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Ecological Psychologies as Philosophies of Perception

On Explaining how we Perceive what we can Do

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Over Verklaren hoe we Waarnemen wat we kunnen Doen

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Introducing the Philosophy of Perception

How we think about perception—about seeing, hearing, smelling, touching and tasting—is determined at least partly by the answer to the question as to *why* we think about perception. Presumably all thinking about phenomena is motivated by the desire of better understanding. But when we think about complex matters, that understanding often depends on the perspective or motivation we bring to the table.

In this dissertation two perspectives, associated with two motives for thinking about perception, are analysed; two perspectives that have played major roles in the philosophy and psychology of perception. We will consider two answers to the question as to why we would think about perception and look at the consequences these answers have for our understanding of the phenomenon. Considering just two perspectives entails that we will neglect all others. This requires a justification, a task we take up in this introduction. We will first sketch the two perspectives we do treat, and then justify our neglect of a third one.

The first perspective on perception we will consider is that of epistemology. If it is assumed that knowledge of the world originates in perception—the central thesis of empiricism—then certain consequences for the concept of perception might be expected. The second perspective is that of natural science. If it is assumed that perception is a natural phenomenon and that the methods of the natural sciences are adequate to study it, this too poses constraints on its conceptualisation.

In traditional epistemology—the philosophical discipline that is occupied with knowledge and justification—the idea that the motive influences the concept of perception is most clear. Since epistemology understands itself as a normative discipline—it attempts to spell out the norms to which states or relations must conform in order to count as knowledge or as justified—its approach to the "epistemological problems of perception" is normative rather than descriptive. Epistemological norms "trickle down", so to say, into the concept of perception.

It has been argued, however, that the epistemology and the metaphysics of perception are not necessarily tied up. Although there are natural affinities between certain descriptive and normative conceptions of perception, there are reasons to consider them as logically independent (Lyons 2016). One of those reasons, put forth by W. V. Quine (1969) in his article "Epistemology Naturalized", will take centre stage in this dissertation.

Quine argued that the natural sciences, when devising their theoretical concepts, should not take into consideration any of the normative constraints of classic epistemology. The natural sciences ought to base their ontological choices—decisions on how to carve up reality via concepts—on nothing else than their own best results: the concepts that figure in scientific theories that best explain and predict natural phenomena are the ones we ought to accept because there is no other sensible criterion. If we apply Quine's view to thinking about perception from the perspective of the natural sciences, then conceptual analysis of perception becomes subordinate to successful explanation and prediction, naturally raising the question as to what constitutes a good explanation in scientific psychology.

Specialists in several fields, such as experimental psychology, the cognitive sciences, neuroscience, biology, and other disciplines, study the perceptual processes or perceptual activities of humans and other organisms, and attempt to explain them in the terms customarily used in their own field of inquiry. Experimental psychophysics attempts to connect physical stimuli to experience, cognitive science treats perception as a stage of information processing, neuroscience models brain dynamics associated with some notion of perception, and evolutionary biology characterises perception as a part of, and as a result of evolution by natural selection. Yet today, there isn't a single concept of perception that is shared by these different branches of science. Only rarely the effort is made to devise a unitary concept of perception based on the best scientific results of each branch. Since each branch works with its own notion—an implicit one or a notion adapted to the methods of the discipline—a unified theory of perception doesn't seem to be forthcoming. The fact that philosophy (of perception) had or has a reputation among scientists of being disconnected from, or even hostile towards, science isn't helpful either. Furthermore, the disagreement among

philosophers over a suitable concept of perception for scientific study doubtlessly surpasses that among scientists.

Contemporary philosophy of perception is concerned with the challenges posed to the common sense notion of perception. That common sense concept usually involves the notions of "openness" and "awareness" (Crane and French 2016). Perception is thought of as a form of openness to mind-independent objects; a form of experience in which objects are experienced as present. Openness, however, applies to non-veridical perceptual experiences too: when one is subjected to illusions or hallucinatory experiences, objects are experienced as present as well. Yet, this is thought to be incompatible with the idea that perception is also a form of awareness of mind-independent objects. Herein lies the so-called "problem of perception".[1]

The idea that "openness", and the "phenomenal character" associated with it, are constitutive of perceptual experience, and thus of perception, may be seen as a barrier to a naturalistic, scientific concept of perception because "openness" and "phenomenal character" are connected to introspection, a method that is rejected by the natural sciences. This leads us to an important motive for thinking about perception that we will neglect in this dissertation: the first person perspective on and of perception. It might be argued that a phenomenological analysis of the structure(s) and/or character of conscious perceptual experiences is indispensable for a scientific notion of perception, but we beg to differ. We think that a functional approach to perception, combined with the assumption that forms of (perceptual) experience are *identical* to ways in which activities of an organism-environment system unfold (Hutto and Myin 2013; Myin and Loughlin 2018), justifies setting aside phenomenological concerns in the quest for a naturalistic concept.

[1] It is important to distinguish between "the problem of perception" and "the epistemological problems of perception". The former problem challenges the coherence of our common sense concept of perception, the latter poses a problem for empiricism, the idea that knowledge originates in perception. The problems are logically independent, but often treated together (Lyons 2016).

Our commitments as to the necessary constraints on naturalistic explanation are the following: First and foremost, we are committed to what has been called "the Muggle constraint":

> One's explanation of some phenomenon meets the Muggle constraint just when it appeals only to entities, states and processes that are wholly nonmagical in character. In other words, no spooky stuff.
>
> Wheeler 2005, 5

The Muggle constraint (also invoked by Hutto and Myin 2013, 66) basically means that the explanantia or explanatory posits of a theory ought to be naturalistically credible notions. In psychology, appealing to notions like the soul, instinct, drives or unconscious thoughts violates the Muggle constraint because it is unclear what, if anything, these terms denote. They are unexplained explainers that mystify psychological phenomena rather than explain them.

Furthermore, we think that naturalistic explanations of psychological phenomena ought to describe the functional dependencies between events. The functional explanations we envision are causal explanations, but with two important qualifications: First, the notion of causality at work in functionalism ought to be freed of the idea of agency.

> "Force" in Newton, is the cause of changes in motion, whether in magnitude or direction. The notion of cause is regarded as important, and force is conceived imaginatively as the sort of thing that we experience when we push or pull.
>
> Bertrand Russell 1946, 524

But, Russell observes, the "agentive" idea adds nothing to our understanding of the causal event or process. All that is needed for understanding is the relation between the independent and the dependent variables. He described the idea of force that connotes the power of an agent as a vitalist ghost that is gradually being exorcised as science progresses (Russell 1946, 524). Functional psychology ought to continue the exorcism.

Second, a notion of causality that doesn't imply a contiguous or sequential relation must be adopted (Chiesa 1992, 1298; see also Baum 2005, 47). This is so because psychological phenomena are functions of historical factors, not just of

factors that momentarily precede them. Past events affect psychological activity as an aggregate. Describing only the *proximal* causes of a psychological event, yields no understanding of that event *as psychological* unless the aggregating history that led to those proximal causes is taken into consideration. The momentary, proximal mechanistic link, then, becomes subservient. The rejection of the causal chain metaphor in the functionalism we deem appropriate for psychological explanation is based on the idea that causal terms don't refer to isolated entities. The terms that figure in a causal explanation also form a conceptual system that gives meaning to the explanation (Chiesa 1992, 1289).

Uncritically putting the causal chain metaphor to work in a causal explanation of psychological phenomena might result in ignoring the conceptual framework that surrounds the event and that allows for understanding a discourse *as an explanation*. This, we think, opens the door to violations of the Muggle constraint. When proximal intermediaries or mechanisms are posited in explanations of psychological phenomena, all too often, historical factors are "illegally" imported into those intermediaries. That is so because in proximal explanations one intermediary must account for all the complexity of the explanandum. This leads to attributing extraordinary properties to the proximal posit, *e.g.* the unexplained property of "representing" a history of interactions that is often attributed to mental states.

We think that adopting the natural history approach prevents that appeals are made to magical properties, precisely because it can appeal to the process of aggregation of complexity; a process that is nonetheless a function of nonmagical, naturalistically credible states and processes. This view of explanation has the benefit that not each and every link in the causal chain needs to be identified. The history of "differences that made a difference" (Bateson 1970) suffices to explain its target phenomena.

As for perception, the historical factors of which it is a function can be situated on multiple levels or time scales, two of which are commonly appealed to: the history of the individual, usually referred to as *ontogenetic* factors, and the history of the species, the *phylogenetic* factors. Other levels can play a role too, for example the group dynamics that persist over several generations. In the functionalist approach we advocate, no scale has prevalence over the other. That

is not only because perceptual activity is usually a function of more than one factor level, but because ontogeny, phylogeny and other possible levels are also functions of one another. For example, descriptions of developmental and learning processes inevitably rely on factors that the organism has in virtue of evolution by natural selection. Conversely, evolution of species by natural selection necessarily relies on developmental factors because all “traits”, including the ones that constitute an evolutionary advantage, develop after an individual organism is conceived by its parents. In other words, evolution provides the context for understanding development and vice versa.

This dissertation deals with three ecological approaches to perception; Gibson’s, the Neogibsonians’, and what we will call the evolutionary-ecological approach. We will see that these approaches vary with regards to their naturalistic and epistemological perspectives and regarding the mode of explanation they advocate, be it mechanistic, magical or historical.

CHAPTER 1

Introducing Gibson's Ecological Approach to Perception

> *The concepts of affordance and of ecological information provide important tools for psychologists to establish experimental control. Yet at the same time, issues of information and meaning, of affordance and value, cry out for careful, naturalistic description and also for appropriate interpretative study.*
>
> Edward S. Reed 1996, 188

> *If the variables of higher order can be shown to specify the world, although not to represent or replicate it, an explanation is possible for perception as defined: the business of* keeping in touch with the world.
>
> James J. Gibson 1959, 458

1.1 Introducing James Gibson

The American psychologist James J. Gibson's (1904-1979) had a long, active and fruitful career spanning from the 1930's until 1979, publishing numerous articles in academic journals, and three books: *The Perception of the Visual World* (1950), *The Senses Considered as Perceptual Systems* (1966), and *The Ecological Approach to Visual Perception* (1979/1986; Classic Edition with a new introduction by William M. Mace, 2015). The latter book, despite its rather narrow scope on *visual* perception, proposes a radical reconceptualization of visual perception that breaks away, not only from the traditional philosophy and psychology of perception, but also from Gibson's own earlier views. Elaborate studies have been written about the evolution of Gibson's thoughts throughout the years, and his publications before his last book have much insights to offer. This introductory chapter, however, doesn't it aim to offer a full view on Gibson's

work. It serves only to familiarise the reader with the essential concepts and argumentations of Gibson's latest, most thought-provoking work. Therefore, this introduction of Gibson's ideas will focus on *The Ecological Approach to Visual Perception* (1979).

1.2 Introducing the environment

In the preface of his book, Gibson (1979, xiii) states that his aim is understanding visual perception, more specifically to explain how it works. He relates to the reader that he, as a young researcher, had assumed that in order to explain perception it would suffice to study the physics of light, and the anatomy and physiology of eyes and brains; that putting these pieces of knowledge together would yield an explanation of vision. But he came to the conclusion that this approach wouldn't suffice because the facts of those sciences are described at a level that is inappropriate for the study of perception. Put simplistically: physics and physiology don't add up to psychology.

A better angle at understanding vision, or perception in general, might be gotten if the question as to "where does vision take place?" is not answered "in eyes and brains", but with "in a natural environment", so Gibson thought. He proposes to define perception as the active achievement of a whole perceptual system that consists of "a pair of mobile eyes [...] set in a head that can turn, attached to a body that can move from place to place" (Gibson 1979, 53).

This entails that a description of the environment—the places in which the animal moves around and acts—is an integral part of a psychological explanation of perception. Vision evolved in a natural environment (Gibson 1979, 2; see also Gibson 1966, chapter 9), so surely "what there is to see" will play a fundamental role for "how it is seen". The first part of *The ecological approach* is concerned with this topic: how ought we to describe the environment such that its description is conducive to psychological explanation? Gibson starts by remarking that "animal" and "environment" form an inseparable pair, a "mutuality".

> Each term implies the other. No animal could exist without an environment surrounding it. Equally, although not so obvious, an environment implies an animal (or at least an organism) to be surrounded. [...] The mutuality of animal and environment is not implied by physics and the physical sciences. [...] an environment is ambient for a living object in a different way from the way that a set of objects is ambient for a physical object. [...] Every animal is, in some degree at least, a perceiver and a behaver.
>
> Gibson 1979, 8

From this, Gibson concludes that the descriptions of the world offered by the physical sciences, as interesting and insightful as they may be, are not of the right kind to serve psychology. For example, the notions of time and space in physics range within scales from nanoseconds to geological eras, and from nanometres up to light years, whereas the perceiving and behaving of animals takes place on a more constricted scale, seconds to years, millimetres to kilometres. The subatomic and the intergalactic scales are thus inappropriate for the ecological psychologist; events at these levels are unlikely to have played a direct role in the evolution of vision. What, then, is the appropriate scale to describe environments? Gibson proposes to use a natural scale with units that are relative to animals' activities and that are "nested". All environmental objects and events are part of larger objects and events, and encompass smaller objects and events. There are no absolute units for psychology (Gibson 1979, 15). The levels and units of environmental description ought to be tailored to the psychological phenomenon under study.

Animals move around. So a description of their environment should reflect that. On land, locomotion occurs on surfaces that support their weight, the "ground", and through air that offers little resistance. That air is also the medium for light to spread, allowing surfaces to be illuminated. This may all seem quite trivial, but it leads up to the crucial point that the light in the environment is structured by the surfaces, that shadows are cast as a result. The structure of the light available in an environment is determined by the layout and textures of the surfaces, as well as by their properties we perceive as colours. But there is more to the structure of ambient light, as we shall see in the next section: the structure that is available to a *moving* animal transforms as a function of that movement.

Gibson concludes the first part of *The ecological approach* with a reflection on "meaning". The entities that populate the world described by physics are meaningless whereas the features of animals' environments aren't. Describing the environment of active animals entails, for example, that objects are or aren't obstacles, that surfaces can or can't be walked upon. In other words, the way the animal interacts with a feature is imperative for its description. Behavioural significance for an animal is the guideline to describe its environment. Gibson enumerates quite a list of environmental features that refer to animal behaviour like enclosures, sticks, a slope, an edge, an obstacle, etc. These contrast clearly with the objects of mathematics and the physical sciences like lines, planes, atoms, photons, H_2O, etc. which have no (direct) behavioural significance, being abstract, formal and intellectual concepts (Gibson 1979, 44).

1.3 Ecological information

1.3.1 Ecological optics vs. the poverty of the stimulus argument

Light, we have just seen, is part of the environment in the sense that it illuminates, allowing for visual coordination of activities. Explaining vision, Gibson argues, requires a particular analysis of light. Unlike physical optics, which approaches light as energetic radiation that propagates from a source and studies its properties (speed, wavelength, intensity, …) and behaviours (reflection, refraction, …) as it encounters physical objects, ecological optics analyses light as it arrives from all directions at a point where an eye might be.[2] This, Gibson (1979, 47) calls ambient light. Ecological optics is concerned with how ambient light is structured by the surfaces in the environment, and how some aspects of ambient light change and other aspects remain when the point of observation moves, when light sources move or when stuff in the environment moves.

[2] In the early sixties Gibson still worked with the idea of physical stimuli. Some aspects of his 1960 article "The concept of the stimulus in psychology" foretells his later views.

Gibson claims that the properties of ambient light, described by ecological optics are essential to understanding vision—far more so than the properties of light described by physical optics. Wavelength and intensity, properties of light as radiant energy, are certainly useful when studying the anatomy and physiology of receptors. But, Gibson emphasises, these physical properties of light are unlikely to correspond to anything else than the physical properties of the light source and to the physical properties of the surface off of which the light is reflected. Physical properties of light don't correspond to the behavioural significance of environmental objects or events, which is precisely what is needed if it is assumed that vision is (mainly) in the service of action.

This fact, that the physical properties of light such as its wavelength and intensity don't correspond to behaviourally significant features of an environment must be well understood because it is a crucial observation that plays a fundamental role, not only for Gibson's theory of perception, but for all theories of perception. It gives rise to a form of the "Poverty of the Stimulus" (PoS) argument which, in its generic form, can be stated as follows: there is a gap between the poverty of stimulation of the senses and the richness of experience (and/or behaviour). So something has to bridge that gap. Let's reflect on this so that we get as clear as possible how what has just been said is a PoS argument, and what depends on it.

The idea of the Poverty of the Stimulus *simpliciter* is the result of the facts of projective geometry. When a three dimensional object is projected onto a plane, information is lost: only three planes of a cube can be depicted on a sheet when "regular" perspective projection is applied. Information about the three other planes is lost. Moreover, several three dimensional objects (sphere, cylinder, cone) can, in perspectival projection, result in exactly the same circle on the projective plane. Furthermore, projection of a large sphere far away can yield the same projected circle as a smaller sphere close by. So, if it is assumed that vision is based on the stimulation of the retina, which is not unlike a two-dimensional plane, a lot of information about the sizes and shapes in the three dimensional world is lost or ambiguous. This (alleged) problem has puzzled philosophers of perception since Johannes Kepler formulated his theory of image formation in a dark chamber (Gibson 1979, 58). It continues to do so today and it is the basis of

many PoS arguments in the context of the sciences and the epistemology of perception.

Gibson aims to philosophically *dissolve* the problems posed by PoS arguments, rather than *solve* them, as one would solve an engineering problem. The dissolution starts with rejecting the assumption that vision is based on stimulation of sensory receptors. It must be rejected, not only because it gives rise to the PoS argument *simpliciter*, but also because it leads to mind-body dualism: the seeming impossibility to connect purely physical properties of the body's sensory mechanisms to the properties of behaviour, mind or experience.

Photoreceptors, like the rods and cones in our eyes, are indeed triggered by light that has certain physical properties. The former react to intensity, the latter to a combination of intensity and wavelength. The receptors convert light energy into electric energy. This process is called transduction. This mechanical process implies that there is a correlation between the electric energy produced by a receptor and a property of the light that set it off. Furthermore, there is a correlation between the light property and a property of the surface from which the light beam originated. Hence there is a correlation between a property of the electric current and a surface property. However, since the light properties and the electric properties are purely physical, they can only correlate with a purely physical, *i.e.* a molecular property of a very small portion of the object's surface is, given its scale, insignificant to behaviour.

That is so for the following reason: A description of an environment is distinct from a description of a portion of the physical world in that the latter is couched in terms that deliberately exclude a "living perspective". The concepts of physical science are designed so that whoever applies them applies them in the same way, irrespective of their or anyone else's perspective or personal stake. An atom or a physical force is the same for everyone.[3] The same goes for physical optics: the properties of light that are studied by physical optics are what they are for all who study it. Personal or subjective factors are excluded from physical science,

[3] The matter whether physics is really non-personal is complicated. We represent physics as non-personal so as to elucidate Gibson's idea of ecological physics. No commitment to any position in the philosophy of physic is implied on our behalf.

and rightly so. The physical sciences ask what can be said about the world that holds true independently of who says it or hears it. This austerity is (part of) its strength. So studying the properties of light in the way of physical optics deliberately strips those properties that could be significant to a *particular* someone.

So, insofar as the correlations between the electric activity in neurons and the physical properties of molecules at the surface of an object can be called information, that information is extremely limited: a physical property of a tiny surface area the size of a molecule. Therefore, explaining vision on the basis of transduced energy from stimulated receptors is impossible, Gibson argues, because more information of the same, physical kind doesn't suddenly become information of another, behaviourally relevant kind:

> The correspondences between the spots of light on the retina and the spots of sensation in the brain can only be a correspondence of intensity to brightness and of wavelength to color. If so, the brain is faced with the tremendous task of constructing a phenomenal environment out of spots differing in brightness and color.
>
> Gibson 1979, 61

The task Gibson refers to is not just tremendous. On the assumption of physicalism, it is impossible. No physicalistic concept of stimulation can be related to the "mental qualities" of sensation and perception. The idea that banks of receptors would form a "retinal image" that is sent to the brain for further "processing" leads to a related problem:

> Then there has to be a little man, a homunculus, seated in the brain who looks at this physiological image. The little man would have to have an eye to see it with, of course, a little eye with a little retinal image connected to a little brain, and so we have explained nothing by this theory.
>
> Gibson 1979, 60

Not everyone agrees with Gibson's analysis. Although no one accepts that a homuncular theory is sound, defenders of "information processing theory" hold that it is possible indeed that brains construct information about the behaviourally significant features of the world on the basis of the physical and

insignificant energy pulses they receive; and that such an information processing theory contains no hidden homunculi that do explanatory work. Whether information processing theory can deliver this will be discussed further in chapters 2 and 6.

Now that it is clear that Gibson rejects "processing" or "enrichment" of information about physical properties by brains, we can move on to the way he proposes to circumvent the Poverty of the Stimulus argument. Evidently, it is related to the ecological description of animals' environments and the ecological analysis of ambient light. When ambient light—light that arrives at a point from all directions—is structured by the surfaces of the environment, Gibson (1979, 65) calls it an "ambient optic array" (AOA). The structure of an AOA Gibson refers to as "stimulus information". Light thus "contains" information in so far as it is structured. And this stimulus information is, according to Gibson, the basis for perception. Stimulus information differs from a stimulus per se in the sense that a stimulus is an energetic entity that is absorbed and transduced by a receptor, after which it is no longer available in the environment. Stimulus information, on the other hand, defined as the structure of an AOA, is not "removed" or "lost" from the environment when it is used. Information, unlike stimulus energy, is not degraded when perception takes place because the law of energy conservation applies only to energy, not to its structure. A crucial characteristic of Gibson's concept of information follows from his distinction between the physically energetic aspect of light and its structural/informational aspect:

> But stimulus information is not anything that could possibly be sent up a nerve bundle and delivered to the brain, inasmuch as it has to be isolated and extracted from the ambient energy. Information as here conceived is not transmitted or conveyed, does not consist of signals or messages, and does not entail a sender and a receiver.
>
> Gibson 1979, 57

1.3.2 Invariants of the ambient optic array

In his chapter on the ambient optic array Gibson analyses a multitude of features of the ambient optic array (AOA). Features or patterns that are "stable" or remain

unchanged in a particular sense while other features do change, he calls "invariants". He discusses variants and invariants of the "unoccupied" and the "occupied" AOA, and of the stationary and the moving AOA. In the description of an unoccupied AOA, abstraction is made of the agent that *could* occupy a place in it, so as to focus on the invariants and transformations that occur from that abstracted point of view. The features described as such are taken to possess a sort of generality that might be relevant to all agents. In the analysis of the "occupied" AOA a particular, embodied creature is taken into consideration yielding a description that includes factors like its own surfaces, the positioning of its sensory surfaces, its gait, etc.

One of the most basic invariants in the AOA that corresponds to the terrestrial environment is the horizon. It obviously separates the ground from the sky by a difference in texture and colour. In open flat lands the horizon is always at the eye height of the occupant. This implies that there is a correspondence relation between an AOA that includes a horizon and the relative height of the observer. Other features that populate the AOA always occupy a position in relation to the horizon, and thus also to the occupant: things that stick out above the horizon are taller than the observer; things below the horizon are smaller. The relation to the horizon is also relevant for the lay-out of the environment. Items that sit on the ground surface and occupy a position relatively closer to the horizon are farther away than those situated lower in the visual field, *i.e.* farther away from the horizon. Hence these features do not only correspond to the size and layout of surfaces in the "external" environment; They relate directly to the observer's proportion and position in the environment. These invariants are said to constitute information that is both "exterospecific" and "propriospecific" (Gibson 1979, 75).

