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An Ecological-Enactivist Account of Interpersonal Affordances

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Abstract

Ecological psychology postulates that perceptual processes occur in order to guide action, are direct (non-mediated by computations of representations), and of affordances, i.e. properties dependent on both the environment and the observer. According to enactivism, cognition is something that we do rather than something that happens to us. In my thesis, I rely on the frameworks of ecological psychology and enactivism to account for the instances of others opening and closing our opportunities for behavior and thought while we are in dyadic interactions. To this end, I argue that the ecological information agents pick up while interacting with their environment (1) includes social meanings, and (2) affords agents opportunities for physically- and non-physically-manifested actions. Further, taking the first steps towards building a positive account of interpersonal ecological psychology, I explain the coordination dynamic that underlies the coupling of two agents by referring to the properties of dynamical systems. I tie this explanation to the dynamical view of affordances and conclude my thesis by introducing the notion of Interpersonal Affordance Landscapes: sets of affordances that exist in the virtue of the ongoing interaction we have with the other agent.

Kurzfassung

Ökologische Psychologie postuliert, dass Wahrnehmungsprozesse stattfinden, um Handlungen zu leiten, direkt sind (also nicht durch Berechnungen von Repräsentationen vermittelt) und von Affordanzen abhängen, d.h. Eigenschaften, die sowohl von der Umgebung als auch vom Beobachter abhängig sind. Gemäß dem Enaktivismus ist Kognition etwas, das wir tun, anstatt etwas, das uns widerfährt. In meiner These stütze ich mich auf die Rahmenwerke der ökologischen Psychologie und des Enaktivismus, um Fälle zu erklären, in denen Andere unsere Verhaltens- und Denkchancen für uns öffnen oder schließen, während wir in dyadischen Interaktionen sind. Zu diesem Zweck argumentiere ich, dass die ökologische Information, die Agenten während der Interaktion mit ihrer Umgebung aufnehmen, (1) soziale Bedeutungen einschließt und (2) Agenten Möglichkeiten für physisch- und nicht-physisch-manifestierte Handlungen bietet. Darüber hinaus erkläre ich die Koordinationsdynamik, die der Kopplung zweier Agenten zugrunde liegt, indem ich auf die Eigenschaften dynamischer Systeme verweise und damit den ersten Schritt zu einem positiven Erklärungsansatz der zwischenmenschlichen ökologischen Psychologie mache. Ich bringe diesen Ansatz zudem in einen Zusammenhang mit einer dynamischen Sichtweise auf Affordanzen, und schließe meine Arbeit mit der Einführung des neuen Begriffes "Interpersonalen-Affordanz-Landschaften" ab, welche als Mengen an Affordanzen verstanden werden können, welche im Zuge von Interaktionen mit anderen Akteuren existierten.

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Contents

1 Introduction

> [Animate objects] are so different from ordinary objects that infants learn almost immediately to distinguish them from plants and nonliving things. When touched they touch back, when struck they strike back; in short, they *interact* with the observer and with one another. Behavior affords behavior, and the whole subject matter of psychology and of the social sciences can be thought of as an elaboration of this basic fact. (Gibson 1979, pp. 135)

In this thesis, I talk about opportunities for action. By opportunities for action I mean the the things that, in a given situation, are possible for us to do; the things we can act on in the situation we are in, at the time we are in it. A good metaphor for opportunities for action is "valid moves" in a game: when her turn comes around, a player chooses from a number of things she can do: move left or move right; draw cards or roll the dice. In life, at any given moment, there is a vast number of actions available for us to do and an even vaster number of actions that are not available.

Specifically, I will talk about the opportunities of action we have *in virtue of others*. Just like a player whose set of possible moves depends on the action of the player before her, what is available to us is sometimes dependent on what other people do. Because

we are rarely truly alone, the horizons of what we can do and what we can think of are usually a result of our interactions. To show the range of phenomena I have in mind, consider the three following examples:

(1) An elderly divorcee John is living in a single apartment at a retirement facility. John has a reputation of being a stern, decisive man, who "does not waste time" on trivialities or small talk. Nonetheless, when a new resident moves into the facility, an attractive widow named Jane, John feels a strange force overtaking him. Around Jane, he finds himself open to hobbies and activities he would have disregarded a month before. The other facility members are astonished to see John dancing tango with Jane, attending yoga classes, and walking around barefoot in the park. John seems to be a changed man, following up on dreams he did not know he had. In other words, Jane opens up a world of possibilities to John–and, as we can suspect, the other way around. The "moves" John can make, the set of things he sees as possible for himself has shifted.

(2) A couple arrives at their holiday destination, but only one of them is ready to enjoy the time off. While Anne is already in holiday mode, her partner, Steve, is still thinking about the work deadline at the end of the month. Instead of making himself home in their holiday suite, he checks his phone for emails. Anne stands at the window, admiring the beautiful view below. Calmly, she makes a relaxed sound of breathing out. With this sound, her partner's attention has shifted; Steve notices the view outside, hears the sound of waves breaking on the beach, and feels the warm breeze on his face; he sees himself swimming in the ocean and wonders if he remembered to bring his favorite swim trunks[1]. Anne has opened up a possibility to Steve that was not accessible to him before.

(3) Imagine an arguing couple: Stacy and Kim. When Kim leaves the flat messy, Stacy

[1]This example was brought forth by Hanne de Jaegher and Ezequiel Di Paolo in their 2007 paper, "Participatory Sense-making. An Enactive Approach to Social Cognition".

tends to react in noticeable quiet discontent. Kim, unhappy with the lack of understanding from her partner, gets defensive and pretends she does not notice when Stacy gets sulky and silent. The more silent Stacy is, the more aggressively indifferent Kim pretends to be, leaving Stacy even more withdrawn. As this situation persists, Stacy's and Kim's behaviors become more established and then escalate further. Stacy *always* chooses to give Kim a silent treatment, which lasts longer and longer each time it occurs; Kim *always* pretends she takes no notice, digging her heels in deeper and deeper. Soon, neither one of them sees a way out of this conflict. Others can open the opportunities for action, but they can constrain them, as well. An example of such a constraint is when instead of having plenty of options to choose from, we can only respond to the other person by doing the same thing, over and over again.

In all of these cases, one person *allows* another to access a certain behavior: whether it is thinking of the beach, sulking, or finding pleasure in dancing. This opportunity would have not been possible if it was not for the other; it exists *because of* and *in virtue of* the social context we are in. This process happens continuously, for all the agents in interaction. Others permit us new possibilities for action, while, at the same time, closing off others. There is something about social interactions that dictates the set of our next available behaviors. What is it? In this thesis, I try to bring this phenomenon to light.

1.1 Research Questions and Their Theoretical Framing

What is the source of John's sudden interest in dancing, why are Stacy and Kim stuck in their ways, and how does Anna make Steve see the beauty of the Mediterranean landscape? It seems that when two or more cognitive systems engage with each other,

they have the power to, at least partially, *guide each other's perception*. In this thesis, I am addressing the question: is there a principle behind *making new thoughts and behaviors available* to others? If there are regularities behind what we can perceive as possible when we are engaged in social interactions, what are they, how do they function, and what stands behind them? Those are the leading research questions of this thesis. Investigating how social opportunities for action arise and how they are related to the interaction itself is my main endeavour.

A framework particularly suitable to address this question is *ecological psychology*. Ecological psychology has been developed by James and Eleanor Gibson and is affiliated with the general 4E paradigm (cognition is Embodied, Embedded, Extended, and Enacted) (Chemero 2011). According to ecological psychologists, we perceive the world in terms of affordances, that is opportunities to act (Gibson 1979). Things we sense are *reachable*, *edible*, *walkable*. Research in ecological psychology tells us what it means to perceive opportunities for action and why we perceive certain opportunities for action but not others. *Social* ecological psychology studies the direct perception of social interactions and the role other agents play in our perception of affordances (Valenti & Gold 1991).

Another, related theory is *enactivism*, established by Evan Thompson, Eleanor Rosch, and Francisco Varela (1991). According to enactivism, cognition is something that we *do* rather than something that *happens to us*. Enactivism is compatible with ecological psychology (Heras-Escribano 2021). In the thesis, I rely on some aspects of enactivism to supplement the framework of ecological psychology.

Because of the limitations of the master thesis format, I focus on a large-scale picture and omit many details. My goal here is to present the first draft of a new theory; I aim to establish new concepts and take the first steps towards the development of a new

framework. I talk about "interpersonal affordances" - a notion that is already present in the ecological psychology literature (cf Brancazio 2020, Richardson et al. 2007, Buck et al. 2019). I propose my own definition of interpersonal affordances that could unify the existing uses. Further, I introduce a completely novel notion of interpersonal affordance landscapes.

The merit of my work is two-fold. Firstly, I hope to shed new light and contribute to the understanding of interpersonal relationships and the way we act when we are around other people. Secondly, this thesis, in its minimal way, contributes to the goal of unification and further integration of ecological psychology and enactivism.

1.2 The Structure of the Thesis, Some Premises, and Methodology

This thesis consists of five chapters. After the introduction, the first large part of the thesis aims to introduce the notion of interpersonal affordances and defend the claim that interpersonal affordances are a valid posit within the ecological psychology framework. To explain ecological psychology, one needs to address both ecological information and affordances, and this is exactly what I do. Firstly, in chapter two, I introduce ecological psychology and argue that ecological information is inclusive of the kinds of meanings that interpersonal affordances demand. Secondly, in chapter three, I show that interpersonal affordances comply with the definition of what affordances are.

In the second large part of the thesis, I focus on developing the account of interpersonal affordances. Firstly, in chapter four, borrowing the concept of agent-agent coupling from

the enactivist theory, I show how a group of two people can be looked at as a system, with its own particular dynamics. Secondly, in chapter five, I connect the dots by showing how the affordances of interacting participants develop over time in *interpersonal quasi-niches*. In conclusion, I argue that the landscape of affordances available to us in interaction depends on the dynamics of this interaction.

Most importantly: although the larger question behind this thesis concerns social cognition in general, for the sake of simplicity, throughout my entire thesis I refer to dyadic groups, i.e. interactions between two people. Accounting for social scenarios that include more agents is likely to significantly increase the complexity of the analysis; the question of extending this theory beyond dyads is valid, but, again, one that I simply do not pose here. This account is a start.

A few more words should be said about the theory that underlies my inquiry, i.e. the dynamical systems theory, a key explanatory tool for both ecological psychology and enactivism (Corris & Chemero 2022). The dynamical systems theory comes from physics and mathematics; it is scientifically employed to describe the behavior of complex systems with the help of differential equations (Lewis 2000). It has been applied within neuroscience, theories of cognitive development, robotics, modeling, and broadly within the connectionist paradigm in general. The dynamical framework poses that cognition is affected by internal and external pressures. An agent throughout their cognitive development undergoes phase transitions from equilibrium to disequilibrium states, where the equilibrium reaffirms the old patterns by repetition, and disequilibrium allows for reconfiguration (Lewis 2000). To the extent it is relevant to this thesis, I explain the dynamical systems theory in chapter four.

On a related note, the basic unit of analysis in this thesis is an *individual* cognitive

organism. In a systems hierarchy, two coupled agents constitute a higher-order unit that can be said to possess properties and acts in its own right. Whenever I talk about affordances, I talk about affordances available to the individuals, i.e. participants of the dyadic unit, as opposed to the affordances of the individuals together, as a whole. Even though it seems there are actions that can be afforded only to a dyad (think: dancing tango), it is not easy to explain how a dyad directly perceives its environment. That is an interesting research question; one that lies beyond the scope of this thesis.

Furthermore, when I discuss various actions or skills, I presuppose that there are many more- and less-coarse-grained levels of description. For example, *taking a trip* is a coarse-grained action, while *getting up in the morning* is a more finely-grained action that might be included in *taking a trip*. A similar structure applies to abilities and features of situations. I do not advocate for any particular level of description; I choose the one that I find most appealing for the explanatory purposes at hand.

I am also very sympathetic to the axioms of human communication presented by Don Jackson, Janet Beavin, and Paul Watzlawick in "Pragmatics of Human Communication" (1967). In one way or another, they are underlying my considerations in this thesis. Following the authors of the book, I agree that agents in interaction always act, even in the case of no apparent reaction from one of the participants. I also look at interactions as if they were *punctuated*, i.e. divided into neat, discernible units, simply because this allows me to talk of them in a simplified manner as if they were a game of chess (and not, what would be a more appropriate metaphor, a tennis match).

Finally, my methodology in this thesis is one typical of a theoretical investigation and comprises (1) literature analysis and (2) synthesis. Firstly, I review the existing literature on ecological psychology, enactivism, and social cognition. Secondly, I introduce

a definition of *interpersonal affordances*, propose the novel concept of *interpersonal affordance landscapes*, and draw a connection between this concept and the dynamics of interactions in dyadic groups.

2 Ecological Information

When we want to investigate social opportunities for action within ecological psychology, the starting point has to be ecological information. Ecological information allows the agent to interact with the world in a meaningful way; without ecological information, there is no perception or action (Gibson 1979). To discuss opportunities for action that we can access *in virtue of our social environment*, the account of ecological information needs to be inclusive of *social meanings*. John is open to dancing because Jane creates a meaningful social context for him to do so; Stacy and Kim dig their heels in because of how they perceive each other, and Steve can enjoy his holiday because of Anne's meaningful social behavior.

In this case, ecological information needs to encompass a wide range of phenomena. On the one hand, the participants need access to the emotional states of the other, possibly mediated through their posture or tone of voice. They need access to the knowledge of previous interactions with this individual (is it a friend or a foe? Do they tend to react with hostility?) as well as to other relevant interactions they previously held with others (such as: what is an appropriate reaction to somebody's emotional distress?). Without it, their behavior is likely to be misguided and ultimately non-conducive to their survival.

Arguing for such a broad understanding of ecological information is a difficult task. This is the challenge I undertake in this chapter; I would like to prove that it is feasible

and legitimate to conceptualize ecological information this broadly. Thankfully, I do not need to start this task from scratch; a suitable account has been already introduced by Tony Chemero in "Radical Embodied Cognitive Science" (2011). In this chapter, I try to defend Chemero's view and show the disadvantages of the competing traditional view. I will first introduce the traditional, Turvey-Shaw-Mace account and explain the cases it struggles with. Secondly, I will introduce Chemero's alternative account, and try to respond to the objections that are raised against it. But before I talk about ecological information at all, I briefly present the overall framework of ecological psychology and enactivism.

Ecological Psychology

The account of ecological psychology was developed by James and Eleanor Gibson: James's work was focused on perception and action and Eleanor's on perceptual learning and development (Gibson 1979). The two most important books for ecological psychology are "The Senses Considered as Perceptual Systems" and "The Ecological Approach to Visual Perception" published respectively in 1966 and 1979 by James Gibson. Gibsons' approach was a direct response to the rise of theories promoting computational understanding of the mind (Chemero 2011). According to these theories, cognitive processes are rule-governed inferences, conducted by an agent on mental representations of the world. Gibsons opposes this view, proposing an account built on three major principles: (1) perception is for action, (2) perception is direct, and (3) all action-relevant information is available in the environment (Chemero 2011). These principles encapsulate a theory of (visual) perception that does not involve mental representations and rule-based computations. To introduce ecological psychology, I discuss these principles below.

Firstly, according to Gibson (1979), *perception serves action* in the teleological sense[1]. Perception has developed to serve our survival and functioning in the world; different organisms perceive the world differently, depending on their biological needs and strategies developed to fulfill them. For example, the perceptual system of a honeybee is calibrated to precisely distinguish shapes and colors, which comes in handy when it needs to find nectar-filled flowers. Posing the survival of the organism as the larger goal of perception makes Gibson's account plausibly compatible with theories of evolution (cf Read & Szokolszky 2018).

