered this skill in infancy and that most people also master this as well as I did do not take away from its highly skilled nature. Perhaps the most important aspect of a schema defined as such is that it is not an internally and passively stored set of instructions that is deciphered and executed by some peripheral systems. What I am calling the schema is the event or the action itself. It consists of events occurring within the nervous system and the body that follow and constrain each other to result in the completion of the schema when it is successful. Notice that this leaves no room for inputs to be processed; rather, we are directly referring to the interaction with the environment itself.

One basic property of schemas is that they can (and seem to have an intrinsic tendency to) combine with each other to form new and larger schemas. We can think of this as a tendency of schemas to cluster together, perhaps analogous to the Hebbian principle of how "neurons that fire together wire together" (Hebb, 1949/2002). This can be considered as a general principle resulting from the biological nature of schemas, that they strive for existence (have a tendency to occur as much as possible) and connect together when doing so. As such, any complex schema like drinking water from a cup can be divided into many "subschemas", many times.[8] The schema of drinking from a cup can be divided into my feeling of thirst, seeing the cup, grasping the cup, etc. Each of these can have even more minute

[8] Note that this is a relative term, any schema can serve as a subschema in a larger schema.

parts, with seeing consisting of certain eye movements, recognizing it as having a certain shape, color, texture, etc., each still further divisible up to minute neural or physical events. How tight a connection there is between two (sub)schemas is a matter of degree, since some schemas (like a well-rehearsed forehand shot) can be more tightly clustered together compared to others (such as drinking from a cup, where it is easier to put other schemas between its subschemas). Keeping this continuum in mind, we can see that where a specific schema begins and ends has a pragmatic aspect to it, based on what we are interested in understanding about it. What defines a specific schema is not necessarily clear beginnings and ends or exact physical events across occurrences, but the flow of events that constrain and enable each other, making up a process that can successfully flow as it has in the past, or can fail to occur.

Notice that the process of me drinking water from the cup does not take place solely within my brain or body. Parts of it occur external to my body, such as the cup holding together as a solid object, the water pouring into my mouth when I change the angle of the cup, and the chemical interactions it creates that quench my thirst and keep me alive. This means that the process that is the schema can only occur when certain external conditions are met. Even if I engage in the same movements without the cup, what occurs is very different. It is indeed not even possible to engage in the same hand movement without a cup, because then I would be holding my hand open in the air, which is different from me applying pressure to the cup when there actually is one that resists the squeezing of my hand. So, a certain schema is a process or set of events each causally constraining each other in the flow of time, and it requires certain external parts and events to be identical with another instance of itself. Defined as such, these events cannot form a coherent flow by themselves.

The schema (as an organism-internal process) has *gaps* in it, that need to be filled by external events (e.g., the pouring of the water).[9]

The idea of schemas with gaps enables us to have room for the anticipatory nature of cognition (or of life, Bickhard, 2009). The events that make up the actions of reaching to and drinking from a cup need the gaps to be filled in a certain way to be able to follow each other. In reaching with my hand, I am anticipating that I will touch a solid object that will resist my holding of it, letting me continue with my grasping and lifting of the object. If these do not happen, the schema cannot continue as it normally does. As such, every interaction of an organism with the environment (in other words, the occurrence of schemas) is intrinsically anticipatory. This is not due to top-down vs. bottom-up process flows that get matched as in the predictive processing models (Clark, 2013), but due to simple physical possibilities of continuation of processes. If there is no solid object that resists my grasping motion, then I cannot hold anything and continue with the motion. Notice also that a schema does not need to anticipate how exactly a gap is being filled but need only to anticipate that it will be able to continue as it normally does.

Note that I included the seeing of the cup as a subschema just like the reaching movement. With schemas, there is no a priori need for distinguishing motor behaviors from perceptions, following the arguments of O'Regan and Noë (2001; Noë, 2004). All schemas have gaps in them that allow for interaction with and anticipations of the environment, and this goes for both seeing and reaching. Reaching has a gap that specifies its successful completion and seeing is constituted

[9] This notion of a gap in a schema is closely related to "implicit presuppositions" in the interactivist framework (Bickhard, 2020). However, while implicit presuppositions of an interaction refer to a boundless set of conditions necessary for the occurrence of interaction, gaps are filled by more immediate processes that are external to the organism but are analogous to internal processes that constitute the schema. This notion will be useful for understanding language and reflection in terms of schemas.

by internal actions like eye movements and neural events that are constrained by the optical qualities of the cup. Just as there is no reaching without the external constraint, there is no seeing without the internal actions making up the seeing. In addition, despite my description of linear events following each other (and some events have to be linearly specified since I cannot drink before reaching) schemas also include a lot of different events occurring in parallel. For example, the musculoskeletal part of my reaching movement needs to be accompanied by my seeing of both my hand and the cup, which constrains and controls the movement. This is also the case for my proprioception of my hand. No schema is purely limited to one domain and is always accompanied by many other schemas that make up the larger schema that we recognize as a certain action.

In addition to perception and movement, schemas can also refer to emotion events. Some emotional aspect is already intrinsic in the quenching of a thirst, as I feel good doing so, and there is room for many other emotions. I can come to have a phobia of the cup that hinders drinking or come to incorporate sexual arousal in any part of it (although some parts possibly give themselves to association with sexual arousal more easily). In fact, it is possible that at least some emotional processes need to be incorporated into every schema, since emotions can serve as tools to guide which schemas need to be strengthened by the system (i.e., that their subschemas need to be more tightly clustered together and get activated more easily), and which clusterings need to be avoided (i.e., that these subschemas should not occur together). Bickhard (2020) argues that emotions have evolved exactly as such action selection systems. As such, schemas can describe cognition very generally, and any singular schema that is large enough likely incorporates perceptual, behavioral, and emotional processes within. Using schemas as units of mentality, we can avoid

presupposed distinctions between different kinds of cognitive events (such as perception and motor action) and start from a general type of process (schemas as described above) and work out how various kinds of schemas (e.g., perceptual, motor, emotional, etc.) can be differentiated. In what follows, I will go on to refer to perceptions and motor actions as different types of schemas, but it should be remembered that this difference is only a matter of degree and not a fundamental difference between inputs and outputs. There are no such things as inputs to be processes in such a framework; we have schemas that are constrained by the environment. Also, note that what I called gaps are not filled by perceptions, but external events that enable the continuation of the schema, and they exist both in perceptual and motor schemas.

3.2 Development through schemas

As sets of events that repeat in time rather than static entities, schemas immediately gain a good standing to explain developmental change. Indeed, no two repetitions of a schema like drinking water from the cup are exactly the same in terms of their specific physical aspects. I do not move my arm exactly the same way each time I reach for the cup, but rather, thanks to other events in the schema that constrain the physical movement like visual perception, I move my arm until I reach the cup. It is reaching-the-cup event that allows for the process to continue with other events, like grasping, and it is the continuation of events that make a schema identical with its other occurrences. However, this is not truly developmental as the expected causal flow does not change in the schema. But we can also imagine the schema changing in more significant ways in further repetitions. Piaget (1952) describes the newborn infant's nipple sucking reflex, and how it changes in time. Through repetitions, the

infant learns to detect and find the nipple after feeling the sensations of touch in his cheek and moves his head towards where he feels the touch. If what stimulates him is the "paternal index finger" (p. 31) instead of the nipple, the schema remains incomplete, because the expected sensation of drinking milk and the satisfaction this provides is not provided, which is normally a part of the schema. This way, the infant learns to *differentiate* the index finger from the nipple. Such differentiation is a central way in which new schemas can emerge and develop.

We can approach some *context-dependency* and *transfer* events by looking at how schemas are combined. For example, following an example by Ginsburg and Opper (1988), a hunter-gatherer may have a schema that involves abstract thinking within a hunting event. But if you put him through an IQ test using problems from a Swiss elementary school context that involve more mathematical problems, he may fail to apply his preexisting schemas. But once he learns that he can successfully apply the abstract thinking part of his hunting schema to this context, i.e., incorporates the perception of the IQ test problem into the hunting schema, he can suddenly come to solve the problem, without building abstract thinking skills from nothing. It is of course not guaranteed that such connecting of schemas (i.e., the perception schema of the test problem and the hunting/thinking schema) is easy or instantaneous. Maybe the connection of the abstract skills with the hunting context (perceptions and bodily actions that make up the rest of the schema) is too tight, and separation is very difficult due to a long time of non-differentiation. This way of thinking can be applied to other context-dependency events, like the Wason card selection task, that is usually taken to as proof for evolutionary selection of innate modules (Fiddick, Cosmides, & Tooby, 2000); an interpretation that seems extremely rich when we see development as occurring through schemas (see also Buller, 2006).

Notice that in the schematic picture the connections between the "central" processes and their applications in certain contexts are of central importance and the recognition and application processes are not externalized as performance issues.

Another phenomenon that can easily be approached by schemas is *attunement* (Maurer & Werker, 2014). Taking face perception as an example, infants can distinguish the faces of different species and different human races better than adults in the first months of life. During their first year, they attune to the faces they see around themselves, losing their skills to differentiate between now less familiar faces like those of different animals. Consider the development of the face perception schema. If we speculate a bit, the infant may be coming to the world with a reflex of making certain eye movements. What gives itself best to being scanned and perceived by such movements is three dots with a similar shape to a face (two above and one below, like an upside-down triangle). In other words, certain kinds of external constraints fill the gaps of the eye movement schema better than others in terms of continuing it.[10] As this schema repeats itself with similar objects that give themselves well to it, like faces, the subschemas (each movement or neural event making up the perception) get more and more tightly connected, and the gaps narrow to be filled by the most frequently encountered examples, i.e., the faces of people of the race the infant sees around himself. The eye movement schema also starts to associate with other schemas like emotions aroused by the mother's face. Considered like this, attunement is a very natural aspect of development. It is just the same process as a tennis player learning to hit a forehand, which she gets better and better at, making the whole schema more fluent and well attuned to the incoming ball,

[10] To repeat, I am making this example up to show the manner with which schemas can develop. The actual development can happen differently and perhaps what is innately constrained is not some eye movement but neural event.

through tighter connections of subschemas and narrowing of the gaps to more specific constraints. Just like in the perceptual narrowing of the face example, the tennis player gets more proficient at the kinds of shots that she practices with. If she learned through hitting balls that come only at a certain speed and height, any different type of ball that she later encounters will pose a difficulty, just like faces of other species and races pose difficulties for adults. The gaps that were so well attuned to up to that point will now have to be generalized and adapt to the different kinds of stimuli. The process of perceptual narrowing and attunement is important, and we can think of it as schemas *shedding* their non-essential parts through development as they get more attuned to external constraints. The mature form of a schema is attuned to a smaller number of constraints as it learned through time which are the essential ones for continuation.[11]

Schemas can also allow us to understand *innateness* much more clearly. As mentioned in the introduction, one way of saying something is innate but implicit until a certain age means that the capacity somehow exists but is masked by "performance" issues (e.g., Onishi & Baillargeon, 2005). This does not make any sense from an action-based perspective (Allen & Bickhard, 2013). An ability is a schema, which is a process, which needs to occur to exist. If a schema has never occurred, there is no sense in talking about its existence as masked by something external. Also, what are called performance issues are crucial parts of the schema that allow its context-dependent occurrence, and understanding the schema requires understanding it as a whole. Only after such an understanding can the researcher choose to focus on certain aspects and make informed decisions about what is external to her interests and what is not. In contrast, a schema being innate in an

[11] Such a process of shedding non-essential parts of schemas will be important in approaching adult mindreading skills in the next chapter.

action-based framework can mean that the development of a schema is constrained by mostly organism-internal processes (such as cellular interactions with genes). For example, the schema for bending my arm through my elbow (which takes place in many other schemas) is constrained by my musculoskeletal structure, the emergence of which takes place within the womb (and itself emerges within interactions of biological systems, genes, etc.). My elbows' capacity to bend only inwards constrains all the actions I can do with them. Similarly, the shape of my hand constrains my hand movements, and very likely favors the development of grasping motions, which leads me to build certain schemas incorporating grasping. There are also no a priori reasons why similar innately constrained neural events should not exist, which might lead me to make grasping motions, certain eye movements, feel certain emotions upon certain experiences, etc. However, these are developmental constraints, not unused internally stored instructions for complex actions that suddenly emerge when the time comes and immediately connect to other schemas that enable its "performance". What needs an explanation when we say something is innate is how it is constrained through its developmental pathway to become the mature schema that it is (Carpendale, 2009). This is exactly the kind of description Piaget (1952) provides when describing how the sucking reflex develops. No matter how innate a schema or reflex might be, it attunes to its environment and learns when and how to occur.