Basic but very important features of the moving or "flowing" AOA are the "occluding edge" and "reversible occlusion". An occluding edge is characterised by Gibson (1979, 83) as a texture difference in texture as a result of the relative positions of two objects and the observer. Accretion and deletion of texture occurs when one of these three move, *e.g.* when one object moves behind another, or when the point of view moves, resulting in the other portions of surfaces coming into and going out of view on one side of the occluding edge. In

the latter case an active observer can reverse the occlusion by moving. These invariants too relate to how things are in the environment, *e.g.* the layout of surfaces. Accreted and deleted textures correspond to objects that are farther away ("behind") than the surfaces that correspond to the portion of the AOA that remains unchanged. As such the position of the observer is implied too.

Furthermore, reversibility of occlusion corresponds to movement of "self", irreversibility of occlusion to movement of external objects—or to the unlucky situation of being stuck. The *rates* of occlusion correspond to relative velocities as a function of relative distances, including one's own speed. Gibson distinguishes three classes of active movements, each generating particular classes of invariants in the ambient optic array. There is stationary movement of the eyes and head by which the AOA can be explored from one point of view. There are the movements of the limbs, for example when one manipulates objects. And third there is movement of the whole animal in the environment. Forward movement corresponds to "outward" flow of the AOA. The area in the AOA where outward flow has the smallest rate corresponds to the direction in which one is moving. Moving backwards reverses the flow, but the area that manifests the "least" flow still corresponds to the direction of one's movement. Only when moving sideways while looking straight ahead there is no such point in the AOA, at least for creatures like us with forwards facing eyes; all AOA areas then "sweep".

Special cases of occluding edges are those that correspond to one's own body parts. The contours of one's nose, for example, are invariantly present in the available AOA. It occludes and "dis-occludes" portions of the environment right in front, and so do one's hands much of the time, yielding optical information about "self" and the environment. Here it becomes particularly clear that moving and acting in an environment literally generates temporally extended optical patterns. This hints at a strong link between these variables of ecological optics and behaviourally relevant properties of the environment. One's own activities correspond tightly with the invariants of the AOA that are available when performing them. The fact that an ecological description of the environment is couched in a terminology that refers to those activities, provides a common language for describing the relation between optical and environmental features.

> The hypothesis of information in ambient light to specify affordances is the culmination of ecological optics. The notion of invariants that are related at one extreme to the motives and needs of an observer and at the other extreme to the substances and surfaces of a world provides a new approach to psychology.
>
> Gibson 1979, 135

This opens up a new way to deal with the Poverty of the Stimulus because it entails a vocabulary that is much richer than that of the physical sciences. The units of description are not abstract magnitudes. Action or behaviour is nested: a particular activity is always part of a more encompassing activity, and always contains "smaller" aspects nested within it that could be described in more detail. A predator running in the savannah is an activity that might be nested within the act of hunting. The running has subordinate aspects such as avoiding this and that obstacle, all the way down to the acts of moving single legs forward with every step or jump. The "nestedness" of behavioural events in the environment is reflected in the nesting of the ambient optic array.

1.3.3 Affordances

To conclude the second part of *The Ecological Approach*, which deals with the information that is available to animals, Gibson introduces the notion of "affordance". The term denotes what we have thus far called "behavioural significance". It is meant to offer a way of talking about behavioural units in relation to the environment; or vice versa.

> The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill.
>
> Gibson 1979, 127

Affordances are usually referred to with neologisms constructed out of a verb, a preposition and "-able". Chairs, for example, are "sit-on-able", cliffs "fall-off-able", etc. In many cases the surfaces of environmental items constitute what they afford to a particular animal of species.

It is important to keep in mind that surfaces aren't considered from the point of view of physics, as objective things. Affordances are not layers of meaning that

are attributed to the physical world by the perceptual process because, for ecological psychologists, the world or environment ought to be described in terms of its significance from the onset. This implies that environments can afford different activities to different animals. A flat surface affording walking over to an ant does so because its flatness is "measured" with respect to the size of the ant. A one square centimetre flat surface doesn't afford walking upon for humans, but it does to the ant because the scale of the surface "matches" the length of the ant's legs. To determine whether a surface is walk-on-able for this or that animal, it might be more useful to measure it in "intrinsic units"[4], for example in "step size". Similarly, the surface of water affords support and "walking-on" to water striders but not to goats, because a surface's property of being able to withstand force is taken in relation to the animal's body weight, among other properties.

A set of affordances associated with a particular (group or species of) animal constitutes its ecological niche, the description of which deals in the first place with *how* the animal lives, not so much with the *where (*Gibson 1979, 128). The niche, Gibson says, implies the animal, and the animal implies the niche. Gibson's most quoted passage on affordances is this one:

> An important fact about the affordances of the environment is that they are in a sense objective, real, and physical, unlike values and meanings, which are often supposed to be subjective, phenomenal and mental. But, actually, an 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 understand its inadequacy. It is equally a fact of the environment and a fact of behaviour. It is both physical and psychical, yet neither. An affordance points both ways, to the environment and to the observer.
>
> Gibson 1979, 129

In this passage he emphasises that perception is not a process that involves *first* detecting physical properties to which, *then*, meaning is assigned. Such a view

[4] "Intrinsic" might be confusing. For Gibson it means intrinsic *to the animal*. Measures that are entirely detached from behaviourally relevant features, like forces expressed in Newton, are "extrinsic" or alien to agents.

would be tainted by a dualism of the physical world and mentalistic meaning. The concept of affordance aims to show that the origin of meaning is not mental. When the ecological approach is adopted, meaning can be accounted for as an animal-environment relation of biological origin. It is on this relational notion of affordance that the Gibsonian idea of information is based. The natural origin of the affordance relation between an animal and an environmental feature supposedly accounts for the informational relation. An affordance relation can only emerge in an animal-niche system if it is detected somehow; an informational relation can only emerge if the affordance is acted upon. That is, when an opportunity for action is realised and has consequences for the animal then, and only then, an informational relation can emerge. The latter Gibson refers to as "specification" in or by stimulus information. Since such "specifying information" is rich in virtue of its ecological ontology, perception can be said to be "direct" or non-inferential.

What this "specification" entails will be discussed at large in chapters 3 to 5 of this dissertation. For now the suggestion suffices that the levels of description of the environment and of light in terms of action establishes a promising approach to "stimulus information". An approach that shows that, at least in part, the Poverty of the Stimulus is a consequence of the choice for a physicalistic level of description.

Gibson concludes his section on "ecological information" with a methodological reflection. The ecological approach to "stimulus information" poses a challenge to experimental psychology. Stimuli, conceived physicalistically as quantifiable units of energy are relatively easy to control experimentally. That is not the case for "invariants of the ambient optic array", especially not when ecological analysis suggests "higher order" or "compound invariants".[5]

> Nevertheless, a unique combination of invariants, a *compound* invariant, is just another invariant. It is a unit, and the components do not *have* to be combined or

[5] There is an implicit suggestion that compound invariants are not bound to one sensory modality, found as well in Gibson (1979, 245). This is not surprising given the fact that perceptual systems aren't defined in terms of receptor properties, but as a function of the activity it supports. Naturally, activities that take place in an environment can involve all types of energy arrays that are present.

> associated. Only if percepts were combinations of sensations would they have to be associated. Even in the classical terminology, it could be argued that when a number of stimuli are completely covariant, when they *always* go together, they constitute a single "stimulus".
>
> Gibson 1979, 141

Regarding the methodological challenge Gibson notes that invariants should only be "made available" to test subjects, but not "applied to" them. And that accurate description of invariants is possible without quantification. The passage we just cited contains another insight that deserves some more analysis, namely that vision is not based on "sensations". Gibson (1963, 9) had already argued that our understanding of "sensations" is obscure because the term is used to refer to different things in different contexts.

> The first meaning refers to the effects of stimulation in general. The second refers to conscious impressions induced by certain selected variables of stimulation.
>
> Gibson 1963, 8

The first meaning is, as discussed above, unsuitable for psychological explanation because it refers only to the physical dimensions of the stimulus. The second meaning, pertains to sensory experience, like the observation that one photon on a retinal cell can cause an experience of light. But sensations conceived in the latter way shouldn't be used as explanatory posits because the relation between stimulus energy and experienced properties is precisely what needs explanation. Phenomenological descriptions may be very useful for perception theory. Reified sensations aren't. Basing one's perception theory on "stimulus information" should guard us from such reifications.

A note of appreciation: parts one and two of Gibson's book—about the environment and about ecological optics, respectively—we consider nothing less than brilliant despite the slightly dwindling clarity in chapter eight, which contains his theory of affordances. These two parts are descriptive in nature, setting the stage for the third part, in which the explanations were to be formulated.

1.4 So how does it work?

Gibson describes many experimental results in part three of his book, which he claims to support his thesis that:

> Direct perception is the activity of getting information from the ambient array of light. I call this a process of information pickup that involves the exploratory activity of looking around, getting around, and looking at things.
>
> Gibson 1979, 147

Much attention goes to indications that the perceptual process is direct rather than indirect. These reinterpretations of empirical research serve to make the case for direct perception plausible, and they do. Yet Gibson (1979, 209) repeatedly asks the following question: "How Does the Eye-Head System Work?"

> What sort of theory, then, will explain perception? Nothing less than on based on the pickup of information. To this theory, even in its undeveloped state, we should turn now.
>
> Gibson 1979, 238

> We can say that the perceiver *separates* the change from the nonchange, *notices* what stays the same and what does not, or *sees* the continuing identity of things along with the events in which they participate. The question, of course, is how he does so. [...] The answer must be of this sort: The perceiver extracts the invariants of structure from the flux of stimulation while still noticing the flux.
>
> Gibson 1979, 247

Perhaps our expectations were too high. We expected an account of how, along with affordances and information, perceptual systems emerged that could pick up or extract the relevant features from the ambient optic array. Gibson's announcements suggested to us that an account would be developed on how pickup works. But that is not what we got. Part three of *The Ecological Approach to Visual Perception*, besides discussing existing research, revisits most of the conceptual analyses of parts one and two, adding more distinctions with the cognitivist theories of his days.

> The theory of information pickup differs radically from the traditional theories of perception. First, it involves a new notion of perception, not just a new theory of

> the process. Second, it involves a new assumption about what there is to be perceived. Third, it involves a new conception of the information for perception, with two kinds always available, one about the environment and another about the self. Fourth, it requires the new assumption of perceptual systems with overlapping functions, each having outputs to adjustable organs as well as inputs from organs. We are especially concerned with vision, but none of the systems, listening, touching, smelling, or tasting, is a channel of sense. Finally, fifth, optical information pickup entails an activity of the system not here to fore imagined by any visual scientist, the concurrent registering of both persistence and change in the flow of structured stimulation. This is the crux of the theory but the hardest part to explicate, because it can be phrased in different ways and a terminology has to be invented.
>
> Gibson 1979, 239

The five enumerated points are developed further in his fourteenth chapter on the theory of information pickup. But in all five of them Gibson conducts conceptual analysis, repeatedly asking the question "so how does it work?", but never really answering it. This lacuna didn't go unnoticed. As we will see in the next chapter, defenders of information processing theory Jerry Fodor and Zenon Pylyshyn (1981) relentlessly exploit it.

Gibson's chapter on the theory of information pick-up is in fact a summary of parts one and two of the book. He describes the conceptual tools that should figure in the new theory. The new definition of perception Gibson (1979, 239) proposes, stipulates that it is a form of awareness of the environment of a "living observer". That means that it is neither a mental act nor a purely bodily act—it is a psychosomatic act that should not be thought of along the lines of mind-body dualism.[6] The form of awareness Gibson has in mind is not an appearance in the theatre of consciousness, but an active achievement of the whole perceptual system.

> One sees the environment not with the eyes but with the eyes-in-the-head-on-the-body-resting-on-the-ground. Vision does not have a *seat* in the body in the way

[6] The resemblance to Merleau-Ponty's "Corps-sujet" has been noticed. See for example Sanders (1993, 1999).

> that the mind has been thought to be seated in the brain. The perceptual capacities of the organism do not lie in discrete anatomical parts of the body but lie in systems with nested functions.
>
> Gibson 1979, 205

Perception is an ongoing activity. There are no discrete percepts but rather there is a continuous flux of "information pick-up". Integration of sequences of sensation caused by stimuli is part of the old definition. Finally, the environment and the "self" are co-perceived since stimulus information in the ambient optic array is both exterospecific and propriospecific.

The information available for perception also receives a new definition. It is not specific to physical energy properties, receptors or organs but to the environment, ecologically described. Since it isn't energy-specific, it has no threshold. "Ecological information" is different from the kind of information that is transmitted over a channel. Perception can't be modelled after communication; there are no messages that can be true or false, no sender or receiver.

Gibson characterises "perceptual systems" by contrasting them to the five "senses" as they are conceived classically. Classical senses are defined on the basis of receptor banks that are triggered by particular energetic properties, whereas a perceptual system is characterised functionally. Any body part that is adjusted in the service of information pickup is part of the functional system. In the case of vision there are, among others, the adjustable lenses of the eyes, the eyes themselves that can be rotated, the head that can be moved independently as well as the whole body that can be oriented in the environment and the whole locomotion system that allows for exploration. Walking around to inspect the "other side" of an item is thus a functional adjustment of the perceptual system. Unlike a classic sense, which is defined in terms of passive reception of energy, a perceptual system obtains stimulation actively. Classical psychophysical experiments (try to) relate sensory input to sensations. The nature of sensations, Gibson stresses, is fixed; new sensations cannot be learned. Perceptual systems, on the other hand, are subject to maturation and learning. One can learn to "extract" invariants that one was previously unable to pick up.

The old view of sense modalities entails that multisensory information must be integrated by the mind or the brain. Input from different modalities must be "associated". But it is this sensation based theory that pried apart perceptual information into modal channels. On the systems view, that rejects the analysis based on energy properties, perceptual systems might become attuned to "transmodal invariants" without association or integration. Mental association is only needed after analytic dissociation; what hasn't been pried apart, needn't be put together again. This idea comes to the foreground most when Gibson discusses how perceptual systems register persistence and change. First he offers a general analysis of perception, directing his attention to the particularities of *visual* perception afterwards (Gibson 1979, 247). See also:

> The error was to suppose in the first place that perception of the environment is based on a sequence of discrete images. If it is based instead on invariance in a flow of stimulation, the problem of integration does not arise. There is no need to unify or combine different pictures if the scene is *in* the sequence, is specified by the invariant structure that under lies the samples of the ambient array.
>
> Gibson 1979, 221

The special senses theory led to the idea that attention takes place in the nervous system. Gibson's approach maintains that attention pervades the whole system. It is conceived functionally, not necessarily as conscious experience. Importantly, attention must be understood as a skill that can be "educated": the notion must allow for an explanation of learning and development, that is, improvement of its functioning.

1.5 A NEW APPROACH TO KNOWING

Gibson indicates that his rejection of the approach that bases perception on "sensations" has an important implication for the so-called "problem of knowledge of the external world".

> The input of the special senses have the qualities of the receptors being stimulated, whereas the achievements of the perceptual systems are specific to the qualities in the world, especially their affordances. The recognition of this limitation of the senses was forced upon us by Johannes Müller with his doctrine of specific "nerve

> energies". He understood clearly, if reluctantly, that the implication that, because we can never know the external causes of our sensations, we cannot know the outer world.
>
> Gibson 1979, 246

Rejecting the sensation-based concept of perception, and adopting instead the idea that perceptual system are attuned to ambient energy variables that are "specific" to environmental features, may imply that there is no problem of knowledge of the outer world. If perception is considered as not based on sensations, the impossibility of deducing or inferring the causes of sensations may be irrelevant to the problem of knowledge. Being attuned to the right features of the ambient array, described at the ecological level, "simply" amounts to knowledge. We have bracketed "simply", because, as we saw above Gibson doesn't offer much of theory of "attunement", only conceptual analysis. Without a proper theory, the problem of knowledge of the external world is merely displaced toward what one might call "the problem of attunement to optico-environmental correlations". It should be noted, however, that this displacement delivers at least one thing to epistemology: if perceptual knowledge is conceived as an achievement (attunement) of *a perceptual system in an environment*, there is no longer a gap between knowledge that is considered as "inner" and a world considered "external" (Gibson 1979, 258).

> To perceive is to be aware of the surfaces of the environment and of oneself in it. The interchange between hidden and unhidden surfaces is essential to this awareness. These are existing surfaces; they are specified at some points of observation. Perceiving gets wider and finer and longer and richer and fuller as the observer explores the environment. The full awareness of surfaces includes their layout, their substances, their events, and their affordances. Note how this definition includes within perception a part of memory, expectation, knowledge, and meaning—some part but not all of those mental processes in each case.
>
> Gibson 1979, 255

The gap was created by the faulty analysis that treats seeing as the having of sensations and knowing as the possession of concepts stored in memory, Gibson adds. Therefore, a theory of perceptual knowledge needn't bridge any gap; it only needs to start from a correct analysis to see that the achievement of "awareness"

of persistent structures covers both seeing and knowing. As such, knowing is considered to be an extension of perceiving (Gibson 1979, 258) and perceiving is thought to be "the simplest and best kind of knowing" (Gibson 1979, 263).

Thinking of perceiving and knowing as unmediated relations between an organism and its environment presupposes that those relata are "real": the world as it is perceived or experienced is not the result of a mental construction, as was concluded by the eighteenth century philosopher Berkeley. He argued that, if knowledge is based on sensations, and sensation stops (*e.g.* by closing one's eyes and hypothetically disabling all other senses too), then one has no evidence that the world persists. "Realism", contra Berkeley, assumes that the world does persist, independently of sense experiences.

"Ecological realism" is not defended explicitly in Gibson (1979) but, according to Alan Costall, the book constitutes an attack, not only on the Poverty of the Stimulus doctrine, but also on the "supposed fact of the poverty of the real world". This is the idea that

> A very large part of what we experience and *believe* to belong to the real world is not real. It is purely subjective, a mental projection upon an inherently colourless and meaningless world.
>
> Costall 2012, 85

Nonetheless, Gibson's ideas on "realism" have evolved. In Gibson (1967) an explicitly epistemological form of realism is defended. In his 1979 book Gibson adopts a more pragmatic, naturalistic stance that entails that the world as we know and experience it is not a mental representation, a product of the mind that can match or mismatch with the "external world". The role of conscious perceptual experience in the new view of knowledge differs:

> The visual system visualizes. But this is still an activity of the system, not an appearance in the theatre of consciousness.
>
> Gibson 1979, 256

Perception and perceptual knowledge—knowledge that is not mediated by descriptions, in Gibson's (1979, 260) terms—don't have truth conditions because they are not thought of as having mental contents that are *about* the external

world, and that can be true or false of that world. So, instead of attempting to assure that there is a match between the content of experience and the state of the world—the goal of epistemological realism—Gibson's 1979 reflections on knowledge entail a non-metaphysical, common sense view of what is "real" (Costall 1984).

Admittedly, our treatment of Gibson's ideas on the consequences of the new concept of perception for epistemology is sketchy. For this there are two justifications: The first is that Gibson dedicates only five pages to this theme. The second is that we will treat the ecological epistemology of Gibson (1967) and that of the Neogibsonians at length in chapters 4 and 5. There it will be argued at length that these epistemological views of perception are at odds with a naturalistic view of perception, not in the least with Gibson's 1979 own new naturalistic notions of perceiving and knowing.

1.6 Gibson's assessment of the establishment and its shortcomings

The primary motivation of Gibson to develop the ecological approach to perception was his conviction that the "information processing view", which in its standard form assumes that perception necessarily entails mental representation, will never be able to deliver a good explanation. However, Alan Costall comments that the reasons for his skepticism about that view are somewhat scattered around in his 1979 book.

> As I see it, Gibson's failure to engage in "essentially negative arguments" had serious costs. By presenting his alternative approach, without setting out a compelling case for the *need* for an alternative, he failed to explain the fundamental point of his whole exercise. [...] By failing to deploy definitive arguments, arguments against representationalism, Gibson did not just make life more difficult for his readers. He missed the opportunity of a lifetime.
>
> Costall 2011, 257–58

Before continuing it must be said that in Gibson's time information processing theory was closely aligned with representational theories. "No computation without representation" (Fodor 1981, 121) has been an adage of most of the

Establishment view against which Gibson acted. There have been exceptions, however, but for our purpose here we can equate representationalism with information processing. In a short section about information processing, Gibson summarises his negative views. Most of Gibson's arguments boil down to the idea that the interpretation or decoding of physical nerve signals implies a little man in the brain. This has been touched upon above.

Another line of criticism is directed at the idea that stored representations of the environment are put to work to bear out the significance of physical stimuli. Gibson's response is that memory conceived as stored representation requires categories or concepts, but that there is no account of where these categories come from. Whether they are held to be "a priori categories of reason", to be innate ideas or to be learned categories, all three options beg the question according to Gibson. Explanations of perception and/or perceptual knowledge that rely on prior knowledge are circular if no account is given of that prior knowledge. Gibson formulates this as follows:

> All forms of cognitive processing imply cognition so as to account for cognition.
>
> Gibson 1979, 253

We will discuss at length Shaw et al.'s (1982) systematic analysis of indirect theories of perceiving and knowing that was aimed at making more explicit Gibson's critique on representationalism. We will, however, see that their view doesn't abandon the old way of thinking about knowledge entirely. The classical way of thinking about knowledge in terms of justified true belief is left behind in part only. The authors make clear that perceptual knowledge doesn't have truth conditions, such that analysing it in terms of belief is inadequate. The aspect of "justification", however, remains part of their program in such a way that seems to go against Gibson's own considerations. We will argue that a more thorough mode of naturalising knowledge is available (Quine 1969) and better suited to accompany Gibson's ecological approach.

We will address additional contemporary arguments against representation as an explanatory posit in psychological theory in our sixth chapter. We will see that the motivation for representationalism nowadays still rests on the same assumption regarding the Poverty of the Stimulus, though it has been given a

different name. Clark and Toribio (1994) hold that some cognitive phenomena are "representation hungry". Our analysis will converge with that of Costall and Richards:

> In fact, the theory of affordances is a challenge to the non-developmental, ahistorical, and unworldly foundation of modern cognitive theory. Cognitive theory is non-developmental and ahistorical precisely because it takes the specific human practices of representation, rule-following, and categorization for granted as *universal*, and as *the starting point*, rather than as *a problem* for psychological theory, not only in relation to human activity in general but to other animals as well. The theory of affordances, far from being reductionist, is an attempt to define the *conditions of possibility* for the evolution and development of language and representational systems.
>
> Costall and Richards 2013, 86

The import of developmental and historical aspects in Gibson's approach is most apparent when he wrote about "the education of attention", his term for perceptual learning (Gibson 1966, 51; 1979, 254), to which we tune our attention in the next section.