Gibson's view has a controversial metaphysical consequence. On the traditional accounts, the level of perception is distinguished from the level of cognition; Gibson believes that there is only one, perceptual, level. It is not the case that an agent perceives *all* information, whether it is action-relevant or not, and only a part of the perceived information gets through the agent's *cognitive barrier*, i.e. is consciously available for her to act on. Gibson's claim is stronger: everything the agent perceives is perceived for action; what is not perceived, does not exist in the agent's world[2] (Chemero 2011).

Secondly, Gibson poses that *perception is not mediated by representations*. At the time, cognition was broadly understood in terms of the so-called "sandwich model" (Chemero 2011). Theorists advocating for the sandwich model are usually either computationalists, representationalists, or both. Computationalists believe that cognition is some kind of computation, a complex mental operation we perform in our minds (Pylyshyn 1980). Representationalists postulate that cognition involves representations. There are many

[1]The answer to the question "Why do we perceive?" could be teleological or causal. In the causal sense, we may answer that we perceive because we have perceptual organs. In the teleological sense, the answer concerns *the goal* of perception. For Gibson, the goal of perception is action.

[2]In psychology, the perception-for-action idea has been further developed under the name of the Action-Specific Perception program. It is controversial: most of the traditional theories of perception pose that it provides us with access to a behaviorally independent and objective representation of the world.

ideas of how we should understand representations; most representationalists agree that representations are some kind of references to or mental equivalents of entities that exist in the external world (Shea 2018). For example, every time I see, think of, or imagine a couch, there is a mental representation of a couch in my mind.

On the sandwich model, cognition is "sandwiched" between the layers of perception and action. Perceiving is understood as collecting data from the environment in a way that is not filtered by the agent. These data are operated on and supplemented by our cognitive processes; at this stage, we perform mental operations such as coming to conclusions or decision-making. The results of these operations are the agent's action (Chemero 2011).

The sandwich model faces several difficulties: for instance, it does not come with a convincing story of the transitions between different stages of the process (how does perceptual information become mental representations?; how are representations translated into action?). It is also challenging to justify how an agent who needs to quickly and efficiently react in a fast-changing environment can deal with such a vast computational load.

Gibson offers an alternative anti-computational and anti-representational account. He develops a sophisticated theory of environmental information, which can be directly picked up and acted on by the agent. For representationalists, an important role of the "cognition" layer of the sandwich is to supplement what we perceive with additional information. For example, I can grab an apple, even though I can only see its "front slice"; the apple's three-dimensionality is not perceptually available, but we have access to it through other kinds of cognitive processes. Ecological psychologists point out that perception is not as impoverished as it is made to be: we access a wide array of perceptual clues that provide us with action-relevant information (Gibson 1979). An example is the

time-to-contact ratio, which refers to how we perceive objects and surfaces in terms of their relative magnitude: as we approach an object, it increases its size in the center of our visual field (Lee 1976). Such variables allow us to act directly on perceptual cues, without the need for mental representations. The time-to-contact ratio is available to *moving* agents: perceiving it is not something that "happens" to an agent, but rather something that an agent does as she moves (think of how we can perceive the softness of the sponge only if we press on it). In this sense, perception is not only *for* action but also *is* action.

The third principle of ecological psychology follows from the first two: when we perceive, we *directly perceive* opportunities for action within our environment (Chemero 2011). These opportunities are called "affordances"; what we perceive affords us particular kinds of interactions with the world.

> The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes,* either for good or ill. The verb *to afford* is found in the dictionary, but the noun *affordance* is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment (Gibson 1979, p. 119).

Any object provides us with a vast but finite amount of affordances; opportunities to act are limited by the physical status of the object and by our sensorimotor system and its capacities. Because different objects afford different action opportunities for different organisms (a human can hold a baseball; an ant can walk on it), the existence of

an affordance depends on both the agent and its environment. As a result, Gibsonian affordances have a complex metaphysical status:

> [A]n affordance is neither an objective property nor a subjective property; or it is both, if you like. An affordance cuts across the dichotomy of subjective-objective and helps us to understand its inadequacy. It is equally a fact of the environment and a fact of behavior. It is both physical and psychical, yet neither. An affordance points both ways, to the environment and to the observer (Gibson 1979, p. 129).

The description provided by Gibson was not sufficient to operationalize the notion of affordances. To make ecological psychology empirically testable, Michael Turvey, Robert Shaw, and William Mace came up with a formulation of ecological psychology laws in the early 1980s (Turvey et al. 1981). Their findings established ecological psychology within the domain of psychology in general and popularised Gibsons' work (Chemero 2011). Since the formulation of the Turvey-Shaw-Mace view, ecological psychologists suggested improvements and competing ecological frameworks (Chemero 2011, Heft 1989, Withagen et al. 2012). In my thesis, I will rely on the formulation proposed by Anthony Chemero (2001, 2003, 2011), because his view allows to account for the social reality accessible to the interacting agents.

Enactivism

In this thesis, I will supplement ecological psychology with an account of interactions that originates in the enactivist approach. The main claim of enactivism is that cognition

emerges from an interaction of an organism with its environment. The enactivist theory arose as an attempt to bridge phenomenology and natural sciences. The paradigm is introduced in the 1991 book "The Embodied Mind: Cognitive Science and Human Experience", written by a philosopher, a psychologist, and a biologist: Evan Thompson, Eleanor Rosch, and Francisco Varela. In the following decades, enactivism rose in popularity among researchers interested in cognition, who supplemented and diversified the theory. We can distinguish three main enactivist camps with different foci and methodological approaches.

The sensorimotor approach is advocated by Alva Noë and focuses on perceptual processes (Noë 2004). The "radical" enactivism approach, postulated by Daniel Hutto and Erik Myin is methodologically oriented and reflects on assumptions and claims made in enactivist debates (Hutto & Myin 2013). The third approach, most directly descending from the thought of Varela, Thompson, and Rosch, undertakes the ambitious task of explaining the biological origins of life through perceptual processes and sensorimotor contingencies (Di Paolo et al. 2017, Di Paolo et al. 2018). Two important figures working on this project are Hanne De Jaegher and Ezequiel Di Paolo, who extended the enactivist ideas to the field of social cognition; their theory of social interactions is called "participatory sense-making" (De Jaegher & Di Paolo 2007); that is the approach I suggest as a supplement to ecological psychology.

Ecological psychology and enactivism are similar, but not necessarily compatible theories.[3] Nonetheless, there are theorists who believe that the approaches are complementary. Heras-Escribano (2021) discriminates three fundamental commitments shared by enact-

[3] "The relation between the schools of thought [enactivism and ecological psychology] is one of strange familiarity, as if their respective practitioners were staring at each other across an uncanny valley" (Di Paolo et al. 2017).

ivism and ecological psychology; a basis for a future potential merger of the accounts. Firstly, perception and action are not separate; they are different sides of the same continuous, dynamic process. Secondly, the environment plays a constitutive role in cognition. Thirdly, cognition is a set of skills, which result from the history of agent-environment interactions. On the post-cognitivist account, advocated by Heras-Escribano, cognition is a form of adaptive behavior: organisms survive in their environments due to their flexible and skillful behaviours[4]. All of this to say that there are grounds to believe that ecological psychology and enactivism are compatible enough to form a coherent framework serving as a basis for my future investigation.

2.1 What Can We Perceive?

As I mentioned earlier, an account of ecological psychology begins with ecological information. For Gibson (1979), ecological information is the relation of energy (such as light or vibrations) and the substances and surfaces in the environment. The regularities of these relationships carry information about the affordances available to the animal[5]. An example of such regularity is the fact that for a human observer, the horizon cuts across objects at a height equal to the height of the point of observation (Sedgewick 1973). What ecological information is and what that entails is the topic of this chapter.

In traditional accounts, cognition is representational, i.e. the agents perceive their environment, and these perceptions are later translated into *mental representations* (Shea

[4] A positive proposal similar to Heras-Escribano's but focused on a relational understanding of agency is offered by Segundo-Ortin (2020).

[5] Bruineberg et al. define ecological information as "the set of structures and regularities in the environment that allow an animal to engage with affordances"; ontologically, information *is* the environmental regularities, nothing over and above them (2018).

2018). These representations have a certain *meaning* to the agents; they allow the agents to appropriately respond to their own needs and the requirements of the environment. Ecological psychology is non-representational (Gibson 1979); perceptions are all there is, and after the act of perception, no cognitive operations on the perceptual information are possible. Ecological psychology, therefore, faces the problem of accounting for the meaning, which cannot be later on "added" to the perceptual data. Gibson argues that the meaning is already in the world; when agents perceive, they perceive *ecological information*, which is meaningful to them (Gibson 1979). This issue makes the account of ecological information crucial to the ecological psychology framework. Ecological information needs to be the source of all kinds of meaningful data that the agent can directly pick up and act on. Social agents need to detect *social* ecological information in interpersonal contexts.

To orient ourselves in social environments (and ultimately ensure our survival), we need to pick up social patterns from our surroundings, and interact with them in a skillful and appropriate manner. An agent in a dyadic interaction *perceives meanings made available by the other agent*. To account for this phenomenon, our ecological information needs to include all kinds of social regularities. Arguing that ecological information can be conceived of in this broad sense is the first issue I will tackle in this thesis.

The Scope of Ecological Information

As introduced at the beginning of this chapter, ecological information can be thought of as more or less inclusive. The proponents of the traditional Turvey-Shaw-Mace view believe that ecological information should be restricted to what is sensorily available in the environment at the moment of perception; I call them the proponents of *the narrow view*

(Turvey et al. 1981, Golonka 2015). The researchers who pose that ecological information should go beyond what is sensorily available, allowing for a broader range of affordances and accounting for more complex, socio-material phenomena are called the proponents of *the broad view* (Chemero 2003, Rietveld & Kiverstein 2014).

In the following sections, I will argue that it is justified to adopt the broad view of ecological information, which will allow us to account for the phenomenon of opening opportunities for action to other agents. I will go about it by (1) presenting the narrow view; (2) discussing the problems of the narrow view; (3) introducing the alternative broad view; and (4) presenting the objections to the broad view and possible responses to them. I will conclude this chapter by stating that despite the objections, we can take on the broad view of ecological information and the further burden of proof against it is on the side of the proponents of the narrow view.

2.2 The Turvey-Shaw-Mace View

The most prominent "narrow" account of ecological information goes together with the affordances-as-properties view of Turvey, Shaw, and Mace, which will be introduced in the next section. This account is "narrow" because it proposes a very restricted idea of what ecological information can convey. It is best formulated in Shaw's Principle of Symmetry, which states that the environment specifies the information available and the information available specifies perception–and the other way around, our perception specifies the information, which specifies the environment (Turvey et al. 1981, Shaw et al. 1982). In short, perception, information, and environment lawfully specify one another, making it a symmetrical relationship, 1:1:1. If perception is there, the environment

and the environmental information will also be there, and so on. How does it work? On the example of vision: when organisms receive information from their environment through ambient optic arrays, the information received is lawfully correlated with the the arrangement of light structured according to a certain point of observation. A certain layout perceived by the organism specifies particular information received which corresponds to a particular state of the environment. Because of this lawful connection, organisms can learn affordances (and, therefore, how to function in their environments).

The environment:information:perception relationship is locally lawful, which means that the regularities occur without exceptions, but not universally. Turvey, Shaw, and Mace refer to these local, lawful correlations as *ecological laws* (Turvey et al. 1981). Ecological laws hold for a particular species in a particular environment. Framing ecological information in terms of ecological laws is a clever trick: on the one hand, it allows us to understand perception as infallible; on the other, it permits variation between species. In this way, Turvey, Shaw, and Mace can address the idea of an *Umwelt*, a lived environment: different species may live in the same physical space, but have access to different environmental information, and, therefore, different affordances. While the Principle of Symmetry performs well in showing how we perceive the physical qualities of our environment, the critics point out that for an organism to survive, more information is necessary (Chemero 2011). Arguably, this additional information is also directly perceived.

2.3 The Problems of the Turvey-Shaw-Mace Approach

Not all relevant information can be captured with Shaw's Principle of Symmetry. For example, argues Chemero (2011), particular environments have specific meanings to

individual organisms that are not contained within ecological laws. The problem is that ecological laws are local but still very general: they account for the inter-, but not intra-species variation (Turvey et al. 1981). Imagine a mouse perceiving a log, which serves it as a permanent shelter. By an ecological law, every mouse living in this niche will receive the same ecological information while perceiving this log. This is suspicious for ecological psychologists, who aim to avoid the risk of computational processes supervening upon the perceptual processes: does the mouse have to compute that this particular log is its shelter if it cannot directly perceive it? Another example is the relationship of a mother and her infant: it seems reasonable to pose that when the infant perceives her mother, she perceives information beyond what *any* infant would observe (Chemero 2011).

Ecological laws are too restrictive in a different sense, as well: they cannot capture all kinds of social information relevant to our lives (Chemero 2011). James Gibson (1979) is very clear in suggesting that ecological psychology should be inclusive of the social aspect of animal existence[6]. Nonetheless, social conventions are not reliable enough to count as ecological laws. For example, perceiving a shop sign ("Grocery Store") is not lawfully correlated with the presence of a grocery store; it is only customary that the shop is where the sign announces it to be. It could be that a prankster changed the location of the sign or the store is out of business. Therefore, on the Turvey-Shaw-Mace view, we cannot say that the sign affords us grocery shopping. This, however, is counter-intuitive: does the sign not provide us with *perceptual information* on what we can do?

Once again, the concern is that what is not directly perceived, needs to be inferred

[6] "[Ecological psychology] comprises the whole realms of social significance for human beings" (Gibson 1979, p. 121); "It is a mistake to separate the natural environment from the artificial as if there were two environments; artifacts have to be manufactured from natural substances. It is also a mistake to separate the cultural environment from the natural environment, as if there were a world of mental products distinct from the world of material products" (Ib., p. 130).

(Chemero 2011). When the ecological information is limited to the physical qualities of our environments, the scope of ecological psychology itself is limited: perception provides us with information about our physical external world; everything else needs to be accounted for by higher-level cognitive processes. If, on the other hand, we directly perceive other kinds of regularities (customs, social and cultural information, etc.) as well, ecological psychology can pertain to the status of a broader explanatory cognitive mechanism. In the following section, I present a proposal of general ecological information, inclusive of all kinds of environmental regularities.

2.4 Chemero's Situational Semantics Model

Wittgenstein introduces the notion of "the form of life", which consists of the relatively stable and regular ways animals do things, including customs, conventions, and normative behaviors (1953). If, following Gibson's wish, we want to account for the form of life within ecological psychology, Shaw's Principle of Symmetry is too restrictive; we need another account of ecological information[7]. Our social lives consist of mostly not-always-reliable correspondence relations. An example frequently brought up by Chemero is a closed can of beer: under most circumstances the can affords drinking beer, but we can imagine that due to a practical joke or a brewery problem, the can is empty or contains a different fluid. This possibility is remote enough not to interfere with our daily functioning. In fact, as we live and engage with our environments, we rely mostly on such "unlawful" regularities.

[7]Some researchers argue that the social vs. non-social distinction is un-ecological in itself: it exists only from the third-person (scientist's) perspective. For an organism, the socio-material environment is uniform; the differentiation is not reflected in the organism's phenomenal experience and is irrelevant to its cognitive processes. In this sense, everything is social because everything has to do with the perception-action activity of other organisms (Baggs 2021).