Understanding innateness as constrained development allows us to see beyond the duality of innateness vs. learning (Allen & Bickhard, 2013). Any schema has to develop, and possibly always through interaction with internal and external constraints. That one such internal or external constraint affects a certain development does not preclude the other aspects of development. This lets us see

beyond the dichotomy of innate vs. learned, not because we necessarily fully eliminated the distinction of internal vs. external constraints (as Oyama suggests, 2000), but whether we see one constraint as something external or internal is much less interesting within the larger developmental story, and possibly often arbitrary. Knowing how something developed through time already tells us what we want to know about it, and this development cannot be reduced to linear percentages of external vs. internal influences on a mature schema.

Notice also how such a story allows us to understand *domain-specificity vs. generality*. Even if a domain general learning schema (like reflection in interactivism, Campbell & Bickhard, 1986) allows for changes in all preexisting schemas, the schemas need to develop themselves. If the domain general shift allows creating new schemas or fundamentally changes preexisting schemas, they actually need to be created by repeated occurrences and practices. The practices may come very easy after the shift, and maybe even occur on the first try, but the new schema still does not exist before actually occurring. It is very much likely that any significant shift will not have such instantaneous effects and any schema needs to be practiced before developing in accordance with domain general enabling constraints. For example, we actually have to reflect upon a schema to change it, upon gaining the capacity to reflect (which itself may be considered as a schema, as I will discuss in the next chapter). It might be that we never apply this shift to certain schemas, even though we potentially could. This might be because we do not often use these at all, and they remain as they were before the shift. Therefore, it makes sense to say there are (potentially) domain general shifts without specific shifts within the domains necessarily occurring simultaneously.

Similarly, we can also imagine schemas at certain levels of development, whether in relation to domain-general shifts or not, rather than being stuck to considering their mature forms that appear in all or nothing ways. When we talk about schemas, we are focusing on things that are happening within an agent, and that constitute the first-person perspective of the agent. We are no longer focused on external descriptions of events as we see them (which is the problem with Piagetian schemas according to Campbell & Bickhard, 1986). We can therefore have a perspective about the level of development of a schema before we can observe its mature form. We can conceive of half-formed skills, that are at a certain level of attunement to constraints or at having partially achieved certain connections with other schemas, in relation to their mature forms we are familiar with. This attunement constitutes the developmental situation of the schema, which does not appear out of nowhere as a pure skill masked by external performance factors. What is externalized as performance factors in the standard nativist approaches (e.g., Onishi & Baillargeon, 2005) are intrinsic parts of the relevant schema that show its development. The problems with attunement (the lower level of accuracy compared to a mature form) can be due to many subschemas, some of which may be outside the realm of interest (such as a tongue being cut off not really influencing the more interesting aspect of language skills), but what subschema is of more interest to the researcher is not an easy question to answer and requires starting with a holistic perspective. We cannot simply assume there is a neatly separable "central" part of the schema that appears out of nothing in the mature form, which unravels once the irrelevant processes are mastered, especially considering no purely central part can occur and be practiced by itself, and always takes place within full interactions with the world that necessarily includes more perceptual and more motor schemas.

Thinking of development in terms of schemas that change, combine, and generalize as they reoccur, both linearly and in parallel (like the seeing schema that controls the reaching for a cup), allows us to do exactly this, and see development as a continuous process of emergence and attunement, where half-formed skills are possible.

3.3 Explanations through schemas

In this section, I will try to describe some other interesting phenomena through schemas. The goal is not to account for them in any significant way, but rather to show that schemas give themselves quite easily to attempts at accounting for them, showing their potential as explanatory tools in cognitive science. As such, what follows are just very brief, and sometimes wild speculations. But even as such, they show that many curious aspects of human life can at least make sense within an action-based perspective.

3.3.1 Object Representation

I will argue later that schemas can potentially replace the notion of singular representations (no matter how action-based they are, as in the case of interactive representations, Bickhard, 2020). However, accounting for object representations is possible with schemas, following the accounts of object representation presented by Bickhard (2020) and Piaget (1954). Consider an infant manipulating a small cube. At first, she has few schemas to help her, maybe just reaching and grasping, and the parallel running seeing schema that controls these. It is possible that through explorations with these, she gains individual schemas that get connected to seeing the cube. At first, these are individual actions that do not have much in common. However, as they occur more and more together, they get associated with the seeing

schema (such as seeing it in one certain position) and with each other, more and more tightly. The perception schemas accompanying the hand manipulation schemas serve as marking the invariations within the actions, creating a closed system of very tightly knit schemas where all schemas are “internally reachable” (Bickhard, 2009, p.572) from one another. This collection of tightly knit schemas constitutes the larger web of schemas we have for interacting with the object, i.e., our representation of the object.

3.3.2 Affordance

The Gibsonian notion of affordance (1979) fits very naturally within such a framework. Notice that with tightly knit schema webs that constitute object representations, the activation of one part of the whole schema results in the beginning of the activation of the rest. However, we do not always continue the schemas that begin happening, but since these beginnings have a direction, e.g., the seeing of the cube leading to holding it in a specific way, we also sense what is more to come, or in other words, perceive affordances. This sensing seems a bit mysterious since I defined a schema as something that needs to occur to exist. However, remember that a schema is not just the behavior observable to an external observer but the whole of the process constituting an action. As such, neural activation patterns constitute a central aspect of the schema, and we can imagine the partial occurrence of a schema as the readiness of a certain neural activation pattern where one sort of activation becomes more likely to occur compared to others. Also note that there are always parallel running subschemas making up a larger schema, so the perceptual control schemas may get activated through increased readiness, which might result in mental imagery of the anticipated events. As such, upon just seeing a

cube, the whole set of schemas that make up the object representation may get partially activated. The influence of this readiness process on other parts of the running schemas can constitute the perception of the affordances of the object. When such partial activation events are considered in addition to the tendency for the formation of such close associations (through the clusterings mentioned before), it is easier to imagine schemas as unitary processes that make up a whole rather than the irrelevant sets of events that occur linearly.

3.3.3 Modules

Modules refer to innate, evolutionarily selected mental mechanisms that serve to accomplish some specific tasks very quickly and rigidly, varying from mindreading modules (Baron-Cohen, 1995; 2000) to cheater detection modules (Cosmides, Tooby, Fiddick, & Bryant, 2005). Problems with this concept are the same as those with "unused innate capacities" mentioned before (Onishi & Baillargeon, 2005). While it does not make sense to talk about the existence of a process that does not occur, it is also problematic that this kind of innateness externalizes the development of attunement processes immediately, and ignores the whole developmental process, whether it is constrained by internal biological interactions or external interactions with the environment. Schemas with interactive histories of development can incorporate the usefulness of modules without these problems. With schemas capable of becoming very tightly knit and specialized, we can imagine some mature schemas working just like modules. Such schemas would still have developed, and we can think of their development with varying levels of "innateness", and they still can have less developed forms. The formation of an object representation can be similar to such a module that serves to perceive objects. This kind of specialized schema that

develops early in development through innate constraints and early experiences is not different from later learned skills in kind. The forehand shot of a tennis player can also be thought of as very specialized and rigid, allowing for very precise actions within milliseconds. Development of such a schema obviously requires externally specified interactions and develops much later than object perception, yet I do not see how it is different from a supposedly innate module in its execution.

3.3.4 Attention

When perception is not considered as a receiving of input but as the activation of schemas, there is not much of a mystery with agents attending to different aspects of the (physically) same environments. The process of attention, in an action-based framework, refers to differential patterns of activation between schemas that are possible to be activated in a certain environment. Attending to the couch in the room rather than the table means the schema of looking at a couch is active instead of looking at a table, where eye movements are made accordingly, and the rest of the schemas related to a couch, such as its affordances, are partially activated. It might also be that the effects of previous activations of these connected schemas are what is guiding our attention, as it happens in priming (Meyer & Schvaneveldt, 1971). If we just sat on a couch, the schema for looking at it may be more active since the two may be connected, and in an immediate visual search we might be primed to look at it or attend to it. Again, this is nowhere near a model of attention but goes to show how natural a phenomenon like attention is to an action-based framework while it is much more difficult to model within a passive input processing framework.

3.3.5 Wanting

It is difficult to imagine what would a computational model of wanting look like. Thinking with schemas, it is again very natural to imagine. We can think of desiring the occurrence of a schema as that schema striving for occurrence, and its gaps being filled by relevant external constraints. Hunger, for example, can lead to the beginning of the activation of the schema for eating, even when we are not eating. The schema begins to happen, yet it cannot conclude without the required external constraints that signal its conclusion, like the ceasing of hunger or tasting sugar (what exactly concludes the schema would depend on its developmental history). When hungry, we can start visually imagining the food (activating the seeing without the external constraint), salivating, or making swallowing motions. The activation of some schemas by some constraints (like hunger) would direct us to external objects that we have learned to be successfully filling the gaps in these schemas. After viewing the process of wanting like this, we can come to investigate what exactly the schema consists of, how it begins and concludes, and how these vary depending on their developmental histories.

3.3.6 Dreams

We can think of dreaming (as well as other processes like mental imagery or hallucinating) as the activation of (especially perceptual) schemas without depending as much on their gaps being filled by the world, and just going on with their flows by themselves. We can dream of doing certain things, without doing them. How exactly this might happen or how this kind of activation of schemas might differ from their occurrences in waking life remain questions for research, but this alone enables us to make sense of making emotional interpretations of dreams. Dreams can reveal more

easily activated forms of schemas unconstrained by the external world or perhaps through the lack of more inhibitory schemas that are more active in waking life. The perceptual accompaniments to gaps in schemas can also accompany them in dreams, creating the visual images we expect to go with our actions. We can also experience the emotional connections of some of these schemas that are more closely associated with others. We can dream that we have fears associated with schemas for certain interactions and that we anticipate certain responses to certain schemas, and thereby avoid them in waking life. Thinking in these terms, we are not bound to push such interpretations outside the domain of science, which is very unnatural to do since dreams are just as much a part of our mental life as other perceptions or cognitions.