1.7 Learning

Becoming better at perceptual tasks, for example by practicing, is called "perceptual learning". James Gibson and Eleanor Gibson (1955) write that a theory of perceptual learning that starts from the assumption of the Poverty of the Stimulus is pushed towards a hypothesis of "enrichment": becoming better at a perceptual task amounts to the capacity to "enrich" poor stimuli progressively on the basis of accumulated, stored information in the mind. Gibson and Gibson describe two experiments in which perceptual learning takes place but in which no "internalistic" enrichment of stimulation need be postulated. Instead, actions on behalf of the subjects constitute differentiation of the stimuli. In one of the experiments the subjects learn to discriminate between curly drawings that look very similar to one another at first sight. In the course of several trials, the subjects' ability to discriminate between the scribbles improves without

“external” reinforcement by the experimenters. Their responses become specific through practice and repetition,

> [...] but there is no proof that it incorporates memories. The notion that learned perception is less and less determined by external stimulation as learning progresses finds no support in these experiments. The observer sees and hears more, but this may be not because he imagines more, or infers more, or assumes more, but because he discriminates more. He is more sensitive to the variables of the stimulus array.
>
> Gibson and Gibson 1955, 40

In *The Senses Considered as Perceptual Systems* (1966, 52) Gibson elaborates on learning as the improvement of discriminative capacities in terms of “a change of attention”. Subjects who go through training undergo “education of attention”. He writes:

> This increase of discernment is not confined to the detection of finer and finer details. The span of attention is increased with practice. It can (within) limits be enlarged in scope. It can also be extended in time.
>
> Gibson 1966, 270

For the explanation of education of attention, Gibson refers the reader to Eleanor J. Gibson’s *Principles of Perceptual Learning and Development* (1969). According to E. J. Gibson, the differentiation process is constituted by the practice and repetition activities the subjects perform in the real world, not by information enrichment processes that supposedly take place in the subjects’ brains; perceptual learning and development are construed on the principle of selectivity. (See also E. J. Gibson and Anne Pick (2000)).

It will become clear in the course of this dissertation that there is a tension between E. J. and J. J. Gibsons’ ideas on learning on the on hand, and the concept of perception as the pick-up of information based on ecological laws. Put simply: if optical invariants correspond uniquely and lawfully to affordances, how can perception improve or evolve? The laws that “underlie” perceptual information would have to evolve with them, it seems. In chapters 4 and 5 this apparent paradox will be treated more in depth.

1.8 EXPERIMENTAL APPLICATIONS: STAIR CLIMBING AND GANNETS DIVING

Gibson and Gibson's early experiments illustrate that ecological psychology consists of much more than conceptual analysis. In fact, experimental ecological psychologists outnumber the theorists who are occupied with its epistemological and ontological issues. In the light of the following chapters it will be useful to give the reader an idea of the nature and goals of the experiments carried out by ecological psychologists. Two classics will be described briefly to finalise this chapter: the "*tau*-hypotheses" for gannets who dive into the sea (Lee and Reddish 1981), and Warren's (1984) research on humans' stair perception.

1.8.1 Plummeting gannets: the "tau" hypothesis

Gannets[7] are large sea birds that hunt for fish by diving into the water from heights up to thirty metres. During the first phase of the dive the bird slightly stretches out its wings so that it can steer properly. In the second phase the wings are stretched backwards so as to allow for a swift entry into the water. The timing of adjustment of the wings is crucial: stretching the wings backwards too early results in less accurate steering, possibly missing its prey. Stretching back its wings too late results in injury from the impact with the water surface.

Time-to-contact with the water surface depends on three variables: the bird's altitude, its speed and its acceleration. It could be argued that the bird monitors these three variables and calculates its time-to-contact to guide the dive. Yet, such an explanation is unparsimonious: detectors for the three variables and the ability to calculate are postulated. Lee and Reddish (1981, 293), using goniometry and derivatives, define a variable "tau" as the ratio of optical size to the optical expansion rate of a feature in a flowing optic array. It is quite intuitive that as one approaches the feature its optical size increases. Additionally, when approaching it at constant speed, the rate optical size increase (*i.e.* optical expansion rate) increases exponentially so that "tau" approaches zero as one

[7] "Jan-van-genten" in Dutch.

comes closer. So, at constant speed, the optical variable “tau” corresponds to the time-to-contact with the object that gives rise to the optical feature.

Lee and Reddish analysed video footage of diving gannets, comparing tau values with other variables (such as distance, dive time) and found that—correcting for acceleration because gannets don’t dive at constant velocity—the calculated tau values converge around the ideal tau-curve whereas the other variables don’t converge. This strongly suggests that the gannets in fact use the optical variable tau to time their wing retraction, rather than the other variables tested. It is empirical evidence that ecological optics may lead to solid explanations of perception-action capabilities.

1.8.2 Visual guidance of stair climbing

Warren (1984) presents a biomechanical model that predicts the perception of the affordance “climbability” of staircases. He summarises the biomechanics of stair climbing as follows:

> The activity of stair climbing is a special case of human bipedal locomotion that is metabolically demanding, requiring up to 15 times the energy expended in walking the same distance on the level. Unlike simple grade walking, the stride length and lift work done on each step are prescribed by the stairway’s dimensions, so that an optimal gait cannot be freely adopted. Thus, to a great extent the metabolic efficiency of climbing is determined by the fit between the dimensions of stairway and climber.
>
> Warren 1984, 685

The energy expenditure while climbing stairs is a function of a person’s weight, her step frequency, leg length, the stair’s riser height and the stair’s diagonal, according to Warren (ibid.). He proposes that the affordance of “climbability” be defined as the ratio of a person’s leg length to riser height, a dimensionless, so-called “pi-number” (analogous to “tau” in the previous section) that is thus independent of the absolute measures of legs and risers. Warren’s experiments consist of asking test subjects to judge the “climbability” of stairs with varying pi-ratio’s. As expected, the judgements are independent of absolute measures. The critical pi-values—the ratio’s above and below which stairs are no longer

perceived as easily climbable—are found to be the same for all test subjects, and the optimal pi-value connected to the subjects' judgements is predicted by the biomechanical model.

Warren (1984, 699) concludes that the visual category of "climbable" is biomechanically bound by the critical pi-values and that visual preference is determined by the optimal ratio. He suggests that it is likely that ecological optics may discover an invariant in the ambient optic array that corresponds to (or "specifies") the critical and optimal pi values, and that such a discovery would suggest that perception of the affordance of "climbability" is non-inferential, *i.e.* "direct", obviating the following possible account:

> [...] environmental dimensions and body dimensions are perceived and represented independently, in units of some extrinsic or absolute metric. These two separate sets of measures would then have to be calibrated and critical and optimal values computed on the basis of prior experience.
>
> Warren 1984, 700

The account Warren proposes is more parsimonious because only one detection ability is needed whereas the computational account postulates multiple detectors, in addition to calibration and computational abilities. Warren provides evidence for the idea that perceptual categories can be anchored to behavioural dynamics such that no categories of "mental origin" or concepts are needed to explain perception of affordances. Warren suggests his approach can be expanded to other affordances' material and informational bases, such as "reaching, grasping, lifting, sitting, passing through apertures, stepping down ledges, jumping gaps, locomotion over surfaces with varying properties, foraging and food selection, predation, and so on" (ibid.)

We will return to experimental ecological studies in our final, sixth chapter where we will analyse whether and how expansion of the ecological approach into more "cognitively demanding" areas is viable.

1.9 Concluding remarks

We have seen that Gibson proposes a novel way of thinking about the Poverty of the Stimulus (PoS) in the study of perception. Explanation of perception shouldn't be bothered by PoS-arguments because PoS is the result of an analysis on a level of description of the world that is unfit for psychology. A better analysis is proposed: description of environmental features and events in terms of animals' action capabilities. This ontology allows for richness of stimulus information, patterns in (flowing) ambient energy arrays that relate directly to action as well. These are the outstanding contributions of Gibson's work.

We must conclude, however, that as to *how* animals detect or pick up those invariants, as well as to how they become able to pick them up, Gibson offers but metaphors and hints. The experiments we highlighted can be said to work on explanations based on these metaphors and hints.

Gibson (1967) wasn't only concerned with psychological explanation of perception, but also with the epistemology of perception. Back then he intended the ecological approach to be pertinent as well with regards to the philosophical puzzles posed by empiricism. His call for a reconceptualization of knowledge has been answered by "Neogibsonians" in a way that gives rise to a paradoxical tension between learning and realism. His 1979 views no longer reflect the earlier commitment to an epistemological concept of perception. He argued that along his new concept of perception, an entirely new way of thinking about cognition, knowledge and memory ought to be pursued.

Experimental research based on the principles of the ecological approach have been introduced. These hold the promise to replace "information processing" and/or "representational" accounts of perception.

CHAPTER 2

Reception of Gibson's theory of Direct Perception

> *[…] unless the notions of pickup and invariant are constrained, it will always be trivially true that there is an invariant property whose pickup is necessary and sufficient for the perception of any object:* viz. *the property of being that object.*
>
> Jerry A. Fodor and Zenon W. Pylyshyn, 1981

2.1 Introduction

Gibson's (1979) *The Ecological Approach to Visual Perception* is directed against what is known now as the Establishment Theory of perception. His aim was to show that, if environment, stimulus information and perceptual systems are conceived in the right way, then mental inference becomes an unnecessary notion in the explanation of perception. In response, Jerry Fodor[8] and Zenon Pylyshyn (F&P), the self-appointed defenders of the Establishment Theory, argue that Gibson didn't achieve what he aimed for. In their fifty eight pages long article F&P aimed to show why Gibson's redefinitions of stimulation and perceptual systems don't warrant the conclusion that perception is direct.

> […] we will examine the thesis that the postulation of mental processing is unnecessary to account for our perceptual relationship with the world; that if we describe the environment in the appropriate terms we see that visual perception is direct and requires only a selection from information present in the ambient light.
>
> F&P 1981, 139

[8] Jerry A. Fodor passed away on November 29, 2017 while we were drafting these pages. Let this chapter be a tribute to his critical thoughts.

The thesis that perception is direct, or its negation that perception is not direct, can be taken in two senses, a psychological and an epistemological one. The claim that perception is direct, in the psychological sense, entails that it is not mediated by a process of inference. The claim that perception is indirect, then, is that perception *is* mediated by inference, here called "mental processing" by F&P. The notion of directness in relation to perception, and its negation, are also used in another sense, namely epistemologically. In epistemology "direct" and "indirect" are terms used to characterise the relation between a knowing agent and the known objects. Those who say that the objects of knowledge are the worldly objects or states of affairs themselves, hold that the knowledge relation is direct. Those who claim that knowing agents are related to proxies or representatives of worldly states of affairs say that knowledge is indirect. F&P (1981, 156) state that their arguments are directed against directness in the psychological sense and independent of epistemological concerns, but we will see that this not entirely accurate.

So, what is the Establishment Theory of perception? And why does it insist that perception depends on inferences? Supposedly, inference solves a problem. What then is that problem? A central question to be answered by perceptual psychology is how it is possible that humans and other animals, when confronted with a variety of sensory stimulation, nevertheless perceive or act unequivocally; how they are able to behave in the same particular way, in response to different circumstances. The answer to this question is not straightforward because it has been observed that sensory stimulation is sometimes ambiguous with regards to worldly states of affairs. This is known as the "Poverty of the Stimulus" (PoS) argument, a phrase coined by Noam Chomsky (1980) in the context of language learning theories, stating that childrens' exposure to grammatical structures is so limited that innate grammatical structures must be postulated in order to explain their ability to learn a first language. More generally in (the philosophy of) psychology any argument that seeks to warrant the postulation of an unobserved entity on the basis of a supposed insufficiency of environmental information has become labelled as a PoS argument. PoS arguments have been used in the context of "simple" seeing, for example the ability of some animals to re-identify certain objects despite the object's supposed resemblance to others of its kind. The PoS

argument may be taken to justify the postulation of a mental "copy" of the object so as to facilitate re-identification.

In another context, often characterised as "seeing *as*", a PoS argument is deployed to justify the postulation of conceptual abilities, that is, the ability to generalise to types. One of F&P's favourite examples to illustrate this is that of 'seeing shoes'. Shoes come in many shapes, sizes and colours. Yet, despite the multitude of properties connected to different shoes, you are able to see them all as one of the same kind of thing: a shoe. So somehow a variety of (possible) stimulations leads to a unified "treatment"; many lead to one. The Establishment Theory of perception proposes that the "unification" process is part of the perceptual process, conceived in a particular way. They propose to solve the many-to-one phenomenon by considering perception to consist (partly) of a process of mental inference, and "memory" delivers part of the content over which the process infers (F&P 1981, 140). If it is supposed that the deliverances of the senses can be considered as premises (representing the variety of sensory properties of shoes), and that memory contains premises that connect that variety of sensory inputs to the shoe concept, then one, supposedly, has a psychological mechanism that can infer "shoe" from the variety of sensations caused by shoes. The Establishment view is committed to the idea that, properly substantiated, this rationale explains perceiving things with many different properties—and some of which seem to have few properties in common—*as* shoes. F&P's specific PoS arguments against Gibson will be discussed in detail in the next section. They add that treating sensory input and memory as premises for an inferential process commits them to mental representations: mental inferences are transformations of representations (F&P 1981, 140). They hold that on the physical level the process is realised as a computational process. The result of the perceptual process is thus a perceptual representation (or a perceptual judgement) that accurately represents the object or state of affairs that caused the sensory stimulation.

It is important, we believe, to point out that treating the perceptual process and its result as representational—that is, as involving and resulting in states that have truth or accuracy conditions—reveals that F&P's commitments go further than what is necessitated by the demands of psychological explanation. The idea

that perception results in a state with semantic content, *i.e.* truth or accuracy conditions, has its origin, we contend, in the epistemology of perception because the notion of truth is related to knowledge primarily. One can have false beliefs and true beliefs. And only the latter can, presumably, constitute knowledge if additional criteria are fulfilled. The fact that beliefs can be based on, or informed by perception has led to the idea that the truth of those beliefs in some sense depends on the "truth" of perception.

> The point is, rather, that a psychology which limits itself to considering only the extensional relations misses something that appears to be essential to explain how our perceptual transactions with the world affect what we know and believe.
>
> F&P 1981, 189

Their idea is that since beliefs involve conceptual or semantic content, for perception to have an epistemic impact on belief, perception itself must have semantic contents too. The point we want to stress here is that the introduction of truth conditions into an empirical psychological explanation of perception is taken for granted by F&P, as it has been by a large part of the Western tradition of philosophy of perception in which psychological and epistemological questions were often not differentiated. Gibson too, sometimes, takes the perceptual relation to be an epistemic relation and takes his psychological theory of perception to supply reasons for epistemological conclusions (cf. Gibson 1967; 1979, 246). Gibson's tentative ideas (cf. chapter 1) about the relation between perceiving and knowing lead F&P to state that:

> Gibson and the Establishment agree that pickup and inference exhaust the psychological processes that could produce perceptual knowledge.
>
> F&P 1981, 141

This statement is not only exemplary of the mix up of psychology and epistemology, it is also highly contentious because it assumes that there is agreement between Gibson and the Establishment regarding the meaning of the concepts of "pickup" and "perceptual knowledge", and that they only disagree about the role "inference" plays in psychology of perception. A large part of this chapter will consist of analyses attempting to show that no such agreement exists. First we will analyse how the Establishment conceive "direct pickup" and

“inference”, and their critique on the ecological approach that follows from their concepts. Then we’ll discuss the shortcomings F&P identify in the new notion of information that Gibson proposed. This will set us on the path of an analysis of the different epistemological and metaphysical assumptions that underlie F&P’s concept of perception on the one hand, and Gibson’s on the other. We will conclude with the implications of this analysis for the concept of “misperception”, and its role in psychological explanation of perception.

2.2 Pickup and/or inference

Throughout their text, F&P make it clear that for them the goal of a perceptual psychology is to account for the causation of perceptual judgements (F&P 1981, 156; 171; 174). Visual perception, according to them occurs in distinct episodes (F&P 1981, 171). Each episode is characterised as an “inwardly” flowing causal chain that starts in the environment, proceeds through light waves that cause activation of photoreceptors in the retina, which in turn causes the inferential mechanism(s) to produce a perceptual representation. This standard conception of the perceptual process has the benefit that it is literally straightforward and intuitive. It entails that, for each particular perceptual episode, its (proximal) causes—light reflecting off surfaces, sensory receptors and the inferential mechanism—are present, and that these proximal explanantia suffice to understand the process. Concretely, it means that it suffices to understand the mechanisms of pickup and inference to formulate an explanation of perception. But why pickup ánd inference? Why not only pickup or detection of properties? Answering this question requires us to investigate F&P’s specific version of the Poverty of the Stimulus argument.

They develop two arguments to substantiate their claim that inference is a necessary posit in the psychology of perception (F&P 1981, 142-143). Both stem from their understanding of “pickup”, or “detection”. In other words, they believe “pickup”, or “detection”, when defined strictly, is by itself insufficient to account for the many-to-one relation that is manifested in psychological processes; and that the perception of a shoe, for example, can’t be explained only on the basis of detection of the properties of the shoe, because shoe perceptions can be caused

by many different sensory stimulations which seem to have little in common, given the wide variety of shape, size and colours of shoes.

The first PoS argument concerns the extension of the sample of stimulation that is actually effective in the causation of perceptual representations, as opposed to a hypothetically "complete" sample. The fact effective stimuli sometimes underdetermine the result of the perceptual process leads F&P to generalise that the stimulation samples that play a causal role in perception are always ambiguous. To make this more clear, let's look at another classic example of the PoS thesis, that of the manifold of geometric objects that could give rise to the perception of a square. A flat square, a rectangle viewed under a particular angle, a cube, a rectangular parallelepiped with two square faces, a pyramid viewed from the bottom, etc., can all give rise to seeing a square when the point of observation is fixed.

A fixed point of observation in the example just described, is a constraint on the extension of the sample of stimulation. When you perceive a square from a fixed position, your sample is limited to the light that reaches you on that spot only. You'd have a more extensive sample of stimulation, should you move a bit to the side. Such a larger sample may disambiguate what you see. When you move, another face of a cuboid may come in view, which eliminates the possibility that the perceiving of the square was caused by an actual flat square. If we were able to sample a cube from all sides, e.g. by moving all around it, our sample would be hypothetically complete. The point is that we don't. When we see objects, our observation is often based on relatively small, "impoverished" samples. F&P's contention is that, the sizes of the samples that are actually used—that is, the effective samples that cause perceptual episodes—are thus limited and that they insufficient to disambiguate by themselves the perceptual representations they supposedly cause.[9] Yet, they contend this without evidence.

[9] Some Establishment approaches to perception take sample sizes to be small because it has been empirically demonstrated that minimal, just above threshold samples give rise to perceptual experiences. Hence, the smallest detectable samples are considered to be the "building blocks" of perception. F&P (1981, 174-176) qualify this view: "In particular, the spatial limits of the immediately detected visual properties may extend beyond the retinal field and their temporal limits may extend beyond the measured refractory period of the visual system as neuro-anatomically defined. [...] The

The second argument F&P offer for the necessity of inferential processes concerns the kinds of properties that can be detected by the sensory apparatus. F&P emphasise the aspects of kind and sample size of the PoS thesis because Gibson's proposed solution for the many-to-one puzzle amounts to, first, an extension of the kinds of properties that can be directly detected, and second, an enlargement of the extent of the samples that can be picked up without inferential mediation. F&P's critical strategy, in response to Gibson, aims at showing that the constraints on kinds and samples proposed by the Establishment are the only valid ones, and that Gibson's "widening" of constraints results in a vacuous theory. They argue that, ultimately, the constraints on the kinds and samples of detection (or "direct pickup") proposed by Gibson, are no constraints at all, so that any kind of property might be said to be detectible, and that there are no limits to the sample size that can be picked up without inferential mediation.

> [...] we can give the following disarmingly simple answer to the question: how do people perceive that something is a shoe? There is a certain (invariant) property that all and only shoes have—namely, the property of being a shoe. Perceiving that something is a shoe consists in the pickup of this property.
>
> F&P 1981, 142

If the theory of direct perception is as it is portrayed here by F&P, then it is indeed vacuous and trivial. It would explain nothing. Some may say that it is a straw man version of ecological psychology. It probably is, but Gibson gave cause for such a reductio himself when he wrote passages like this one:

> [...] when the young child sees the family cat at play the front view, side view, rear view, top view, and so on are not seen, and what gets perceived is the *invariant* cat.
>
> Gibson 1979, 271

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pressing issue is thus to understand what sorts of empirical considerations are operative in deciding which properties of light are transduced, and what the empirical consequences of such decisions are." They maintain that Gibson offers no (sufficient) empirical considerations to decide the matter.

Perhaps, this example of the cat isn't so problematic because the property of being a cat might be sufficiently determinate to constitute a natural kind. But there are also reasons to deny this (cf. chapter 6), so that the inclusion of "cat invariants" as detectibles presents a slippery slope towards detectability of non-phycislistic properties like being a shoe, being born after 1958, being a grandmother and being painted by Da Vinci—all examples courtesy of F&P.[10]

F&P make it clear that all psychological theories of perception, including their own, must formulate constraints on what can be detected directly, *i.e.* without inference, because the stage that precedes inference must deliver part of the "input" for that inference.

> Fundamentally, this is because inferences are processes in which one belief causes another. Unless some beliefs are fixed in some way other than by inference, it is hard to see how the inferential processes could get started. Inferences need premises.
>
> F&P 1981, 155

So, for the inferential mediation to get started, there must be some prior direct contact with the environment surrounding the perceiver. That stage they call "detection".[11] One of the crucial questions to be solved by perceptual psychology, according to F&P, is to draw a firm line between the properties that can be detected directly and those that cannot. Those that cannot be directly detected, then, supposedly need to be inferred. For direct detection you obviously need a "detector", called a transducer mechanism by F&P.

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[10] It might be asked whether F&P's portrayal of Gibson as if he aims to account for the perception of properties is a fair one. Gibson writes that perception is of substances and events insofar as they relate to behavioural possibilities; what they afford. If "property" is used liberally, "affordances" may resort under them. The properties F&P enlist, however, aren't conceived as action related but as "universals".

[11] Note that F&P's characterisation of the mechanism of inference as one belief causing another implies that "direct detection" amounts to a form of belief, *i.e.* that stimulation of a receptor results in a state with truth conditions. See chapter 6 for an analysis.

> [...] transducers are technically defined as mechanisms which convert information from one physical form to another.
>
> F&P 1981, 157

F&P continue that this definition of transducers is still too wide to figure in an explanation of perception. Without further constraints an entire organism can be considered a transducer. *E.g.,* when I describe a picture, I may be said to transform optical information to acoustic information. Therefore, I am a transducer. But transducers so conceived are, again, vacuous as explanantia without a further account of how precisely I can do this—we will contend that such an account is possible in terms of one's history of interactions, but let's not get ahead of ourselves. F&P, on the other hand, propose to secure the explanatory purchase of transducers in perception theory by constraining them in terms of natural laws:

> [...] the decision about what detectors there are is linked to the decision about what laws there are. A world in which there were laws about the property shoe would be a world in which there could be detectors for shoes.
>
> F&P 1981, 164

The idea to couple detectors to natural laws can be elucidated as follows: for some mechanism to count as a detector of a certain property P, the mechanism's "output state" S_i must be reliably correlated with the presence of P. However, being reliably correlated—even one hundred percent reliably—to P doesn't suffice, because P may also be reliably correlated to some other property R. When that's the case one wouldn't know whether S_i "signals" for P or for R. Therefore, it is said that the generalisation that expresses the correlation between P and S_i must be "counterfactual supporting". This means that, although *in fact* P and R always co-occur, if P *were* to occur *counterfactually* without R, then the detector would have state S_i (and, inversely, to be a P-detector, when it is in state not-S_i, P mustn't be present even when R would be, although the latter—that is, R without P—*in fact* never occurs).

If it is indeed the case that the decisions on what natural laws there are and what detectors there are (F&P 1981, 164) are to be made together, then it follows that there can only be detectors for the kinds of properties that (can) figure in those

natural laws. F&P (1981, 146) call these “projectible properties”; also known as “natural kind properties”. F&P (1981, 164) state that only the laws of the physical sciences qualify as natural laws, and thus that only the kinds of properties referred to in physical law statements are directly detectible. They claim that Gibson’s views on the matter are consistent with their idea on the conceptual connection between natural laws and detectors, because Gibson argues for direct detection of ecological properties on the basis of the existence of ecological laws.