Our interactions with the world can be explained by the concept of *coupling*. Coupling is defined through coordination; when an agent is coupled with an aspect of its environment, the agent and this aspect of the environment exhibit some kind of coordination[8] (De Jaegher & Di Paolo 2007). This coordination underlies Shaw's ecological laws: the environment reliably correlates with the affordances available to an organism. Whenever the organism acts on one of the affordances, the environment responds in a coordinated way (imagine repeatedly reaching for a glass of water–and always being able to drink it). In this sense, the notion of coupling is normative: the behavior of the environment and the agent reliably meets a certain standard. We know that this principle works with what is sensorily available to us, but can it also account for more complex behaviors (for example: waiting for a bus at a particular hour)? Chemero (2011) comes up with a theory of ecological information that allows us to track agent-environment coupling beyond the sensory. Therefore, we can distinguish between *specific* (lawful) ecological information, in accordance with the Principle of Symmetry, and more inclusive *general* ecological information that follows the Chemero model (Bruineberg et al. 2019).

General Ecological Information

The idea of general ecological information is based on the concept that some things in our environment come together: radiators and heat, plants and water, appetizers and main courses. These regular relationships make it possible for an animal to couple with aspects of the socio-material environment that are not sensorily present (distal).

> General ecological information is any regularity in the ecological niche between aspects of the environment, x and y, such that the occurrence of aspect x

[8] Coupling and coordination will be explained in more detail in chapter four.

> makes the occurrence of aspect y likely. (Bruineberg et al. 2018, p. 5237)

The concept of general ecological information is ubiquitous, cheap, and minimal (Bruineberg et al. 2018); there is an abundance of such information in an animal's environment. Environmental regularities that constitute general ecological information are not relative to the observer and are independent from a point of view[9]. In themselves, such regularities cannot be "wrong" or "incorrect", in the same way, ambient optic arrays cannot be "incorrect" (Chemero 2011).

All ecological information relies on correspondence (Bruineberg et al. 2018); on this account, the specific (lawful) ecological information is a subspecies of general ecological information. Ultimately, the specific ecological information underlies all other kinds of correspondence. For the perceiver, nonetheless, this is irrelevant. Imagine typing the letter "k" on your keyboard: there is a lawful correlation underlying the correspondence between you pressing the key on the keyboard and the letter popping up on the monitor in front of you. This correspondence has to do with the physical properties of the hardware of your computer. For you as a computer user, these processes are not accessible: the regularity between the key and the sign on the screen is enough to guide your action. This is an example of an organism utilizing general ecological information.

What are the examples of general ecological information that are available to us in social situations? For instance, others could provide us with the opportunity to soothe (by providing support), proceed with our activities (by watching over us or providing protection), or play (as our playmates). These opportunities correlate with other stimuli,

[9] Affordances are relative to the observer and the environment. Following Bruineberg et al. (2018), ecological information is nothing beyond the correlations that occur in the environment. In this sense, ecological information exists also without an observer and does not share the "dual" ("neither objective nor subjective") metaphysical status of affordances.

such as seeing our partner in a particular state (attentive, following our gaze, mirroring our body movements), hearing an utterance ("Would you like to play basketball?"), or other environmental information (a clock showing it is 4 pm on a Sunday–the time when you usually receive a call from your friend).

Let us consider the example of Steve and Anne. Anne's sigh guides Steve's attention to the view of the blue sea, the soothing sound of the waves, and the warm touch of the breeze on his face. What Steve is perceiving is not merely the sound of Anne breathing out; there is a social meaning to a sigh that comes from a history of correlations between breathing out and feelings of relaxation, rest, and grounding. The account of *general* ecological information, as opposed to the narrow view, allows us to account for this perception. Chemero (2011) proposes that such broadly conceived ecological information can be understood and analyzed through the situational semantics model.

The Situational Semantics Model

We can describe the process of perceiving general ecological information following the situational semantics model proposed by Chemero (2011). This model is based on situation semantics, according to which information is a natural part of the world–as opposed to something that is just in our minds as knowledge or mental representations (Barwise & Perry 1981)[10].

Situation semantic poses that information exists in *situations*, which are understood as local, incomplete possible worlds. Situation types (*S1* and *S2* in Figure 2.1) are connected

[10] An alternative model inclusive of general ecological information is offered by Withagen & van der Kamp (2010). For Withagen and van der Kamp, information is a relationship between an array pattern and the perceiver. Following Oyama's ontogenetic information account, they propose that the informative character of information relies on the relation between the informational patterns of the array and the perceptual processes of the perceiver (Oyama 1985). On this account, information is not pre-existing but emerges in the developmental process.

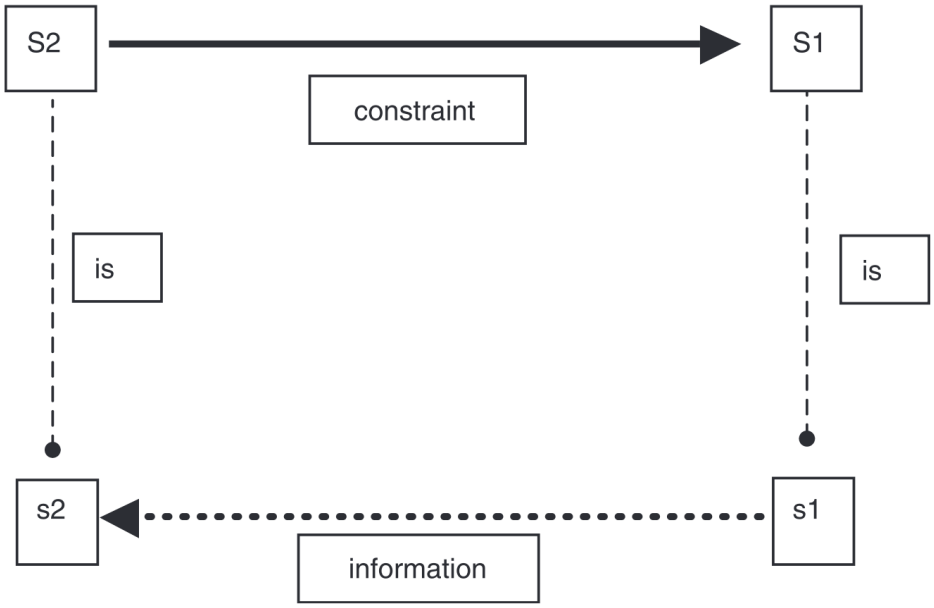

Figure 2.1: The Situational Semantics Model of Ecological Information (Chemero 2011, p. 117)

to other situation types through situational constraints. The constraints allow us to account for the regularity and apparent lawfulness of perception. What we perceive are situation tokens (*s1*, *s2*), which are connected to the situation types. Situation tokens provide us with information about other situation tokens, based on the relationship of their types.

We can connect this model to an example of Steve and Anne. When Steve perceives a particular token of a situation, i.e. a specific structure of light, this token is connected to a general situation type. In the past, whenever Steve perceived Anne in a particular state (*S1*, we can call this state: "relaxed Anne"), it correlated with the environment being so that Steve could relax as well (*S2*). This correlation is established by a constraint: it is not exactly *lawful*, but it is *regular*, law-*like*. Therefore, when Steve sees relaxed

Figure 2.2: Turvey-Shaw-Mace: The Symmetrical View

Figure 2.3: Chemero's (2011) Causal-Normative Model of Information

Anne (*s1*), he receives not only the information about the "relaxed Anne" situation token but also about the correlated "opportunity to relax" situation token (*s2*). Likewise, the model shows how light provides us with information about the beer can, but also about the beer inside the can.

As we can see, the situational semantics model accounts well for cultural and customary aspects of our environment. The constraints between situation types are not fully lawful but suffice in terms of successfully guiding an animal's behaviour[11]. The situational constraints are regularities between situations that reduce possibilities; they are *relationships such that something being in a particular state constrains the state in which something else can be* (Bruineberg et al. 2018, p. 5242). Constraints can be brought about by causal structures, ecological laws, conventions, or habits.

The difference between the situational semantics model and the Turvey-Shaw-Mace view is the lack of symmetry (Chemero 2011). Shaw's Principle of Symmetry expresses

[11] A compatible view is endorsed by Millikan (2000). Millikan argues for both *informationL*, carried in virtue of natural laws, and *informationC*, carried in virtue of correlation. Millikan agrees that correlation is reliable enough to guide animal behavior.

that the environment specifies the information available and the information available specifies perception–and the other way around, perception specifies information, which specifies the environment (Figure 3.2). Chemero agrees that the world causally specifies the information available, which specifies perception (what exists in the world is what we perceive). He disagrees that there is a causal, lawful relationship *from* perception *to* the world (what we perceive is not exactly what exists in the world). The objects of our perception are normatively (through constraints) connected to the environment (Figure 2.3)[12].

An important feature of general ecological information is how abundant it is in our environment. Correlations, on a larger or smaller scale, are ubiquitous. We tend to eat our breakfast at a particular time, drive to work taking a similar route, and greet our colleagues using the same conventional, repeated phrase. In social interactions, we conventionally ask "How are you" and chat about the weather; we express concern or interest during a conversation with a friend; we form our own interpersonal traditions and customs. On the situational semantics model, this information can be directly perceived and, paired with our abilities, serve as an affordance. In the following section, I will discuss the problems of the situational semantics model and their possible solutions.

Objections to the Broad View

The strength of the situational semantics model also makes for its biggest problem: the lack of a symmetrical relationship between perception, information, and the environment makes it impossible for us to specify the exact object of our perception (Withagen &

[12]Notice that this model can accommodate the objection Chemero raises against the ecological laws: situational semantics can carry information meaningful to individuals within particular species. For instance, a mouse can perceive an individual log as its shelter; this information does not have to be added to perception in later cognitive "processing".

van der Kamp 2010). Consider perceiving a clock with its longer hand pointing to 12, and the shorter one to 4. This situation token is, through the situation types, correlated with many other situation tokens: it is the time when I like to go the gym, the time my lecture starts, and when my sister comes back from work. All of these are relevant correlations–which one of them is the one I perceive when I look at the clock?

Bruineberg et al. (2018) consider possible responses to this objection. They point out that Chemero can bite the bullet and admit that ecological information includes all of these alternative situation tokens, and all of them are perceived by the agent simultaneously. Since this is not sufficient to guide the organism's actions, the situation token that is needed is specified later, through some kind of intention. This additional intentional process determines what affordances the agent *actually* perceives. This solution is predictably not acceptable for ecological psychologists: once again, it violates the principles of ecological psychology by suggesting a "cognition sandwich", an additional computational process succeeding the perceptual one.

Chemero points out that the empirical data shows that ecological information does not have to be specific to successfully guide action (2011). Since this answer is not sufficient to account for all the ambiguous cases, he further rejects the idea of an additional intentional process but suggests that our *subjective awareness to affordances* performs the filtering role (2011). In other words, Chemero agrees that ecological information contains countless situation tokens, but claims that it is not problematic: the situation tokens that are relevant to us are the ones we are aware of anyway. This explanation is only half-satisfactory: how do we arrive at the relevant affordance? Nonetheless, this larger issue is an Achilles' heel of most affordance accounts: how is a vast set of available affordances connected to the ones we actively *notice* as actable, and those to the one

particular affordance we act on?[13]

Closing Remarks

As we interact, others extend our possibilities of perception; they open and close novel opportunities for our thinking and acting. We can perceive these new meanings because we are attuned to the social regularities that occur in the environment. Consider one of our examples: the divorcee John who perceives Jane's interests and her zest for life. At the retirement facility, John is seeing not simply *Jane at a dance class* but also how active, joyful, and playful his life can become. What Jane's behavior is correlated with brings forth novel possibilities for behavior in John. To account for John's perception of new affordances, our view of ecological information needs to be *broad*, i.e. include regularities beyond the lawful physical ones. This is what I have argued for in this chapter.

To summarise my argument: both the narrow and the broad views have weak spots. The main disadvantage of the broad view is that the general ecological information cannot specify what to act on as we perceive our environment: correlations are omnipresent in the animal's environment. On the other hand, adopting the broad view has the advantage of allowing us to account for *all* aspects of the agent's environment. Any other approach introduces an artificial division between the material and the social, which is incompatible with the phenomenal experience of the agent. Furthermore, the broad view allows us to account for the perception of individuals that have particular meaning to an agent, e.g. a

[13] An alternative solution to the problem of specificity brought up by Bruineberg et al. (2018) is to concede Chemero's idea altogether and define information relationally, as use-dependent; an approach taken by Withagen and van der Kamp (2010). On this view, information is relative to a system to whom it is relevant. Such usage-relative information is less ubiquitous than the general ecological information proposed by Chemero: it exists as a relationship between the animal receiving the information and the pattern in the environment. Even though this notion of ecological information is not as minimal and cheap as Chemero's, it is still inclusive of non-lawful cultural correlations. Nonetheless, since it is not the approach I chose to follow in my work, I will not pursue it further.

mother to an infant. Since the proponents of the narrow view cannot provide decisive arguments against the broad view, and since there are good reasons to support it, I will adopt the broad view for my further work in this thesis. I suggest that the further burden of proof against the broad view lies on the side of the proponents of the narrow view.

Having adopted a broad view of ecological information, in the next section, I will discuss whether we can legitimately account for our phenomenon from a different perspective: through examining the ontology of affordances.

3 Affordances

The concept of affordances has spread among many disciplines: psychology, anthropology, architecture, and design, to name a few (Mace 2014). It is an attractive phrase with intuitive appeal and plenty of explanatory power. In some of these new applications, affordances remain firmly rooted in the larger framework of ecological psychology. In others, they are taken out of context, simplified, or re-defined.

The fertility of affordances and the liberty with which scholars use this notion is a cause for concern among ecological psychologists (Segundo-Ortin & Heras Escribano 2023). It undermines the goal of ecological psychology, which implies a clear definition that would allow operationalization and assure extensive empirical testing. Applying affordances "frivolously" is a threat to this project.

In this chapter, I address this worry. My goal is to show that we can legitimately pose that others open opportunities for action for us and that *applying affordances to this context does not threaten the project of ecological psychology*; on the contrary, it is fully consistent with the leading account of affordances as relations (Chemero 2011). What we perceive when we interact with others are, in fact, affordances. Such interpersonal affordances do not "trivialise" the concept.

My argument has the following structure: firstly, I deconstruct Chemero's notion of affordances to analyze the building blocks of his account. Based on this analysis,

I formulate four criteria something needs to fulfill to be classified as an affordance according to his theory. Secondly, I introduce both sides of the debate on mental and cognitive affordances; I argue that posing a clear demarcation line between mental and non-mental affordances is impossible and that the debate refers to the arbitrary problem of measurement rather than a qualitative difference. Lastly, I check various examples of mental and cognitive affordances against the four criteria specified at the beginning of the chapter and confirm that they can be accounted for within Chemero's theory. Interpersonal affordances, which afford all kinds of actions, can be therefore legitimately posed within the framework of ecological psychology.

3.1 Affordances as Relations

To fully understand Chemero's view on affordances, it is helpful to see it in the context of other approaches. After the publication of "The Ecological Approach to Visual Perception" (Gibson 1979), we can distinguish two prominent attempts to elaborate on and operationalize the notion of affordances: Edward S. Reed's selectionist approach (1996) and the Turvey-Shaw-Mace approach (Turvey 1992). Both views share the same basic assumption, taking affordances to be *properties of the environment* relative to the animal perceiving them. The differences lie in the details: Turvey and Reed disagree on the kind of properties affordances are, and the aspect of animals affordances are relative to. As a result of this disagreement, they have divergent ontological commitments: while Reed believes that affordances exist independently of animals, Turvey, Shaw, and Mace do not.