We can grow the list with speculations on metaphors, aesthetics, creativity, etc. The point is not that these speculations will be immediately correct, but thinking with schemas, it becomes easy to speculate on previously mysterious phenomena, and we can build models and come up with testable hypotheses about these just like we do with more familiar perceptual or cognitive processes. Note that some of these issues may still be more difficult (or even impossible) to test, but theoretically they would have an equal standing. In the next chapter, I will look at mindreading literature and experimental situations in greater detail to show how schemas might be useful there. But before that, I will conclude this chapter by noting some other approaches to cognition with specific affinities to a schematic framework.

3.4 Historical affinities to schemas

In the previous section, I tried to show how schemas can be used in explaining various phenomena and that they allow us to scientifically approach mental life in a more comprehensive way. Here I will briefly refer to some other approaches that also

try to take advantage of the insights that schemas can provide. The most immediate candidate is the "genetic epistemology" of Piaget (1952; 1970), as I have been referring to him and his use of the notion. Although he refers to action-based schemas while describing the sensorimotor skills of newborn infants which appears to be similar to how I am trying to use the term, the criticism of Campbell and Bickhard (1986, p. 56) is worth noting. They argue that Piaget comes to use the term as "task descriptions", i.e., descriptions of events as seen by an external observer, rather than the organism-internal parts of process flows of interactions with the environment. As such, they are observer-dependent and do not focus on the actual occurrences within the agent. Bickhard (1988) also notes that Piaget's description of more developed and abstract cognition is based on such internalized structures, which conflicts with his otherwise action-based approach. In contrast with Piaget's aims to approach the organism as an organic and active agent, the internal structures that allow for higher cognition are problematically static and conflict with Piaget's own goals, according to Bickhard (1988). Whether or not this criticism of Piaget's use of schemas is accurate is beyond the scope of this thesis, but it is worth noting that my definition of schemas is intended to be the opposite of task descriptions and static internal structures, as action flows that occur in interactions between organisms and their environments.

How do schemas stand in relation to the interactivist framework, then? As noted earlier, they are intended to be fully compatible and serve as tools to apply the interactivist (and also more generally action-based) insights into empirical research practices and serve as communicatory tools. However, the interactivist framework itself (Bickhard, 2009; 2020) does not explicitly define such notions as important units of explanation, despite sometimes referring to action flows and building an

action-based model of representation, as I described in the first chapter. I suggest that taking schemas instead of representations as the main explanatory tools for research is more useful within such a framework. Interactivist representations are defined by their truth-bearing capacity and allowing for the (organism detectable) errors that can occur in interactions. So, the possibility of misrepresentation is central. Schemas, with their anticipatory aspects, can also accommodate this, and as combining and clustering processes, can be applied to more complex action flows encompassing many instances of possible error. They can at the same time be less confusing in certain respects by not solely focusing on truth value in individual instances.

Consider the criticism of interactivist representations by Thorpe (2021). He suggests that some events, like a lion representing a gazelle while hunting, can end in failure despite the representation itself being true. It is natural for the hunt to be successful only a fraction of the time, yet, with the emphasis of interactivist representations on failure or success, it is difficult to differentiate external reasons for failure (such as the gazelle being a good runner) and genuine misrepresentation. It might be possible to answer this problem within the interactivist framework itself, but however this might be done, it is probably easier to do so by referring to schemas. Referring to representations that are true or false, despite such truth being accounted for by success conditions, we are focused on individual events like that of the instance of a lion hunting a gazelle, with an all or nothing truth value. When we talk about the whole hunting schema, on the other hand, we do not necessarily think of an individual event with truth conditions but can think of a repeating process with "goodness" conditions. It is more natural within this kind of framework to say that some action is on a continuum of being good or bad, and whether it is more good or more bad results in other schemas (or its own dynamics) strengthening it to occur

again or create variations in it to change it. Such conditions can be different for individual schemas, with the hunting schema, for example, being considered good as long as it leads to eating one out of ten times. The schemas that would induce the variations are less sensitive to individual failures and more sensitive, perhaps, to long-term hunger. The goodness of the schema can be immediately seen as detectable across numerous events, rather than as a singular occurrence as thinking of the truth of an individual representing event might lead us to think.

In addition to keeping us focused on long-term repetitions, the subschemas of any larger schema can be evaluated in themselves as well. The lion's schema of seeing the gazelle may not be problematic for his failure to catch the gazelle, but parts that control his running may be. This problem may or may not be successfully detected by other schemas, but we can differentiate the two. We can then attempt to explain why variations are induced in the running schemas that actually failed, rather than in the seeing schemas. This might be because of the seeing schema (and other related seeing schemas) being successful in other events in the lion's life, and hence the failure of its role in the hunting schema is not enough to detect poor performance in it, unlike the running schema which may be occurring only during hunting. Thinking in terms of schemas, the existence of which stretch in time across repetitions, as well as stretch across subschemas even in individual occurrences, makes coming up with these kinds of explanations more natural; unlike representations that may or may not be true in individual instances that do not seem to have much room for being on a continuum of goodness. Again, the point is not that the same explanations cannot be given within interactivism (as I am already taking notions like variation inducing error detecting processes from it, Bickhard, 2020), but that schemas seem to be better tools than representations for doing so.

I will approach language through schemas in greater detail in the next chapter, but it is worth noting here that similar notions have been used in theories of language. Tomasello (2003), for example, argues for a "construction grammar" that he contrasts with a Chomskian universal grammar. Constructions in this account of grammar are the basic units of acquisition and replace what are normally considered algebraic procedures operating on words and morphemes. Constructions (like the *-ed* construction in English) themselves are learned as meaningful units of communication just like words. This simple trick of thinking what used to be thought of as abstract rules that operate on the actual products as no different than the products themselves and seeing the units of communication as self-organizing processes that in time learn to combine in useful (and orderly) ways, allows Tomasello to approach acquisition processes in a truly developmental way. This is the same way of thinking that schemas enable, which themselves eliminate the distinction between processing mechanisms in the mind and the processed inputs. Even Jackendoff, a nativist former student of Chomsky, evolved his theory into one that resembles construction grammar quite a bit, as he himself admits (Jackendoff & Audring, 2018, p. 18). Instead of constructions, he calls his units schemas as well. His schemas, like constructions, refer to what are normally known as rules and have variables within them that can be filled by individual words and serve to unify the lexicon and syntax. Again, there are no operations that work on atomistic entities, but complex beings that are the same format as words which combine with them to form whole utterances. Notice that both theories of language emphasize the combinations that their units make, and both define them as having gaps in them to be filled by other constructions and schemas, like a grammatical sentence structure that can be filled out by specific words (which are also schemas). Jackendoff and Audring even

claim that the same mechanisms exist across domains like music, objects, spatial layout, and social knowledge, similar to my claim that schemas are domain general units that can be applied to possibly all of mental life.

While the affinities with these theories of language are interesting, I have mainly positioned the idea of schemas within the action-based frameworks like interactivism (Bickhard, 2009), ecological psychology (Gibson, 1979), and enactivism (Noë, 2004). These are overtly action-based frameworks that have developed with a critique of mainstream computational approaches. While it is interesting to find Piaget as an earlier proponent of such ideas when the cognitivist framework was only just emerging, it is much more striking to find that we can trace the same insights and criticisms of mainstream psychology even further back. Dewey (1896) made many of the same points at a time when computers and computations were not even imagined yet, let alone be used as the main metaphors driving cognitive research (Gardner, 1987). In talking about the psychology of his time, he notes that "[t]he older dualism between sensation and idea is repeated in the current dualism of peripheral and central structures and functions" (p. 357) and

> [i]nstead of interpreting the character of sensation, idea and action from their place and function in the sensori-motor circuit, we still incline to interpret the latter from our preconceived and preformulated ideas of rigid distinctions between sensations, thoughts and acts. (p. 358)

In his paper that reads like it could have been written today by a frustrated interactivist or enactivist, he argues against the use of a concept called "the reflex arc", that separates not only stimuli and responses as distinct things from each other but also the central processes that take place between them from peripheral processes. He emphasizes the coordination of sensorimotor processes where the sensory parts are also actions just like motor behaviors. He even notes the anticipatory nature of these process flows, as he notes when describing the child's

perception of a burning candle upon learning that it hurts when it is touched: “It is no longer mere seeing; it is seeing-of-a-light-that-means-pain-when-contact-occurs” (p. 360). As such, he precedes by over a century the contemporary criticisms of the computational framework by action-based approaches. I could have called the action schemas described here “Deweyan reflex arcs” just as well, as they are aimed to convey exactly these criticisms. It seems to be an extremely curious historical fact that mainstream cognitive science has been operating with these criticisms that existed well before its emergence as we know it, and yet these are still cast as radical and new criticisms.

The aim of this chapter has been to add one more attempt to the over a century-long struggle to build an action-based framework to understand mentality. My tactic has been to define a simple concept that can be used by researchers and at the same time sneak in action-based insights, especially those that are extensively defined within interactivism (Bickhard, 2020). A schema as I defined it is a very simple thing to exist, which is just a repeating action within the organism. The details I tried to develop about schemas, such as their change in time, clustering, shedding, and combining in various ways are intended as merely an initial sketch and can be developed much further through both empirical and theoretical work, and in cooperation with other disciplines like neuroscience. In trying to build this sketch, I have referred to both how they are truer descriptions of development compared to nativist approaches and how they can be more useful than compatible notions like interactivist representations. In an action-based, processual framework where truth is viewed as successful interaction, the being truer and more useful are not different things, and I am not differentiating between the “true existence” of schemas and the advantages they provide to our understanding and studying of mental phenomena.

While this chapter has been a general sketch of such a useful concept, in the next chapter I will aim to compare it more directly with the computational approaches to show its advantages over it, with a closer focus on mindreading research.

CHAPTER 4

MINDREADING THROUGH SCHEMAS

In the previous chapter, I defined action schemas as potential tools for us to approach and do research on cognition within an action-based framework. To recap, a schema is a repeatable, anticipative process of interaction between the organism and the environment. Schemas can combine with one another, tend to cluster together, have gaps in them that are to be filled by processes in the environment that allow for the continuation of the process flow, can include perceptual, motor, emotional, or more abstract processes, attune to their environments through repeated occurrences and shed their unnecessary parts as they do so. Thinking in terms of such schemas, I argued, we can understand the organism as something that develops and explain various mental phenomena.

I have mostly given examples like drinking water from a cup or hitting a forehand while playing tennis. While these are often seen as skilled motor actions, we do not need to refer to such categories when thinking in terms of schemas. We can approach more abstractly cognitive actions like thinking, using language or building an argument in one's head as schemas with the general characteristics described in the previous chapter. Indeed, if one is to argue that more "highly cognitive" processes are radically different in kind compared to sensorimotor actions, one needs a solid argument to show why that is the case and why we should not start with the idea that all actions of organisms are broadly similar kinds of processes. And since we are not viewing sensorimotor actions or associative processes that constitute schemas as "mere" associations empty of any sort of content, but rather as anticipative processes, we are not haunted by the ghost of behaviorism as Dennett

(1978) was, as explained in the first chapter. We do not need to separate simpler, skilled cognitive actions learned through attunement from the more internal and abstract processes that are possibly parts of such schemas. Indeed, I have argued that concepts used by various linguists like the constructions of Tomasello (2003) and schemas of Jackendoff and Audring (2018) share many aspects with schemas as defined here.