> The perceiving of these mutual affordances is enormously complex, but it is nonetheless lawful, and it is based on the pickup of the information in touch, sound, odor, taste, and ambient light.
>
> Gibson 1979, 135

It becomes, then, a pressing question for Gibson to offer an independent characterisation of “the ecological” (and also of lawfulness; cf. below). Independent means that, since he defines what properties can be picked up or perceived directly in terms of “the ecological”, “ecological” itself mustn’t be defined in terms of being directly detectible or perceivable, on pains of vicious circularity, F&P point out. They aim to show that Gibson offers no independent definition of the ecological realm, and thus, that he has no way to properly constrain direct detection and what can be detected. This argument by F&P, however, rests on the presupposition that Gibson’s and their own definitions of (direct) detection amount to the same thing. This, we think, is not the case. Gibson (1979, 52) explicitly writes that energy may be transduced but information, as he defines it, is never transduced, conveyed or transmitted:

> When stimulus energy is transformed into nervous impulses, they are said to be *transmitted* to the brain. But stimulus information is not anything that could possibly be sent up a nerve bundle and delivered to the brain, inasmuch as it has to be isolated and extracted from the ambient energy. Information as here conceived is not transmitted or conveyed, does not consist of signals or messages, and does not entail a sender and a receiver.
>
> Gibson 1979, 57

From this it follows that the system responsible for information pickup in Gibson’s approach is not a transducer mechanism as defined by F&P. That isn’t

to say that there is no relation between direct pickup and lawfulness in ecological psychology but its concept of detection is certainly different, despite F&P's assumption:

> We will assume, in what follows, the identification of what is "picked up" with those properties that transducers respond to.
>
> F&P 1981, 158

F&P are, of course, free to assume whatever suits their own theoretical aspirations. The point here is that they assume that Gibson would agree to their identification of information that is available for pickup and energetic properties that might be transduced. We have just seen that he doesn't. Yet, Gibson's refusal to reduce direct pickup to transductive mechanisms doesn't entail that he has no criterion at all to constrain his idea of pickup, as F&P (1981, 152) claim.

Admittedly, Gibson's characterisation of perceptual systems meanders between two implicitly present, but distinct explanatory strategies. The first strategy appears to remain relatively close to the Establishment's explanatory style: explanation in terms of natural, albeit ecological laws, so it adheres to a deductive-nomological model of explanation. This strategy is, as we will see in the next chapter pursued further by Neogibsonians, who attempt to specify further what informs the decisions as to what perceptual systems there and as to what ecological laws there are. Without such further specification, it may indeed be so that Gibson's characterisations of perceptual systems as active, non-mechanistic systems that search, or "hunt" for information, become "attuned" to, or resonate to ambient information (Gibson 1979, 238), "amount to little more than whistling in the dark." (F&P 1981, 150).

A second explanatory strategy that is present in Gibson's work—rather diffusely in *The Ecological Approach* (1979) but more explicitly in *The Sense Considered* (1966, chapter IX) and in Gibson and Gibson (1955)—focuses on the evolution and the development of perceptual systems. This alternative approach is ignored entirely by F&P, as we will see shortly. Such "historical explanations" are not deductive, but rely on inference to the best explanation. They don't necessarily or exclusively rely on natural law. Gibson's references to the explanatory relevance of the historical antecedents of perception is ignored entirely by F&P.

To summarise: Starting from the observation that not all properties can be detected directly, F&P stress the need for an empirical ground as the basis for the decision which properties can be detected directly and which can't. They contend that this decision must be made together with the decisions as to what natural laws there are and which mechanisms can count as detectors. This implies that detectible properties ought not to be defined in terms of their detectors or vice versa. F&P argue that Gibson does exactly that: he, supposedly, defines his perceptual systems in terms of the properties they supposedly pick up directly, without offering sufficient, independent empirical grounds that allows to settle both matters at once. F&P also argue that Gibson defines the properties that are picked up in terms of perceptual systems. This follows, they say, from Gibson's concept of information. This is the subject of our next section.

2.3 Establishment analysis of Gibsonian information

As we have seen in the previous chapter Gibson goes through great lengths to define a new notion of information. As forming the basis for perception, Gibson's theory of information is set out primarily to distinguish it from the classic notion of a stimulus that is taken to cause a sensation. Secondly, it was to be distinguished from the kind of information that is encoded, transmitted over a channel, and then decoded. Gibsonian information is taken to reside in the ambient optic array. It exists independently of receptors. F&P analyse it as follows:

> The basic idea is that the state of affairs S1 contains information about the state of affairs S2 if and only if S1 and S2 have correlated properties.
>
> F&P 1981, 158

But, F&P note, "information-cum-correlation" is a symmetrical notion. If a property of S1 is informative about a property of S2, then S2 is also informative of S1. Gibson, however, insists that informative properties "specify" other properties. Unlike correlation, "specifying" is not symmetrical, it has a direction. The direction of specification depends on the type of detectors an organism possesses and thus, F&P conclude, specifying information is not a purely objective

notion. For example, when there is a correlation between properties of light and the layout of a place, then the direction of specification is determined by the kind of detection mechanisms an organism has. If it has light sensitive surfaces, light properties may specify layout properties. And conversely, if it has direct lay-out detectors then lay-out properties may specify light structure properties. The point is that, since specification depends on the pickup capacities to determine its direction, specifying properties are circularly defined. Without a theory of perceptual systems responsible for pickup, specification is a void notion that explains nothing.

Transducer mechanisms solve this problem for F&P. If P is a property of S1, correlated with R of S2, and P is a transducible property in virtue to some transducer mechanism then the direction of specification is fixed. But, so F&P state, this comes at a cost, because only projectible properties are transducible. That implies that only projectible properties can specify their worldly correlates. And, although "being correlated with R" is a property of P, "being correlated with R" is not a projectible property of P. This means that while P might be informative about R, P can never of itself be "informative about its being informative". This is, nevertheless, what Gibson means with "specifying information", F&P claim.

> Having introduced the (purely relational) notion of states of affairs *containing information about* one another (i.e. being correlated) Gibson then slips over into talking of *the information in* a state of affairs. And, having once allowed himself to reify information in this way (to treat it as a thing, rather than a relation), it is a short step to thinking of detecting the information in the light on the model of, for example, detecting the frequency *of* the light; *viz.* as some sort of causal interaction between the information and the states of a perceptual mechanism (the information makes the perceptual mechanism "resonate").
>
> F&P 1981, 167

In other words, what F&P point out is that the fact that properties P and R are correlated cannot cause a psychological state in the organism because correlations aren't things that can cause anything. It follows then that such facts as "being correlated" can't be detected directly. We think this conclusion of F&P is correct, both for the transduction conception of direct detection, and for the—yet to be defined—perceptual systems notion of detection. By extension, even if

informative properties correlated to "ecological properties" (F&P's term to refer to affordances; 1981, 145) can be picked up directly—on some construal of direct pickup—pickup of the property of "being correlated with affordances" requires an explanation of its own. This, we think, can only succeed when the environment and history are taken into account.

F&P (1981, on nearly every page) draw a further conclusion from this: that inference is the only mechanism that might explain perception on the basis of non-projectable properties. But this conclusion is false, we think, for two categories of reasons. The first negative, the second positive. The negative reason against their conclusion is that inferential mechanisms can't explain this either (we will see why the Establishment's is a pseudo-explanation in chapter 6). The positive reason, naturally, amounts to a demonstration that the perceptual process can be explained without positing inferential mechanisms which is the general goal of this dissertation, which we share with the ecological approach to perception.[12]

We can see now that achieving that goal depends in part on finding an empirical ground to make the decision on what defines perceptual systems and the informative properties they "pick up". The decision on what natural laws there are may be connected to the decision too, but whether this is crucial will be scrutinised in chapter three.

2.4 Concepts of perception

In this section we will focus on F&P's qualification of the perceptual relation as an "intentional" relation, and their critique on Gibson that, supposedly, he has no theory of intentionality (F&P 1981, 192). Importantly, F&P take their qualification of perception as an intentional (and epistemic in a particular sense) relation to entail that it is a capacity that involves truth conditions: explaining perception amounts to an explanation in terms of the causes of a perceptual judgement that can be true or false. So, for F&P (1981, 188) "intentional" is equivalent to

[12] It's a goal also shared with radical behaviourism and radical enactivism.

“contentful” and to representational. Gibson’s concept of perception is different. What he calls a percept is not a state with truth conditions. This is most evident when he writes of misperception; he doesn’t take this to involve a false judgement or representation although his phrasing is often sloppy, using terms like “incorrect perception” and “specifying false facts” (Gibson 1966; see the next section for a discussion of misperception).

Besides being a process that ends with a true or false perceptual representation, the Establishment also identifies a particular beginning of the process: transduction. This approach, thus, strictly delimits the explanantia for the causation of a perceptual judgement to the proximal causes of transduction and the inferential mechanism. F&P project this logic onto the Ecological approach. Not only do they falsely take Gibson to see the relation between “direct pickup” and perception as a causal relation, they also assume that the ecological approach conceptually limits its explanatory resources in the same way as they do. Both are false attributions. Gibson denies the first explicitly:

> An application of stimulus energy exceeding the threshold can be said to cause a response of the sensory mechanism, and the response is an effect. But the presence of stimulus information cannot be said to cause perception.
>
> Gibson 1979, 56-57

Gibsonian “pickup”, or direct detection, is not a cause of perception, contrary to the Establishment’s “transduction”, which is a cause. For the former, “direct pickup” is explanandum, for the latter explanans. It might even be said that, for Gibson, the pickup of information is “constitutional” for perceptual activity, while F&P’s pickup as transduction is merely a cause of the perceptual process. This assessment has two important consequences, one for each approach. The first regards the question as to what then are the explanatory resources for the ecological approach. The second pertains to the Establishment: since they limit themselves to transduction and inference, intentionality, or truth conditions, need to be postulated on the level of these proximal causes. That is, transducer states must be considered as having truth conditions. In their 1981 paper they don’t elaborate on that assumption, besides expressing hopes for a future theory of psychosemantics:

> The hope is, however, that theoretical appeals to the semantic content of mental representations will ultimately prove dispensable; in particular, that identities and differences among the semantic contents of mental representations will be reconstructable in terms of identities and differences among their functional (e.g., causal) roles.
>
> F&P 1981, 190-191

With regard to the explanantia of the Ecological approach, in the new foreword to the Classic Edition of *The Ecological Approach to Visual Perception* (2015) William Mace describes a view of Gibson that can serve as an entry point into the matter:

> The activity of the visual system does not begin at the moment of being "stimulated" by the distant object. Rather, it is operating *continuously* in the service of detecting information in the reflected light that specifies the object.
>
> Mace 2015, xxi (emphasis added)

Gibson objected to an arbitrary temporal cut-off point for perceptual episodes in the following way:

> A special sense impression clearly ceases when the sensory excitation ends, but a perception does not. It does not become a memory after a certain length of time. A perception, in fact, does not *have* an end. Perceiving goes on.
>
> Gibson 1979, 253

Perceptual episodes, to use F&P's term, on Gibson's view are thus not demarcated with a beginning and an ending in the way F&P propose.[13] The demarcation of perceptual episodes is joined with the demarcation of *events* (Gibson 1979, 93; 110). Importantly, events are *nested.* Shorter events, like the falling of a leaf are nested within longer ones, like the seasonal change from summer to autumn. Since perception is understood as the regulatory aspect of organismal activity with regards to such significant events, it should be seen as a nested affair too. This indicates that explanatory resources are not limited to the proximal causes

[13] Note that Gibson (1979, 254) seems to contradict himself when he writes that "The perceiving of the world begins with the pickup of invariants", unless this is read as a logical beginning, as opposed to a temporal/causal one.

of transduction and inferences. Instead, Gibson constrains perception in terms of action. Perceptual systems are action systems that perform exploratory and optimising adjustments.

> I call this a process of *information pickup* that involves the *exploratory activity* of looking around, getting around, and looking at things. This is quite different from the supposed activity of getting information from the inputs of the optic nerves, whatever they may prove to be.
>
> Gibson 1979, 147 (emphasis added)

F&P don't engage at all with the idea of perception as exploratory activity. Their only reference to the conception of direct pickup as an achievement of perceptual systems as active, exploratory systems is a flat denial, without argument, that this notion can be used to break out of the circle of interdefinition of perceptual systems and the information they can pick up (F&P 1981, 152). This may in part be due to the fact that Gibson himself remains ambivalent regarding the mode of explanation he envisions. In a sense he seems to pledge allegiance to the Establishment's idea that the decision as to what perceptual systems there are, at the same time involves the decision as to what (ecological) natural laws there are. This line of thought in Gibson is found in passages like this one, in which he distinguishes between ecological laws and the laws of mechanics:

> Ecological events are various and difficult to formalize. But when we attempt to reduce them to elementary physical events, they become impossibly complex, and physical complexity then blinds us to ecological simplicity. For there *are* regularities to be found at the higher level, regularities that cannot now be encompassed by the simple equations of mechanics and physics. The movements of animals, for example, are lawful in ways that cannot yet be derived from the laws of orthodox mechanics, and perhaps never can be.
>
> Gibson 1979, 100

Gibson's "ecological optics", which describes how ambient light reflecting off of surfaces, joined with a moving point of observation leads to (disturbances of) the structure of flowing optic array, is a subdomain of the ecological approach to vision that is rightly characterised as explaining in terms of laws. Gibson strategically uses these lawful correlations between environmental and optical

properties as an argument against Poverty of the Stimulus arguments. He takes his proof of the objective existence of one-to-one mappings, or "projective correspondences" in ecological optics (Gibson 1979, 108) to solve part of the many-to-one puzzle that is posed by the PoS thesis. Prima facie, ecological optics reduces, in part, the "many" aspect of the PoS. The arguments of F&P we have just discussed show, however, that ecological optics by itself can't do all of the work—direction of specification falls outside its scope. Gibson was probably aware of this, leading him to explore the possibility of ecological laws beyond ecological optics, that include aspects of perceiving and acting animals, as suggested in the above quote. Hence his reference to laws that may explain the regularity of animals' movements and his insistence that perceiving affordances is a lawful matter (Gibson 1979, 135). Yet, Gibson's adherence to a "laws centred approach" isn't univocal. The other, evolutionary-developmental strategy shimmers through in passages like the following.

> Evidently the theory of information pickup does not need memory. It does not have to have as a basic postulate the effect of past experience on present experience by way of memory. It needs to explain learning, that is, the improvement of perceiving with practice and the education of attention, but not by an appeal to the catch-all of past experience or to the muddle of memory.
>
> The state of a perceptual system is altered when it is attuned to information of a certain sort. The system has become sensitized. Differences are noticed that were previously not noticed. Features become distinctive that were formerly vague. But this altered state need not be thought of as depending on a memory, an image, an engram, or a trace. An image of the past, if experienced at all, would be only an incidental symptom of the altered state.
>
> Gibson 1979, 254

Even though the focus of this passage is on negation of the role of memory understood as mental representations of past events, the aspect that concerns us here is the idea that perceptual systems change over time, become sensitised to optical variables they previously were unable to pick up. There is a way of reading this that stays true to the laws-centred account. If you presuppose that there is one, unique property that correlates lawfully with a worldly state or event, you can maintain the idea that it is only a matter of time and interaction

until a perceptual system gets attuned to that unique variable, and that eventually it always will because of the lawful nature of the correlation (cf. our brief introduction to Jacobs and Michaels' (2007) theory on direct learning). The idea that there is just one such optimal invariant is, however, an assumption that is at best methodologically motivated; it is not an empirical fact. Convergence upon one informative property may occur in some cases, but empirical research has shown that it doesn't happen in all cases (cf. chapter 5).

Another challenge for the laws approach is the possibility that perceptual systems are or become sensitive to disjunctive sets of informative properties. That is so because if, for example, an affordance is "specified" by ambient array invariant *a* or *b* or *c* or …, the idea of specifying information as a lawful relation is hollowed out, particularly if no "overarching" relation can be demonstrated between the invariants, and the open disjunction could be extended at any time. A problem may arises too with regards to constraining perceptual systems, if the latter are to be defined in terms of the invariants they are attuned to. Defining a perceptual system in terms of being attuned to invariants *a* or *b* or *c* or *whatever it attunes to tomorrow and/or next week*, doesn't offer grip on the explanandum. Consequentially, appealing to an underlying lawful relation doesn't help since it would have the same open-ended form: "If *a* or *b* or *c* or …, then R". Even if it is granted that such a law statement could be a counterfactual supporting generalisation, its explanatory value for future R-perceptions is poor. Such laws, perhaps better labelled "local constraints", don't exist as a matter of principle. They are empirical, and their origins need to be explained too. So, in the end, the deductive-nomological explanatory strategy relies on the understanding of the historical antecedents of the laws/local constraints. Hence, what is needed to constrain perceptual systems is a theory of how such systems become attuned or adapted, in the form of a history of differentiation into new perceptual systems.

F&P (1981, 188) conclude their critique on Gibson's supposed lack of constraints on the invariants perceptual systems can pick up with the claim that he treats perception as "extensional" even when it is not. The claim that perception is an extensional relation is to be contrasted with the idea that it is sometimes taken to be an intensional (with an "s" relation. This distinction can be illustrated by means of the terms "seeing" vs. "seeing as". "Seeing" simpliciter is taken to

require no or fewer prior knowledge on behalf of the perceiver. Suppose that you see a man on a horse. The man is Zorro, but you're unaware of this. You can be said to see Zorro on a horse, nevertheless. Equally, you can be said to see Don Diego on the horse. The clause "but you're unaware of this" assures that your seeing is an extensional context in which co-extensional substitution of "Zorro" and "Don Diego" is possible because both terms refer to the same man. Suppose now, that you have some knowledge about Zorro but you don't know that he is Don Diego. You can now be said to see that the man on the horse is Zorro, or you see the man as Zorro. This statement provides an intensional context because since you don't know that Zorro is Don Diego, substitution of the names is not possible. You don't see the man on the horse as Don Diego.

This distinction is important because simply seeing Zorro on a horse, or seeing a rider as Zorro or as Don Diego can have significant behavioural consequences (as well as experiential differences, if you like); hiding from the masked man—he may be a robber; hailing Zorro; going to Don Diego's house knowing he won't be home, etc. According to the Establishment approach to perception and cognition, the difference in experience and/or behavioural responses must be explained in terms of how Zorro is seen. This is possible only, F&P (1981, 189) argue, if prior knowledge about Zorro serves as a premise in the inferential process that underlies perception. F&P's adherence to a representational theory of intentionality, and to their preferred format of representational content, conceptual or propositional content, commits them to the idea that "intensional" and "inten*t*ional" imply one another. That is why they oppose extensional contexts with inten*t*ional (with a "t") contexts, in spite of the traditional logical contrast between extensional and intensional (with an "s") contexts. From the fact that Gibsonian information is correlational and thus extensional[14], and the fact that Gibson rejects inferential mediating of perception, F&P conclude that Gibson has no way to account for the different action courses one may take after seeing Zorro. Their own explanation is, of course, that there are two (or more) different representations of the man on the horse.

[14] F&P take Gibsonian information to be extensional. In the next chapter, we will see that Turvey et al. (1981) disagree with this analysis.

Although we think F&P's explanation is vacuous—they try to explain intensionality by assuming that memory and transduction are representational so that they can serve as premises for inferences—they are correct in saying that any theory of perception must postulate "two of something" to explain the different consequences of perceiving one thing (F&P 1981, 192). F&P interpret Gibson as postulating two different properties of a thing that perceptual systems might pick up, the property of being Zorro and the property of being Don Diego, for both of which optical information that is law governed must be present (F&P own solution is to posit two different perceptual representations to explain the different consequence).

F&P use Frege's (1892) example of the Morning Star and the Evening Star as an illustration. Both terms refer to the planet Venus, but the former is used when Venus is seen in the morning sky, the latter in the evening. It is perfectly possible for someone to use these terms accurately without knowing about the identity of their referent or extension. This shows that meaning (intension) and reference (extension) do not necessarily coincide, so that although "seeing the Morning Star" is in some sense equivalent to "seeing the Evening Star", "seeing Venus as the Morning Star" is not equivalent to "seeing Venus as the Evening Star". Consequentially, if Gibson wants to explain this difference of seeing as (or its differential behavioural consequences) by attributing two non-identical properties to Venus, "being the Morning Star" and "being the Evening Star", he faces a serious problem because on his extensional (correlational) theory of information, whatever property of the ambient light array correlates with the Morning Star, also correlates with the Evening Star, making differential pickup impossible.[15]

If we accept that any theory of perception must posit "two of something" to explain the different perceptions of a single object is correct, the historical line of thinking in Gibson's work that emphasises learning, becoming attuned, and the education of attention is able to supply differential causes: two learning

[15] Differential pickup would be possible if, for example, the Morning Star would always move away from the horizon and the Evening Star would move toward the horizon. Detection of such properties entails an extensional context, so F&P would insist that it is non-intentional.

trajectories, two paths of becoming attuned, and two histories of education of attention may be able to explain differential consequences to one feature (see also Gibson 1966 and Gibson and Gibson 1955, as referenced above). If different histories of becoming attuned to informative properties of events are taken as explanantia, then they are extensional (non-intensional with an "s") indeed, in the sense that they don't require abstract properties like "being the Morning star" or truth conditions. Establishment theorists will still protest that such a theory is still non-intentional (with a "t"). It would be on their own view of intentionality, the view that equates intentionality with representation and mental content. But this is not the only view of intentionality that is around. There is the possibility that intentionality comes in different kinds. One kind may be "basic intentionality" that lacks truth or accuracy conditions (*i.e.* content). A second, contentful kind is manifested in public symbol use and other explicitly representational practices (Hutto and Myin 2013, 2017).

This distinction between kinds of intentionality could supply the ecological approach with an empirical basis to decide upon F&P's question as to what perceptual systems there are, and what properties can be picked up directly. The answer would take the form of a natural history—evolutionary and developmentally—of selection of perceptual capacities that make a difference for animals in a certain ecological niche that consists of properties (or events, features, …) that may make a difference when picked up.

If a historical, yet empirical basis for constraining perceptual systems and ecological properties can be established, the challenge posed by F&P, that the ecological approach is vacuous, is resolved. Gibson's reconception of perception as an ongoing activity that allows organisms to regulate their comportment in relation to ecological events that unfold on different time scales leads us away from mechanistic explanations in terms of transduction and inferential mechanisms—the supposed proximal causes of perception—towards the distal causes that shaped perceptual systems. The natural history of "the differences that made [make] a difference" (Bateson 1970; see also Oyama 2000; Withagen and van der Kamp 2010).

2.5 Misperception

The analysis of Fodor and Pylyshyn's critique of Gibson's ecological approach would be incomplete without considering their arguments in response to Gibson's thoughts on misperception. They start their analysis of misperception by stating that direct perception can either be factive or non-factive. Saying that perception is factive means that if an apple is perceived then there is, necessarily, an apple. It follows then that perception is infallible, that misperception is metaphysically impossible so that experiences "as of" an apple when no apple is present must be considered as non-perceptual. Given the importance F&P attribute to illusions and hallucinations for perception theory, they find this interpretation of Gibson so incredulous that they choose another interpretation:

> Probably the line that Gibson wants to take is that *if* an affordance is correctly perceived, *then* it is perceived directly; and that is, of course compatible with the factivity of "directly perceive". Notice, however, that such an approach does not help with the problem of misperception, since it does not tell us how we are to describe the cases where the antecedent of the hypothetical is *false*.
>
> F&P 1981, 154

If direct perception is said to be non-factive, it means that when an apple is seen, then it may or may not be the case that there is an apple. Although metaphysically possible, non-factive misperception is hard to explain when it is taken to be non-inferential. For example, directly misperceiving the edibility of an apple—taking it to be edible when it isn't—can't be explained in terms of directly picking up the property of apparent edibility because fake apples misperceived as edible apples *do* have the property of being apparently edible, according to F&P, and one needs to explain how a property that they *don't* have is perceived. The Establishment's own solution is that edibility is falsely inferred from apparent edibility. Obviously, being committed to a non-inferential account Gibson can't take that route.