The selectionist approach of Reed combines ecological psychology with the Darwinian

account of evolution. Reed argues that the environmental resources available to animals create selection pressures, which in turn cause animals to develop particular perceptual systems (1996). Affordances are the properties of the environment that shape species over the course of generations; organisms that adapt and become capable of perceiving environmental resources, stay around. In this sense, affordances come first and the animals' perceptual systems second. Since affordances would exist even if the species did not evolve to perceive them, affordances are animal-independent. Because the "old" selectionist approach to evolution fell from grace, the Reed view is currently unfashionable among ecological psychologists (Chemero 2011).

The alternative view of Michael Turvey, Robert Shaw, and William Mace proposes that affordances are best understood as dispositions: properties of the environment that occur only given specific circumstances (Turvey 1992). A typical example of a disposition is brittleness; a property actualized only when the brittle object is acted upon by a particular force in a particular situation. On the Turvey-Shaw-Mace view, an object affords an action if it has dispositional properties that are complimented by the dispositional properties of the organism that perceives it. The dispositional properties of the organism are called *effectivities* (Turvey 1992). For Turvey, Shaw, and Mace, a sword affords holding if the object's dispositional property (affordance of holdability) complements the agent's dispositional property (effectivity of being-able-to-hold) under the right actualizing circumstances. Affordances are animal-dependent: they occur if both the environmental resources and the animals' perceptual systems are in place.

Chemero disagrees with both parts of the Turvey-Shaw-Mace view: affordances are neither *properties*, nor *of the environment* (Chemero 2011). He proposes an alternative, on which affordances are relations between the perceiver and the environment. For Chemero,

affordances have the following structure:

Affords-ϕ (environment, organism), where ϕ is behavior.

which means: "The relation 'affords-ϕ' holds between 'environment' and 'organism'", or: "The environment affords behavior ϕ to the organism" (Chemero 2003, p. 187). The relational nature of affordances is best understood if we compare it to other relations. Consider the relation between the height of two objects:

Taller-than (Jack, Amy)

which means: "The relation 'taller than' holds between 'Jack' and 'Amy'", or "Jack is taller than Amy".

In the sections below, I delve deeper into both sides of the affordance relation: the environmental and organismal affordance relata. What in the environment relates to what in the organisms?

Environmental and Organismal Relata

Chemero argues that the environmental relata of affordances are features of situations, as opposed to properties of objects. The difference between spotting a feature and perceiving a predicational property was introduced by Strawson (1959). Consider the example of a property in the sentence: "My cup is red". Understanding "My cup is red" implies understanding the identity of the object (the cup), whom the object belongs to (me), the color of the object (red), and so on. In contrast, we can understand a non-predicational

property such as "It is raining" without knowing anything else about the object; we only notice one thing (the rain). A property of the environment that does not belong to any particular object is called a *feature*. A feature-placing sentence indicates the existence of a feature in a space-time region; the purpose of the sentence is not to specify an object but to specify a way of filling space, for example: "It is cold", "That is ice" or "There is sticky" (Clark 2004)[1].

For Chemero, the environmental relata of affordances are features of situations (Chemero 2001; Chemero et al. 2018). For instance, the affordance of holdability of a teacup for a particular individual, Amy, will have the structure:

Affords-holding (teacup-feature, Amy).

where the teacup is not considered as an object, but a property of the environmental situation that encompasses both Amy and the teacup. In this case, the shape of the teacup plays a relevant role; for Strawson (1959), shape is a suitable candidate to serve as a feature[2]. The feature approach is preferred over the environmental-properties view since it is more consistent with the direct perception postulate of ecological psychology: on the Strawson view, perceiving a property is more likely to include higher-order reasoning than placing a feature.

Chemero suggests that not only the environmental relata but also (perceiving) the affordance itself should be understood as a feature, read as: "Teacup-holding opportunity!

[1] Strawson spoke of feature-placing languages: languages that contain no proper names, no definite descriptions, and no means to quantify or numerically distinguish objects. In a feature-placing language, it is possible to identify substances as space-fillers ("There is mud"), but not as distinct entities ("There is a mud puddle"); features can be indicated, but not counted or identified as individuals (Clark 2004).

[2] "[T]he idea of a simply placeable feature might include—might indeed be—the idea of a characteristic shape." (Strawson 1954, p. 253)

Here! Now!" or "Need to hold the teacup! Here! Now!" (cf Chemero 2001, p. 114), where the affordance expresses something about the situation but is not a sum of added animal and environmental properties.

What are the organismal relata? In post-Gibsonian ecological psychology, body scale was considered a prominent candidate for organismal affordance relata (or effectivities), following a number of experiments on stair-climbing (Warren 1984). Nonetheless, further studies (Cesari et al. 2003) seem to suggest that *ability* is a better candidate, with the body scale only sometimes serving as a reliable place-holder. For example, the affordance of climbability is not straightforwardly related to the length of our legs; flexibility seems to play a role as well (Chemero 2003). It is reasonable to assume that the organismal relata are a bundle of factors that includes but is not limited to body scale.

Chemero (2011) suggests that abilities should be understood as functional properties of organisms. As a functional property, an ability is a function of the animal and its environment, where the output depends on the evolutionary history of the organism. Abilities stay around if their organismal carriers flourish and reproduce (Chemero 2003). Seeing abilities as functional properties has the advantage of tying ecological psychology with the evolutionary approach. The ability can be operationalized as:

> Ability-to-ϕ (behavior, affordance)

makes the definition of affordances circular:

> Affords-ϕ (feature of situation, (behavior, affordance)) (Chemero & Turvey 2007).

The circularity of this picture is defended by Chemero as a strength, showing that the organism and its environment exist only within a truly unified network; they should not and cannot be understood on their own. The organism-environment relationship is a complex system and complex systems are often best explained with the tools of the hypersets theory, which permits circular explanations (Chemero & Turvey 2007).

There is one important advantage of Chemero's view over the Turvey-Shaw-Mace approach: affordances coupled with effectivities under the right actualizing circumstances *should never fail*; dispositions are exhibited reliably and without exceptions (think of brittleness). For example, on the Turvey-Shaw-Mace view, a person capable of walking coupled with a walkable surface should never fail to walk. From everyday experience, we know that it is not the case[3]. This problem alone is a sufficient motivation to depart from seeing affordances as environmental properties.

Perception and Phenomenology of Perception

The perception of affordances is a relationship between the perceiver and what is perceived:

> Perceives [animal, affords-ϕ (feature, ability)]

which we can read as: "An animal perceives that a feature relative to its ability affords behavior ϕ" (Chemero 2011). Chemero notes that this form of perceiving affordances is phenomenologically uncommon and reflects the experience of only trained agents. Humans tend to perceive:

[3] Chemero (2011) argues that there is something essentially normative about abilities: they imply a standard that may fail to be met. To the best of my knowledge, he does not specify how this normativity can be accounted for as a structural part of the affordance.

Perceives [animal, affordance-of-ϕ]

which we can read as: "An animal perceives the affordance of ϕ" (for example: holding a spoon). Faithfully to the ecological psychology postulate, perception is always direct.

Ontological Commitments

Since affordances are relations, they are not "extra entities" in the environment (Chemero 2011). Consider the taller-than relation; it is neither a property of Jack nor Amy that Jack's height surpasses Amy's height. The relation is not an ontological entity on its own; its being depends on the relata. The fact that affordances do not exist independently of animals is tricky for ecological psychologists, who are usually committed realists about the external world (Chemero 2011). If affordances depend on animals to exist, are they not a construct of the animal mind? One way of navigating around this problem is to admit that affordances depend on animals, but not on the act of perception (Chemero 2011). That is: affordances do not disappear if there is no animal to perceive them; the animal's mere existence in the environment is sufficient for the affordance relations[4].

So far, I have analyzed Chemero's view of affordances and shown its advantages over the Turvey-Shaw-Mace approach. I have introduced what Chemero's affordances are from multiple aspects: their ontological status as relations (and the implied complex realist commitment), their organismal and environmental relata, and the way they are perceived

[4]Ecological psychologists encounter further problems when they try to explain how the environment is meaningful to animals; how do animals know which affordances should be acted on? Since ecological psychology does not allow computational processes, meaning needs to be somehow directly picked up from the environment; affordances need to be meaningful in themselves (Chemero 2011). For these two reasons, even if ecological psychology avoids constructivism and idealism, it leads to a very nuanced form of realism.

by animals. From this analysis follows that for something to be an affordance, it needs to meet the following criteria:

> **Affordance criteria**: Something is an affordance if (1) it is a relation between a feature of a situation and an animal's ability (defined as a function of the animal's behavior and the affordance). (2) The existence of the affordance depends on the animal but exists independently of the act of perception. (3) The process of perceiving the affordance is a direct relation between the animal and the affordance.

There is an element of the affordance structure that we have not discussed yet: since affordances are inherently *teleological* (they exist for action), the kind of action that the affordance facilitates is another potential limitation to the scope of the concept. In the next section, I argue that there is no sufficient basis to restrict the realm of afforded actions. This is relevant for interpersonal affordances, as in interpersonal interactions, the perceived opportunities for physically manifested action are just as important as the perceived opportunities for non-physically manifested actions.

3.2 Affording:Affordance Analysis

In this section, I argue that there are no good grounds to preliminarily limit the concept of affordances to physically-manifested actions. To achieve this goal, I introduce both the inclusive and the exclusive approach to defining affordances and present arguments for both. I offer two arguments to accept "mental" affordances, that is affordances in

which *the affording* is based on the standard feature-ability relation, but *the afforded* action is mental. The first argument has to do with the ambition of ecological psychology to offer a unified picture of human cognition, and the second with the impossibility of demarcating between mental and non-mental actions.

Before we start this investigation, we need to clarify the terminology. The term "mental affordances" has been coined by Tom McClelland (2020). I follow McClelland's vocabulary, although not uncritically, in my analysis. In this thesis, unless specified otherwise, "mental" refers to the things an agent can do "internally", such as: thinking, attending, planning, and so on. Respectively, "non-mental" refers to the things the agent does that have a physical manifestation, to the agent's behaviour, such as: carrying, running, eating, and so on.

Further, one way of analyzing the structure of affordances is dividing them into *the affording* and *the afforded*. The affording is the agent-environment relation and the afforded is the action made possible by this relation. For example, the affordance of holdability (of my coffee mug) consists of the affording (the relation of the specific properties of the mug and my ability to hold things) and the afforded (the action of me holding the coffee mug). The holdability affordance could be analyzed as "(mug handle, ability to hold):holding a mug".

3.3 The Scope of Affordance Perception

As we have discussed so far, within the scope of ϕ fell the following actions: perceiving, holding, hand-shaking, and being driven to work. All of these actions require a certain kind of motoric activation on the part of the agent. As opposed to these actions, there

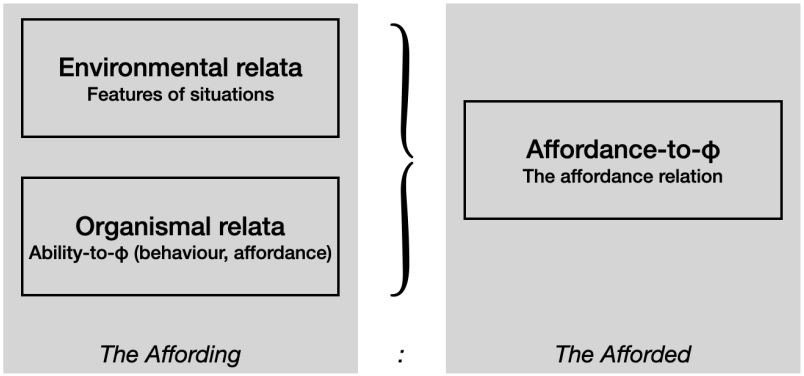

Figure 3.1: The Affording (Relata):The Afforded (Action) Analysis

are also things that an agent can do that are not necessarily physically manifested, for example: thinking, planning, attending, and so on.

Are these activities "actions"? On the most general definition, an action is "something a subject does in contrast with movements that the subject might perform as a reaction to something else or movements that merely happen to the subject" (Jorba 2020, p. 861). An action can be defined as something an agent is in overall control over; something that can be intentionally continued or stopped (Frankfurt 1978). In this sense, accidental trip-and-falls are not actions, since the agent cannot decide not to perform them. Reaching out to catch a ball is an action, but so is mentally going through the itinerary for the trip next weekend or reflecting on the solution to a math problem.

The Inclusive Approach

Some philosophers apply the notion of affordances to all actions, understood in the sense presented above. One of the prominent proposals was put forward by Tom McClelland in his paper "The Mental Affordance Hypothesis" (2020). McClelland suggests that mental actions such as attending or imagining can be afforded in the same sense as holding or

climbing. The proponents of the inclusive approach are not necessarily considerate of all ecological psychology principles; instead, some apply the notion of affordances understood in its minimal form[5]. In most cases, the compatibility of these approaches with the Gibsons' doctrine remains unexplored (cf Jorba 2020; Siegel 2014; McClelland & Sliwa 2023).

An example of a mental affordance is:

Affords-solving the puzzle(mathematical quiz question, mathematical skills).

There are several good reasons to be inclusive of "mental" affordances. Firstly, an account that grounds both mental and non-mental action in affordances rejects the artificial distinction between the two kinds and paints a more holistic picture of our cognitive lives. The well-known counterargument posed against the direct perception accounts points out that besides the low-level processes, human cognition involves high-level ones such as planning or critical thinking (Chemero 2011); ecological psychology is poorly equipped to account for them. Limiting the notion of affordances to physically manifested actions supports the idea of a lack of continuity between different kinds of cognitive processes and hinders the development of ecological psychology as far as more complex cognitive activities are concerned. The parallel worry is that if ecological psychologists do not commit to directly perceived affordances for mental actions, mental actions would have to be accounted for in representational terms.

Secondly, the line between mental and non-mental affordances is difficult to draw. Consider the following cases:

[5]For instance, consider Jorba's definition: "A minimal characterization of the concept [of affordances] refers to the possibilities or opportunities for action, which are always relative to an organism with certain abilities–a tree appears climbable to an organism capable of climbing" (2020, p. 859).

Affords-out-loud reading(book, ability to read).

Affords-silent reading(book, ability to read).

Affords-reflecting(book, critical thinking).

It is unclear how to distinguish between mental and non-mental actions without falling into the trap of Cartesian dualism. Mental phenomena are rooted and reflected in bodily actions, such as involuntary muscle movements or even quiet pronunciation of certain phrases during "silent" reading. As stair-climbing requires certain "mental components", actions such as attending include "physical components", for example, gaze following or muscular tension. There is not only a continuity between mental and non-mental actions, but also all actions are manifested, to an extent, in a mental and non-mental way (if such vocabulary does not presuppose the dualist division in itself). The debate on what kinds of actions can be afforded may be, in the end, a debate on which actions can be reliably measured with the technology and methodology available today. This gives us a sense that drawing a boundary is ultimately artificial.

The Exclusive Approach

Ecological psychologists who insist on rejecting "mental" affordances stress that the concept applied non-rigorously is likely to lose its explanatory power (Segundo-Ortin & Heras-Escribano 2023). If affordances are opportunities for action, it is in the scientific, not everyday sense of the word.

> The affordance concept cannot be expected to explain everything about mental life and experience. That is not what the concept is intended for. If everything in experience is an affordance, then the concept loses all explanatory power

> and becomes vacuous. The affordance concept is designed to perform a specific theoretical role (Baggs 2021, p. 8).