Of course, the question of how the linguistic or abstract thinking schemas differ from others or how they emerge in development are legitimate questions to ask, but it is an empirical one that needs to be worked out, rather than the differences being assumed. I will not attempt to explain fully the emergence of "highly cognitive" schemas here but assume that they share the general characteristics of schemas described earlier and try to build on that in order to approach empirical findings surrounding mindreading. I will begin by applying schemas to explain associated developments of mindreading as described in the first chapter and how they make a difference compared to some (meta)representational explanations (Flavell et al., 1983; DeLoache, 2004; Leslie, 1987). I will then apply such a schematic approach to mindreading and make sense of the curious case of socially competent adults who fail the false belief test. Next, I will try to understand how language and meta processes that I will call metaschemas might be related within a schematic picture, and what such a relationship means for passing the false belief test. In presenting a schematic picture of mindreading and the false belief test, I will provide anecdotes from our study, presented in chapter two. Before concluding the thesis, I will compare this schematic account of mindreading with those provided by embodied cognition approaches (e.g., Ratcliffe, 2007) and interactivism (Mirski & Bickhard, 2021; Campbell & Bickhard, 1986). Overall, the goal of this chapter is to

show how schemas can make a difference in understanding experimental settings and results and allow us to build new models of development, using mindreading as the main example.

4.1 Associated developments to mindreading, revisited

Recall that in chapter one, I described several associated developments of mindreading that focus on children's understanding of objects with multiple possible identities, such as those that appear one way while being something else (e.g., a sponge that looks like a rock, Flavell et al., 1983), those that symbolize another object or place (e.g., a scale model of a room, DeLoache, 2004), or those that are used in pretend play (e.g., a banana used like a telephone in play, Leslie, 1987). Here I will try to reimagine these developments through schemas, and briefly show how this retelling can make a difference to (meta)representational accounts.

4.1.1 Appearance/reality test and tagged representations

Flavell et al. (1983) describe young children's difficulties with objects that look one way while actually being something else (such as a sponge that looks like a rock), as they give the same answers to questions about what they look like and what they really are until about the same time they start passing the false belief task at age four. The authors explain this with reference to children's difficulties in understanding the nature of their own representations and see development as involving "the acquisition of this higher level, metaconceptual understanding of the distinction [between appearance and reality]" (p. 115). There is nothing intrinsically conflicting with a schematic, action-based approach in this reference to the "meta" aspects of this skill, as involving mastery over one's own cognitive processes. Indeed,

interactivism, with all its emphasis on process, also refers to reflection on one's own interactive skills as the enabling constraint for mindreading and similar skills (Allen & Bickhard, 2018). However, Flavell et al. model this process with static representations that are "tagged" based on the way in which they were acquired, depending on their "veridicality and trustworthiness" (p. 117). Within the computational framework, the overall picture seems to be a given, with the authors declaring that "[l]ike older children and adults, young children of course have and use mental representations" (p. 117). However, it is not at all obvious that the meta-level process should be a tagging of a static representation, that then allows the child to answer questions about appearance and identity based on those tags. The general kind of explanation is not argued for but seems to be assumed in Flavell et al.'s account.

Let's try to apply the same "metacognitive" view on what is happening in such development, i.e., as development requiring an understanding of one's own mental processes; but this time referring to schemas instead of representations with tags and see if it can make a difference. In the experiment, first, the child is visually presented with the rock-looking sponge. With her skills and already developed knowledge of objects, the child sees a rock, i.e., the schema for looking at a rock is activated. This schema is connected to others that involve some anticipations of the object, such as resistance to pressure when touched, a rough texture, etc. When these touching schemas continue the flow of the visual ones, the overall schema of looking at a rock fails because its anticipations do not hold with the now perceived softness of the object. The looking-at-a-rock schema is now discarded, and a new schema (or

a set of closely connected schemas)[12] is activated: that of looking at and touching a sponge. Now, the experimenter asks two questions, one about the appearance of the object and the other about its true identity. In order to pass, the child should now activate the relevant, linguistic-social schemas when answering the questions, which are constrained by her experience with the object and provide different answers to each question. What should constrain these answering schemas is the event of the discarding of the first schema, which would require this event to be differentiated and remembered as an episode of making a mistake. So, the correct answer would require the child saying something like this: "first the object afforded the activation of looking-at-a-rock schema, which failed and was replaced by the looking-at and touching-a-sponge schemas", or simply "it looks like a rock but actually is a sponge". What we can call "metaschemas" of differentiation and remembrance of the discarding event have constrained the further interactions of the child with the researchers and enabled her to answer the experimenter's questions correctly.[13] For the young child who cannot give answers based on an understanding of the mistake event, what is happening is simply the replacing of one schema with a better one that has better anticipations, and as long as this limited success is reached by this replacement alone, no other questions need to be asked about previous problems and the discarding event does not need to be remembered (unless one wants to talk about those events with others).

Notice that this schematic account does not change the basic insights of Flavell et al.'s explanation based on tagging representations, but rather changes how

[12] Recall that the strength of connections between schemas is on a continuum and there is an arbitrary aspect to at what moment can we talk about a single larger schema made up of such connections. So, I am using the terms schema and set of connected schemas somewhat interchangeably.
[13] I am using the term "metaschema" tentatively to describe schemas that mainly interact with and anticipate other schemas. I will say more about what they may look like when discussing language.

it is modeled. The meta aspect is still there with the metaschema of differentiating and remembering the discarding events relating to the use of other schemas. However, the tagging metaphor seems to be the end of the discussion as it relates to the nature of the process, and it is assumed that the tagged object representation is the locus of the newly emerged skill. The schematic account, on the other hand, leaves room for many other questions about the nature of the meta level process. Firstly, the object representation is not necessarily the locus of the process, and our attention shifts to the contexts where metaschemas are used, such as the child answering the questions of the experimenter about the object in question. The locus of the schematic change can involve increased competence in this socially interactive context just as much as it can involve the object representation itself. Secondly, the nature of the metaschema as to what processes it consists in also remains open to further modeling. One possibility is that it is the language related schemas that are sensitive to schematic events like discarding, since it is largely in a linguistic context that their effects are observed (i.e., that of answering the questions of the experimenter). Thirdly, what sort of schematic events these metaschemas are sensitive to is also an open question. It might be that what triggers them is the existence of other people while an event happens (as a marker for potential further interactions that would require one to be sensitive to what is happening). In that case, what is "tagged" is not the object representation but the social context of the event. Failure to answer the questions can also take place not only because the objects cannot be tagged, but because the context may not be recognized as one that requires activation by metaschemas, while the child can still possess metaschematic abilities in other contexts. In these cases, schemas direct our attention not towards how the object representations are modified (which is assumed in the computational

framework), but to the tagging process (or a process analogous to it) itself. With this perspective shift, we find ourselves in a much better position to ask further questions about that process and about how and when it occurs, which are occluded by reference to static representations and assumptions implicit in them. In asking these questions, the skills like answering the question of the experimenter are not externalized as mere performance but are potentially of central importance in understanding the nature of the relevant meta level skill.

4.1.2 The scale model task and dual-representation

We can also rethink the scale model experiments in the same way (DeLoache, 1989; 2004; 2011). DeLoache explains children's difficulty with using a scale model of a room like a map to find a toy hidden in the room by referring to their lack of "representational insight" into the representational nature of the scale model. The model requires being understood both as an interesting object in itself and as a representation of another object, i.e., the room. Gaining this representational insight requires a "dual-representation" of the model that encompasses these two aspects. This symbolic aspect of the model (as representing the room) added to the non-symbolic aspect (as an object in itself) makes for the dual-representation. Possessing this dual representation is necessary (though not necessarily sufficient) for gaining representational insight and interacting with the object successfully, for example when using it as a map that shows the location of a hidden toy in the room. This explanation is similar to Flavell et al.'s (1983) explanation of updated and tagged representations. What constitutes learning, in DeLoache's account, is the representation of the model gaining a new property by becoming a dual-representation, just like the object representation getting a tag.

How would schemas make a difference? Firstly, the dual characteristic does not make too much sense, as what needs to be achieved is the learning of a specific affordance of the scale model (as showing the location of the toy in the room), not necessarily a one-to-one mapping between the model and the room and a sort of representation that reflects this. The model should constrain the schema for going into the room and looking for the object, and direct it to the correct place, by allowing for the anticipation of finding the toy in a certain place. This is not a special quality that turns the object representation into a dual-representation, but a simple learning of a new affordance in addition to the many affordances that the object already possessed. What might allow for such constraining of further actions may not be instructing the child by describing the correspondences of objects in the room and the model as is done in the standard procedures of the experiment (DeLoache, 1989), but rather showing how the objects in the room and the model constrain some schemas in the same ways (the ones for searching and finding the toy). Failure can be attributed to children not activating the same schemas while perceiving the actual room and the small model, the latter naturally not affording sitting on or walking around, etc. Success would lie in applying the same schemas to the visual appearances of objects in the room and in the model despite their differences in size and the lack of actions that can be perceived in the model. The description through dual-representation, although it does emphasize the misperception of the model by the child, has little explanatory power. A sign for its limitation can be that despite multiple versions of the experiment through the years by DeLoache and her team (2011) and attempts to make the task easier for younger children, there has been no attempt to make the schemas for (affordances allowed by) the room and the model similar, for example, by introducing a puppet in the room who engages in the

searching-for-the-toy schemas that the child herself would engage in.[14] This would emphasize the affordances of the room and the model as similar and allowing for certain schemas, constraining the child's later actions which were already activated when observing the actions of the puppet. However, a focus on static representations and their properties that change in development may be occluding a focus on the critical role of actions for the child.

4.1.3 Pretense and metarepresentation

Leslie (1987) presents a theory of pretense that he traces to the development of mindreading (or rather, theory of mind in his terms), as measured by false belief tests. Unlike many others, he explicitly states that his theoretical background is a cognitivist, information processing approach. Accordingly, he defines the goal of representations as "to represent aspects of the world in an accurate, faithful, and literal way" (p. 414) and uses familiar diagrams with received inputs on the one end and outputted actions on the other, with the important central processes occurring in between as operations on representations. These are in contrast to an action-based perspective where the goal is not accurate representation but successful interaction constituted by continuous processes coupled with the environment without received inputs to be processed or actions that are mere outputs.

Leslie describes pretend play as involving metarepresentations decoupled from primary representations of objects. While pretending that a banana is a telephone, for example, the primary representation of the object as it actually is (i.e., a banana) is taken out of its context and "copied" to a metarepresentational context,

[14] Some variations that DeLoache and her colleagues introduce do relate to affordances and can be interpreted through them, such as the helpfulness of putting the model behind a glass panel (DeLoache, 2000). However, the explanations provided by DeLoache still focus on object representations and their salience, rather than the activated schemas and perceived affordances.

where it is no longer a representation of the object but a representation of the first-order representation. The metarepresentation is now decoupled from the "normal input-output relations" (p. 417) of the primary representation and can allow freer use as can be observed in pretend play. Leslie also argues that such possibilities for creating metarepresentations are also what underlies success in false belief tests. He suggests that when the child observes a person holding a mistaken belief about the world (as in the location of the toy in a change-of-location false belief test) she should be able to form a metarepresentation that is decoupled from her own perceptions and corresponds to the representations of the character who holds the false belief. By using this metarepresentation the child can predict the behavior of the character. Note that this explanation is similar to both Flavell et al.'s (1983) and DeLoache's (2004) accounts described above, in that all of them refer to representations for objects and how they gain added qualities in development, which might be tags that mark trustworthiness, a dual character that enables understanding of symbolic function, or a metarepresentational copy of the initial representation.