Neogibsonians (Turvey and Shaw 1979; Turvey et al. 1981; Shaw, Turvey, and Mace 1982), as we shall see in the next chapter, have a reply to this challenge of reconciliating non-inferentiality, factivity and (apparent) misperception. F&P pre-empt that reply as follows:

> This problem is such a serious one that it sometimes drives Gibsonians to truly desperate recourses. For example, Turvey and Shaw (1979) suggest that we should cope with the issue of perceptual error by "tak(ing) perception out of the propositional domain in which it can be said to be either right or wrong… and relocate(ing) it in a nonpropositional domain in which the question of whether perception is right or wrong would be nonsensical". (p. 182). Apparently, this means either that we should stop thinking of perception as eventuating in beliefs, or that we should stop thinking of beliefs as having truth values. Turvey and Shaw describe this proposal as "radical", but "suicidal" might be the more appropriate term.
>
> F&P 1981, 154

Besides the *ad baculum* appeals to desperation and suicidality, F&P offer no real argument here. They suggest that taking perception out of the propositional domain presents us with a dilemma of which both horns are inacceptable. But it is a false dilemma because the first horn is deceptively ambiguous. "Perception eventuating in beliefs" can be read in two ways. Giving up on the idea that perception eventuates in beliefs is unpalatable for anyone who holds that perception is a form of belief; if perception defined as resulting in a perceptual representation, and perceptual representations have propositional content by definition, then perception eventuates in a belief simply because it is taken to be a form of belief. On this interpretation it is just F&P's refusal to reconsider their definition that pushes one towards the second horn. The second, epistemological interpretation of the first horn suggests that assuming the nonpropositionality of perception entails that belief cannot ever be informed by perception. Put differently, this interpretation suggests that empirical knowledge is impossible on the assumption that perception doesn't involve truth conditions. Yet, F&P give no argument for this either[16], let alone any evidence that Gibson (or anyone else) would have to agree to this.

[16] F&P (1981, 156) write: "In what follows, then, the epistemological issues will be put completely to one side: we make no assumptions about the epistemological role of whatever is directly detected; for us, "direct" means only "noninferential". Yet, our second interpretation of the first horn of the dilemma does rely on the epistemological role of perception. Also, their judgement that Gibson's theory has no implications for epistemology (ibid.) might be too quick.

2.6 Concluding remarks

We think that Gibson's attempt to account for misperception in terms of misinformation, or in terms of failing to pick up all the relevant information, aren't powerful enough to settle the matter. His proposed explanation of misperception as based on misinformation is only as good as his explanation of how perception is based on pickup of information, which we found lacking.

F&P's critique on the laws-centered explanatory strategy that is present in Gibson's work is justified to a considerable extent. Gibson's characterisation of perceptual systems is not concrete enough to help us understand how information is picked up. Gibson's thesis that perception is governed by ecological laws risks being trivial if all it says is that an organism seeing *Y* is explained by the existence of a law such that optical pattern *y* specifies *Y*. The problem is that the notion of lawful, specifying information has a "direction", which depends on the nature of the perceptual system. The mutually constraining relations between perceptual systems and ecological laws have an air of circularity. Another formulation: say that optical invariant *r* is correlated with a feature R in the environment, then it is a property ρ of *r* that it is correlated with R. F&P's argument is that ρ can't be picked up by a perceptual system unless it already has, through some other means, access to R. Or, no ecological law about ρ can account for perception because establishing that a law about ρ exists requires or presupposes perception.

Gibson certainly knew of this problem. But his tentative solutions are ignored entirely by F&P. They make no mention of several ideas central to Gibson's ecological approach: that perception is an activity of the whole organism, that as an "exploratory activity" it may be an aspect of action rather than a causal antecedent. Nor do F&P mention or engage Gibson's idea that perception is an evolved and a developed capacity. Thus they ignore the possibility of an explanation of perceptual abilities in the form of natural history and its potential to do away with the puzzle of misperception.

We have seen that, despite their insistence that they treat only the explanatory aspect of perception theory, F&P's motivation for maintaining perception in the

“propositional realm”, is in fact epistemologically motivated. Perception ought to be propositional so that it can “eventuate” in beliefs or perceptual knowledge.

In the next chapter we will discuss the extensive reply of Turvey et al. (1981) to the Establishment’s critiques on Gibson. They focus on defending the idea that there are indeed ecological laws, and that they do explain perception.

CHAPTER 3

Turvey, Shaw, Reed and Mace: In reply to Fodor and Pylyshyn

The fundamental hypothesis of the ecological approach to vision, elaborated at great length by Gibson (1966, 1979) is that optical structure specifies its environmental source and that, therefore*, mobile organisms with active visual systems that can pick up this information will see their environments and suitably adjust their activity, if and when they detect that information (and only then).*

Turvey, Shaw, Reed and Mace 1981, 243

3.1 Introduction

In response to Fodor and Pylyshyn's (1981; referred to as F&P) article which we discussed in the previous chapter M. T. Turvey, R. E. Shaw, E. S. Reed and W. M. Mace (1981; henceforth Turvey et al.) wrote a lengthy article in which they explicate Gibson's approach to perception in the terminology of the philosophy of science. They engage with the criticisms formulated by F&P, attempting to rebut them, and they also criticise F&P's own Establishment Theory of perception.

The influence of Turvey et al. (1981) on the further development of ecological psychology is hard to overestimate. Their interpretation of Gibson's work has become the orthodox, "Neogibsonian" view within the ecological psychology community, not only regarding its ontological underpinnings, but also concerning its modus of explanation and its methodological commitments. Nevertheless, at times their orthodoxy has been challenged from within the community; most notably by E. S. Reed (1996) himself, by Harry Heft (2003, 2007), and by Anthony Chemero and Rob Withagen. These latter authors' assessment of the orthodox approach within ecological psychology will be discussed in detail in chapter 5.

The above quote from Turvey et al. contains two theses that should be taken into consideration. First there is the assertion that "optical structure specifies its environmental source". The second thesis is that organisms that are able to pick up information perceive when they exercise that ability. Between the two theses is the word "therefore", indicating that the first thesis explains the second.

The first thesis is thus about stimulus information. It contains three crucial notions: "optical structure", "specifies" and "environmental source". Put together they form the denial of the Poverty of the Stimulus doctrine (PoS), the idea that environmental information that is available to animals is not rich or detailed enough to account for perception. PoS motivates the postulation of inferential processes and it is the source of the epistemological puzzles dealt with in the philosophy of perception. As concluded in chapter one, we think Gibson's greatest contribution to perception theory is his emphasis on the "primacy of action" (Costall 2004b, 70) in the descriptions of optical structures and of the environment. The invariant optical structures—aspects of dynamic optical flow that remain unchanged while other aspects vary—were discovered to correlate, in many respects, with aspects of organisms' activities in its environment. The least one could say based on this discovery, is that stimulation is a lot less impoverished than it was often assumed, when considered in a wider temporal window, and in the context of an organism's activities.

"Specification", the second crucial concept, is a tricky one, because it entails not only the idea that spatio-temporally extended optical structures provides sufficient information about environmental features that are relevant to animals' activities, but also that there is a one-to-one mapping of specific optical structures to specific environmental features. It seems to imply that an animal can use one, and only one, optical feature to guide its behaviour with respect to a particular environmental feature. Hence the frequent talk, in Neogibsonian research (REF), about *the* invariant for, and *the* information for this or that affordance. Additionally, the notion of specification, as we have seen in the previous chapter, is not a straightforwardly ontological relation; specification has a direction. It has a psychological and/or epistemological dimension. While Gibson didn't pay much attention to this, Turvey et al. do, but their elaboration of the concept of specification is unsatisfactory, as we shall see.

The third crucial concept of the first thesis, “environmental source” receives a two-stage analysis in Turvey et al. (1981, 264). They exploit Gibson’s (1979, 101) term “ecological physics” to provide affordances with a lawful, materialistic basis. Ecological physics describes the physical features of objects or events in relation to the agent’s physical features (for example, Warren’s (1984) biomechanical model of energy expenditure of stair climbing we briefly discussed in chapter one). The “occurrent properties” borne out by ecological physics are taken to relate lawfully to “affordances”. Stage two of individuating affordances consists of relating occurrent properties to ecological optics (for example, Lee and Reddish’s 1981 proposed connection between the optical invariant tau with the occurrent property “time to contact”.

The second thesis is that animals that can pick up specificational information perceive their environment when they pick up that information. This thesis contains a reference to the ability to pick up information, and asserts that when pickup occurs, perception occurs. So, we will have to investigate whence comes this ability (which is conceived as an “epistemic” ability by Turvey et al.), and on what basis it is attributed to the animal. And second, what precisely is the relation between pickup and perception, because it is prima facie not clear whether the assertion refers to an identity relation, or to a logical or a causal consequence. It is clear that this thesis is a reply to Fodor and Pylyshyn’s misrepresentation of the Gibsonian concept of perception. We will see that Turvey et al.’s conceptual analysis of “to perceive” may be metaphysically plausible. But such plausibility should not be mistaken for an explanation of a phenomenon.

Additionally, we must note that in between the two theses just mentioned, there is the word “therefore”. It indicates that what comes before “therefore” explains what comes after it. Hence, the quote we started with is directed at F&P’s Establishment critique that the ecological approach to visual perception is vacuous, that it explains nothing. F&P do, however, agree with the following hypothetical conditional (F&P 1981, 164). Let’s call it (C):

(C) [...] if affordances were lawfully specified in ambient light, then direct visual perception of affordances would be possible.

Turvey et al. 1981, 238

F&P agree with (C) because if there were natural laws connecting light properties to affordances, transducer mechanism for such properties may exist.

But of course, F&P aimed to demonstrate that the Ecological approach fails because Gibson articulates no way of constraining "ecological properties", *i.e.* affordances, and that therefore, the antecedent of (C) is false. It follows then that the consequent of (C), that visual perception is direct (in the psychological sense of "non-inferential")[17], can't be deduced. Note that, even if it were demonstrated that affordances are not specified in ambient light, *i.e.* if the antecedent is false, it doesn't follow from (C) that the consequent is false.

Turvey et al.'s (1981) aim is to establish the truth of the antecedent of conditional (C), that affordances are specified in light, so that the consequent may be deduced. They believe that this argument will deliver them two things. First, they believe that if ecological laws can be demonstrated, such laws will (help to) explain the psychological capacity of perception. The second reason for establishing ecological laws is epistemological: if the existence of such laws can be demonstrated, such laws would form a foundation of perceptual knowledge. So, in this chapter we will look at how ecological laws should be thought about, according to Turvey et al., and how they think ecological laws explain perception. The epistemological aspect will be discussed in the next chapter. Our source for discussing the ecological epistemology will be Shaw, Turvey and Mace (1982), which can be considered to reflect the same views as Turvey et al. (1981) but focus primarily on epistemology of perception, whereas Turvey et al. is concerned

[17] There is another, epistemic sense of directness attached to the philosophy of perception. This classical debate about the role of perceptual *experience* for the justification of knowledge about the world will be discussed in the next chapter, based on Shaw et al. (1982). These authors, like Gibson himself, hold that direct, non-inferential perception in the psychological sense goes hand in hand with *direct* or *naïve realism*, the doctrine that our perceptual experience is of the real world. *Indirect or representative realism* holds that experience is of representatives or proxies of the real world. Both realisms aim to provide reasons why we are justified in believing that our experiences are of a real world in the first place, as opposed to the idealist's position that there is no real world independent of experience, or the sceptic's claim that (perceptual) experience provides no justification for knowledge at all.

mainly with psychological explanation. The epistemological aim shared by Turvey and Shaw in both articles is apparent already Turvey et al (1981):

> *These laws that epistemically bind an organism and its environment* are termed 'ecological laws' and it is the existence of such laws that is denied by Fodor and Pylyshyn.
>
> Turvey et al. 1981, 254 (emphasis added)

The fact that both the Establishment and the Neogibsonian ecological approach accept (C) tells us something about a commitment they share regarding explanation in general: the deductive-nomological model. Law statements describe necessary, or counterfactual supporting correlations that say something about future observations of the relata. The Establishment Theory of perception has an analogue to such a statement that fulfils the same role: the "information" stored in memory and that functions as the major premises for mental inference expresses the relation between stimulus information and behaviourally relevant environmental properties. So, the Establishment's major premises and the Neogibsonians' Laws are not only "rules" about the same relations, they also play the same role in their respective explanations. The difference is as to where that rule is located; in the world according to the ecological approach, in the head for the Establishment.

If this interpretation of (C) is correct, if Turvey et al.'s approach indeed entails that ecological laws play the same explanatory role as the mentally represented prior knowledge of a perceiver that mediates perceptual judgement, then Turvey et al. too, have a proximal explanation in purview (cf. chapter 2). Where F&P's Establishment approach must meet the challenge of explaining how an agent can acquire a mental representation that can mediate an inference, Turvey et al. would be confronted with the question as to what further explains that ecological laws can specify anything to a particular animal at all. If not dealt with adequately, one may have to conclude that the ecological explanation and the Establishment's share the same problem of unexplained explainers.

3.2 EXPLANATION IN ECOLOGICAL PSYCHOLOGY: ECOLOGICAL LAWS

In the previous chapter we have analysed why F&P believe that only physical properties of light are detectible, and why they deny that there can be ecological laws at all. In this section, the opposite position is scrutinised: that ecological properties, *i.e.* affordances, are the right kind of things that can indeed enter into lawful relations, and that such laws play a role in the scientific explanation of perception. As said, the ecological laws Turvey et al. argue to exist, supposedly hold between properties of light and affordances. The properties of the ambient optical array are called "optical invariants". Such invariants are aspects of the flowing optical (or more generally, energetic) array that persist while other aspects of it change. Turvey et al. define affordances[18] as relational, dispositional properties:

> [...] ecological science is the study of the inclusion relations, *i.e.* properties of evolved things. The notion of affordance can be schematized as follows: A propertied thing X (*e.g.*, a crevice) affords an activity Y (*e.g.*, crawling into) for a propertied thing Z (*e.g.*, a lizard) if and only if certain properties of X (*e.g.*, the spatial extent of the crevice in the horizontal dimension) are dually complemented by certain properties of Z (*e.g.*, the substantial width of the lizard in the horizontal dimension), where dual complementation of properties translates approximately as properties that are related by a symmetrical transformation or duality T such that: $T(P_1) \rightarrow P_2$ and $T(P_2) \rightarrow P_1$.
>
> Turvey et al. 1981, 261

Before continuing our discussion of ecological laws, a bit more needs to be said about the way Turvey et al. (1981, 260) use the term "property". Properties are real, according to them, but they do not exist by themselves but always as

[18] Turvey et al. thus define affordances as dispositional properties that are complemented by dispositional properties called *effectivities*: "A propertied thing Z (an organism) can *effect* activity Y with respect to a propertied thing X (an environmental situation) if and only if certain properties of Z are dually complemented by certain properties of X" (Turvey et al. 1981, 261; emphasis added). This definition of affordances as dispositional properties has provoked several debates in the journal *Ecological Psychology*: Turvey 1992; Sanders 1997; Stoffregen 2000, 22; Chemero 2000; Stoffregen 2003, 115; Chemero, Klein, Cordeiro 2003; Michaels 2003; Chemero 2003. See also monographies by Reed (1996) and Chemero (2009).

“propertied individuals”. The realist position of Turvey et al. reminisces Aristotle’s; properties are real, independently of the minds of cognisers, but unlike in platonic realism, they don’t exist in a realm of their own, but inhere in the worldly individual things that instantiate the property.

> The nominalist claim that universals are collections of individuals is denied as is the Platonist claim that individuals in themselves are clusters of universals. […] There are no universals in themselves but there are properties that are invariant across a given collection of evolving individuals.
>
> Turvey et al. 1981, 260

They continue by stating that properties are inclusion relations among things. The property “being a horse” includes its propertied things. Ecological laws are construed as holding between properties (invariants) of ambient energy arrays and affordances. They are based on, and discovered on the basis of, two kinds of underlying lawful relations, say Turvey et al. (1981, 264), which we will analyse now.

3.2.1 Laws relating occurrent properties to affordances

Turvey et al. (1981, 261) aim to show that there is a lawful connection between *occurrent* properties of environmental features (e.g. the spatial property of a crevice, its height, width and depth) and the possibility (or opportunity) this offers to an organism. The *occurrent* property is referred to as “*o*-ness” by Turvey et al., and the dispositional property, the affordance, as “*c*-ness”. (The “*c*” comes from “climb-up-able”, one of their favourite examples). The conception of such laws is then that whenever a certain occurrent environmental property is present, animals with certain occurrent properties of their own have the possibility to act in a certain way. Hence: “*o*-ness → *c*-ness”. These laws are discoverable by combining ecological physics with evolutionary ecology (Turvey et al. 1981, 265).

Take the oversimplified example of a lizard and a crevice. Evolutionary ecology may find that lizards that hide in crevices when they are in danger get eaten less frequently by predators compared to their kins that don’t hide. A disposition to

crawl into crevices may thus be selected for and lizards with that disposition will thrive in areas with a lot of crevices. In relation to lizards so disposed, crevices may be said to have a dispositional property; they are disposed to be crawled into by lizards under certain circumstances. Those circumstances can by (partly) identified by ecological physics. The lizard's and the crevice's relevant occurrent properties with regards to their mutual disposition are their height and width. If these are mutually compatible, the former fits into the latter. (Threat of predator is also a mutual dispositional property—lizards afford eating to buzzards or are disposed to be eaten by them. The compatible, occurrent properties of lizards and buzzards are to be identified by ecological physics too, e.g. the weight of a lizard in relation to the weight a buzzard can master; or ecological chemistry, the chemical composition of the lizard in relation to the digestive system of the buzzard).

Turvey et al. (1981, 263) note that since affordances are evolved dispositional properties, that are "grounded" in the occurrent properties, affordances are real in the sense that they exist without being (subjectively) experienced. Affordances, as dispositional properties differ from "regular" dispositional properties, *e.g.*, the property of being soluble, because affordances depend on the existence of animals that possess occurrent properties of their own that match the occurrent property that underlies the affordance. If there are no lizards or animals that crawl in to crevices at all, crevices don't afford crawling into. This means that, whereas the dispositional properties of salt and water are grounded in a single underlying property—being a solvent and being soluble are accounted for by the same physical principle—affordances and effectivities[19] depend on two underlying occurrent properties, each of which are to be accounted for independently and a compatibility relation must exist between them so as to give rise to the mutual dispositions.

[19] An "effectivity" is a "dual", dispositional property that can interact with an affordance to actualise a particular action. Put simply: a lizard possesses an effectivity of crawling-into-crevices that is realised when it meets the affordance "crawl-into-able" on the right occasion. "Effectivity" is a Neogibsonian addition to ecological psychology.

Turvey et al. hold that the relation between affordances and occurrent properties that we just described are lawful. These laws can be discovered by the science of ecology. Turvey et al. conclude that the lawful relation pre-empts the need to posit any conceptual or inferential abilities on behalf of an animal that acts on an affordances. Since the dispositions of the animal and the environment are grounded in a lawful, empirically substantiated relation, there is no need on behalf of the animal to categorise the object it interacts with or infer its behaviour relevance from physical stimuli. Nor does it require an epistemic relation to the occurrent properties that ground the affordance.

In other words, the descriptions of the occurrent and the ecological properties should not be ascribed to the animals as some sort of mental content—nor the relation between them as a mental rule. For lizards, the details of the physical or chemical properties or microstructures of the objects they happen to crawl into are irrelevant. What matters are the pragmatic, or behaviourally relevant properties, such as being strong enough to support its weight, having a certain height and width in the order of magnitude of the animal itself. *Prima facie* the "*o*-ness → *c*-ness" is indeed a candidate for being a lawful relation. Considering the example of the lizard and the crevice, it may indeed be said that it is necessarily so that a crevice of a certain height affords crawling into for a lizard that is not too large. The statement is counterfactual supporting: had crevice O, which is in fact too small for lizard P, been slightly larger, it would indeed have been possible for P to crawl into it.

The lawfulness of "*o*-ness → *c*-ness" is important to Turvey et al. because it constitutes one of two components of an ecological law of a wider scope. The idea is that if both component relations are lawful, the idea of "transitivity of lawfulness" assures that the wider relation constitutes a law as well. One could ask the question, however, whether being "non-accidentally" (Turvey et al. 1981, 64) related must be accounted for in terms of laws. It may be said that the treatment of non-accidental relations as laws is primarily motivated by the explanatory model, but that this model is not necessarily the most suitable for perception theory. Although explanation relying on ecological law is the main focus of Turvey et al.'s article, they leave open a route to natural history too,

referring rather casually to the role of *evolutionary* ecology, in addition to ecological physics, in the quest to ground affordances.

3.2.2 Laws relating optical properties to occurrent properties

The second component of ecological laws is the supposed lawful relation between the aforementioned occurrent property (*e.g.*, the height of a crevice expressed in the unit "height of lizard"; the crevice is 0.9 lizards in height) and a structural property of the energy (*e*-ness can be optic, acoustic, ...) array to which it gives rise. These laws are of the form "*e*-ness → *o*-ness", expressing that whenever an energy array has a certain invariant property, then an occurrent property (that caused the optical invariant) is present. We must note here that the direction of the arrow in the law statement runs in the opposite direction of the (intuitive) causal relation. The occurrent properties, together with the location and movement of the animal, causally determines the invariant patterning of the ambient optic array. But the law "*e*-ness → *o*-ness" expresses the reverse relation. In itself this is not problematic. There is no rule that says that all lawful relations must be causal relations or follow the direction of causation.

Laws of the type under discussion here are discoverable by ecological optics, and Turvey et al. cite the optical invariant "τ" ("tau"), which is taken to specify time-to-contact, as a paradigmatic example of *e*-ness. The empirical claim is that gannets, large sea birds that hunt for fish, use the optical variable "tau" to guide their diving behaviour. More specifically, tau is a mathematical expression of the rate of optical outflow that exists at a moving point of observation. If tau indeed lawfully specifies time-to-contact and if the gannet can detect critical tau values, then it doesn't need to (mentally) compute or infer its time to contact based on lower order parameters (speed, distance, ...) because tau provides that "information" directly.

That lawful "guarantee" is hedged in so far as the conditions in which the dive, or any perceptually guided behaviour for that matter, takes place in ecologically "usual" circumstances, associated with ecological niche of the individual, group or species. Extra-niche circumstances would be, for examples, that animals would be tricked by experimental setups that generate the same optical patterns,

but in which the occurrent property is absent (see the example below, where a shark is misled by an artificially produced electromagnetic field that under "normal" circumstances specifies the presence of a flat fish, but is put there by scientists to deceive the shark).