This does not need to be the case. Firstly, if "mental" affordances are compatible with operationalizations and definitions in use, the theoretical basis of the approach is not compromised and the argument loses its validity. In the following part of the section, I show that while some understandings of "mental" affordances are likely to be rejected by ecological psychology on good grounds, others should be permitted.

Secondly, ecological psychologists argue that positing affordances for mental actions does not solve any problems but adds to the explanatory burden (Segundo-Ortin & Heras-Escribano 2023). While perception is for action, there may be actions that are not preceded by and do not need to be explained in terms of perception. On the contrary: when we postulate that mental events should be preceded by some kind of perceptual processes (and do not simply happen on their own), we find ourselves in a position to explain both the mental action and the process preceding it. Affordances for mental actions do not "pay for themselves" in explanatory currency.

This objection, however, does not apply to affordances that result from dyadic interactions in a straightforward sense. In interacting with other agents, we always respond to some kind of stimuli: other agents are always external to us. Reacting to their (perceivable) behavior is the only way the interaction can continue. In this sense, interpersonal affordances are always preceded by acts of perception and should be addressed in those terms. When the agents are in interactions, but react to their own inner worlds, they do so outside of the interaction. In the first case, what affords mental action is non-mental; in the second case, both the afforded action and what affords it is mental. I elaborate on this distinction below.

Mental:Mental vs. Non-Mental:Mental Affordances

Some authors propose that happenings in our inner experiential worlds afford further happenings of the same nature (Jorba 2020). Such mental:mental affordances can be defined as:

> **Mental:Mental Affordances**: Affordances in which a cognitive or a mental state is both what is affording the action and the afforded action (mental action affords another mental action).

An example of a mental:mental affordance is:

> Affords-thinking of the beach[6](thought of summer holidays, associative cognitive capacities).

In the case of the mental:mental affordances, the environmental relata are found in the *internal* environment of the agent[7]. Imagine somebody who recollects a conversation with her friend; she recalls the content and the order of the exchange and runs through it in her mind. The agent's mental state co-constitutes the situation she is in; her abilities (remembering) and features of the situation (the experiences she is undergoing) afford further mental actions, like the desire to call her friend and reconnect.

Understandably, this interpretation is worrisome for ecological psychologists. In particular, it is difficult to say how the mental:mental affordances comply with the rule of

[6]Thinking is not equivalent to inner speech; authors such as Hurlburt and Akhter (2008) or Siewart (1998) make arguments for unsymbolized thinking.

[7]Walsh (2014) argues that the internal changes of the organism are a part of its environment. In this sense, a thought ("I am on holiday") could be a spotted feature, affording another thought ("I could go swimming"; "I do not have to worry about work"). The proponents of this view may argue that, once again, drawing the line between the external and the internal environment is difficult.

direct perception. For perceiving mental:mental affordances we rely on nothing similar to optic visual arrays (Segundo-Ortin & Heras-Escribano 2023); to postulate the existence of mental environmental relata we would need a convincing story of how the direct perception requirement needs to be interpreted or adapted. In its absence, proposals such as Jorba's (2020) do not seem to be compatible with the principles of ecological psychology[8].

This does not have to be the case for non-mental:mental affordances, which only deviate from the "accepted" affordances in the scope of their afforded actions[9].

> **Non-Mental:Mental Affordances**: Affordances in which a standard ability-feature relation affords mental action.

For example:

> Affords-thinking of the beach(airline billboard, associative cognitive capacities).

The non-mental:mental affordances avoid the criticisms posed by the proponents of the exclusive view, as long as they rely on the same mechanism as non-mental:non-mental affordances (e.g. stairs affording climbing). In the following section, I explain how this discussion is connected to interpersonal affordances.

[8] Jorba (2020) argues that the perception of mental affordances is not as relevant as the *experience of them*: "The object "demands" that a certain action takes place, and this is phenomenologically salient. The same seems to apply to cognition" (p. 863). She poses that what makes affordances is their experience, not perception. Following this thought, we depart from Gibson but can account for mental and non-mental affordances in a uniform manner.

[9] Such non-mental:mental affordances are proposed by e.g. McClelland (2020).

3.4 Interpersonal Affordances

Posing mental affordances as legitimate entities in the ecological psychology lexicon allows us to argue for the same status of interpersonal affordances. In this section, I define interpersonal affordances and show their compatibility with Chemero's criteria. I wrap up the chapter by summarising what we have achieved so far.

Defining Interpersonal Affordances

Interpersonal affordances are affordances that exist in virtue of the interaction between the agents. In a dyadic setting, constituted of the agent-in-interaction and other-in-interaction, they are the affordances of the agent-in-interaction that are made possible by her perceiving of other-in-interaction. They are what we perceive *due to* and *through* interacting with the other.

Interpersonal affordances include both non-mental:mental and non-mental:non-mental affordances, which means that they do not originate from our own internal environments, but from the perceptual experience of the other. This experience can afford mental and non-mental actions. A part of these actions is going to be physically manifested; these may come to form a feedback loop if the other-in-interaction perceives them. In other words, a subset of all interpersonal affordances of agent-in-interaction, when acted upon, will afford further action to other-in-interaction.

We could think of the following interpersonal affordances:

Affords-appreciating time-off(relaxed partner, empathy).

Affords-dancing together(dancing partner, dancing skills)

Affords-thinking of the summer(conversation about the upcoming holidays, associative and reflective skills)

The Affordance Criteria

Do interpersonal affordances qualify as affordances according to Chemero's definition? To answer this question, we need to (1) verify them against the criteria presented at the beginning of this chapter and (2) confirm further compatibility with ecological psychology, specifically with the notion of ecological information. While I discuss (1) below, (2) is evaluated in the next chapter.

According to my analysis of Chemero's view, for something to be an affordance, it needs to, firstly, be a relation between a feature of a situation and an animal's ability, secondly, depend on the animal but exist independently of the act of perception, and, thirdly, be directly perceived.

The first relevant notion is the *environmental relata*. For Chemero, the environmental relata are features of situations, encompassing both the agent and the environment (2011). Features refer to the ways of filling a spatiotemporal region: "It is windy", "There is flat", but also: "There is handle-shaped". While such examples point to simple, one-dimensional attributes, affordance-relevant features are more often *clusters of* rather than isolated and singled-out qualities. For the affordance of holding, we do not simply perceive the feature of handle-shapedness, but also a particular texture, density, and proportion to our hand (Chemero 2011). This complexity of perceived features is mirrored in the case of interpersonal affordances: Steve's perception of Annie is extended in time and includes the nature of her movement, her body posture, the pitch of her voice, the direction of her

gaze, and other factors. The process of perceiving others is not different than the process of perceiving our inanimate environment: ecological information includes information about other agents and interactions with them (Gibson 1979, p. 135), which we will learn more about in the following chapter.

The *organismal relata* (defined as Ability-to-ϕ(behavior, affordance)) of interpersonal affordances can consist of the cognitive and social abilities of the agent (Chemero 2011). Fundamentally, in parallel to how we cannot distinguish between "mental" and "non-mental" actions, most skills exist somewhere on a spectrum that involves the body of the agent, sociality, and higher-level mental processes. Even if we do not accept this continuity, there is no reason to treat social and cognitive skills differently. Firstly, while ecological psychologists often rely on Reed's convincing account of nested abilities (1996), on which more complex abilities depend on the most basic ones, a similar logic might be adapted to cognitive and social skills: for instance, the ability to write a novel depends on literacy; the ability to hold a conversation depends on the skill of joint attention. Further, we can say that the abilities to exercise both mental and non-mental actions have normative success criteria (a feature relevant to Chemero (2011), distancing himself from the abilities-as-effectivities view). Similarly to how one sometimes fails to walk on a walkable surface, a student may have the skillset to remember about her homework, yet still forget; a child may have the ability to guide his attention but fail to succeed at it.

Since interpersonal affordances always rely on perceptually perceivable stimuli, the process of *perceiving* them is by definition the same as the process of perceiving non-interpersonal affordances. Further, we can see that the *phenomenological experience* of mental and non-mental affordances shows parallels. In both cases, we can perceive the affordance as a clear, individuated opportunity for action that we may decide to act on

or not, or, on the contrary, act on it reflexively and habitually without much awareness. Consider the difference between keeping an upright posture and making breakfast: while keeping an upright posture is an action insofar as we can decide to not do it, we do not tend to perceive that our environment affords us keeping an upright posture; we simply stay upright. In contrast, the affordance of preparing a breakfast is something that we may be very aware of ("Should I make a breakfast now or wait? Or perhaps I should buy a sandwich on my way to work?"). Similarly, many "mental" affordances are automatic, but training, such as meditative practices, shows that they might enter the realm of our awareness. After such training, it makes sense to ask: "Should I stay focused on my project or worry that my colleague looks disappointed?".

If affordances apply only to intentional actions, the boundary between mental affordances and "what happens to us" or simple reflexive responses is very blurry. Consider seeing written text; if the text is provided in a language you are proficient in, it is almost impossible for the agent not to understand its content. Similarly, understanding spoken language is, in most cases, a reflexive response. In fact, the higher our familiarity with a stimulus and the more developed our ability to deal with it, the more likely it is that the affordance disappears and the automated, reflexive action takes place instead (cf Martens 2021). This, nonetheless, is the case for mental and non-mental actions alike: consider a ball flying in the direction of a professional football player; he is likely to reflexively respond to it, also out of the context of a playing field.

Finally, interpersonal affordances, as both "mental" and "non-mental" affordances, exist dependently on the animal but independently of the act of perception. The ontological status of affordances does not change based on whether the action is physically manifested or not. In either case, the existence of the animal is necessary, but the act of perception is

not: seeing Annie's particular behavior affords Steve to think of swimming, even if Annie never manifests this behavior in the first place. This is not a straightforward realist view, but introducing non-mental:mental affordances does not change the picture.

From this analysis, we can see that interpersonal affordances, both in their non-mental:non-mental and non-mental:mental form, comply with Chemero's view. The "mental" affordances, insofar as they rely on the external environmental relata and not the inner experiences of the agent, uncontroversially fall into the scope of ecological psychology.

Closing Remarks

The prevalent worry during this chapter was extending the notion of affordances beyond what is empirically measurable. While it is clear that the scope of ecological psychology needs to be restricted in some way, it is not clear where this line should be drawn. This is a relevant and understandable concern of ecological psychologists. I argued that while there is no (and there might not be) a clear demarcation point for what constitutes and what does not constitute an affordance, opening opportunities for action in dyadic interactions is a legitimate case of affordance perception. While we interact, we do allow others to access new perceptual areas; we *unfold new meanings* that were not accessible to them before. They perceive these new spaces as affordances, in relation to their own abilities.

I made this point it in the following way: I introduced the account of affordances by Anthony Chemero (2011); I presented the reasons for choosing this account and explained what an affordance is, by Chemero's standards. Then I presented the analysis of

affordances along the affording:the afforded lines; I proposed that while the mental:mental affordances do not comply with Chemero's account, other kinds of affordances (resulting in both "mental" and "non-mental" action), as long as they rely on the external environmental relata, do not pose a similar problem. In the next chapter, I introduce the idea of agent-agent coupling, which will allow us to better understand the interaction between the agents.

At this stage, I have established that if we adopt the framework of ecological psychology to look at the phenomenon of making new thoughts and behaviours available to each other as we interact in dyadic groups, we can say that: (1) ecological information conveys *social meanings*, and (2) in social interactions, we perceive *affordances*, i.e. opportunities for action. Both of these statements can be made in reference to the view of ecological psychology proposed by Anthony Chemero (2011).

Having ensured the legitimacy of our framework, we can now direct our attention to the research questions I posed at the beginning of the thesis. Namely, (1) *is there a principle behind making new thoughts and behaviors available to others?*, and (2) *if there are regularities behind what we can perceive as possible when we are engaged in social interactions, what are they, how do they function, and what stands behind them?* In the next part of the thesis, I will address these questions by getting to the core of interaction: the dynamics between interacting agents. Firstly, in chapter four, I will discuss what happens when two agents become a single system. Secondly, in chapter five, I will present a developmental view of interpersonal affordances as niches which results from the coordination dynamics between the agents. I will also introduce the concept of *interpersonal affordance landscapes*.

4 Agent-Agent Coupling

After proving that ecological psychology is a suitable framework for my phenomenon, I move to developing the account. In this chapter, my goal is to address how when we interact, others guide our perception by making it possible for us to perceive some opportunities while closing off others. As an example, we can recall the story of Stacy and Kim who seem to have fallen into an established pattern that allows them to perceive very limited opportunities for action. Why, instead of opening novel opportunities (like in the story of Jane and John), are Stacy in Kim seeing only one way to respond to each other? I argue that the *dynamics of interaction* is key to what we can perceive as possible.

In this chapter, I investigate (1) coordination, (2) coupling between two agents, and (3) the dynamics of a dyadic system. These three sections together, from three different perspectives, give us an idea of what the interaction between two agents (like Stacy and Kim) is constituted of and depends on. Firstly, I discuss *coordination*, because every interaction is based on and exists in virtue of coordination. I examine what coordination looks like, what it is defined by, and where we can find it. Secondly, I discuss *coupling* between two agents. Coupling is defined by coordination and varies depending on the *agency* of the participants; the coupling of two agents looks differently from the coupling of two non-agents, or an agent and a non-agent. I explain the difference between them, and the particular properties of the agent-agent coupling, relevant in the case of interactions.

Thirdly, I discuss *seven properties of the dyadic system dynamics*. As Stacy and Kim are a dyadic system (so are Jane and John, Anne and Steve, ...), these properties are exhibited in their interactions.

At the end of the chapter, I hope that what we will have achieved is (a) an understanding of a dyadic group as a system, (b) which is based on coordination and doubly co-modulated by both agents and, (c), exhibits seven properties: emergence, context-sensitive behavior, attractors and repellers, hysteresis, sensitivity to initial conditions, equifinality, and reciprocal compensation. With this understanding, we can see Kim and Stacy as *falling into a pattern* characteristic of a dyadic system. In the next chapter, I will connect this pattern with what they can both perceive throughout the interaction.

4.1 Coordination

Stacy and Kim are in continued interaction. Their interaction is sustained because their responses are somehow *coordinated*: Stacy and Kim respond to each other's behaviors. When Stacy does one thing, Kim does another based on Stacy's action. Because Stacy and Kim are responding to each other in a non-accidental way, they are *coupled*. Coordination sustains coupling: as soon as two entities are somehow coordinated, we can say they are coupled. Coordination is defined as *a non-accidental correlation between the way two systems behave when they are in sustained coupling* (De Jaegher & Di Paolo 2007).

In this section, we will get a closer look at what coordination is and how we can define it. I specify the four most important features of coordination: (1) there are different kinds of coordination; (2) coordination can be absolute or relative; (3) coordination is ubiquitous; (4) coupled (coordinated) systems exhibit organizational closure.

There are different kinds of coordination

When we think of coordination, we usually think of synchronized behavior. In reality, there are many kinds of coordination, with synchronization being only one of them. Other cases of synchronization include mirroring, anticipation, or imitation (De Jaegher & Di Paolo 2007). Any case of sustained non-accidental correlation is a case of coordinated behaviour.

Coordination can be absolute or relative

All kinds of coordination come in degrees. In some cases, systems exhibit absolute coordination ("pure phase locking"); in others, relative coordination (Kelso 1995). If coordination is *absolute*, the behavior of two systems is correlated without any variation. In the cases of *relative* coordination, systems oscillate around the states of absolute coordination (De Jaegher & Di Paolo 2007).