How can we reimagine what is happening during pretense in terms of schemas? The phenomenon of pretense itself fits very nicely with a schematic framework. It refers to the application of a schema without too much care for the appropriateness of the object, or in Piagetian terms as cited by Leslie, "an extreme form of assimilation" (Leslie, 1987, p. 412; Piaget, 1962). While playing with the banana, the child activates the schemas for interacting with a telephone over those for interacting with a banana. Note that this is not totally random, as the child does not simply go around treating every object like a telephone but chooses one that gives itself well to some of the subschemas for the telephone schemas. The banana does fill the gaps of being held in hand like a telephone and reaching from ear to

mouth when put next to one's face. What it does not successfully fill is the part where a telephone lets us hear the voice of someone else through it, which is unlikely to occur with a banana. So, what the child is doing is applying a preexisting schema to an environment that does not allow for its full successful occurrence but does allow for its application to some extent, at a certain level of abstraction from the specifics of the context. And considering that a child might not have too much experience with functionally using telephones (or many other commonly described pretense actions like filling up tea cups, cooking, driving etc.) it might as well be filling up the gaps of most of the preexisting subschemas of the child.

But are the telephone schemas metaschemas in any way? In Leslie's account the representations that allow for free use of the object should be metarepresentations. But the telephone schemas here are simply preexisting schemas applied in a looser way (or perhaps in a more abstract way). What is loose about it is that it is not the exact same set of schemas that are active when using a telephone, at the very least because the perception schemas that go with them are different (as the child perceives the banana instead of a telephone). This loosening of a schema to be applied in an overgeneralized way to a new context is similar to Leslie's notion of decoupling as allowing for freedom. But the decoupled and loosely activated schema has no need to be a copy of a first-order schema that is moved into a metarepresentational context, as in Leslie's account. Indeed, being applied differently in certain contexts is not a mysterious quality with schemas at all. In chapter three I argued that every instance of a schema is already different in terms of its specific physical qualities, as I may move my hand slightly differently when reaching for a cup every time, and what is important for the schema is the continuation of the whole flow. I can apply most of the same schemas when grasping

a specific cup as when I grasp another, with perceptual schemas being slightly different in perceiving different aspects of the cup. Similarly for the child, the movement schemas for interacting with telephones may not be as closely connected to others like perceiving a telephone as a working telephone or hearing a voice through it, and the other schemas (like holding it in a certain way) may be activated by themselves when the context is appropriate. The detection of the context that activates such loose schemas also does not need to be a metarepresentational process, as the play context (where the end state is having fun rather than actually hearing a voice on the phone) may by itself start off these kinds of loosened schemas, just like any other context starts one set of schemas rather than another. So, imagining a similar process of decoupling that enables freer interaction with objects through schemas alleviates the need for positing an event where representations are copied into metarepresentational contexts. Indeed, what seems to be a more likely explanation of the phenomenon of pretense and the decoupling process is the existence for the child of less developed schemas for interacting with objects, actual functions of which are not very central for inexperienced children who may not have as firm expectations for those qualities. This is also in concert with the early emergence of pretense at 18-months of age.

Alleviating the need to make complex additions and changes to preexisting representations to explain development is a common quality of the three schematic accounts of developmental changes described above. All three representational accounts assume the existence of well-formed, static representations of objects, and understanding what we as adult researchers see as changes in those representations involves adding things to them, such as tags, dual-representations, or metarepresentations. The unitary object representation is a given with some aspects

of the interaction (such as answering the experimenter's questions) externalized as performance factors or outputs of internal computations. Thinking in terms of schemas, we do not start with a unitary object representation but skilled interactions that can make up such a unitary bundle when combined. We can then question how each skilled action making up the interactions may be connected to others and how might developmental change occur within those interactions and connections. For Flavell et al.'s (1983) tags, this means we can reimagine the meta aspect of what is happening and produce alternative models. For DeLoache's (2004) dual-representations, we can question the usefulness of the explanation and build new experimental settings to test hypotheses about the role of actions (such as the potential role of a puppet in the model). For Leslie's (1987) metarepresentations, we can reimagine the same processes (i.e., decoupling) without needing to refer to anything meta at all. For all three cases, what seems to be the case is that children have less of a singular and fully differentiated bundle of object schemas compared to those of adults, and it is the primacy of actions rather than objects with identities that marks their interactions. Of course, there is also new room for understanding how children might be learning to understand their own schemas and make new ones that interact with other schemas. Imagining the emergence of these metaschemas in this way, through the dynamics of children's interactions, they can now become grounded and continuous developments to preexisting schemas, instead of resulting from the need to make additions to static and substance-like concepts to explain developmental change. I will attempt to understand the nature of metaschemas more closely when considering language shortly, but before that let's look at mindreading through schemas and try to make sense of deaf and hearing adults failing at it.

4.2 Failing the false belief test

In the last section, I argued against explanations of developmental changes that refer to static representations, suggesting that they can obscure alternative explanations or lead to unnecessarily rich explanations (as in the case of metarepresentation in pretense). However, it is still possible to view mindreading and success in false belief tests through metarepresentations as in Leslie's (1987) view, or, more broadly, view mindreading as the capacity to attribute mental states to others as is traditionally done (Ratcliffe, 2007). In this section, I will argue that it is difficult to account for findings with socially competent adults who fail the false belief test within such a perspective and that schemas provide a better alternative. Within the former framework, if we want to preserve the false belief test as a reliable measure that really does detect an important development in children's understanding of other persons and accept the finding that some uneducated adults, either hearing or deaf, tend to pass the test only half the time, then we seem to have two options. One option is to say that the failing adults do not have the same mindreading skills most others do and the second is that the false belief test is not a good measure when applied to adults. I will look at these two options in turn and conclude that neither is a good alternative, and that the best course is to switch to a schematic framework where we can view the relationship between our social competencies and false belief test performance in a new way where active use of meta level mindreading skills is not necessarily a part of daily social interactions.

It immediately sounds like a radical claim to say that some adults do not have the "mental state attribution" skills that normally develop around age four while children go on to pass second-order false belief tests which are more complex and require an understanding of what a person would think about the false belief of

another person around ages 6 or 7 (Perner & Wimmer, 1985). If we think that our interactions with other people and our understanding of their perspectives about the world requires such a skill, then an adult without it should be seriously hampered in her daily life. She would perhaps remain reality-bound without being able to consider things that are not immediately observable, at least to a degree that hinders her from considering other people's "unobservable" states. We would be able to imagine this to be true if we think that only rare cases like signers of emerging sign languages or homesigners were in this situation. However, Gagne and Coppola (2017) as well as this study observed that uneducated hearing adults were also passing the false belief test only around half of the time. In addition, neither the signers nor hearing adults in our study seem to be seriously hampered in this way at all. They communicate with others in their daily lives constantly, and take care of their fields, socialize, have guests, and have fights. While it is difficult for an outsider to observe how deaf people function in their social lives, the well-adaptedness of the hearing people who fail the test is even more obvious. They are regular people who do not seem different from their neighbors who do pass the false belief test. If they are hampered in their mental state attribution skills from others, it is not observable within social interactions. As such, it does not seem viable to maintain that these adults are seriously hampered in their social cognitive skills and that daily social interactions require constant mental state attribution.

If we think there should be more to what the false belief test is measuring than something not so relevant to daily social life, then perhaps the test is not well-suited for adults? This is a valid possibility, especially considering that the findings from adults mainly come from minimally linguistic versions of the test such as the experiential false belief test or the video-based false belief test described in chapter

two. In our study, it is a possibility that the video-based false belief test did not work as expected, since most participants correctly answered around half the time without a significant difference for false belief and true belief events. It is possible that the events were too complex to follow, and participants answered randomly without following the beliefs of the characters. However, with the experiential false belief test, we can be more confident that the test worked as expected since participants included in the analyses passed the control questions making sure they understand the situation in the real world that causes the false belief, and that they needed to predict the answers of the confederate. What's more, the test did produce some variation even with the small sample size, with two participants in both groups passing the appearance/reality test and three in the hearing group passing the unexpected contents test. This is also the case in the study by Gagne and Coppola (2017), who find not floor performance but find that half of the participants succeed. If the test is not suitable for use with adults, it is very curious that it is not producing a floor effect but allows for one in two participants to pass. In addition, if one is to suggest that the false belief test is suitable for children but not for adults, one needs to explain why this might be so. What reason could there be for such performance change, in a test purportedly measuring a very basic skill that underlies crucial social interactions occurring on a daily basis?

I suggest that the best way to get out of such a dilemma in the face of the adult false belief performance is to question the definition of "attribution of mental states", as is argued by many others as described in the first chapter (Ratcliffe, 2007). It is a curious assumption to say that in our daily lives we constantly go about thinking about the mental states of others, as Ratcliffe points out with many examples. When we change the central computationalist assumption that the main

role of cognition is to accurately represent the environment and instead realize that the goal is successful interaction, this is not mysterious at all. We engage in schemas we already practiced many times before, and they make up our daily interactions with others. These schemas for specific interactions may or may not be sensitive to the perspectives of the people we are interacting with, but this would depend on the specific schema itself, and it seems like a very loaded assumption to say that we are constantly sensitive to mental states whenever there is a person to whom we can attribute a mental state. Even if we do need to use metaschemas that interact with our preexisting schemas to follow false belief events and pass the false belief test,[15] this does not immediately mean we have to do this every time once the relevant schemas for daily interactions are developed. Instead, the role of the metaschemas in development may be to alter the preexisting schemas in a way that allows us to be sensitive to others' perspectives (perhaps through simpler cues like facial expressions), without being active every time themselves.

As I mentioned in chapter three, it is useful to think that schemas *shed* their unnecessary parts through development, so once an interaction is mastered and its schema well attuned to the environment, the unessential subschemas can be dropped. An example for such shedding is the finding that young children who just recently managed to pass certain mental rotation tasks experience difficulties when performing an incompatible hand movement, while older children and adults do not have this difficulty (Frick, Daum, Walser, & Mast, 2009). From the outside, these younger children perform the same as older ones and adults in this test, but it seems that their schemas also include added motor subschemas, nonexistent in older children and adults. Those motor schemas might have been important for the

[15] I will discuss the possible role of metaschemas in the false belief test in the next section in more detail.

development of mental rotation schemas but are not included after a certain mastery is attained. We can approach the adults who fail the false belief test in the same way. They may have developed their relevant interactive skills through metaschemas when they were young and solidified their schemas applicable to those situations by being sensitive to perspectives of others, but this mastery may be limited to the schemas that are familiar and active, and unfamiliar, non-interactive contexts like the false belief test may not be activating those schemas. In addition to established, perspective-sensitive schemas not being active in that case, the metaschemas that allow for the creation of those skills in development (and allow for generalization to strange contexts like the false belief test) may have been shed due to unuse, after having accomplished their function of creating the perspective-sensitive schemas used in daily interactions. It is not viable to think that passing the false belief test involves the mastery of attribution of mental states whenever possible, through, for example, the use of metarepresentations that refer to those mental states. If one has no metarepresentations, in such a view, then that person should not be able to attribute mental states, which is a claim that contradicts with differences in performance during the false belief test and daily social interactions. Metaschemas, in contrast, can be learning tools that modify other schemas that are used often, and can potentially be dropped once these other interactive schemas are mastered.