In the interest of reconstructing Turvey et al.'s theory, let's assume that the two types of ecological laws we have just discussed do exist. It follows then by transitivity of lawfulness that "*e*-ness → *o*-ness" conjoined with "*o*-ness → *c*-ness" yields "*e*-ness → *c*-ness", which expresses that whenever an ambient energy array has property *e*, then affordance *c* is available to the organism.[20] On this basis Turvey et al. (1981, 266) conclude that "there is a *lawful* specification of an affordance by an optical property", and they take it that this removes F&P's ground for denying that perception of ecological properties (affordances) can be direct i.e., without inference. For the case of the gannet this means that the optic variable tau specifies an affordance we could describe as "allowing optimal steering as long as possible before hitting the water surface too hard". The precise formulation for the affordance is not so important for our purpose. What matters is that it is claimed that a lawful relation exists between the optical property and the affordance. And if this is accepted, that means that we come one step closer to the truth of the antecedent of the conditional (C):

(C) [...] if affordances were lawfully specified in ambient light, then direct visual perception of affordances would be possible.

Turvey et al. 1981, 238

One step closer is not all the way, however. Having established the existence of ecological laws is not necessarily the same thing as saying that one relatum

[20] Turvey (1987) offers an elaborated version of the relations between occurrent properties, optical properties and the perception of affordances under the name of the "principle of symmetry", which reads like this: "That the environment is the way it is specifies that information is the way it is and that information is the way it is specifies that perception is the way it is, and that perception is the way it is specifies that the information is the way it is and that information is the way it is specifies that the environment is the way it is." Chemero (2009, 111) summarizes this to "the environment specifies the information, which specifies perception, and perception specifies the information, which specifies the environment."

“specifies” another. Specification is a peculiar concept, and its use by Gibson and Turvey et al. certainly can’t be the way it is used in common language. When you ask me to specify something, you can expect me to do one of several things, one of which is offer you a description of the item you wish to be specified. This is, arguably, not the way Turvey et al. intend “specifying information”; ambient light properties, no matter how sophisticated, don’t describe their environmental source.[21] A second possibility is that you expect me to point out the item you want specified. But this too is not something that can be established by a lawful correlation alone. One correlate (the light pattern) can only be thought of as pointing out its environmental source to an agent if that agent is already acquainted with the idea or practice of “pointing out”. The “pointing-out” notion is carried by the agent’s ability, not by the law. This interpretation is present in much of the Neogibsonian literature. A third interpretation of “specification” is that of one-to-one correlation between the relata. On the one hand this raises an empirical question as to whether the information animals actually use is always based on a one-to-one correlation. Might they not use less perfect correlations to guide behaviour? Turvey et al. (1981, 272-274) refer to this idea of less than perfect correlations as the “limp correlational view”. They argue that it can’t explain perceptual achievements and inform the reader that information as (weak) correlation as a basis for perception was rejected by Gibson already in 1950. The correlational view, Turvey et al. continue is “extensional”, while their own view of natural law, and the specifying information that is based upon it is “intensional”. What this means will be analysed now. We will ask whether the trivialisation challenge posed by F&P still lurks.

3.2.3 Intensional versus extensional analysis of natural laws

Turvey et al. (1981, 243) insist that the specificational view of information is to be taken as an empirical claim.[22] They go through great length to make explicit what

[21] Ecological psychologists Wilson and Golonka (2016) seem to veer towards this interpretation. They state that ecological information amounts to representation.

[22] The empirical status of the claim is somewhat troubled because “specifying information” is also held to be a “necessary a posteriori truth” (Shaw et al. 1982) that follows logically from first

specification, then, precisely entails. Fred Dretske's (1977) philosophical paper on how natural law statements should be understood, is taken as the basis for explicating the notion of lawful, specificational information. We shall now examine how Turvey et al. rely on Dretske to construe the concept of specifying information. In other words, we will assess whether Dretske's intensional reading of natural law statements supports the notion specification and at what cost. Turvey et al. write that the correlational view of information is associated with an extensional reading of (lawful) correlation.

In the previous chapter we have briefly described the difference between the extensional and the intensional contexts of predicate use. To repeat: the extension of a predicate is the set of all objects to which it applies; the extension of "red", for example, is the set of all red objects. The intension of "red", on the other hand is the concept of "redness" under some "mode of representation". Recall that the singular terms "morning star", "evening star" and "Venus" have the same extension: the planet Venus. But these words have different intensions or meanings. Their uses constitute different modes of (re)presenting. The term "Morning star" is used when talking about (representing) Venus as seen in the morning, "Evening star" for descriptions of the planet as seen in the evening. That implies that they cannot be used interchangeably. A person saying at 9 PM "the morning star is now in the sky" says a falsehood, although extensionally the term "morning star" picks out the right object. That is so because meaning or intension includes a "way" or "mode" of picking out an object and the way of presenting of "morning star" is that of picking out Venus in the morning. Another example involves the terms "the fortieth president of the United States of America" and "Ronald Reagan". These terms have the same extension but different meaning, understood as intension. In 1984 a person could say "I see Ronald Reagan" without knowing he is the president, without seeing Reagan *as* the president.

The extensional (correlational; Establishment) reading of statements of natural law entails that they express a relation between extensions, that is sets of objects. And that, whenever a predicate picks out the same set of objects as another predicate—when they have the same extension—then those predicates can be

ontological and epistemological principles (Jacobs and Michaels 2002, 128).

substituted for one another in the law statement. Turvey et al. (1981, 268) illustrate how the extensional reading of law statements makes specificity impossible by the example of the marsh periwinkle's ecological niche. Marsh periwinkles are snails that live in the intertidal zone. It has been observed that when the tide is incoming, periwinkles climb up onto the grass blades that grow in its habitat. When no tide is incoming, they navigate around these grasses. Grass blades can thus be said to afford two things to the snails: "climbing up" and "colliding with". Therefore, the predicates "climb-up-able" and "collide-with-able" overlap extensionally. This means that if laws are read as relating extensions to one another, a light pattern correlated with all things climb-up-able is also correlated with the extension of "collide-with-able", and therefore cannot be specific to either affordance. What the periwinkle does (climb or avoid) when confronted with such a light pattern then can't be explained in virtue of that light pattern alone since it underdetermines its behaviour. So the extensional reading of law statements entails ambiguity of stimulus information, so Turvey et al. believe.

Fred Dretske (1977), independently of the ecological psychology movement, criticises the extensional reading of law statements. We will summarise his main arguments insofar as they are relevant to specification. Here is a statement that is a suitable candidate to denote a lawful relation: "All metals conduct electricity". Formally, this sentence can written as follows: "$(\forall x)(Mx \rightarrow Cx)$", which is called a universal conditional in predicate logic. Compare this formula with another universal statement: "All things in my backpack are blue", which can be formalised as

"$(\forall x)(Tx \rightarrow Bx)$". Although it has the same logical form, this latter statement is clearly not a candidate law. The predicate "is a thing in my backpack" is not projectible, not likely to have lawful relations to any other predicate. So, the general form of both statements, "$(\forall x)(Fx \rightarrow Gx)$" can be either a contingent or a necessary (lawful) universal conditional. Dretske (1977, 249) then continues that the property of "being a law" of such universally quantified statements is generally conceived of as a sort of modal property—a kind of necessity—that is added to a universal statement. But he is sceptical about this conception of law because it is mysterious how particular, empirical evidence could ever bear on

such necessities. Observing an instance of the universal statement, "F*a* → G*a*" may raise the likelihood that the universal is *true*, but it doesn't raise the probability that the yet unobserved instances will be similar to the ones that have been observed.

Therefore, Dretske objects to the idea that statements of natural law have the logical form of a universal truth plus some additional condition that confers onto them the status of necessity or lawfulness. His second argument for his rejection is that co-extensive predicates—different predicates that apply to the same set of things—can be freely substituted in universal conditionals *salva veritate* (preserving truth-value). But the status of law is not preserved by co-extensional substitution. E.g. if "all things in my backpack are made of metal" is true as well as "all metals conduct electricity", then it is also true that "all things in my backpack conduct electricity". But certainly it is no law that all things in my backpack conduct electricity, because that latter statement is not counterfactual supporting: "Had this none-conducting plastic rod been in my backpack, then it would conduct electricity" is false. Co-extensively substituting predicates in statements of law does not preserve the lawful status.

A third argument by Dretske regards the explanatory function of laws, and again, a universal conditional can't play the role that is expected of law statements. "All humans are mortal" makes inferring Socrates' mortality possible (if he is human). But, Dretske notes, when prompted "why is Socrates mortal?", responding "because all humans are mortal" isn't much of an explanation.

As a remedy, he proposes that statements of laws are not universal statements relating the extensions of predicates, but particular statements that relate *intensions* (the properties which the predicates express) to one another. They take the form: "*F*-ness → *G*-ness".

> Once a law is understood to have the form "*F*-ness → *G*-ness" the relation in question (the relation expressed by "→") is seen to be an *extensional* relation between *properties* with the terms "*F*-ness" and *G*-ness occupying *transparent* positions. Any term referring to the same quality or quantity as "*F*-ness" can be substituted for "*F*-ness" [...] without affecting its truth or its law-likeness.
>
> Dretske 1977, 263

The absence of a quantifier and variables (*x, y, …)* indicates that the statement is not about particular entities, but about the properties themselves, suggesting that Dretske propagates realism about universals. Further in his article, Dretske (1977, 254) affirms scientific realism. He states that laws of nature can be discovered, implying their reality being independent of our epistemic and scientific practices. Dretske states that he doesn't advocate property realism per se, only that "universal properties exist […] *if* there are any laws of nature." (Dretske 1977, 267)[23]

Turvey et al. apply Dretske's idea about law statements as being relations between intensions of predicates (*i.e.* properties) to the marsh periwinkle example. Before we analyse the consequences of this application, it must be noted that Turvey et al. share with the Establishment the view that all theories of intentionality—and theory of perception in particular—require the notion of intensionality. Neither even considers that a purely extensional account could ever explain psychological phenomena. This view is mistaken, we will argue in chapters 5 and 6. Both the Establishment and the Neogibsonian approach reify intensions, albeit in another way. Turvey et al., nevertheless, have the virtue of an attempt to account for intentionality without mental contents. In doing that, it shows inadvertently that the problem of intensionality, *i.e.* content, needs a different approach altogether; one that doesn't reify intension, nor ascribes intensions by metaphysical stipulation—but offers an empirical account instead, or so we will argue below.

But let's first see where applying Dretske's intensional view of laws to the periwinkle's perilous decision whether to climb or evade the grass blade brings us. It allows Turvey et al. to formulate two separate laws (remember cf. chapter 2 that one needs to postulate "two of something") because, whereas extensionally the two affordance-predicates comprise the same set of things, intensionally, they

[23] For a critical analysis of Dretske's account of natural law see Niiniluoto (1978). In this article it is argued that universal generalisations stating relations between extensions can be confirmed, predictive, etc… Hence that commitment to lawfulness doesn't imply Platonic properties or a form of realism close to it.

"designate" different properties. So the two laws are 1) optical property *e* is said to specify "climb-up-able", and 2) optical property *f* specifies "collide-with-able".

> Generally, the optic array is specific to environmental properties, *e.g. affordances*, for any environmental property that can modulate light there is a corresponding and unique optical property.
>
> Turvey et al. 1981, 268

Turvey et al. continue that circumstances determine which law is applicable to the periwinkle's (perceptual) activity. Let O be the occasion of incoming tide. This event O makes it so that the law that connects *e* to "climb-up-able" governs the snails behaviour. When the tide goes out the snail-niche relation comes back under the "aegis" of the law that ensures that *f* specifies "avoid collision".

> In the ecological view the occasion of contact with the incoming tide plays the role of a state of affairs that *selects* (in the sense of *attunes)* a marsh periwinkle/niche relation. The marsh periwinkle/plant stem situation expresses a central problem for the theory of intentionality: how an organism can take the same propertied thing to afford different acts on different occasions.
>
> Turvey et al. 1981, 298

The proposed "switching" of nomic contexts may indeed hold the key to solving the problem of intentionality for perception theory—that is, how one can account for the fact that the snail is "directed at" the one or the other affordances, as Turvey et al. say—but oddly, the authors omit to work out precisely how "contact with the incoming tide" establishes this. Despite Turvey et al.'s expressed belief that their approach provides a natural basis for intentionality, their proliferation of intensional properties suggest the opposite: without further constraints one can always invoke some occasion to postulate a property (intension) that is specified—hence the charge of triviality by F&P. We will propose that the needed constraints can be provided by (re)constructing the natural history of the organism-niche system. History, rather than law, can elucidate how the consequences of actions on occasions like the incoming tide have selected, and continue to select or attune the system.

3.2.4 Construction of the predicate "to perceive"

Turvey et al. propose to very strictly regulate the use of the term "perceives" in the context of psychological theorising: "The term 'perceives' must enter *legally* into some statements [...]" (Turvey et al. 1981, 283; emphasis added). That is to say that (tentatively) the use of "perceives" presupposes an ecological law L, relating ambient energy property *e* to property *a*, and that "Z perceives X-having-property *a*" can only be said when three conditions are fulfilled:

(i) X-having-*a* is present,
(ii) The *e* resulting from (i) and L is available to Z,
(iii) Z detects *e* defined in (ii).

Turvey et al. 1981, 282-283

In these conditions it is stipulated that a present X in fact has property *a*. (Confusingly *a* is used now to refer to an occurrent property of X and to refer to its affordance). If statements involving "Z perceives ..." are analysed as such, and all these conditions apply, then perception is factive: when X-having-a is perceived, X-having-a is necessarily present. The law L conceived as a relation between properties is transparent because the predicates are taken to express intensional properties, and thus the opacity that results from co-extensional substitution cannot occur. Turvey et al. indicate that two issues need further elaboration: how is "X-having-*a*" to be interpreted, and what does it mean to say that something is "available to Z". For the former Turvey et al. refer to their account of complementary dispositional properties of affordances and effectivities and the occurrent properties that underlie them. Basically, whenever ecologists describe that an animal has a practical ability to effect some result in its niche, the complement of that effectivity defines the affordance. When "perceives" applies to the agent-environment system on the occasion, the predicate is said to be meaningful; the animal is in a possible world that contains affordance Y. The predication is true, or "ecologically true" when the "dual" predicate of "perceives", "Effects (X,Z,O) = action Y" is successful. In the following paragraphs we will relate Turvey et al.'s further discussion of their concept of perception. They, themselves, refer the reader to Shaw et al. (1982) for a fully

worked out conceptual analysis based on possible world semantics. So we will come back to that too when discussing that text in the next chapter.

Before we turn to the implications of Turvey et al.'s lawful restriction of the use of "perceives", a clarification is required with regard to the "unicity" aspect of specifying information. They write that the intension of predicate *c* is the affordance "climb-up-able", and *e* is an optical property that corresponds uniquely to *c*. This idea sparked much confusion because one might wonder what is the scope or domain of the law "*e*-ness → *c*-ness". Does it mean that all animals that climb up such grass blades use the same optical property *e?* Or just all marsh periwinkles? Or a population of periwinkles in a particular area? Or just one periwinkle, but on all occasions? Or can the periwinkle on one occasion use *e* and *e'* on another? Can *e* be disjunctive "e_1 or e_2 or e_3 or ..."? Turvey et al. are not explicit about this, and so the unique specification idea is easily misinterpreted.

> [...] *e* is an optical property that corresponds uniquely to *c*.
>
> Turvey et al. 1981, 268

This statement can be reformulated as: "*e* corresponds to affordance *c*, and not to another affordances". In this interpretation the unicity condition applies to the "correspondence to *c*-relation". It doesn't say much about *e* itself. So in principle a disjunctive *e* is compatible with Turvey's theory, so long as it corresponds to *c* and no other affordance. "Intractable non-specificity" only results when the predicate on the right hand side is disjunctive. Regarding the question of the scope of the laws, Turvey et al. maintain that it is an empirical question whether or not a whole species uses the same specifying information. This openness to different levels of analysis (species, individual organisms, perceptual episodes of one individual) is natural given the law's being about the intensions of predicates and not about individuals (the *x*'s in quantified statements), be they species or groups or individual animals.

> The universal scope of laws of nature should not be taken to mean that the same laws apply everywhere and everywhen, for laws can only apply when they are instantiated.
>
> Turvey et al. 1981, 274 (sic)

Together with the idea that "occasions" determine which laws are applicable, "unicity" becomes a very relative matter because in principle each and every occasion might entail a different, though unique, optical property to specify the same affordance. We will return to the relativity of unicity and specification in chapter 5.

On the basis of lawful ecological information, Turvey et al. (1981, 290) advocate "a more richly endowed semantic theory".

> [We] distinguish among the meaning, interpretation (or designation), and extension of a property. The meaning of 'edible' in the ecological world of the shark is given in the dual complementation of certain properties of the propertied thing shark and certain properties of certain kinds of things that, in juxtaposition with shark, actualize eating, felicitous metabolizing, etc. The meaning of 'edible', therefore, is in the province of the physical analysis of edibility as an affordance for the species *Scyliorhinus;* the *meaning* of 'edible' is not in the province of the shark. But the *designation* of 'edible' can be. In the province of the shark, it is the property 'electric field of type F' (among other properties suited to detection by vision and olfaction). And in that same province, the *extension* of 'edible' is the various forms of marine life that exhibit that property.
>
> Turvey et al. 1981, 290

By saying that the meaning or intension of "edible" is not in the province of the shark, Turvey et al. mean that the shark doesn't have the concept of edibility. This seems right and it is directed against the approach to perception of Fodor and Pylyshyn. Recall that F&P hold that any perceiver must have concepts (in the language of thought) because only meaningless—that means behaviour-independent—properties can be directly detected and mental concepts (representations) are needed to mediate perceptual knowledge that can bear on action. The concept (meaning, intension) of "edible" is only in the domain of the scientist describing the shark's behaviour or perceptual activities. The scientist proffers the intensional description "the shark perceives an edible thing". Such description, Turvey et al. rightly note, is not a licence to attribute to the shark the concept—or mental content—of "edible thing", as inferential theory does. However, Turvey et al.'s paraphrase and criticise F&P as follows:

> Under the semantic doctrine of extensionalism [attributed to Fodor & Pylyshyn; *JVE*], the ontic correlate of a property is its extension. It follows that if a number of individuals are collected under a rule, an intension, then that rule, that intension, must be subjective—of mental origin not physical origin.
>
> Turvey et al. 1981, 251

Their criticism of F&P is well taken, but *in cauda venenum.* The last three words of this quote entail that rules or intensions are of physical origin. This means that Turvey et al. project rules or intensions into nature as opposed to F&P's projection of rules into the mind. This is in line with Dretske's metaphysical property realism.[24] Nonetheless, they insist that for an animal to perceive an affordance is not to perceive an essence, but a significant property. Explaining how and why a property "acquires" such significance for an animal should thus be a part of explaining how they manage to perceive them. This is essentially the same question as to how ecological laws come into existence and how they relate to detectible properties. We see a tension arise between their aspiration to construct an empirical account based on ecological science and their reliance on rather heavy metaphysics to resolve the challenges posed by the Poverty of the Stimulus doctrine and the need for an account of intentionality.

As for the semantics of predications of "to perceive", Turvey et al. continue to elaborate on their example of the shark. They propose that to predicate "perceives *c*", with *c* being an affordance, of a shark is to construct a new predicate on the basis of *c*.

> In this semantics, which takes properties seriously, the extension of a predicate built from a borrowed predicate, such as 'can perceive an edible thing', would be a function of the extension of the borrowed property. In short, this constructed predicate ascribes a relation between a property of one propertied thing, *viz*., shark, and a property of another propertied thing, *viz*., magnetic field, that is based on the nomic relation between 'edible thing' and 'magnetic field of type F'.

[24] Turvey et al. (1981, 251) deny they are property realists. For a precis of their realism they refer, again, to Shaw et al. (1982).

> [...] the constructed predicate for the shark of 'sensitivity to an edible thing' is simply a way of referring *indirectly* to a lawful relation between properties.
>
> Turvey et al. 1981, 290

The indirect reference to the ecological law thus ensures that predicating "to perceive" picks out the right objects. To state it more clearly: the occasion "picks out" the law that applies to the instance of perceiving. That law is said to be about intensional properties, *e.g.* the property of being edible. Therefore the extension of the predicate "edible" is fixed to edible things and no intensional context can be generated when "to perceive" is "legally" predicated—the law ensures that edible things are *seen as* edible and not as anything else, so that "perceives *c*" is transparent.

Since this may still be slightly abstract, let's attempt to construct a more intuitive example. The semantic difference between "Seeing Venus as the Morning Star" and "seeing Venus as the Evening Star" indicates that "seeing as" generates an intensional context: although Morning Star and Evening Star have the same extension, the terms can't be co-extensionally substituted in the sentences with "seeing as". A Turvey-style solution would look as follows. Let's postulate two occasions; occasion *M* occurs in the morning, occasion *E* in the evening. When *M* occurs perception and action that involve Venus are governed by a set of laws, one of which states that whenever optical property *e* is present the property of being the Morning Star is present. *E* occasions the Evening Star property when *f* is optically available. Therefore, the laws are taken to explain the two instances of "seeing as". Co-extensional substitution is no longer a problem because, so to say, on occasion *M*, "Evening Star" has no extension for the perceiver. Metaphysically this solution is neat. But as said, a further explanation is needed of how *M* and *O* determine designations.

As said above Turvey et al. don't pay much attention to "pickup" or "perceptual systems" despite Fodor and Pylyshyn's emphasis on the lack of constraints on these notions in Gibson's writings. Turvey et al. (1981, 246-247) briefly state that the genesis of selective sensitivity is to be accounted for by the theory of "self-organizing systems coming from non-equilibrium thermodynamics" where the basic properties of living systems are concerned, and for more advanced

functions of organisms they relegate explanation to the new synthesis of Darwinian natural selection and molecular biology. We think Turvey et al. are correct in referring to the fundamental role of these sciences for a scientific psychological theory, but their attitude is very much "hands off". We're left in the dark as to how these sciences precisely constrain psychological explanations.

Turvey et al. do comment on the conceptual relation between pickup and perception, like we did in the previous chapter. "Pick up", they say too, is not equated to transduction, as Fodor and Pylyshyn have interpreted it. The terms instead refer to two different perspectives on a single phenomenon. The identity of the two descriptions is asserted in an example about the evergreen vine called *Monstera gigantea*, a plant that climbs up trees.

> In the niche of *Monstera gigantea,* 'darkest sector of a minimal extent' and 'a climb-upable thing' are nomically related. Again, to predicate of *Monstera gigantea* (a) 'detects darkest sector of a minimal extent' and (b) 'takes it to be a climb-upable thing' is not to identify two states of affairs mediated by inference. In the physical design of the system comprised of the vine and its niche, (a) and (b) refer to a single state of affairs.
>
> Turvey et al. 1981, 278

This identity theory is ontologically neat and contains a promise to explain away misperception, as we shall see shortly. But it only explains misperception insofar as it explains perception itself, as we have seen in the previous chapter. Gibsonians sometimes take pride in stating that theirs is not a mechanistic explanation, insisting that it is a dynamical one. Despite its failure to deal with the problem of mental content, the Establishment Theory is more clear about how it aims to explain perception: transduction and computational mechanisms cause a percept. The ecological approach lacks this apparent clarity. We have understood that "pick up" or detection of an energy variable doesn't cause perception, it merely describes it on another level. But is that, then, an explanation? "Pick up" itself still seems to remain unexplained, dynamically or otherwise.

But let's assume for now that this issue can be resolved, and look at how the ecological approach can deal with misperception. For this we pick up the case of the shark and reiterate:

(i) X-having-*a* is present,
(ii) The *e* resulting from (i) and L is available to Z,
(iii) Z detects *e* defined in (ii).