An example of relative coordination is taking a walk with a child. Two adults, with a similar stride length, can walk in nearly absolute coordination. A child walking with the adults will go in and out of the state of absolute coordination due to its shorter stride. For some time, it will be able to keep the same pace to eventually fall behind and run up to the walking adults (De Jaegher & Di Paolo 2007). Relative coordination is characterized by *phase attraction*. Phase attraction occurs if two systems are not perfectly synchronized but are sometimes closer and sometimes further away from absolute coordination (De Jaegher & Di Paolo 2007).

Coordination is ubiquitous

A system might be coordinated with multiple aspects of its environment at once. For example, the movement of plant's leaves is non-accidentally correlated with the movement of the sun, but also with the strength and the direction of the wind. Furthermore, coordination with different aspects of the environment may happen at the same time or on different timescales (Winfree 2001). The plant behaviour is non-accidentally correlated with the wind, but also with the seasons.

Since coordination comes in degrees and on different time scales, as a consequence it is ubiquitous: there is plenty of it in our environment. We are often coordinated with *some* aspects of our environment, often without being aware of it. For example, we coordinate when we walk on a street at the same pace (De Jaegher & Di Paolo 2007). In nature, coordination is easy to find (Haken & Koepchen 1991; Cook 1991). In the world of animals, we see the coordination of a school of fish or a flock of birds (more examples: Kelso 1995; Kuramoto 1984; Winfree 2001). In this sense, coordination is not necessarily "the mark of the cognitive", but rather a tendency exhibited by all kinds of entities. In a very minimal sense of the concept of coordination, agents are always coordinated with their environment because there is a lawful correlation between the way they interact with their environment and the way this environment responds to their actions (cf. Heras-Escribano 2021).

Coordination assures us that the world functions in a stable, predictable way. Because of the feedback loops between the agent and the world, we can learn how to act as agents in our environments.

Coupled systems exhibit organizational closure

Finally, we can look at coordinated participants as a new entity; a higher-level system (Meadows 2008). Such a system exhibits its own emergent properties that do not belong to any of the sub-parts of the system (De Haan 2006). A good example of this phenomenon is a flock of birds: a flock exhibits behavior not attributable to any of its members alone. Nonetheless, if the members of the system stopped their activity, the system would disintegrate; a flock exists only as far as the birds exhibit synchronized behavior.

Understanding coordination is crucial to understanding interaction; *every case of interaction is a case of coordination.* The behavior of two interacting agents is non-accidentally correlated, whether they are performing synchronized movements, mirroring, anticipating, or imitating each other (De Jaegher & Di Paolo 2007). In a single conversation, all these kinds of coordination are likely exhibited to some extent. As we *respond to* somebody, we act with an intent (non-accidentally) towards another agent. Therefore, we become temporarily *coupled with another.* As soon as we are coupled, we become an *organisationally closed system* with its own dynamics.

In the following section, I discuss the ways how, through coordination, two agents can be coupled together. This will allow us to better understand the dynamics of a two-people (dyadic) system.

4.2 An Agent-Agent System

Systems that are in a non-accidental, sustained correlation are *coupled* together. In this section, I discuss two different kinds of coupling: one between an agent and its

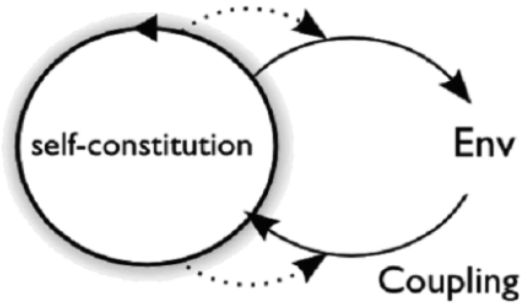

Figure 4.1: An agent modulating its interaction with the environment (Froese & Di Paolo 2011).

environment, and one between two agents (when two agents constitute each other's environment). Stacy and Kim are an agent-agent system and therefore exhibit special properties, unique to the agent-agent coupling.

Agent-Environment Coupling

According to the enactivist theory, the way agents couple with their environment is characterized by modulation (Froese & Di Paolo 2011). In other words: agents have some say in the way they and their environment interact. To get to this point, I will explain, in brief, some of the concepts and principles of enactivism, which will allow us to understand why and how this process occurs.

In enactivism, agents are characterized by three things; I briefly introduce all three properties here, and elaborate on them later. Firstly, agents are self-sustaining; they exhibit precarious self-organizational closure. Because of this, secondly, there is a normativity to their interactions: in the virtue of their metabolism, certain things are good (sustaining) and others bad (non-sustaining). To cope with this, thirdly, they modulate their environments, i.e. non-symmetrically interact with what is around them, which

means that as they couple with their environment, they can impact their environment more than their environment can impact them (Barandiaran et al. 2009)[1].

As explained in the introduction, precarious organizational closure can be understood in terms of self-sustaining processes (De Jaegher & Di Paolo 2007). Organisms survive because the processes they are constituted of are continuously ongoing; where the processes are disintegrated, there is no life (Luisi 2003). Sustaining life is the main goal of autopoiesis, which is a key concept within the enactivist theory. An autopoietic unit has an inner network of recreating processes that regenerate the system's components; *the system can therefore maintain the very network process that produces them* (Luisi 2003, p. 51).

To keep the self-sustaining processes ongoing, organisms require continuous maintenance. From the perspective of this maintenance, certain things in the environment are to strive for, while others are to avoid. Therefore, as the organisms perceive the world, this world is inherently normatively-laden (Barandiaran et al. 2009). What is valued depends on the current state and context of the organism; something helpful in one situation could be lethal in another. Because organisms need to ensure their self-maintenance, they *modulate* the way they interact with their environment (De Jaegher & Di Paolo 2007). Since the world and the internal state of the agent are dynamic (the internal and external situation the agent is in continuously changes), modulation is a never-ending labour[2].

What is exactly meant by modulation? As autopoietic systems monitor the meaningful (internal and external) perturbations, when the situation calls for it, they trigger compensatory processes by internally regulating their motoric pathways (Froese & Di

[1] Organisms can *moderate* their interactions with the environment while the environment (unless it consists of another agent) cannot moderate their coupling with the organism. *Moderation* will be explained in more detail later in this chapter.

[2] Nonetheless, it is not true that modulation is always necessary: even minimal autopoietic systems exhibit tolerance or robustness, which means that their autopoiesis can be maintained in the face of external and internal changes (Cuffari et al. 2015).

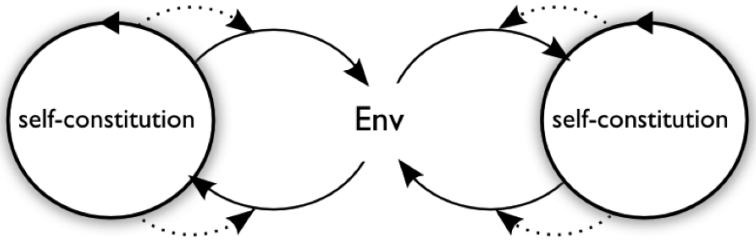

Figure 4.2: Multiple agents in a shared environment (Froese & Di Paolo 2011).

Paolo 2011). Modulating one's relationship with the environment is, in short, changing the way the organism and the environment are related. There are several strategies an organism can undertake to modulate; one of them is a self-reorganisation of the agent; another–changing the relevant aspects of the environment. For instance, Stacy on a very hot day might need to modulate her relation with the environment by turning on the air conditioning system in her room. In one way or another, systems continuously *adapt* to their environemnts.

Agent-Agent Coupling

Because our environments are social, sometimes the way we couple with our environment is impacted by the coupling processes of another agent (Figure 4.2; Froese & Di Paolo 2011). Other agents are also a part of our surroundings; since they are agents in their own right, they have a modulating power.

The modulating process can be volatile; both the organism and the environment undergo continuous changes. When another agent is involved, the modulation becomes much more difficult for both agents (think of an air-conditioning setting in an office where everybody has different temperature preferences).

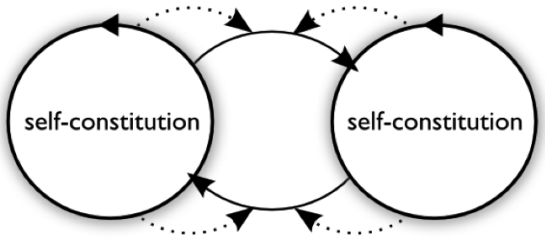

Figure 4.3: Agent-agent coupling (Froese & Di Paolo 2011).

In interactions, we couple directly with aspects of other agents (Figure 4.3; Froese & Di Paolo 2011), which means that there is a non-accidental correlation between our actions and the reactions of other agents. In the case of a dyadic interaction, both agents modulate the coupling directly and simultaneously. Because of the modulation processes, there is an inescapable element of unpredictability for both agents. Unlike the environment, the other cannot ever be completely known to us (De Jaegher & Di Paolo 2007). The coordination process between the agents is relative, oscillating from higher to lower levels of correlated behaviour[3]. In the interaction between Stacy and Kim, they both continuously shape how the coupling looks like by adjusting their responses to each other.

De Jaegher and Di Paolo (2007) define social interactions following the co-modulated coupling model. According to them, all social interactions are

> [a] regulated coupling between at least two autonomous agents, where the regulation is aimed at aspects of the coupling itself so that it constitutes an emergent autonomous organization in the domain of relational dynamics,

[3]The researchers tested the hypothesis that high coordination between participants is correlated with a feeling of high rapport and therefore satisfaction from the interaction (Condon and Ogston 1971; Kendon 1990). Interestingly, humans tend to prefer moderate levels of coordination (Jaffe et al. 2001).

> *without destroying in the process the autonomy of the agents* involved (though the latter's scope can be augmented or reduced). (p. 493; italics added)

Social interactions have their own organizational closure, a precarious identity that requires continuous maintenance. The interaction (as a higher-order entity) has properties which may diminish but do not completely override the individual agency of the agents involved[4]. A simple example of social interaction is a conversation about the weather (De Jaegher & Di Paolo 2007). The agents jointly decide on the topic of the conversation, co-regulate how long the interaction lasts (when it begins and when it ends), and how it unveils. While the participation of both agents is required for the conversation to exist, the exact shape of the conversation does not depend on either of the agents on their own.

Consider the following example of agent-agent coordination: the famous perceptual crossing experiment (Froese & Di Paolo 2010). Two participants are together in a minimal virtual environment; their task is to find and recognize each other. Besides the agent who is participating in the study, there are three other kinds of objects in the environment: the other agent, "shadows" which mirror the movements of both agents from a distance, and two agent-sized static objects. The task of both participants is to diagnose which of the objects in the environment is the other agent by moving the cursor. Surprisingly, the study participants are very good at this task: they search and recognize the other agent based on an emergent coordination process. As the agents encounter an object, they tend to "examine" it; they oscillate around it and repeatedly check for reactions. While the stable objects and the shadows do not interact, the other agent's reaction creates a stable coordination pattern that clearly distinguishes it from other objects. This empirical

[4] Otherwise the interaction would fall apart: we would only be interacting with a tool, an object–not another agent (De Jaegher & Di Paolo 2007).

test-and-see approach (contrary to, for example, inferential reasoning) is a simple and reliable way to solve the puzzle for both of the participants.

Cases of such coordination occur not only spontaneously. De Jaegher and Di Paolo (2007) propose that with repetition, a certain kind of coordination can consolidate and stabilize because agents get better at maintaining it. In familiar contexts, interactions break down less often; the self-sustaining processes of the interaction are reinforced and their self-identity is reaffirmed. If processes are not repeated, they eventually fall apart. An example of that, provided by de Jaegher and Di Paolo (2007), is the custom of greeting each other. Migrants from the same country, after having spent years abroad, might experience a conflict of different coordination patterns upon seeing each other away from their homeland. Do they follow the forgotten pattern from their native country or the reinforced pattern from the country they currently live in?

What De Jaegher and Di Paolo point out can be observed on the example of Stacy and Kim. Once learned, the pattern becomes stable and robust, possibly resistant to changes initiated both from within and from the outside of the system. The Stacy-Kim dyad exhibits precarious organisational closure; the processes occurring between them are self-maintaining. The co-modulation of both Stacy and Kim stabilised the system in the state of defiance/withdrawal. Their reactions to each other have consolidated; the continuity of the system is preserved.

4.3 The Dynamics of a Dyadic System

To further examine the patterns between interaction partners, in this section, I review seven properties of dyadic system dynamics. In my investigations, I refer to *dynamical*

systems theory–a vast body of work, from which I am only borrowing a few fundamental and basic elements. I focus on the properties I consider enlightening in the context of my work, and which help me explain the background behind the behavior of dyadic groups. I will go through the properties briefly. In many cases, projecting them onto the examples that I provided at the beginning is straightforward, and I chose not to spell it out. In some cases, I elaborate on them briefly. Overall, it is easy to understand how these properties are exhibited in the behavior of interaction partners, both in the example cases I provided and in our own lives. At the end of this section, we will have a better understanding of the dynamics behind the dyadic systems.

The properties I discuss include (1) emergent behavior; (2) context-sensitive behavior; (3) attractors and repellers; (4) hysteresis; (5) sensitivity to initial conditions; (6) equifinality, and (7) reciprocal compensation (Paxton 2023). All properties are relevant to dyadic interactions, and some, e.g. hysteresis and equifinality, are crucial to understanding our phenomenon. In the order and explanation of the properties, I follow Paxton (2023).

Before we start, to establish some common ground, I introduce the notion of a *dynamical system.* A dynamical system is *a set of components that interact and change with time* (Paxton 2023). Such a system may include any number of components, but importantly, there needs to be an interaction between them. There is no centralized governance; dynamical systems do not have a decision center that sends information to all of the subsystems; instead, a dynamical system just *is* the interaction of the subsystems. Dynamical systems do not always change linearly; they sometimes undergo *phase transitions*, where the system quickly jumps from one stable state to another, qualitatively different stable state. Dynamical systems are often nested within one another; for example, a human is a dynamical system; a community, and a society, as well (Paxton 2023).

Emergence

Emergence means that parts of a system while interacting, create new patterns. These patterns are novel and not predictable from simply observing the components in their non-interacting state. De Haan (2006) defines emergence as *some property or phenomenon* [which] *is observed that somehow transcends the level of the objects that nevertheless produce it.*

Every system has higher- and lower-level components. Usually, the lower-level components undergo more frequent and drastic changes while the higher-level components are more stable (Paxton 2023). Emergent behavior is, on the one hand, a constraint on individual components as they interact; in turn, the individual components constrain the emergent behavior. This dynamics is called a *circular causality.* In the case of higher- and lower-level components constraining each other, it is a *cross-scale interaction* (Paxton 2023).

An example of an emergent behavior is a "corridor dance" which happens when an agent stumbles upon somebody else in the hall and they both coordinate while unsuccessfully trying to get out of each other's way. The dance is constrained by the individuals in a dyad (if either one of them behaved differently, the "dance" would be interrupted); at the same time, the dance constrains the individuals, who have a hard time escaping its dynamics[5].

Emergence is a fundamental property of dyadic systems. In practice, it means that as soon as two agents engage in an interaction, the properties of this interaction constrain the agents. Kim and Stacy are dictating the course of their interaction, but the interaction also dictates their behavior toward each other. Because of the emergent properties of the

[5] Additionally, the dance is also of course constrained by the conditions dictated by the environment.

interaction, the agency of the participants is not completely diminished, but partially compromised.