Such a story is compatible with the following informal observations from our study, about what the failing adults are experiencing. The best way to describe why these normally successfully social adults are failing, it seems to me, is to say that they are making a mistake in this context, rather than being incapable of using similar skills in other contexts. One deaf participant, whom I will refer to as Ahmet, made this very clear. Ahmet is a 35-year-old homesigner who never had any formal

education. He is married to a CTSL signer and lives in a town with a population of 60,000. Unlike some older signers of CTSL, his signing seems highly developed, with clear, quick, and individuated signs. While he does occasionally use signs from the highly developed Turkish Sign Language, he is not fully using a well-established sign language. He only uses three mental state signs in the elicitation test, despite referring to situations related to mental states very often and using signs like "DRUNK" or "HUNGRY" in his descriptions. He also has no trouble with the procedure of the experiential false belief test including the prediction phase, and he correctly and very quickly answers the control questions, which is in contrast to especially older signers who had difficulties with the procedure. Yet despite all this, he fails to correctly predict the choices of the confederate in both the appearance/reality test and the unexpected contents test. What is especially interesting is that immediately after Ahmet marks the object that he thinks the confederate will choose, he realizes his mistake before the confederate makes his choice. He hits his head and laughs at himself, showing that he is not incapable of understanding what is happening, but nonetheless repeats his mistake for both tests. He does seem to have the schemas to understand the false belief event, but it is just not generalized to this context enough to easily constrain his actions before observing them. A similar case is a hearing participant that I will call Hüseyin. Hüseyin is a 63-year-old resident of the village that CSTL originated in and is excluded from analyses due to his 12 years of formal education experience. He also goes through the experiential test with ease and understands the procedure well but fails in both tests. After one failure and observing the confederate's choice, he laughs and says something along the lines of "I chose from my point of view, but he did based on his" as an explanation of his mistake. He too seems to be making a mistake

in this strange context while being capable of understanding that others have their own perspectives and act accordingly. A third hearing participant who also failed both tests in the experiential test explains her failure, after being asked sometime after the procedure, as “having forgotten” what the confederate would do.

What to make of these mistakes? A mistake implies that the person possesses the understanding of the kind of things that is happening but has failed to generalize to the immediate situation during the interaction. This is in line with the idea that adults possess schemas sensitive to others’ perspectives in the well-practiced interactions of their daily lives but fail to generalize to the unfamiliar observational context of the test. It is possible to say, from the computationalist perspective, what mistakes show is that the failure with adults is due to performance factors external to mindreading skills. The metarepresentations are there, but just not used in this situation. But then it is possible to say that the same thing happens with young children too, the only difference being that they are not articulate enough to explain their mistakes as adults do. This is indeed the nativists’ claim (Onishi & Baillargeon, 2005), who argue that very young children can attribute mental states to others. Thinking this way, the current power nativism has over developmental psychology is not surprising, since it is very easy to externalize failures as performance issues and show incipient skills as full-fledged representations (Allen & Bickhard, 2013). The problem here is the strict separation of the representations from their use, which adds an arbitrariness to explanations and what can count as performance issues. For example, it is still unclear why children pass the test more easily while some adults are stuck with these performance factors. Instead, using a schematic explanation, we can still give a role to the false belief test (as measuring some meta processes) while understanding what is happening with adults as mindreading schemas having

crystallized and shed their metaschematic parts that were there during the development of the schemas, making the generalization to the unfamiliar false belief test difficult (but not impossible). Having discussed the issues with failing the test, I now turn to what passing the test may imply through (meta)schemas, which will enable us to see the potential role of language in a new way.

4.3 Language, metaschemas, and passing the false belief test

So far, I have been using the term "metaschema" tentatively, as a sort of schema that has its gaps filled not by the external world but by other schemas, and hence enables one to interact with these other schemas and change them, not just as a result of failure in their interactions with the environment but purposefully. Here I will suggest that looking at language, when thought of as a schematic process, can help imagine the nature of such metaschemas, and in turn, how these processes may help with the generalization of interactive skills into unfamiliar and observation-based situations like the false belief test. I will assume that language has a crucial role in passing the false belief test as a lot of research suggests (see chapter 1), even though we did not definitively replicate it here in our study. The point is to see how exactly language may relate to such performance, rather than prove that it does so. Also, the following account for metaschemas and language is inspired by and largely parallel to the interactivist account of reflection (Bickhard, 2020; Campbell & Bickhard, 1986), but I will leave the comparison to the next section and focus on a retelling with schemas here. I will begin by thinking about what it might mean to think of language as made up of schemas. I will then turn to how linguistic schemas can constitute metaschemas that enable us to interact with our own schemas. Then, I will

look at how metaschemas can enable success in the false belief test and look at some anecdotes from our empirical study.

4.3.1 Language through schemas

Thinking of language skills as processes that have gaps in them to be filled by other linguistic processes and combine in complex ways to make larger units is not a new idea. As mentioned in the third chapter, construction grammar approaches (e.g., Tomasello, 2003) and Jackendoff and Audring (2018) make use of exactly those kinds of tools. A sentence or a grammatical form comprised of multiple words can be thought of as a single schema. Tomasello gives the example of the utterance that children use "wanna X", where X can be filled by the word that refers to whatever object or activity is desired at the moment. He also notes that during acquisition, children do not necessarily start with small units and combine them into larger constructions, but when first acquired, the "wanna X" construction is a whole, and only later is it differentiated into more detailed grammatical structures like "I want to X".

Due to the holistic nature of a schema as made up of many subschemas at many levels, such differentiation processes are easy to imagine. Grammar, in such a framework, is not a preexisting set of rules but is emergent from patterns of combination between these constructions or subschemas, akin to schemas not being instructions for actions but constitutive of actions themselves. These linguistic schemas have the same overall properties with other schemas as described in chapter three, but what sets them apart seems to be how their gaps are filled. In most interactions with the world, as in the drinking water example in chapter three, what fills the gaps of the schema are external processes, such as the flowing of the water

when the cup is held at a certain angle. When linguistic schemas combine with one another to form a whole utterance, on the other hand, what is filling the gaps of a larger schema are other schemas, such as a grammatical sentence form being filled by certain words, the gaps of which in turn are filled by morphemes, etc.

When we consider such internal connections in linguistic schemas, it seems they have a freedom not found in more direct interactions with the environment involving perceptual and motor schemas, since the interactions with the environment can only take place when the environment is fitting, while linguistic schemas that serve as the environment for other linguistic schemas can freely be activated. We can form series of whole utterances made up of numerous schemas whose internal connections with one another are successful in that they follow preexisting patterns and connections. We can think of syntax as constituted by success in such internal connections made among linguistic schemas. Note that having their gaps filled by other schemas is not necessarily unique to linguistic schemas and immediately makes them into metaschemas with very different qualities to others, but only provides them with a relative freedom of occurrence compared to those that can occur only or predominantly when the external environment is fitting.

So, the rich options for internal connections among linguistic schemas give them a degree of freedom from environmental conditions and richness compared to others. But how about their connections to other schemas that more directly interact with the environment? What are other, more external success conditions for the occurrence of linguistic schemas? Within an action-based perspective, the obvious answer is successful communication with other people. Just as the goal of cognition is not to create an accurate internal copy of the environment but to successfully interact with it, the goal of forming an utterance is not to accurately describe the

environment but successfully interact with the interlocutor, which can often correspond to accurately describing the environment (but not always, for example when success lies in deception or when we just want to make the person do something without referring to the current environment, Bickhard, 1980). As such, we should consider the main form of language as the utterances children learn to speak with the people they talk to and see other forms of more developed language such as writing or thinking as later developments scaffolded by cultural settings. The goal of the larger schema made up of purely linguistic schemas in addition to schemas constituting other aspects of the interactions like following the other person perceptually, emotions involved in the conversation, etc., broadly, is to successfully carry out the conversation (which might include sharing an experience, asking for help, making the interlocutor do something, etc.). Therefore, we should think of linguistic schemas not as purely grammatical forms and words, but as including subschemas that enable interaction with the communicational context as a whole in order to make communication possible and meaningful.

These external, social/communicative success conditions of linguistic schemas provide a setting with potentially far-reaching effects. For example, a crucial role for these external conditions for carrying out conversations is that they direct us to view the world in a new and more comprehensive way. Consider the discussion of the appearance/reality test from above, where these conditions were hinted at. For a child (or any other organism) that has no concern for successfully answering the questions posed by the researcher (about the appearance and real identity of the object), there is no need to remember the mistake that occurs when the looking-at-a-stone schema is first activated and then replaced by schemas related to interacting with a sponge. The child can go about her business since successful

interaction has been managed, without being aware of the discarding event. But such success is challenged by the social and linguistic environment we find ourselves in. Often, we find the need to describe events, not just about our own mental life but whatever events we come across, to others and with the linguistic schemas developed to enable such descriptions, the need for the skill for a correct description of conversable events emerges, including reasons for the actions of ourselves and others which are important concerns of social life.

4.3.2 Metaschemas through linguistic schemas

It is the combined effect of the internal freedom of linguistic schemas and their external success conditions that allow us to think of *metaschemas* that let us purposefully interact with our other schemas. The external success conditions of linguistic schemas can provide the setting and hence the motivation for the emergence of schemas that interact with mental experiences (like having made a mistake) and make them conversable. In addition, they are also the prime candidate for explaining the dynamics of how we become able to follow those events, due to their internal freedom and close relation to external success conditions. Take for example the metaschema of a child that enables her to differentiate and remember the discarding event and answer the questions of the researchers by explaining that she made a mistake about a deceptive object's identity. This metaschema is not just a combination of schemas that occur during the mistake, namely the looking-at-rock and looking-at-sponge schemas, but such a process that anticipates these schemas to fill its gaps, and once this filling happens, it continues with the social linguistic schemas that describe them to another person. The first level schematic events constrain the linguistic schemas, which come to be able to lead to successful

interactions with other people when we talk about them. Since this conversational context is where these metaschemas are used and most likely emerge in, the linguistic schemas that follow the metaschemas are themselves in an excellent position to do the work of differentiating themselves, (i.e., constitute the metaschemas). We can think that they are already being activated as the event happens, anticipating a conversation about it, even though the conversation is not occurring yet, and such activation serving to differentiate and make memorable those first-level events. The power linguistic schemas gain by having rich internal combination patterns independent from external conditions can allow them to anticipate complex events and narratives like the discarding of schemas.