Turvey et al. 1981, 282-283

Suppose a scientist puts under the sea bed a device that generates an electromagnetic field *e* that is similar to the field generated by flatfish, fish that the shark habitually preys on. This artificial situation clearly falls outside the shark's usual ecological niche where law L holds between *e* and *a*, the *a*ffordance of a fish X. In the scientist's setup condition (i) is not met and the *e* available to the shark results from the planted device, not from (i) and L. Condition (iii) does obtain: the shark detects field *e*, whereupon it starts digging in the sand trying to catch a non-existent fish. Traditional thinking about perception would suggest that the shark misperceives because it falsely infers *a* from *e*. But since the conditions (i) and (ii) aren't met, "perceives" nor "misperceives" ought to be predicated of the shark. Additionally, the shark has not erred in any way. It hasn't made a false judgement (percept). On the contrary it has adjusted its behaviour properly with regards to the environmental circumstances because in its niche ecological law L exists, to which the shark is attuned on occasion *O* of being hungry. Turvey et al. suggest instead to predicate of the shark that it "has been appeared to" that affordance *a* was present (Turvey et al. 284). What happened was not an instance of (mis)perception. In fact, it would have been an error of the shark not to investigate the source of *e*, and there is no sensible argument for saying that it should have appeared to the shark that an inedible thing, or nothing, was present.

Turvey et al. also apply their analysis of "to perceive" to the Müller-Lyer illusion and to the phenomenon that a straight stick appears bent when partially submerged in water. The latter is sometimes qualified as an illusion or misperception too, although, given the optical laws of refraction, there is no way in which the stick could or should have appeared straight in water. It is

questionable to call such experiences as erroneous because science has an explanation of the difference in appearances of the stick in the air and the stick half in water. Since there is an explained difference in appearance, no misperception needs explanation. Analogously, Turvey et al. write that science may explain the difference in appearance of the lengths of lines in different circumstances, as manifested in the Müller-Lyer illusion, appealing to physical principles. Once these principles are known there is, again, no reason to assume that the lines could or ought to have appeared otherwise than they do, and no misperception has occurred that needs further explanation. The crux of their argument is then that it is simply irrelevant whether the explanatory physical principles concern what happens to the light outside of the observer, or to what happens within his skull. Metaphorically, an explained "light refracting air-water surface" in your head causes differential appearances depending on circumstances. They sum up:

> To assume that the figure is appearing as it ought to appear is to deny the assumptions that legalize the claim of perceptual error.
>
> Turvey et al. 1981, 280

The principle they refer to in the context of the Müller-Lyer illusion is the difference of intrinsic and extrinsic measurement standards. The (centi)metre is an extrinsic measurement standard. Nowadays it is defined as the length of the path travelled by light in a vacuum in 1/299.792.458 seconds.[25] This is now the chosen standard because the speed of light is a fundamental physical constant famously independent of the observer. Precisely this observer-independence makes it extrinsic. Conversely, intrinsic measurements are observer-dependent. Measuring the length of a line in the "index-finger-unit", for example, will result in different measurements when we use my index finger versus yours. Visually estimating the length of a line, Turvey et al. say, amounts to a sort of intrinsic measurement. The observed difference compared to the extrinsic centimetre

[25] The second is also extrinsically defined as a function of the energy levels of the caesium-133 atom. See http://wikipedia.org/wiki/Second. Earlier definitions of the metre were a function of the distance from the equator to the North Pole in 1793, prototype metre rods in 1799, and a function of the wavelength of krypton-86 radiation. See http://wikipedia.org/wiki/Metre.

measurement is thus explainable on the basis of (physical) properties of the perceptual system of the observer and what information is used by it. Again, the explained difference makes labelling one or the other as erroneous a category mistake (cf. Husserl's *Krisis* (1936) for an elaborate critique on the idea that extrinsic measurement standards are more fundamental or adequate than intrinsic ones. It is quite the opposite: extrinsic standards presuppose intrinsic ones). Summing up, Turvey et al. refer to Gibson who wrote:

> But the *information* for length of line, I have argued, is not simply length of line. [...] A line drawn on paper is not a stimulus. The stimulus information for the length of a line is altered by combining it with other lines. [...] the geometrical illusions are not subjective phenomena as they have always been taken to be, but instead are special cases of the information in variables of optical structure as displayed in drawings.
>
> Gibson 1966, 313

What is said here is basically that when we visually assess the length of a line, we don't exclusively rely on that aspect of the optical array that "reflects" the line. Perceiving distance in natural surroundings relies on multiple invariants of the optic array. Using a yardstick excludes those other invariants, naturally leading to a different estimate.

3.3 Concluding remarks: the ecological view on intentionality

Gibson's concept of information will allow us to cut the Gordian knot of intentionality, Turvey et al. (1981, 293) write. So what is the Gordian knot? The authors describe it as the challenge of explaining how some activity can be directed at something else, *e.g.* the shark digging in the sand upon detection of a magnetic field of a certain type. We may say that the shark's activity was directed at an edible thing, both in a normal ecological situation and in the case where an experimenter has planted a device to deceive the shark. The fact that the shark's behaviour is still said to be directed at an edible thing is more difficult to explain since there was no edible thing. The Establishment approach therefore posits an intentional object that has "intentional inexistence", the content of a mental representation that was inferred from the presence of the electromagnetic field

(Turvey et al. 294). That view is criticised because it remains unexplained how the shark acquires the mental rule "if there is an *e*, then there is an edible thing". How could the shark even form the concept "edible thing" that figures in the rule, if transduced information is never activity-relevant as the Establishment presupposes. Sharks who rely on that kind of inference would never eat, one could say. The alternative the ecological psychologists supply states that ecological information is intentional.

> *The pick up of information* involves two relata that must both exist—a propertied thing Z (an organism and a property of a propertied thing E (ambient energy)—and therefore *is relational;* the *specificity of information* involves two relata, one that must exist and one that in extraordinary circumstances may not exist—a property of a propertied thing E and a property of a propertied thing *X* (a piece of the environment)—and therefore *is intentional.*
>
> Turvey et al. 1981, 294

Perceptual adjustment of activity is held to be intentional because the specificity of the information it relies on is intentional. But as noted before, stipulating that specificity is intentional doesn't suffice as a theory of intentionality. In fact, Turvey et al. ascribe the equivalent of mental content to environmental properties on the basis of epistemological and metaphysical considerations, rather than offering an empirical theory.

This might be a good place to sum up. Gibson's underdeveloped notion of "specification" has been substantiated by Turvey et al. The law formula "*e*-ness → *a*-ness", upon which the notion of specification is built, excludes only that an optical property *e* corresponds to more than one affordance on a particular occasion. It doesn't say anything about what *e* must be like, allowing in principle for disjunctive *e*'s. The notion of ecological law was given a metaphysical grounding that may be able to accommodate the fact that ecological niches evolve, and so that "nomic contexts of nested laws" themselves change. At the same time Turvey et al. say little about "to whom" and how *e* can specify *a.* Regarding these matters there is a serious tension in Turvey et al. On the one hand they relegate these questions to physics and biology; on the other, they rely on heavy metaphysics, positing (intensional) properties. With Dretske, they reject

nominalism: properties are instantiated in reality independently of how agents and/or language users, group them.[26]

We have also seen that conceptually perception is constrained in terms of ecological laws. But in their conceptual analysis of the predicate "to perceive" the notion of being "available"—cf. condition (ii) that an energy variable *e* resulting from condition (i) and L be available to the organism—was left unexplained. Evidently, this notion is crucial for understanding what makes correlations, lawful or not, informative for animals. Turvey et al. refer the reader to Shaw et al. (1982) for this so, naturally, that is where we will look next for clarifications of the scientific psychology they claim to aspire.

The explanatory model Turvey et al. propose has an uneasy relationship with evolution by natural selection, to which they seem to pay lip service. They foresee explanation in terms of natural laws. In one slip of the pen they state that ecological psychology envisions mechanistic explanation:

> Very roughly, whereas the Establishment has tried to give a mechanism for perception, that is, an account of intensional contexts like (M), on the basis of getting the borrowed property *x* of X into the organism, the ecological approach tries to give a mechanism for perception on the basis of keeping the borrowed property *x* where it belongs, *viz*., with X. To do so, however, requires the ecological approach to provide a richer semantic context in which to interpret perception; one that allows *natural laws*, relating occurrent properties to both animal and environment dispositions, *to replace cognitive rules*, relating concepts and representations.
>
> Turvey et al. 1981, 292 (emphasis added)

[26] Gibson did not explicitly reject nominalism. This passage suggest the contrary: "If you know what can be done with a graspable detached object, what it can be used for, you can call it whatever you please. The theory of affordances rescues us from the philosophical muddle of assuming fixed classes of objects, each defined by its common features and then given a name. As Ludwig Wittgenstein knew, you *cannot* specify the necessary and sufficient features of the class of things to which a name is given. They have only a "family resemblance." But this does not mean you cannot learn how to use things and perceive their uses. You do not have to classify and label things in order to perceive what they afford." See Withagen and Chemero (2012) for a discussion of the "sidebar" in which this citation is found in Gibson.

This, we think, is the hallmark of proximal explanation, as opposed to evolutionary explanations. Even more worrying are the phrases we italicised. Let's make explicit these worries in the context of a reassessment of thesis (C):

(C) [...] if affordances were lawfully specified in ambient light, then direct visual perception of affordances would be possible.

Turvey et al. 1981, 238

Regarding the antecedent, we now know what "lawfully" stands for and that it is supposed to support "specified". We found the account of laws laden with unexplained explainers (wildly distributed intensions, physical rules, and seemingly *ad hoc* occasions) and in lack of support for "specificity". An intermediary conclusion may thus be that the antecedent is possibly false. But we noted too that the falsehood of the antecedent doesn't make the consequent false.

In this chapter we have mainly focussed on the "directness" of perception in the sense of "non-inferential". If that is how "direct" is meant in (C), we think there are good reasons to believe that the consequent is true (see chapter 6). But, as we shall see soon, "directness" in the philosophy of perception has a second meaning; that of "epistemic directness". This sense will occupy us in the two following chapters. We will see that, if this particular sense of directness is meant in (C), the consequent is no longer an empirical statement.

We have identified epistemological issues connected to the Neogibsonian approach and postponed them to the next chapter. The issues are the following: the "direction" of specifying information—identified by Fodor and Pylyshyn as an epistemic notion—remains unaccounted for. It is postulated that ecological laws epistemically bind organisms to their environments (Turvey 1981, 254). This is a peculiar idea because it seems to imply that natural (ecological) laws are taken to function as rules or norms. If this is how Turvey et al. intend ecological laws to be, a tension arises between their empirical, scientific program and their metaphysical assumptions.

CHAPTER 4

The Neogibsonian Approach to the Ontology and the Epistemology of Perception

He lit another forbidden cigarette and stared at the chauffeur's ear. That, at least, was something solid and true: the chauffeur had an ear. And, no doubt, one on the other side, even though he couldn't see it. So it was an ear which existed only in his memory—or, more exactly, his imagination—until such time as he saw it again. Deliberately, he leant across until the wing and lobe of the other ear came into view. Another question solved, for the moment.

Julian Barnes
The Noise of Time 2016, 120

4.1 Introduction

The two previous chapters mainly concerned questions as to how perception, as a psychological phenomenon, is best defined so as to facilitate psychological explanation. We analysed Fodor and Pylyshyn's critiques on Gibson's reconception of perception and his explanatory project, and the Neogibsonians' responses to those critiques. We concluded that the latter's conception of ecological laws as natural laws gives rise to two worries: a naturalistic notion of perception defined as pickup of lawfully specifying information still faces F&P's challenge of being trivial because that lawful specification is an unexplained explainer. This leads to the second worry: specifying information also plays the role of epistemically binding organisms to the niches they inhabit. We note that the exchange between the Establishment theorists and the Neogibsonians discussed so far contains hardly any reference to the relation of perception to knowledge. Shaw et al. (1982) address this epistemological aspect of the ecological approach to perception. And so do we, in this chapter.

In our general introduction and in chapter one we have observed that neither philosophy of perception in general, nor Gibson's ecological approach to perception are concerned exclusively with conceptual analyses of perception that serve to facilitate its scientific study. Gibson's work explicitly deals with the epistemological aspects of perception too, for example Gibson's 1967 article, as well as his books of 1966 and 1979. As such, Gibson inscribed himself in a long tradition in the philosophy of perception that is concerned with the relation between perceiving and knowing. A tradition that deals with the so-called "epistemological problems of perception" (Lyons 2016). This branch of philosophy attempts to answer questions like "does perception bring us in touch with the real world?", and "how are we justified to trust our senses to deliver us knowledge about that real world, considering that the senses may be deceived?" Since it is (almost) generally accepted that so-called "non-veridical" perceptual experiences (misperception, illusions, hallucinations) are sometimes subjectively indistinguishable from veridical ones, some philosophers have concluded that we can't be sure when, if ever, perceptual experience is veridical. This has raised doubts about perception as a suitable basis for knowledge and about the justification of perceptual beliefs.

Gibson's inscription in this tradition manifests itself via his theory of information, which he takes both to pave the road for a scientific account of perception and to lend support for "realism" in epistemology.

> If *invariants* of the energy flux at the receptors of an organism exist, and if these invariants correspond to the permanent properties of the environment, and if they are the basis of the organism's perception of the environment instead of the sensory data on which we have thought it based, then I think there is new support for realism in epistemology as well as for a new theory of perception in psychology.
>
> Gibson 1967, 162

Realism, for Gibson, refers in the first place to the common sense idea that the world of ordinary objects and events is "as it is", and that we come to know that world by perceiving it (Gibson 1967, 167). Saying that the world is "as it is", basically means that the world is not a mental fabrication, as for example, was concluded by Berkeley and others in the phenomenalist and idealist traditions.

Gibson, on the contrary, thinks that support for realism can be provided by taking "stimulus information" as the basis for perception, instead of sensations. Taking sensations, or other "epistemic intermediaries", as the basis of perception puts pressure on realism because the experiential qualities of sensations are thought to be determined by the sensory receptors, the stimulation of which is supposed to cause them. That makes what happens "further out"—the causal antecedents of the stimuli—uncertain, particularly when the Poverty of the Stimulus doctrine is accepted such that "proximal stimuli" are underdetermined by the "distal stimuli". Gibson's stimulus information, on the other hand, is defined as a relation to "distal" features of the world "out there", namely to affordances. As a result, perception defined as pickup of information, is a direct epistemic relation, according to Gibson (1967) in the sense that it doesn't rely on epistemic intermediaries. This he refers to as "direct realism".

Alan Costall (2004b, 82) identifies a tension within Gibson's works between his common sense realism and a more fundamental, ontological sense of realism that becomes apparent in his theory of information. In his zeal to do away with subjectivism and mentalism associated with sensation based theories, Gibson has a tendency to objectify or reify stimulus information and the environment itself. For example, his identification of stimulus information with the variant and invariant structures of ambient energy arrays entails that "being informative" is an intrinsic property of those structures.

> [...] despite Gibson's attempt at reification, "information" is not an intrinsic property of structures in light, sound, and other forms of energy. "Information" is a *functional* concept—information in relation to a particular animal, in relation to a particular purpose, and "realized" within that relation. This is obviously the case for the information relating to affordances, since, surely, such information must relate to an agent.
>
> Costall 2004b, 82

Gibson's attempt to define information structurally and independently of the particular animal that might exploit it, is at odds with his own notion of propriospecific, "self-related" aspects of that very same information, Costall continues. (See section 1.3.2 of our first chapter for brief a description of propriospecific invariants). Costall (2004b, 84) attributes Gibson's tendency to

objectify affordances and information to the fear that they might be considered "less real" or even "unreal" when defined as animal-environment relations rather than "objective" properties. Sometimes, nonetheless, Gibson adopts a more pragmatic stance, as when he writes:

> The central question for the theory of affordances is not whether they exist and are real but whether information is available in ambient light for perceiving them.
>
> Gibson 1979, 140

This isn't so surprising either given the historical ties of Gibson to the American pragmatist tradition (Heft 2001, 189). This (sometimes latent) pragmatism offers, we will see, a way to resolve the tensions that Gibson's realism generates.

In this chapter we will look at the Neogibsonian interpretation and further development of ecological epistemology and its implications for the nature of perception. We will describe their analysis of the "problem of (knowledge of) the external world" and see that, in response to that problem, they commit to a "psychological approach to the problem of knowledge" (Shaw et al. 1982, 168). In general, psychological approaches to knowledge entail that—contrary to traditional, a priori, normative philosophising about knowledge—an important role is attributed to the empirical facts of the psychology of knowing agents. It might thus be said that, in general, approaches to knowledge might be situated on a spectrum. Depending on how much weight the normative and empirical concerns are attributed, an approach is less or more "psychological". On the one extreme there is the classic epistemology that offers a priori, conceptual analyses of truth and justification with little consideration for how knowledge is in fact instantiated or produced; at the other extreme end of the spectrum there is "naturalised epistemology", the approach coined by W.V.O. Quine (1969), that eschews all a priori reasoning. It is fully "psychologistic".

In the following sections we will first summarise the main arguments of Shaw et al.'s analysis of perception and perceptual knowledge. Then we'll explore Quine's naturalised epistemology, so that we can use it as a benchmark to see where Shaw et al.'s psychological approach diverges from the radical, psychologistic view. We will argue that the more thoroughly naturalised conceptions of perception and of

knowledge are compatible with most aspects of Gibson's ecological psychology, in particular with the aspects in his work that favour the "natural history approach" to perceiving and knowing. Shaw et al.'s analyses show more fundamental differences with the strong interpretation of the psychological approach to knowledge. As a consequence, the ontological notion of realism in Gibson's work (cf. Costall 2004b), which is also defended by Shaw et al. will have to be qualified considerably. This qualification—or even deflation—may still be in line with the pragmatic tendencies in Gibson's work. It actually resolves the tension identified by Costall (see above).

4.2 Indirectness and evidence in epistemology of perception

4.2.1 Direct realism and the problem of the external world

In epistemology the "problem of the external world" is the result of a sceptical argument that starts from the possibility of perceptual error and the idea that erroneous perceptual experiences (illusions, hallucinations) are sometimes subjectively indistinguishable from veridical ones.[27] This leads to the idea that all we have to go on are perceptual "appearances" of which we are unsure whether they correspond to an external world or not. This is called the "Indirectness Principle":

> Nothing is ever directly present to the mind in perception except perceptual appearances.
>
> Lyons 2016

From the indirectness principle, the sceptic derives two further premises. First, that without a good reason for thinking that a perceptual appearance is veridical, it shouldn't be counted as evidence for knowledge (the meta-evidential principle[28]); and second, that we have no good reason for thinking that any

[27] For now we will not challenge the idea that a concept of perception should start from the notion of perceptual experience. We will return to this when treating Quine's 'Epistemology Naturalized'.

[28] "Indirectness principle" and "meta-evidential principle" are terms from Lyons (2016). They are not used by Shaw et al. but we are confident that they would agree with an analysis of their arguments

perceptual appearance is veridical (because any such reason would have to rely on other perceptual experiences, leading to an infinite regress). Thus, the sceptic concludes, we have no perceptual knowledge of an external world (Lyons 2016).

Gibson's, and the Neogibsonians' denial that perception is based on sensations amounts to a denial of the Indirectness Principle. (The awareness of sense-data is equated to "having" appearances. Shaw et al. 1982, 173). The Indirectness Principle must be rejected, according to Shaw et al. because it is incompatible with knowledge of the external world, that is, with all forms of realism. Shaw et al. state that a commitment to realism is in fact implicit in all sciences. All scientists assume that the objects they study exist, that they are not products of their own minds. For ecological perceptual psychology in particular, a real world must be assumed, because it takes the core of its explanandum to be functional: Perception is that function of agents that allow them to successfully guide their activities using environmental energy distributions. And, practical successes of such activities makes sense only if they take place in a real world (Shaw et al. 1982, 159). Hence their rejection of phenomenalism.

Indirect realism, the attempt to marry the assumption of a world that exists independently of agents' minds with the Indirectness Principle is self-defeating, they hold. A considerable portion of Shaw et al.'s essay is dedicated to demonstrating that indirect realism—the idea that there is indeed a mind-independent external world, but that we come to know it through epistemic intermediaries like sensations or appearances—is an epistemically weak position: accepting the indirectness principle gives a sceptic enough room to undermine realism altogether. That is so because if one accepts an epistemic mediator the sceptic can question the grounds on which it is accepted that the mediator reflects the properties of the external world.

In order to make clear the distinction between direct and indirect realism, Shaw et al. (1982, 182) analyse the semantics of the intentional verbs "appearing", "perceiving", "believing", and "knowing". "Appearing" adheres to the same logic as believing, they state. Statements like "it appears to Z that *x* is *y*" and "Z believes

in these terms.

that *x* is *y*" can be true whether "*x* is *y*" is true or false. True appearances and true beliefs entail contingent truths: a true belief is of something that could have been false. Therefore, if knowledge is regarded as a form of true belief, knowledge too is of contingent truths. In other words, if the Indirectness principle is accepted, "Z perceives that *x* is *y*" and "Z knows that *x* is *y*" are varieties of "appearing" and "believing" that only happen to be true. So it follows that perceiving and knowing would be of contingent facts, and that all possible forms of justification would depend on contingencies too. On the direct view, however, "perceiving that *x* is *y*" entails necessarily that "*x* is *y*" is true, and thus that *x is y* is a fact of the world. Perceiving and knowing are of necessary facts on the direct view. Hence, direct realism is an epistemically stronger position than indirect realism. The assumption of direct realism gives a sceptic no wiggling room.

Shaw et al. (1982, 182) argue that appearances can't be constitutive to perceivings, just as having a belief is not constitutive of knowing. That is so because the evidence for perceiving and knowing must be "real" facts of the world. Should indirectness hold, one can't appeal to facts, only to reasons (arguments) for taking instances of appearances to be veridical or beliefs to be justified. Hence, Shaw et al.'s commitment to realism necessitates them to also reject the meta-evidential principle that forms part of the Problem of the External World: they reject that one should be able to give reasons for taking perception to constitute evidence. Acts of perceiving and knowing aren't successful ("true") by "force of arguments", but by "the force of existence" (Shaw et al. 1982, 194). They develop an epistemology in which coherence of experience is central wherein the fact of coherence, rather than reasons suffices to attribute perceptual knowledge. (See section 4.4 for more detail).

4.2.2 Against the representational view of perceptual experience

In the philosophy of perception, the representational view of perception, often referred to as "intentionalism" (Crane and French 2016), holds that perception is not a relation between an agent and a worldly object. Intentionalists attempt to solve the challenges to the common sense concept of perception posed by the arguments from illusion and hallucination, by characterising perception as a

mental state that has semantic properties. That is, that perception is a mental state that truly represents the world when it is veridical, and thus that illusions and hallucinations are false representations.

Shaw et al. (1982, 169) reject this view for three reasons. The first reason is that the notion of representation deployed by the intentional theory implies a user if, at least, the representational state is to be understood as an epistemic state. They distinguish between representation *by* and representation *for*. Representation by is defined as structural isomorphism. Structural isomorphism can exist naturally without agents, *e.g.* the impression in mud left by an some object that is subsequently blown away by wind may be structurally isomorphic with the object. But, Shaw et al. argue, a representation *by*, or a structurally isomorph token by itself can't be a source of knowledge. To come to know something about the object that made the impression in mud via the impression, one must already be able to use the impression as a representation. It must already represent something *to* or *for* the agent in order to be a source of knowledge. But the representational concept of perception can't rely on the notion of representation *for* either, because it makes it so that the perceptual state and the agent are two different entities, which leads to an inner homunculus, and eternal regression arguments.