Context-sensitive behaviour

Since a dynamic system has no centralized control, the interaction is "not a script that is run" (Paxton 2023), but a new pattern that is created as the interaction unveils. The relationships of the lower-level components are local and self-organizing. As a result, the system exhibits *context sensitive behavior*: the setup of the lower-level components impacts the higher-level components (Paxton 2023). It is easy to think of an example of a society, which, as a whole, is influenced by the state of the individuals that it consists of.

Attractors and repellers

A system has certain states it is more likely to be in and certain states that are difficult to sustain. The first ones are called "attractors"; the second ones– "repellers". A set of attractors and repellers constitutes an attractor layout (Paxton 2023).[6] Attractors are the stable states of the system; repellers are the unstable ones. The attractor layout defines the most commonly maintained states of the system. The context of the system impacts the attractor layout (cf. the subsection "Context-sensitive behavior") (Paxton 2023).

In the context of dyadic interactions, the attractor layout defines certain interaction dynamics as likely, and others as unlikely to occur. This property of dynamic systems is relevant to our phenomenon. Imagine a couple who tends to end up in a violent argument, where one of the partners takes on the attacking, and the other "the victim" role. This

[6] Also called *an attractor landscape* (Paxton 2023), but I will proceed with using the word "layout" to avoid confusion with *affordance landscape*, which will be introduced later.

dynamic, even though it is bad for the interaction participants, might be the stable state of the dynamic system. On the other hand, apologizing or compromising might constitute a "repeller" - a dynamic which is unlikely to be sustained for long. In the case of Stacy and Kim, their defiance/withdrawal dynamic is an attractor state.

Hysteresis

Hysteresis refers to the way the past or the current state of the system determine its future states (Paxton 2023). In other words, hysteresis is the memory of the system; the way the system tends to remember its own dynamics. In dyadic interaction, an example of this is how dyads get "stuck" in a specific kind of behavior[7]. Hysteresis is different from attractor states because it refers to a sequence of events rather than a particular status of the system.

This feature is crucial to understanding my phenomenon: hysteresis is the property that reveals why we stick to the same dynamic, over and over. A dyad with a history of a particular dynamic will have a tendency to fall into the same pattern unless other forces outweigh this tendency. In the example of Stacy and Kim, we can see how their first interaction makes future interactions following the same trajectory more likely. Once established behavior creates a "path" that future behaviors tend to follow, making the "path" more and more pronounced over time.

[7] A related concept frequently used in social sciences is *path dependency*. Path dependency *refers to the idea that events occurring at an earlier point in time will affect events occurring at a later point in time* (Djelic & Quack 2007, p. 161), and, in a stronger sense, that a sequence of contingent events can establish a pattern with deterministic properties (Ib.). Path dependency is as suitable as hysteresis to describe my point. Following Paxton (2023), I refer to hysteresis

Sensitivity to initial conditions

Similarly to hysteresis, sensitivity to initial conditions concerns the way the future states of the system are influenced by its past or present states (Paxton 2023). It points to the fact that all systems exist in an environment, and the state of this environment impacts the trajectory the system will follow. The system may exhibit different kinds of behavior depending on where (at which point of the phase space) the interaction begins. A trivial example of sensitivity to initial conditions in a dyadic dynamic can be simply whether a conversation occurs before lunch (on an empty stomach) or after lunch (when the participants' hunger is satisfied). Such initial conditions can influence the future path of the interaction dynamics.

Equifinality

Equifinality indicates that there are many different ways a system arrives at the same end state: even though the system is sensitive to initial conditions, it may continue rearranging itself to persist (Paxton 2023). Equifinality equals to achieving the same end state through many different paths.

In interactions, we can think of examples in which a dyad arrives at the same state, whether it is positive (like rest or laughter) or negative (argument, tears), independently of how the interaction starts. Once again, this property is relevant to our phenomenon: eventually, we end up perceiving the same opportunities for action independently of the preceding dynamics. For instance, it might be the case that independently of how the conversation starts (in a friendly or a threatening tone), it ends up in the same way (with a conflict or appeasement).

Reciprocal Compensation

The final property of the system dynamics is reciprocal compensation: the ability of self-organizing systems to flexibly adapt and reorganize themselves to persist despite the changing context (Paxton 2023). In the example of interaction, we can think of a ball dance, which persists even if one of the partners misses a step or forgets their moves. Experienced dancers will be able to compensate and fix the issue by spontaneously rearranging their choreography to make up for the problem.

Closing Remarks

In the last section, I named seven properties of complex systems and related them to the dynamics between two interacting agents. My aim was to understand and explain the principle behind and the mechanics of making new meanings available to the other as the interaction unfolds. Discussing the properties of dyadic systems and considering their impact on the interaction is a step in this direction. The properties of complex systems dive into the core of my research question; the interaction dynamics *is* the regularities that I am searching for when discussing the patterns behind *opening and closing perceptual opportunities for others.*

The above review of dynamical systems properties provides a good insight into the dyadic relationship dynamics. In this chapter, we learned that coordination can be absolute or relative and is ubiquitous in the environment. Furthermore, we have learned how an agent and its environment coordinate, and how two agents can coordinate together and, in this way, constitute each other's environment. Lastly, we have learned that two agents as a system exhibit a number of system properties. The properties of system

dynamics that are particularly important to us explain that a dyadic system tends to repeatedly go back to the same states (has memory) and may end up in particular (attractor) states independently of where it starts.

In the next chapter, I explain how the system dynamics is connected to the phenomenal and cognitive view of the agents, i.e. perceiving opportunities for action. Specifically, I connect the interaction dynamics we analyzed in this chapter to our previous discussion of interpersonal affordances. I synthesize what we have learned so far by introducing the notion of *interpersonal affordance landscapes*.

5 Towards Interpersonal Affordance Landscapes

In this chapter, I will explain how interpersonal dynamics is tied to affordances. I will do it by introducing the notion of *interpersonal affordance landscapes*, which are sets of possibilities that are available for participants in the interaction at any given time. Then, I will explain how interpersonal affordance landscapes develop in *interpersonal niches*.

Before I start, I would like to make clear that in my further writing, I am making a simplification regarding the course of an interaction. In this section, more than in any of the previous sections, I talk of interactions as if they consisted of a set of moves made by participants, a and b, one after another: $a1, b1, a2, b2, a3, b3, ...$. This is rarely true of actual interactions (although, in the digital age when a large portion of our relationships is happening via messenger apps, it is more and more common). In real life, our interactional moves are interrupted and picked up again, or they change as they happen depending on the received feedback (source). In some sense, all interactional actions are *joint*, i.e. they are not completely independent from the other individual in interaction, they are something we do together. Nonetheless, simplifying this picture will allow us to shed more light on the affordances available in interactional contexts[1].

[1]This point has been inspired by the discussion on the axioms of interaction in Watzlawick et al. (1967)

5.1 Affordance Landscapes

The notion of an affordance landscape was introduced by David Walsh (2014). An affordance landscape is a complete set of affordances available to an organism. Affordance landscapes change continuously; like in a game of chess, they correspond to a number of "moves" available to an organism. With every new move (action) or the opponent's move (change in the external environment), the set of available affordances changes (Walsh 2014). Both external and internal changes can alter the affordance landscape of an organism: for example, if I learn a new language, the same environment will offer me different affordances. Because organisms learn over time, they are able to change and adapt to their environments. As they do that, they alter their affordance landscapes.

For the purposes of this analysis, I suggest (following Chemero 2011) that for every situation s, there is an affordance landscape which is a set of affordances $a_1 ... a_n$. Every affordance consists of a relation between a piece of ecological information available at the given moment (perceived as a feature of the situation, f) and an ability, Ab. This exact set of a feature and an ability specify the afforded action, aa.

s1:

$a_1 = (f_1 : Ab_1) : aa_1$

$a_2 = (f_1 : Ab_2) : aa_2$

$a_3 = (f_2 : Ab_1) : aa_3$

$a_4 = (f_2 : Ab_2) : aa_4$

$a_5 = (f_3 : Ab_4) : aa_5$

...

a_n

An important characteristic of an affordance landscape is its vastness[2]. Affordances are plentiful; there are more-than-can-be-counted affordances available to an organism at any time *t*. In chess, the rules define what is allowed and not; affordances are very limited. Human action is analog, not digital (Watzlawick et al. 1967): most of what we do can be done in a slightly different way (think of the thousands of different ways you can phrase a paragraph of text). The landscape is not limitless, but it is too vast to specify.

We can more closely examine the limits of an affordance landscape if we review the definition of affordances and ecological information. The affordance landscapes are limited by, on the one hand, the ecological information available in a given situation and, on the other, the agent's skills. As we have established, the *general* ecological information is very vast, because it goes beyond what is directly perceivable: the specific ecological information we perceive additionally informs us of other, non-lawful correlations. Our skillset, within certain boundaries, develops and changes over time as we grow and adapt to our environments. Both ecological information and the agent's skills indicate a broad horizon of actions available.

The boundaries of affordance landscapes are fuzzy. Firstly, what constitutes both ecological information and the skillset of an organism is undefined and negotiable. Many instances of information rely on a weak, uncommon correlation. Skills are similarly

[2]Here, it is useful to consider the difference between an *affordance landscape* and an *affordance field*. The notion of affordance landscape is discussed in a number of works (Kiverstein et al. 2021; Rietveld & Kiverstein 2014; Bruineberg & Rietveld 2014; Rietveld et al. 2018). In their common understanding, *a landscape of affordances* encompasses *all* affordances available to the animal. *A field of affordances* refers to the affordances that are *relevant* to a particular organism at a particular time. A field of affordances is synonymous to *a field of solicitations*. Affordances that are defined as relevant are the affordances that solicit the individual, i.e. "stand out" to them. From an epistemic perspective of an individual, the relevant affordances, that constitute the affordance field, are the affordances that exist. Not all affordances within an affordance field are equal; some of them are less salient, some of them are more. When an affordance landscape encompasses everything that an organism could possibly do, the affordance field encompasses everything that an organism could possibly do *from the perspective of that organism*, i.e. what enters into the realms of its choices. An affordance field is incomparably narrow next to an affordance landscape.

negotiable. Imagine solving a crossword puzzle–whether you manage to complete it depends on your mood, your level of hydration, the amount of hours you slept, and so on. In other cases, the normative standard of being able to do something or not is fuzzy. Imagine riding a bike: there is a difference between managing to ride a bike in the sense a professionally trained cyclist does, and not managing to ride a bike at all (or riding a bike for a few meters before a crash because one cannot use the brakes).

Secondly, the affordance landscapes are fuzzy because every attempt at taking a "snapshot" view of an affordance landscape is artificial; landscapes change continuously. We could talk of a "center of an affordance landscape", with the affordances that are always or almost always within our affordance landscape and different levels of the outskirts, which contain the affordances that appear and disappear from our horizon. For example, the ability to close our eyes is likely to be in the center of an affordance landscape, because it is an affordance available to us in most situations. Drinking coffee is more on the periphery since it is only available when there is coffee around us that we can drink (and when nothing inhibits our skill of drinking coffee).

Interpersonal Affordance Landscapes

An *interpersonal affordance landscape* is a landscape of affordances that exist in the virtue of the ongoing interaction we have with another agent. All affordances that pertain to this interaction are included in the interpersonal affordance landscape. In interaction, at any point of time $t1$, the agents have a certain affordance landscape. The affordance landscape continuously and seamlessly changes for both participants as the interaction progresses.

In the next section, I introduce the concept of niche construction, which will allow us to better understand how the other constitutes our environment. Then, I connect the notion of niche construction with interpersonal affordance landscapes to explain how our interactions develop in niches.

5.2 Niches and Niche Construction

Niche is a concept that originates in ecology and means *the ecological environment of an agent* (Heras-Escribano & De Pinedo-García 2018). A niche is not simply a space, which is called the animal's *habitat*. Both a habitat and a niche are a match between a species and some of the environmental conditions, but habitat is not equal to niche; niche is about *how* the animal lives and not *where* (Pocheville 2015; cf Gibson 1979, p. 120). Habitat specifically refers to the kinds of resources that are available in the area; it specifies the physical aspects of the environment relevant for a species, for example, temperature, moisture, or the kind of light available. Niche, on the other hand, is dependent on the actions, intentions, and goals of an organism (Walsh 2014)[3]. Overall, the notion of an ecological niche goes beyond the concept of habitat in that it accounts for the role the organism plays in its environment. In this way, it does not make sense to talk about an organism-less niche (Walsh 2014).

Because niches depend on the intentions and the way of life of an organism, they are *dynamically constructed* (Walsh 2014). Niches change over time because organisms *do things* in environments, which further change the niches, which provide different conditions

[3]Niches are sociomaterial (Laland & O'Brien 2011). Typical niches are both trans-culturally and socio-culturally constructed; the biological and cultural processes both contribute. On the niche view, there is no nature-nurture division in the traditional sense. On the contrary, there is a continuity in our socio-cultural environment (cf Heras-Escribano & De Pinedo-García 2018).

for the organisms, and so on. For Gibson (1979), a niche is simply a set of affordances available to an animal. Suppose that organisms are sets of abilities[4]; the niche of an animal is a set of situations in which its abilities can be exercised. For every ability, there is a set of possible situations in which this ability can be exercised (Chemero 2003).

When an organism acts on an affordance and makes a change in its environment, it creates new affordances; its niche changes (Walsh 2014). In a *habitat*, organisms are passive receivers of the environmental conditions; in a *niche*, organisms are active shapers: what they do revises the features of the environment by creating new selection pressures and removing others (Walsh 2014). The niche is changed–for both these organisms in the future, and the next generations of the same species.

In nature, an example of a species famous for shaping its niche is beavers. Beavers build dams to store food for the winter and to create ponds, in which they are safe from predators such as wolfs or bears. A beaver dam modifies the entire environment, changing the niche not only for the beavers themselves and their offspring but also for other species.

This view of niches (as *shaped* by the organism) is a new reading of the theory of evolution (Walsh 2014). According to the previous idea, organisms were conceived of as being passively shaped by their environment. These two views of the relationship between an organism and its niche can be illustrated by the symmetrical-asymmetrical analogy (Heras-Escribano & De Pinedo-García 2018). On the asymmetrical reading, close to the classical interpretations of the Darwinian theory of evolution, the environment applies pressure on the organisms: whichever organism is best suited to survive, stays around and can spread its genes. On this view, organisms are passive and evolution is

[4]Reed (1996) points out that there are basic and more complex abilities. The more complex abilities depend on the more basic ones. Abilities exhibit a nested structure.

driven exclusively through natural selection. When Walsh introduces the notion of an "affordance landscape" (2014), he argues for the symmetrical view (which he calls "new adaptationism"). On the "old adaptationist" view, "adaptation" is a feature external to the agent. The organism is asymmetrically dependent on the niche; the niche follows its own trajectory. There is nothing the organism can do to change its niche; the niche stays the same, independently of the kind of inhabitants it hosts and independently of their presence.

Walsh proposes that niche construction should be seen as a symmetrical relationship: symmetrical because it is not only the environment that impacts (and selects) the organisms, but also the organisms that impact (and select) their environment:

> *If adaptive evolution is changed in response to conditions of existence, then in altering the conditions of existence the adaptive plasticity of organisms contributes to the process of evolution. When an organism makes an adaptive response to its conditions of existence, it also changes those conditions of existence. These changes, in turn, introduce new evolutionary challenges and opportunities. In this way, organisms are participants in adaptive evolution, not mere objects of it* (Walsh 2014, p. 228)[5].

In the next section, I introduce Chemero's dynamical view of affordances which is based on the idea of new adaptationism. Chemero (2011) connects ecological psychology with the idea of niche construction and comes up with a model of affordance landscape

[5]Suitably for this account, the symmetrical "new adaptationism" is compatible with Chemero's view of affordances as relations. Walsh (2013) further notices that the first, asymmetrical account would suit Turvey's view of affordances and effectivities, where the entire burden of change can be moved to effectivities, on the organism's side.