To be sure, the metaschema that anticipates these events and accompanies them as they are happening is not exactly the same as the linguistic schema used in conversation after the event happens, since the child is not (necessarily) constantly talking to herself in full phrases while making the mistake as she would in a conversation. But it can be the activation of some words or linguistic structures that anticipate some events, like the discarding of a schema, for example by the words like “mistake” or “oops”, or more specifically for the use of discarding of a visually perceptive schema “look like”, in anticipation of a potential later conversation about it. These activations of linguistic schemas can serve as placeholders that accompany and mark the schematic events while they are occurring, making them memorable and readily describable. In other words, the metaschema can be a sort of *inner speech* that describes and accompanies occurrences of other schemas, as events to talk about with other people. Such a metaschema, constrained by yet other schemas and external conditions, can not only differentiate and make conversable schematic events but also come to change and manipulate them, for example, by anticipating a

mistake that occurs in certain situations and preventing its occurrence. New clues in the environment can be detected that lead to the occurrence of such mistake events, and the first level schemas can themselves be altered to be sensitive to such clues and gain the capacity to avoid mistakes. This would be a powerful tool for the system to have power over its schemas and use them to modify preexisting schemas in ways that were not possible before or could be done only through trial and error in interaction with the environment.

As an aside, this account is neutral concerning the debate about whether understanding of one's own mental states or those of others is primary in development (Carruthers, 2009). Which is first in development would depend on which first-level schemas are constraining the metaschemas. It might be that the internal parts of those schemas that are unobservable from outside are important (making self-knowledge easier), or it is possible that the perceptual and motor schemas and their anticipations (such as the activated hand movements when touching a rock instead of a sponge and their perception) are important for constraining the metaschemas (making external observations just as easy). However, from this perspective, for any schema whose observation when performed by other people is closely connected to its own activation (i.e., it is easily recognized by the metaschema) there would not be too much difference for the metaschema as it can be constrained by both. Whether self-knowledge or external observation is easier may depend on the recognizability of a specific schema or one's developmental history with it, but from the perspective described here, there is no mysterious difference between the two, especially when we remember that the observation of another is itself a schema just as any other. Although, without metaschemas, unfamiliar

observational events like in the false belief test may pose difficulties for recognition, as I now turn to.

4.3.3 False belief understanding through metaschemas

How would having these linguistic metaschemas relate to performance in the false belief test? What the false belief test is measuring seems to be exactly the use of such metaschemas. For a child who has just recently developed the metaschemas that anticipate schematic events like being mistaken about the location of an object, the false belief test measures whether such an event is recognized when performed by others in an unfamiliar context (i.e., whether the metaschema is activated) and whether it leads to further correct interactions (i.e., answering the experimenter correctly, showing that the metaschema is strong enough to constrain interactions). The unfamiliarity of the observed false belief situation ensures that what enables the child to predict the flow of interaction are not some interactive cues from familiar interaction patterns but the abstract schematic events that lead to false anticipations by the observed agent. Recognition of the course of events implies that the child has mastery over perceiving these abstract schematic flows and can interact with others about them (i.e., answer questions correctly). For a child who has no schemas that follow mistake events like this, the event will not be recognizable at all, and the child may answer based on other cues such as the actual location of the object as it often happens with younger children.

However, consider again the adult. The adult may have developed these schemas that describe such events when she was young, and through social interactions gained mastery over them. These metaschemas allowed her to create and change many of her schemas for interacting with others, which allowed her to

anticipate how things might differ for others based on their own perspectives and experiences. However, there is no reason for the metaschemas to remain fully active if the specific first-level interactions have already gained their perspective-sensitive powers and do not depend on metaschemas for success in each interaction. This perspective sensitivity can occur in multiple ways without metaschemas. Once new clues have been detected about the mental state of the person interacted with, such as their facial expressions, mannerisms in their behavior, eye movements, or simply the external constraints of the familiar events (such as locations, goals, etc.), the linguistic schemas may become unnecessary, or at least not as active as they once were during the interactions themselves, to follow perspectives. Once the metaschemas are shed from specific interactions, the first level schemas can lose their powers of generalizability and the false belief test may have become difficult once again and make adults prone to mistakes, although they still have an understanding of such mistakes in other contexts. Since the simpler interactive clues that replaced the metaschemas are possibly nonexistent in the strange context of the false belief test, it may be difficult for participants to generalize their (now more context-dependent) perspective following skills to this situation. The linguistic metaschema is different from these context-specific clues guiding specific interactions because it is much more generalizable (since it detects abstract schematic events), and can be applied to new situations, even if these situations are based on observation and lack the well-rehearsed interactive aspects. They are generalizable because they use the same utterances (i.e., specific schemas) to describe and interact with various events relating to uses of other schemas, rather than context-specific cues. This explanation accounts for both language and education effects on false belief performance in the literature which are partially replicated here. Without the

relevant language schemas generalization to new unfamiliar situations is very difficult even if the perspective sensitive skills are there yet bound to specific contexts.[16] Education effect (Gagne & Coppola, 2017) can be attributed to the increased variance of interactive contexts and mental work in adult life it brings, which can keep the linguistic metaschemas more active through adulthood, where experiences of giving explanations to others about complex events are more likely to be a part of life.

Although our findings in relation to the role of language have been only partial, giving some further anecdotal examples can be helpful about the role of language. Consider Ahmet again, mentioned above. During the mentalistic vocabulary elicitation task, he uses words like "HUNGRY" and "BORED" quite often, as well as describing the contents of the characters' minds, such as signing "WATER DEEP" for a shallow pond that Charlie Chaplin mistakes for a deep one. These suggest that he is not bound to what is visible in the world, and can even communicate about these "unobservables", but he is not prone to use more abstract words like *think* to describe such events. His mastery of many situations, like a person being mistaken about the depth of water, is enough to understand and follow the events, but such mastery is not generalizable and strong enough to constrain his actions in the less familiar setting of the false belief test, where he should mark his predictions of another's behavior on paper before they happen. Contrast this with

[16] Of course, this might also be the case with young children, who might possess perspective-sensitive skills in familiar interactions and are having trouble generalizing them to the false belief test. However, in this picture this does not eliminate the relevance of the false belief test as a measure of generalization skills based on metaschemas. It is an empirical question whether such perspective-sensitivity can develop without metaschemas, but one needs to demonstrate how that sensitivity can come to constrain certain interactions rather than claiming that it is there without being used. Such a finding could also provide an alternative way to imagine metaschemas without language. My assumption here has been that such perspective-sensitivity in first level schemas need metaschemas to develop in the first place since there are no motives to observe mistake events without the conversational contexts, which leads to metaschemas.

Hüseyin, also mentioned previously. He is the only person throughout the study, among both hearing and deaf participants, to correctly answer all questions in the video false belief test, including both true belief and false belief events. His success seems to be due to his vocal narration of the change of location events as he watches them. He narrated the events he watched using phrases like “she left it there, he took it out but she did not see it” etc. This vocalization seems to have allowed him to recognize what sort of events are happening and how he should watch them (i.e., pay attention to the nature of events as he watches them, or, activate the correct schemas while watching). His use of these accompanying narrations allowed him to generalize his schemas to be sensitive to perspective, even while following a potentially complex set of events. A contrast to this narration is the accompanying imitation most of the deaf participants performed while watching the videos. They imitated the movements of the characters as they are happening, very naturally and without any prompts as if they are following what is happening with their hands and movements. However, this imitation may allow them to interact with the videos (making them laugh at appropriate places showing they have the correct anticipations), but the schemas they use for these imitations may not be as generalizable as abstract linguistic schemas that would enable generalizations to unfamiliar situations. This is apparent in the fact that most deaf participants fail the false belief tests, including the video-based tests where they actively used imitations while watching.

An additional difficulty for the development or active use of metaschemas for deaf participants is the lack of conversational contexts that would motivate the development of such schemas. This is apparent in that there does not seem to be a clear differentiation between question words like “what” “why” or “which”. During

testing, when asked why the protagonist of elicitation videos did a certain action (using the same gesture as used for other questions accompanied by the relevant mouthing of the Turkish word), many of the older participants did not make much sense of the question and repeated their previous answers. The lack of linguistic experience of contexts where they need to converse with others about such events (i.e., success conditions for metaschemas) may have hindered their development, or at least their active use in adulthood. Nonetheless, to what extent do such adults have had metaschemas, or whether there are other ways for these metaschemas to develop are open questions not fully accounted by the arguments provided here. Indeed, findings with various age groups suggest that some people who never had mentalistic vocabulary may fail the false belief test at all ages, from childhood up to age 15 (Russell et al., 1998; Peterson & Siegal, 1999), or from around 20 up to over 50 (Pyers & Senghas, 2009; Gagne & Coppola, 2017). Considering some people may never have been able to pass the false belief test yet develop interactive skills for social interactions, it may be possible that developing these skills may be possible without metaschemas at all, or linguistically deprived deaf people may be using other nonlinguistic and less powerful metaschemas that are enough for developing some skills but not enough to have the generalization powers to pass the false belief test.

Another note that may contradict with the role of language is the 7-year-old deaf CTSL signer from our study mentioned in chapter two. While having the maximum score possible from the mentalistic language elicitation test, she failed all false belief tests. In chapter two I suggested that her use of the mentalistic words may be due to her having recently acquired them or having been primed by the prompt questions involving such words, thus not having mastery of the word enough to form powerful metaschemas yet. Another possibility is that the relationship between

language and false belief performance may not be as direct, at least not for people with unconventional language development. Whatever is the case, my aim in this section was to imagine how language can have an impact on such development, assuming that it does so. It is also possible that its function is limited to providing the motive for metaschematic development while not necessarily having that much of a role in their constitution.

Another open question is how "meta" metaschemas are, as they are described here. I claimed that they are meta in the sense that what they differentiate are events concerning other schemas rather than environmental processes, and many different kinds of schemas can fill the gaps of a single metaschema as long as the structure of the event of these first-level schemas is the same with regard to the sensitivities of the metaschema. Thus, while most schemas have a connection with each other in a way that activation of one leads to the activation of the other (either in parallel or linearly in time), the connection between metaschemas and the first-level schemas they differentiate is built on the latter filling the gaps of the former, thus enabling differentiation and use. I suggested that metaschemas can function similarly to reflection in interactivism (Campbell & Bickhard, 1986) or what metarepresentationalist accounts like Leslie's (1987) want to cash out, namely the organization of one's own schemas purposefully by the organism without trial-and-error interactions. However, this is not that different a kind of schema than others, and potentially many other simpler schemas also take other schemas to fill their gaps. What would separate the metaschemas here is their power to reorganize other schemas based on this gap-filling relationship. They are also not necessarily constant parts of new schemas created through them, so not every seemingly meta-level event (such as perspective-sensitive interactions) involve metaschemas all the time. Such

possibilities make these meta processes more grounded and continuous with other processes, even though they may not seem as meta as they once did.

When meta level processes are imagined with schemas with properties like shedding, new possibilities open for us to think about how they may work, and how they connect to what has been so far thought of as performance factors. Although it may be possible to tell a similar story to the one provided here with more standard notions of representation by changing the mental attribution definition of mindreading, it seems very difficult to capture later developmental changes (that I used to explain adult performance) or the close connections to external success conditions (that I generalized to internal dynamics of the skills themselves). The main point I aimed to demonstrate here is that thinking in terms of schemas helps us imagine much richer developmental stories and ask new questions that can be turned into empirical hypotheses. In the rest of this chapter, I will briefly look at how this account can be related to other action-based approaches discussed before.

4.4 Comparisons with other action-based accounts

In chapter one, I summarized several approaches with similar insights under the umbrella of embodied cognition approaches. The shared insights concerning the role of the perspective of the organism (Varela et al., 1991; Thompson, 2007), the dynamics of coupling relationships (Van Gelder, 1995), the active nature of perception (Noë, 2004), the closely interrelated organism-environment relationship based on the affordances the environment offers for actions (Gibson, 1979), the continuity of what has been seen as central and peripheral processes (Dewey, 1896) and possibly more, can be captured, as I tried to demonstrate throughout the thesis, by the use of schemas as the main explanatory units of mental life. In addition,

schemas can be used to closely view development and experimental settings, providing a guide to discovery that Chemero (2011) argues is provided by representations in computationalism.

In terms of embodied approaches to mindreading (Gallagher, 2001; Krueger, 2012; Ratcliffe, 2007), the account detailed in this chapter captures three important insights, also mentioned in chapter one. First, the primary intersubjectivity Gallagher (2001) talks about is in line with the central role of interactions with others, which then provide conditions for mindreading skills to develop, without observations of others taking the central role. Second, the observability of others' supposedly unobservable mental states (Krueger, 2012) had an important role in this account, as enabling socially interactive schemas to remain perspective-sensitive even if metaschemas are shed. Once a person gains the capacity to rearrange these schemas and recognize the events, simpler cues such as eye movements, emotions, knowledge of situations can become hints to those internal events, making it possible for metaschemas to be shed in further development. Once developed, it is these more embodied aspects of internal events that can take on an important role. The third insight about the crucial role of such knowledge of situations and social roles that has been emphasized by Ratcliffe (2007) who claimed that not all interactions involve mindreading in a full sense of mental state attribution, is also captured by such processes. With schemas, we do not need to think of mental state attributions but interactions with others based on knowledge of embodied aspects of mentality and situations.

There are also some potential points of conflict with these accounts, both in terms of mindreading and more generally. For example, the emphasis on first-person perspective in enactivism is different from what I suggested schemas can provide

(Varela et al., 1991; Thompson, 2007). These enactivists put the first-person perspective in a much more central position, with Thompson suggesting that phenomenological self-observation techniques should be incorporated into research practices. While such practice could have no harm, what has been crucial in my use of schemas is that they make it possible to ask what exactly an organism is doing mentally, without being limited to external conditions of observations and assumptions of researchers. In addition, Bickhard (2016) argues that such an emphasis problematically reintroduces the mind-body dualism, which action-based accounts aim to get rid of, through the separation of first-person and third-person perspectives.

There are also potential differences within the approaches to mindreading. While I noted the role of second-person interactions and the important role of learned situations, I nonetheless argued that such capacities are gained through a metaschematic process and that passing the false belief test may actually mark the development of such a skill. Many interactive skills that allow for perspective sensitivity develop through metaschemas, in this account. While the observational aspect of the false belief test contrasts with the importance of such skilled interactions, the capacity to generalize perspective-sensitive schemas to such situations is not an external problem but is related to the development of metaschemas. The observation aspect is not intrinsically problematic, but only so in virtue of the lack of schemas that can be applied to the situation, so it falls under a more general problem with familiarity. So, an unfamiliar mindreading-requiring context, though less observational yet still interactive, can still hinder successful interaction without metaschemas, which is in parallel to findings with children younger than four years of age being unable to pass interactive versions of false

belief tests (Wellman et al., 2001; Kammermeier & Paulus, 2018). Schemas can be a way of applying these insights more concretely and allow us to view their role in development and experimental settings more clearly.

I noted throughout the thesis that interactivism (Bickhard, 2009; 2020; Campbell & Bickhard, 1986) is the main inspiration for a notion of schema as used here and seems to be the most compatible approach among those mentioned here. The aim has been to turn Piaget's use of schemas without falling into structuralist problems in his framework (Bickhard, 1988) and apply interactivism to experimental settings and descriptions of developmental processes. In chapter three, I noted how schemas can differ from interactivist representations and handle potential difficulties (as posed by Thorpe, 2021, for example) more easily. I would also argue that they are much easier to incorporate into research and carry the action-based insights more easily. When we use the word representation, even if we mean interactivist ones that refer to processes of representing rather than static entities, it is difficult to keep this aspect in mind and avoid the use of individual entities that refer to static entities, with object representation being the prototypical case. In contrast, by virtue of schemas not being a singular process with truth value and being a set of such processes with many connections and gaps with anticipations, they seem better terms to describe interactive processes.

As mentioned earlier, the metaschematic account of mindreading is also mainly inspired by the interactivist account of reflection, described in the first chapter (Campbell & Bickhard, 1986; Bickhard, 2020). Campbell and Bickhard present a theory of developmental stages, which they call knowing levels, akin to stages of Piaget (1970; Ginsburg & Opper, 1988). Children progress through stages by reflecting on aspects that are implicit in first-level interactions themselves.

Language (or a system with equal power) provides indicators for the events of the first level processes, with which the system can now interact with, resulting in the creation of the second knowing level. To a large extent, the metaschematic account provided in this chapter can be considered a cashing out of this reflection process within the language of schemas. However, one difference lies in that, in the interactivist picture, what interacts with the first level is the second level itself, implying differentiable levels that are somewhat autonomous from one another. This is in contrast to metaschemas described as internal language making other schemas differentiable and changing them, and then getting shed when possible. Here there is no need for the emergence of an autonomous level distinct from the first one, but rather the metaschemas enable the modification of the first level itself when necessary (though we can still describe metaschemas themselves as being on a higher level). It is an open question how different these two approaches to meta-level processes are, but whatever the case, schemas can provide a way to phrase specific questions about the nature and development of knowing levels and make interactivist accounts of mental processes more graspable within research contexts.

4.5 Conclusion

My goal in this thesis has been to come up with a concept, that of action schemas inspired by Piaget (1952) and interactivism (Bickhard, 2009; 2020), that can help us make an action-based science of the mind, focusing on mindreading research as the main example. After surveying the relevant literature in chapter one and presenting an empirical study partially replicating findings from the literature, I defined the general notion of an action schema in chapter three. This was a general definition applicable to all mental processes and showed that we can use such concepts to make

better sense of development, explain various phenomena, and present a more holistic view on the nature of mentality as based on processes. The fourth chapter has been an attempt to apply schemas in greater detail to mindreading and other phenomena related to it. To repeat, the main goal was not to prove a certain ontological point about the nature of the mind or of mindreading but to show how we can approach it more comprehensively and ask better questions that are very much relevant for empirical research. Using a notion that does not create unbridgeable gaps between perception and action, central and peripheral processes, change and stability; we got to imagine in a new way the relationships between mindreading and language, the false belief test, daily social interactions, and potential changes in adulthood. I hope this shows the relevance of such theoretical questions for research purposes, and the necessary continuity between empirical and theoretical work in building a scientific practice that can move us to new spheres of understanding rather than being stuck in the same dualities that are perhaps thousands of years old (Bickhard, 2020).

As has often been mentioned, the picture of schemas presented here is only a sketch. There are so many questions that can be asked about how they can be used, or many possible holes that can be poked in this sketch that can be fruitful for improving the picture. Although I tried to present them as potential basic units to explain mentality and mainly replace representations (both in computationalism and interactivism), they are not necessarily used alone. Already at many points, I referred to affordances to complement this picture especially in this chapter, which itself can be defined using schemas. Another potentially complementary concept is “situation knowledge” as defined in interactivism (Bickhard, 2020), which refers to the organisms’ general understanding of a specific situation in terms of which actions and anticipations are appropriate. Such a concept can fit very nicely with schemas,

and we can think that in a certain context, a large set of schemas come to be partially active and ready to fully occur. The situation image, as a well-defined notion, can help provide a clearer picture to my references to contexts throughout this thesis and also make schemas more readily applicable to less well-rehearsed activities such as exploration.

In chapter three, I emphasized that schemas are applicable not only to cognitions or movements but almost always involve some emotional processes as well. I did not have the chance to consider the emotional aspects of mindreading in this chapter in order to focus on well-known experimental settings. But a discussion of the emotional components of mindreading schemas, which is possible to model in an action-based framework since no distinction between central and peripheral processes is assumed, could significantly enrich our understanding of mindreading and social life. For example, I referred to uneducated adults with successful social lives to show the difficulties of a computationalist approach based on mindreading as mental state attribution and underline the need for a notion like schemas. A contrasting example to these adults can be emotionally challenged adults like highly educated narcissists or psychopaths. Such people could in all likelihood pass the false belief test due to the active existence of some metaschemas but would be unable to maintain what we would consider normal social interactions (or at least longer-term interactions) due to problems with connections between emotional and mindreading schemas. We have no a priori reason to externalize these connections to emotional schemas, as they are very likely to have crucial roles in providing the motivations for the development of less emotional parts of mindreading schemas, especially in our earliest social interactions with caregivers. The position of these emotional schemas is similar to those of answering-questions schemas I referred to in this chapter. Just

as not externalizing these linguistic schemas used for talking to people about events (such as talking to the experimenter about the experimental events) allowed us to see the relationship between language and metaschemas in a new way, looking carefully at the emotional schemas in such situations can provide us with new insights. Thinking of mentality in terms of such closely related processes can bridge all sorts of problematic gaps, from those between the body and soul to those between different and poorly communicating branches of the sciences of the mind. I hope action schemas can be helpful to make such connections and build a science that provides a fulfilling and comprehensive understanding of mentality, and that can improve that understanding through empirical research.

APPENDIX

ETHICS COMMITTEE APPROVAL

Evrak Tarih ve Sayısı: 18/06/2020-42

T.C.
BOĞAZİÇİ ÜNİVERSİTESİ
SOSYAL VE BEŞERİ BİLİMLER YÜKSEK LİSANS VE DOKTORA TEZLERİ ETİK İNCELEME KOMİSYONU
TOPLANTI TUTANAĞI

Toplantı Sayısı	:	05
Toplantı Tarihi	:	15/06/2020
Toplantı Saati	:	14:00
Toplantı Yeri	:	Zoom Sanal Toplantı
Bulunanlar	:	Prof. Dr. Feyza Çorapçı, Dr. Öğr. Üyesi Yasemin Sohtorik İlkmen, Prof. Dr. Özlem Hesapçı Karaca, Doç. Dr. Ebru Kaya, Prof. Dr. Fatma Nevra Seggie
Bulunmayanlar	:	

Berke Can
Psikoloji – Bilişsel Bilim

Sayın Araştırmacı

"The effect of atypical language experience on adult mindreading skills: The case of two deaf populations in Turkey" başlıklı projeniz ile ilgili olarak yaptığınız SBB-EAK 2020/33 sayılı başvuru komisyonumuz tarafından 15 Haziran 2020 tarihli toplantıda incelenmiş ve uygun bulunmuştur.

Bu karar tüm üyelerin toplantıya çevrimiçi olarak katılımı ve oybirliği ile alınmıştır. COVID-19 önlemleri kapsamında kurul üyelerinden ıslak imza alınamadığı için bu onam mektubu üye ve raportör olarak Fatma Nevra Seggie tarafından bütün üyeler adına e-imzalanmıştır.

Saygılarımızla, bilgilerinizi rica ederiz.

Prof. Dr. Fatma Nevra SEGGIE
ÜYE

e-imzalıdır
Prof. Dr.Fatma Nevra SEGGIE
Raportör

SOBETİK 05 15/06/2020

Bu belge 5070 sayılı Elektronik İmza Kanununun 5. Maddesi gereğince güvenli elektronik imza ile imzalanmıştır.

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