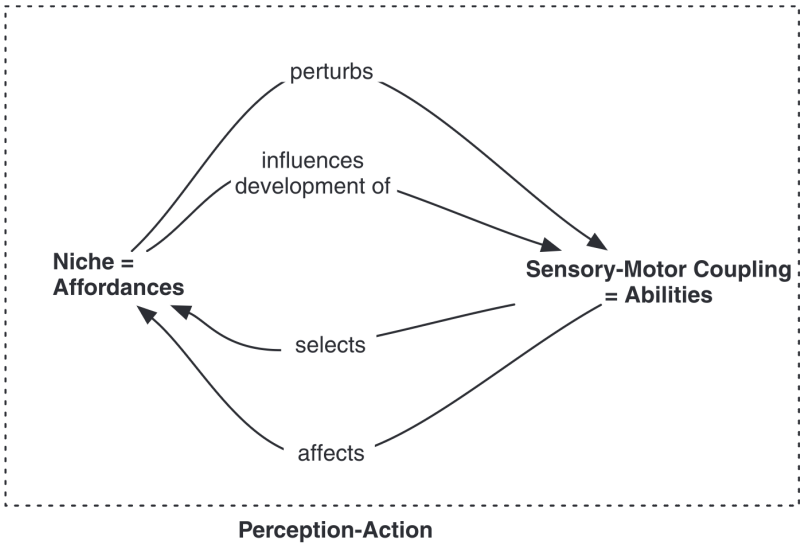

Figure 5.1: The Dynamical View of Affordances (Chemero 2011, p. 152)

construction. With Chemero's model, we will be able to discuss how interpersonal niches develop. I will firstly explain his model, and secondly apply it to interactions.

5.3 Interpersonal Niche Construction

On the new adaptationist model, niche construction and trait selection go hand in hand: the development of the organism is inseparable from the development of its niche (Walsh 2014). Chemero (2011) proposes to adapt the idea of niche construction on a smaller scale of organismal development. He proposes a dynamical view of affordances (Figure 5.1), where the affordance landscape of an animal is impacted and impacts the abilities of this animal. This model allows us to picture how the affordance landscapes available to an animal change over time: the organism selects and affects its niche; the niche perturbs and influences the development of the organism.

The picture painted by Chemero corresponds to niche construction but happens on a relatively short time scale and concerns individuals instead of populations. Chemero's "behavioral, cognitive, and phenomenological niche" (Chemero 2011, p. 152) shows how an agent and its environment are continuously reshaped by one another.

With this concept, we can introduce the idea of *interpersonal niches*. A niche is a set of affordances available to an animal (Walsh 2014)[6]. An interpersonal niche is a set of affordances that are available to an organism that pertain to an interaction with a particular other [7]. An interpersonal niche between two animals sums up to all the affordances that they can act on that exist in virtue of their interaction.

In interaction, as we have learned in the preceding chapter, we couple with the other; the other constitutes our environment and affords our actions. Chemero's model therefore applies to agent-agent interactions, in which the Other-in-interaction perturbs and influences Self-in-interaction, and self-in-interaction selects traits of Other-in-interaction and affects Other-in-interaction (Figure 5.2). The model is bi-directional; who is the "self" and who is the "other" in interaction depends merely on a point of view. In interactions, the interpersonal affordances of both participants unfold simultaneously; no participant has priority. An interpersonal niche exists only on the level of the dyad.

An example of interpersonal niche development can be easily found within the attachment theory, popular in developmental psychology. Attachment theory proposes that the way humans build their relationships as adults depends on the kind of relationship they establish with their primary caregiver. The kind of attachment patterns formed vary from

[6] A niche is different from a landscape in that a landscape is related to a particular time of observation, whereas a niche is more generally connected to the animal's capacities in a given environment.

[7] For clarity purposes, I further use the vocabulary: *other-in-interaction* and *self-in-interaction*, following De Jaegher & Di Paolo (2007).

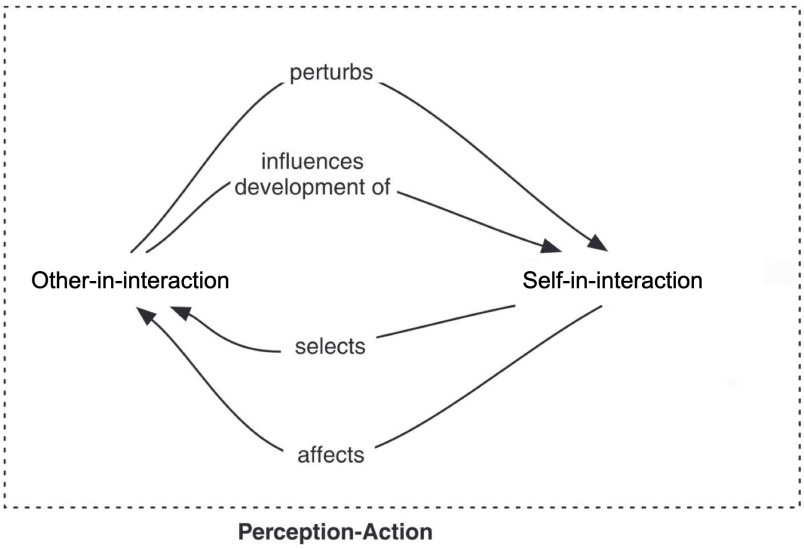

Figure 5.2: The Construction of an Interpersonal Niche

secure, anxious-ambivalent, anxious-avoidant, to disorganised (Hicks & Korbel 2013). Following the idea of attachment theory, the primary caregiver may perturb the infant or change its location (e.g. by putting the baby to sleep in the bedroom). She influences the development of the infant by providing nourishment and care when the infant demands it. On the other hand, the infant selects certain behaviors in the mother by selectively reacting to particular kinds of stimuli (choosing one food over another; reacting with joy to one kind of playful interaction over another) and affects the mother by, for example, depriving her of resources. This model, of course, could be reversed; in no sense is the mother a niche to the infant more than an infant is a niche to the mother, once the two interact.

5.4 Interpersonal Landscape Dynamics

So far, I have established that what we perceive in interpersonal interactions are *interpersonal affordances*, i.e. affordances that pertain to this interaction. All the affordances that pertain to the interaction that we perceive at a given time are an *affordance landscape*. The affordances available to us develop in *interpersonal niches*.

The strength of the interpersonal niche model can be fully appreciated when you think of interactions that develop over longer periods of time. It seems particularly true that certain interpersonal affordances, i.e. possibilities for cognitive and non-cognitive action in interaction are specific to their niche. An individual will develop the primary niche with their first caregiver, and eventually create other niches with other figures in their life. Coupling with a particular other, the agent will access affordances impossible (or unlikely) to access in other niches they are a part of. With the interpersonal niche model, it is particularly clear that the affordances available to an individual *depend on the history of coupling with this individual*.

The interaction in interpersonal niches is an example of dyadic system dynamics, with the element of unpredictability added by the way both agents modulate the coupling at the same time. Because two agents are coupled together (they constitute an agent-agent system), they will exhibit properties of a dyadic system.

The properties of dyadic system impact the affordances available to the agents. For example, hysteresis (the memory of a system), responsible for the way the system "remembers" its own dynamics and gravitates towards it in the future, will reinforce certain affordances as "central" in the affordance landscape, while keeping others "peripheral" to the point of their complete disappearance (like in the case of losing a skill, e.g. to play

piano, because of a lack of practice). In the case of an interpersonal niche, the participants will learn certain responses, which will be prevalent in their further interactions. The opportunities to act in a different way may remain possible but will become unlikely because of the dynamics of the agent-agent system. This is the case in the example of Stacy and Kim.

We are not only closing each other's opportunities for action; primarily, we are continuously opening them. The crucial factor is the *agency* of the other; because of their modulating power, the interaction continuously escapes us; what we perceive is novel and unexpected to us. In the example of John and Jane, we can see how Jane impacts the interaction so that the landscape of affordances available to John drastically changes. The same is the case for Steve and Anne. Both Jane and Anne behave in a way that opens a novel perceptual opportunity for their partners. By picking up on this opportunity, John and Steve consolidate the niche and impact what behavior is further available to Jane and Anne. This is not to say that Jane and Anne are in full control of these interactions; on the contrary, the affordances available to them are a result of the emergent property of the interaction which is only possible when all parties participate.

Closing Remarks

In this chapter, I introduced the novel notion of *interpersonal affordance landscapes*, and I connected it with the niche construction model proposed by Chemero (2011) to establish the concept of *interpersonal niches*. Even though social niche construction is not a new idea (cf. Yamagishi & Hashimoto 2016), and the notion of interpersonal affordances has been previously used in the ecological psychology literature (Brancazio 2020; Richardson et al. 2007; Buck et al. 2019; Boiger et al. 2014), I make a number of novel contributions.

Firstly, I define what interpersonal affordances are and I justify the usage of this notion within an established interpretation of Gibsonian ecological psychology (Chemero 2011). While previously the concept of "interpersonal affordances" has been used in various ways in different contexts, here I unify and specify the meaning of this notion. I further connect it to the idea of sets of affordances available at a time to an individual ("affordance landscapes"). Therefore, I come up with the idea of *interpersonal affordance landscapes*.

Secondly, I develop the notion further by connecting it to the concept of niche construction. My novel contribution is posing that in dyadic interactions, our affordances develop in *interpersonal niches*. While the connection of ecological psychology to the niche account is established (Walsh 2014), the concept of interpersonal niches is novel.

Thirdly, in chapter four, I discuss the dynamics of interaction as having an impact on the development of interpersonal affordance landscapes in niches. Even though I just dipped my toe in the dynamical systems theory, this is setting the direction for future research on interpersonal interactions. I choose the dyadic setting because it is a good starting point; the next natural direction of inquiry is scaling up the account to address multi-agent (larger than dyadic) groups.

In this thesis, I tried to take the first steps towards the development of a framework of *interpersonal ecological psychology*. To this end, I sketched the basic idea of this framework and established elementary concepts. Because of the limitations of this format, many details are yet to be worked out and filled out.

6 Conclusions

Within the Gibsonian framework, perception does not exist independently of action. The agent is not a *receiver* of perceptual information, but he actively discovers the world. The Gibsonian action-perception loop could be described as follows: firstly, the agent acts upon the environment; secondly, some new information emerges and the agent is able to detect it; thirdly, by being aware of that information, the agent controls or coordinates their own actions in order to respond to it (Heras-Escribano & De Pinedo-García 2018). This is also true of our engagement in interactions, where the other is our environment. We act upon the other, detect the emerging information, and then adjust our actions based on this information.

In this thesis, I established that interpersonal affordances are "mental" and "non-mental", and through these affordances, we perceive information of all kinds of correlations available in the environment. As agents, we tend to couple with other agents in our environment, creating a higher-level system. This system oscillates between different levels of coordination and is particularly volatile because both agents modulate it at the same time, while the emergent dynamics of the system, in turn, impact the agents' behavior. Consider that every state s_1 of the interacting agent consists of a set of affordances: $a_1...a_n$. These affordances unveil themselves, like in a game of chess, to interacting agents as the agent moves from one state to another. Agents make their choices and with the

behavior they exhibit, they provide further information for the other to act on. The sets of affordances–affordance landscapes– change continuously as the interaction unfolds.

When Agent 1 interacts with Agent 2, they are each other's environment; their actions correlate in a non-accidental manner. Agent 1 perceives the ecological information of Agent 2. This information includes the physical properties of Agent 2 (e.g. the scent, the posture, the sounds produced...) and, beyond that, because of the environmental correlations, all other kinds of information. Many of the correlations will not refer to the particular history of coupling with Agent 2, but to any past social experiences of Agent 1.

The interpersonal affordance landscape available to an agent develops over time in a dyadic *interpersonal niches*: environments consisting of two interacting partners. These partnerships exhibit properties typical of complex systems. For example, the interaction between the participants tends to oscillate towards certain states (attractors) and away from other states (repellers). Independently of where and when the conversation starts, it might end up in the same state (equifinality). The dynamics of the coupling between the two participants is responsible for the sets of affordances they perceive. A dyad, throughout its development, undergoes phase transitions from equilibrium to disequilibrium states, where the equilibrium reaffirms the old patterns by repetition, and disequilibrium allows for reconfiguration (cf Lewis 2000).

The most important assumption I am making in this thesis states that interpersonal affordance landscapes are correlated with the dynamics of the dyadic system. In the agent-agent system, certain affordances are available for both agents. I presuppose that the affordances available to the agents change as the system changes. Because the system at t_1 is different from the system at time t_2, affordances available at t_1 differ from the affordances available at t_2. If the state of the system at t_3 resembles in the relevant

aspects the system at t_1, the affordance landscape available at t_3 will be, in the relevant aspects, similar to the affordance landscape available at t_1. The coupling between the agent and the environment is always based on the idea of coordination, which is why I first explained coordination, then a coupled system, and then, what the dynamic of such a system is.

Limitations

In this section, I would like to discuss the shortcomings of this project. One can question whether the problem of my phenomenon concerns *affordance landscapes* or *affordance fields*, i.e. affordances that solicit action and are present in the phenomenal world of the agent (Rietveld & Kiverstein 2014). After establishing that the dyad dynamics impacts the affordance *landscapes*, we still do not know how it impacts the *fields*. We know even less of how the dyadic dynamics impacts *what we actually choose*. The notion of general ecological information is very broad and therefore affordance landscapes will include many, many different affordances. The deeper question underlying my inquiry is not about the options available to act on, but about the option we *do* end up acting on. To understand this issue we need to talk about the problem of intentionality in ecological psychology: how come we actually perceive some of the things possible for us, and not others?[1].

The problem of intentionality is, in fact, two problems that are often conflated. Firstly, there is a problem of *why certain options enter our epistemic landscape, while others do not*. If a boy and a girl see a tree, the tree might appear as *climbable* for the boy, but not for the girl; the option of climbing the tree might never occur to her. We have many

[1] Or it can be phrased as a question of attention: How come certain things come to our minds and others do not?

ways of interacting with the environment, but many of these ways will never appear to us as something that we could do. The second version of the problem of intentionality has to do with what we choose among the options that already appear "on our radar". For example, if I am hungry, I may go for a cheese sandwich or soup. How do I choose? While the first problem can be seen as "bottom-up", the second one is "top-down". They are not always differentiated. Addressing it would give us further insight into the phenomenon in question.

Future Work

There are a number of avenues that I chose not to pursue within this work. I can indicate at least five different directions for the continuation of this work, which I hope to address elsewhere.

The first one concerns the connection between ecological psychology and the dynamical systems theory, which I am only engaging with superficially here. What we perceive depends on how we are correlated with the other, and the insights from the dynamical systems theory can be helpful in this inquiry.

Secondly, as I have already mentioned, this thesis can be scaled up to account for multi-agent groups, with more than two participants. Examining multi-agent dynamics is extremely difficult, theoretically and even more so–empirically. This is connected to the next point: thirdly, the research on dyadic interactions should be supported by empirical studies. Designing and conducting those is an ambitious project, hopefully someday in line as a continuation of this work.

Fourthly, as mentioned in the section above, the question of intentionality is a difficult

and engaging topic for further theoretical (and empirical) investigations, and in some sense, a research field on its own, involving studies on attention and consciousness.

Finally, and most importantly, this work could be a starting point for analyzing and diagnosing intervention points for interpersonal contexts, which could be of use in organizational and therapeutic settings.

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