The second reason of Shaw et al.'s (1982, 172) rejection of intentionalism is that, if the characterisation of perception as a representational state is to serve as an explanation, it needs a theory as to how such representational states arise, and how their content (semantic properties) is determined or selected. (More on this in chapter 6).

Third, in representational theories the semantic content of perception is often characterised as propositional. Shaw et al. (1982, 192) argue that the propositional concept of perception implies that perception is essentially a form of judgement or inference. To evaluate the truth of a judgement, one needs evidence. And evidence can only be a direct experience of what exists, they continue.

> To deny the directness of experiences of the world, what we called the "nonpropositional" use of the term *perception*, leads to a hopeless regress where judgments feed parasitically of other judgments, which ultimately feed off nothing.
>
> Shaw et al. 1982, 193

Thus, in order to play an epistemic role perception mustn't be conceptualised as representational.

4.2.3 Ecologically improved empiricism: on PoS and dualism

Shaw et al. (1982, 162) state that their functional approach assumes that perception is a biological function, a result of biological adaptation. The commitment to an evolutionary view forces a choice for empiricism rather than rationalism with regards to the origin of knowledge, they write. Evolutionary theory entails that any living animal has an ancestor that had sufficient knowledge of its environment such that it was able to successfully reproduce. Such knowledge encompasses that it is able to somehow "relate" the behaviourally significant features of its environment to the energy media (*e.g.* light). That is so because even if it is supposed that this ancestor's knowledge originated not in perception but in reason, then it is still the case that its reasoning capacities ought to be constrained by the demands of its environment. Otherwise it wouldn't be successful. But unless it is assumed that perception is the primary source of knowledge (*i.e.* empiricism) it is impossible to explain how those constraints on reason arose through evolution. If knowledge is not perceptual in origin, then rationality must have its origin in something extra-evolutionary. A conclusion that should be rejected, according to Shaw et al. (1982, 166).

Empiricism, on the other hand, is challenged by two problems of its own: The Poverty of the Stimulus (PoS) argument, referred to by Shaw et al. as "intractable nonspecificity"; and mind-body dualism, which they call "incommensurability of natural kinds". A quick summary of PoS: several different states of affairs can cause one and the same optical pattern on a retina; therefore, retinal patterns are taken to be ambiguous, *i.e.* non-specific, with regards to the worldly states of

affairs, or events, that have caused the retinal pattern. Hence, on the assumption that PoS is true, empiricism faces the problem of securing knowledge on the basis of ambiguous stimulation of the senses. This results in the "intractability" of the external world because sensations "inherit" the ambiguity of sensory stimulations with regards to what caused them. Classical empiricism, according to Shaw et al. (1982, 166) adopted the idea that perception must thus involve mental "enhancement" operations upon sensations, mediated by memory, so as to dispel the ambiguity and gain traction. The question arises then how sensations can ever be associated with their causes, given that one can never be sure what precisely caused the ambiguous stimulation. Memory and associations were taken to play that role, but that only shifts the epistemological burden: what's to ensure that the remembered associations are valid? Shaw et al. conclude that by basing perception on sensations and taking ambiguity of sensations seriously, classical empiricism was undermined by its own assumptions (Shaw et al. 1982, 166).

The solution to "intractability" or PoS proposed by Gibson and perpetuated by Shaw and Turvey is to assume "specificity", more precisely that "specific" or "specifying" information for affordances exists. That is, they reject the idea that stimulus information is necessarily insufficient for veridical perception. By veridical, Shaw et al. don't mean that all the properties an object possesses must be perceived. Veridicality is construed as "sufficient to allow the animal to live and reproduce" (Shaw et al. 1982, 162; See also chapter three where we discussed the lawful basis of ecological information).

But, Shaw et al. continue, assuming that stimulus information is sufficiently rich or specific to dispel ambiguity (purportedly) solves the problem of intractability, yet leaves a "qualitative gap" between physical and mental properties or objects. Non-veridical perceptual experiences have been taken to show that the object to which perception "refers", the real world object, does not always coincide with the object experienced, the so-called intentional object. Moreover, objects are often perceived to have properties that are hard to trace back to their "real" worldly properties. For example, an unattended packet in the train station may be seen as "suspect", yet there is no physical property of the packet that makes it suspect (see also Dennett 1998). The "suspectness" comes from the mind of the

perceiver. It is said to be "subjective" and thus, for some, less real, leading to a divide in reality, a dualism that makes some properties or objects, the ones that perception stands in reference to, more real than other properties or objects. Perception construed as involving two objects between which there can be "slippage" is a threat to realism.

The resulting dualism—the idea that mental and physical kinds have a fundamentally different nature—can be solved, Shaw et al. (1982, 194) propose, by assuming Gibson's relational ontology referred to as "mutualism" or "animal-environment synergy". Overcoming the qualitative gap between the physical and the psychological domain is possible if a single theoretical language is devised that can capture both aspects. This implies that physicalism, the attitude that takes only physical entities to be real, is abandoned, or at least amended by an "ecological physics", as we saw in the previous chapter. Physicalism, Shaw et al. observe, is the source of dualism, rather than an antidote:

> It would seem that conclusions opposed to realism arise from describing the reference object in a physical language that is committed to a reality but is noncommittal or neutral with regard to animals as epistemic agents, and from describing the intentional object in a phenomenal language that is noncommittal on reality but is agent oriented.
>
> Shaw et al. 1982, 204

The central notions in a mutual language designed to close the mind-world gap are "affordance" and "effectivity", according to Shaw et al. Affordances are usually conceived as possibilities for action. Effectivities are those aspects of organisms responsible for the possibility of performing actions, as seen in the previous chapter. Words (usually verbs) that refer to actions thus form the core of the common language in which both environment and organisms are described in ecological psychology. Affordances and effectivities allow for a semantics of "perceiving" and "acting" in which the referential object and the intentional object are united. Shaw et al. (1982, 221) propose a conceptual schema for "perceives" that includes the agent, the perceived object and the semantic context for the interpretation of the predication. Perception, it is said, is intentionally related to a "complex particular object" that includes these factors. It is formalised as follows:

Perceives (X, Z, O | gX ◊ fZ) = affordance Y

Shaw et al. 1982, 221

In this formula "X" stands for the referential object of the perceptual act, "Z" stands for the agent, and "O" stands for the occasion upon which the act takes place. (Remember, for example the occasion of the incoming tide that selects the lawful context that applies to the marsh periwinkle's perception of grass blades, cf. chapter 3). The expression "| gX ◊ fZ" designates the semantic context for interpreting the predication of "perceives": it stands for the mutuality or complementarity of certain aspects of reference object X and agent Z which must hold for the predication to be meaningful. For example, to say of an animal Z that it perceives an edible item, it must be so that some properties of Z's digestive system must match some properties of the food item. Together these properties constitute the fact that the item is digestible and they guarantee logically that when it is perceived as such then it actually is that way. Shaw et al. stress the importance of the idea that perceiving a complex particular is immediate, non-inferential. The agent doesn't construct affordance Y out of the composing elements. On the contrary, perception is defined as an indexical act in which "an object that is both its own intention and reference" presents itself (Shaw et al. 1982, 208).

The corresponding, or "dual" schema for effectivity contains the same variables. It defines the intentional object of an action in terms of the reference object X, the organism and its psychological state given the same compatibility of dispositions of X and Z.

Effects (Z, X, O | gX ◊ fZ) = action Y

Shaw et al. 1982, 222

The fact that the operators "Perceives" and "Effects" have the same object, expresses the central ecological idea that perception and action aren't just coupled causally, but logically. What an agent can perceive and what it can do are connected logically.

4.2.4 A Possible worlds semantics for the concept of perception

As said above, the semantics of "perceives"—that is, the meaning of statements involving "perceives", and the truth conditions of such statements—depends on a compatibility relation between an environmental aspect "gX" and an organismal aspect "fZ". Compatibility ensures that the predicate "perceives" is meaningful in the described situation. A "possible worlds" semantic theory is required for perception as an epistemic act because the classic "correspondence theory" of meaning and truth is ill equipped to do the job (Shaw et al. 1982, 199).

They develop the following argument to support this: Correspondence theory holds that a statement is meaningful if and only if the property that is predicated of a thing (in its broadest sense) is conceivably among its set of properties. The statement is true if that property is indeed found in the set of properties the thing actually has. For example, the statement "snow is white" is meaningful if and only if "white" is a property that can possibly be attributed to snow. To contrast: "snow is a prime number" is not meaningful because being prime is not conceivable as a property of snow; it is a category mistake. Whether "snow is white" is true, then, is evaluated by identifying a thing "snow" in the world and check whether "white" is indeed one of its properties. Hence, truth evaluation according to correspondence theory depends on an epistemic act; a perceptual "rapport" with the world. (At least, when non-analytic statements are evaluated). Hence, correspondence theory depends of perceptual contact. That entails, however, that if the semantics of "perceptual contact" or "perceives" is itself correspondential, one ends up in a vicious circle: evaluating whether someone perceives Y requires checking whether a correspondence relation obtains and checking the correspondence relation necessitates a perceptual act.

A way out of that vicious circle is found in a "possible world semantics" (PWS) for perceiving and acting, according to Shaw et al. (1982, 199). A possible world semantics provides a model for evaluating the meaning of statements like "Z perceives Y", not by looking for a correspondence relation between the statement and the world, but by constructing multiple, "possible" worlds in which the statement might be meaningful. These worlds are then compared to one another, evaluating them qua coherence.

> Rather, it [PWS] only offers a conception of meaning or truth based upon a very carefully constructed model that exhibits coherence in the account of reality, much the same as a cogent legal case can be built upon circumstantial evidence. In other words, it produces no absolute, objective account of what is true or meaningful but produces an account to be evaluated against other accounts to see which is most "fit" to survive at advanced stages of elaboration. The view that can incorporate most consistently meaningful statements wins the crown of reality.
>
> Shaw et al. 1982, 199

PWS entails that truth-evaluation cannot ever occur of one isolated sentence, because in order to evaluate its truth, one must "know" its meaning, and to know its meaning, one must look at the semantic context, the other facts incorporated in the model in which it is embedded. Instead of evaluating the truth of individual sentences, whole possible worlds are evaluated against one another. When two possible worlds are aimed to describe how the real world is for a particular perceiver, they are compared to one another, so to say, to see which one best predicts the observations that would be expected from them.

The possible world semantics is applied to describe the perceptual knowledge animals might have. The possible world description which best explains the animal's successful actions in its environment is taken to best characterise its knowledge.

> Thus in all cases where an energy display resembles other energy displays, the resemblance relation specifies—as a self-presenting fact of experience—"possible worlds" in which the percipient may be living. Such "possible-worlds" have no necessary existential import but are mere *virtual* worlds that resemble the world to the extent that they remain internally consistent when elaborated. The elaboration takes place through actions or inferences.
>
> Shaw et al. 1982, 201

Take, for example, a person being presented with an optical pattern that, under "normal circumstances" would correspond to a lake in the distance. In a possible worlds analysis constructed to adjudicate whether "person perceives lake" is a meaningful and true statement, the "normal circumstances" present one possible world. Another possible world is one in which hot air ascending from the desert sand created a resembling optical pattern and there is no lake. Elaboration of

these two possible worlds would consist, for example, in running in the direction "indicated" by the optical pattern. "Person perceives lake" coheres better with encountering a lake after a while than with chasing a mirage and eventually dying of thirst. In that case, "perceives" ought not to be predicated. But, Shaw et al. (1982, 199) note, the possible world analysis provides no absolute, objective account. It is possible that the person chases the optical pattern but collapses from thirst before reaching the lake that was actually there. For that person, the elaboration failed. Although *we* can say that he saw the lake, his own evaluating or elaboration was suspended prematurely. For that person it remains undecided whether he saw a lake or was deceived by a mirage. It is for this reason that the possible world semantics of perception doesn't deliver absolute truths.

"Coherence" plays an important role for the attribution of knowledge. It should be noted that coherence, here, doesn't necessarily apply to beliefs, but first and foremost to experiences while elaboration through action takes place. In this Shaw et al. differ from coherence theories of justification, which hold that coherence is a forceful argument in defence of a true belief to count as knowledge. That is to say that a candidate knower is able in principle to justify his knowledge by referring to the coherence of his beliefs. But the theory of knowledge Shaw et al. develop is not "internalistic" in that way—they reject the idea that a knower must have access to the reasons why he can be said to know something is rejected. As said, Shaw et al. reject the meta-evidential principle. Ecologically valid knowledge cannot, need not and must not be justified by arguments (invoking coherence or anything else). It is the experiential fact of "reaching the lake" that blocks the sceptical argument; this is what is meant by "force of existence" as opposed to "force of argument". Reaching the lake, swimming in it, drinking from it are facts of experience that are taken to be self-evident, against which a sceptic has no argument. Shaw et al. (1982, 186) humorously illustrate this idea by letting a sceptic reach the desert lake. He maintains that his experiences of swimming and drinking the water still provides no evidence for its existence. When his comrade, a realist, holds the sceptic's head under the water surface, the latter faces a practical dilemma: acknowledging its existence or drowning. The example shows that elaboration involves pragmatic action, and the idea that only those "states" that lead to correct or right action

may be labelled perceptions or perceptual knowledge. States that don't or can't provoke elaborative actions—and thus have no consequences—are excluded.

> The *real* world, as opposed to a virtual or merely possible world, is defined as whatever remains consistent *across* all "possible worlds" after they have been elaborated by action (or reason). By definition, we speak of *right* action (like right reason) as the activity the percipient-as-actor engages in whenever the elaboration increases the consistency of a selected "possible-world" over the others—that is, when the agent's actions are consistent with the interpretation of the world that his or her primary perceptual experiences entail. Thus, the *real* world, properly speaking, is not a possible-world per se but a set of resemblances that is invariant over all possible-worlds. The real world garners existential import from the consistent or mutually compatible properties that hold across all "possible-worlds". In this sense, its world is knowledge of these "transworld" consistencies discovered through perceptions and elaborated through actions.
>
> Shaw et al. 1982, 201

This view of perceptual knowledge underlines Gibson's idea that perception and ecological knowledge are active, ongoing achievements. So, to refer to them as 'states' is rather inaccurate. Importantly, those achievements can be situated on multiple levels of analysis and time-scales.

> [...]"possible-worlds" semantics may provide contexts of interpretation at more than a single grain of analysis. By our previous arguments, it should be clear that for ecological knowledge to be possible, the affordances of X must be commensurate with the effectivities of Z at all grains—that is, where X ranges from econiches to objects and Z from species to individuals on particular occasions, respectively. To illustrate this fact, consider three grains of analysis that are significant for ecological psychology: those of species, individuals, and distinct episodes of experiences.
>
> Shaw et al. 1982, 215

The three "nested" levels they offer as illustration of multiple grain analysis are (1) a species, in this context, consists of (groups of) individuals over a long period of time; (2) an individual, on the other hand can be seen as a set of consecutive (3) distinct episodes. Each level comprises the level below, so to say. We may add that the amount of levels in the illustrations of Shaw et al. is merely a matter of

example. The number three is not settled a priori: levels can be chosen in function of the ecological knowledge one wants to conceptualise; any functional unit could be defined, for example a pair of parents raising a cub, a hunting pack, a social group of animals, etc. Shaw et al. (1982, 215) note that "culture" and "linguistic communities" can also be useful levels of analysis.

As illustrations, Shaw et al. (1982, 215-216) define three useful levels of analysis. At the species level they define the operator "EVOLVES", for the level of the individual animal, "ADAPTS OR LEARNS" and in reference to a single episode "KNOWS, BELIEVES". What a species can see or know can then be described as a function of its evolutionary history. For example, frogs' perceptions of small, black things darting around (flies) as edible follows from their evolved dispositions to respond with a snap of the tongue when presented with stimulus patterns within a similarity space. When the description of the frog species' possible world of "affordances" has a complement in its possible world of actions (effectivities) the species is said to have evolved, ecologically valid knowledge of edible small, black, darting things.

> When the semantic context of its experiences is altered, then their meaning varies accordingly. The possible-worlds of experience of one species or one individual may not be those of another. No puzzles for epistemology or psychology, however, are entailed by this fact unless one holds to a rigid, universal theory of truth rather than a more flexible, relativistic one.
>
> Shaw et al. 1982, 218

So far we have treated Shaw et al.'s arguments for rejecting the Indirectness principle and the meta-evidential principle as a consequence of a commitment to realism. The epistemological upshot of their approach is that their possible worlds approach to perceiving entails that perceiving is of necessary facts, conceived as "complex particulars" that include an organismal, an environmental and a situational factor. Conceived as of a necessary fact, there can be no slippage between intentional and referential objects of perception. As a result, arguments from illusion and hallucination can't threaten knowledge, according to Shaw et al.

In addition, they argue that perception is non-mediated—the complex particular is experienced directly. We looked at their arguments why such experiences shouldn't be characterised as representational, nor as a form of judgement involving inference, nor as a mental state with propositional content. We have analysed the features of Shaw et al.'s notion of perception that allows for a "psychological approach" to the problem of knowledge. They advocate that a psychological concept of "perceiving" is possible such that it is a form of knowledge.

In the following section we will explore W.V.O. Quine's psychological approach to knowledge, which is generally considered to represent the most radical departure from classic epistemology. We will use Quine's naturalised epistemology as a benchmark so as to identify in which respects Shaw et al.'s approach to knowledge reflects "old" epistemology.

4.3 NATURALISTIC EPISTEMOLOGY

4.3.1 Quine's radical departure from classical epistemology

Quine's (1969) "Epistemology Naturalized" presents an approach to knowledge that subordinates the normative questions regarding the concepts of knowledge and justification to the scientific, factual study of knowledge production. In the article he aims to show that "classical epistemology"—by which he refers to, among others, Hume's *Treatise* (1738) and the epistemology of the Wiener Kreis, most notably Carnap's—is fuelled by a misconception of knowledge.

Quine proposes a new conception of knowledge, which we will elaborate below, that entails that epistemology becomes a branch of empirical psychology. As the empirical study of knowledge production, naturalised epistemology can no longer claim any privileged methods beyond those of the natural sciences, nor maintain that it is a (purely) normative discipline. Such a view is sometimes called "psychologism" or the "strong replacement thesis" which states that all epistemological questions should be answered by psychology, and that when they have received psychological answers nothing (but pseudo-problems) remains to be clarified (Kornblith 1994, 4).

According to Quine (1969, 74) the motivation of "classical epistemology" has been "the Cartesian quest for certainty". When confronted with sceptical arguments that lead to the problem of the external world, the classical response has been to seek a way to secure beyond doubt our knowledge of the external world. Some forms of immediate experience were taken as the paradigm of certainty beyond doubt, *e.g.* Descartes' experience of the impossibility of doubting that he had doubts, or the certainty beyond doubt that one experiences pain when one experiences pain. Traditional epistemology thus attempted to provide knowledge of the external world with a foundation as secure as those allegedly indubitable experiences.

Drawing on the philosophy of mathematics Quine (1969, 70) asserts that epistemology of natural knowledge—knowledge of the external world, that is—has two aspects: The conceptual and the doctrinal aspect. The conceptual side deals with questions as to how terms (words, sentences) get meaning; how they come to refer to worldly objects, as opposed to referring to sense data. That is, if it is accepted that all that is directly present to the mind are appearances, how do we connect the terms we use to refer those appearances (i.e. sensations), to the external causes of those appearances. Hume's proposal to address this question was to identify "sense impressions" with "bodies", material objects including the human body with sensory receptors. The idea was that this identification of mental entities with worldly entities would allow for a translation of all sentences involving the former into sentences about the latter.

The doctrinal aspect of epistemology deals with truth. Once one would have a way to translate all sentences about sensations (impressions, sense data, or another epistemic intermediary) into sentences about the world, a way is needed to determine which sentences about the world are true, and to prove that they are true so that they qualify as knowledge. But, Quine argues, even if the conceptual project were successful—it wasn't, see below—proving knowledge of the external world on the basis of sensations and the rules of logic, the ambition of logical positivism is unattainable.

> But the mere fact that a sentence is couched in terms of observation, logic, and set theory does not mean that it can be proved from observation sentences by logic and set theory. The most modest of generalizations about observable traits will

> cover more cases than its utterer can have had occasion actually to observe. The hopelessness of grounding natural science upon immediate experience in a firmly logical way was acknowledged. The Cartesian quest for certainty had been the remote motivation of epistemology, both on its conceptual and its doctrinal side; but that quest was seen as a lost cause.
>
> Quine 1969, 74

The "lost cause" Quine refers to here is Rudolf Carnap's project of *Der Logische Aufbau der Welt* (1928) the failure of which was announced by Carnap himself in "Meaning and Testability" (1936). Carnap had aspired to reduce the terms (concepts) we use for worldly objects to descriptions of the similarities of sensory experiences. This aspiration, referred to as "rational reconstruction", failed because it couldn't overcome solipsism: even if it would be possible to reconstruct of one's subjective conceptual space, based on sensations, logic and sets, constructing an intersubjective conceptual space based on private experiences proved impossible.

The doctrinal side gives rise to an additional question: if a rational reconstruction of all discourse about the world would be possible, how would we know that it is the one and only correct rational reconstruction? If one reconstruction would be possible, many are possible. Quine (1969, 70) refers to Gödel's work on proof theory to illustrate the impossibility of a certain basis for this decision.

Quine concludes that the idea of "certainty" regarding knowledge of the natural world is out of place. Strict deduction of science from sensory evidence is impossible (Quine 1969, 75). But, this is no reason to concede to scepticism.

> We may not be able to explain why we arrive at theories which make successful predictions, but we do arrive at such theories.
>
> Quine 1969, 79

Although science can't be deduced from sensory evidence, the empiricist idea that all the evidence we have for science (knowledge) *is* sensory, remains valid, according to Quine (1969, 75). Also, learning the meaning of words and sentences—their reference to the world—relies ultimately on sensory evidence. These are the reasons, for Quine, to naturalise or "psychologise" epistemology in a nutshell: if rational reconstruction of meaning and truth from experience is

impossible, the best chance of understanding how referentiality emerges, and how we evaluate truth, *i.e.* how we arrive at knowledge of the world, is to study the actual relations between sensory stimulation and the theories we ultimately arrive at.

> The stimulation of his sensory receptors is all the evidence anybody has had to go on, ultimately, in arriving at his picture of the world. Why not just see how this construction really proceeds? Why not settle for psychology? Such a surrender of the epistemological burden to psychology is a move that was disallowed in earlier times as circular reasoning. If the epistemologist's goal is validation of the grounds of empirical science, he defeats his purpose by using psychology or other empirical science in the validation. However, such scruples against circularity have little point once we have stopped dreaming of deducing science from observations.
>
> Quine 1969, 76

So, instead of searching for a secure, epistemically basic, foundation for knowledge, Quine proposes to study empirically the relation between theory and evidence without the a priori assumption that the former must be derived from the latter. Quine's project thus entails a reversal of the evidence relation. Whereas in old epistemology, knowledge was to be deduced from evidence, in naturalised epistemology evidence is at the "end" of the logical chain. Evidence, in the form of observation sentences are deduced from a theory to be tested against sensory experience.

> The old tendency to associate observation sentences with a subjective sensory subject matter is rather an irony when we reflect that observation sentences are also meant to be the intersubjective tribunal of scientific hypothesis. The old tendency was due to the drive to base science on something firmer and prior in the subject's experience; but we dropped that project.
>
> Quine 1969, 87

Observation sentences—particular statements to which a linguistic community of speakers would assent given that they are provided the same sensory stimulation (Quine 1969)—have their meaning directly connected to evidence. Other statements, like general statements and statements about the future, have no "experiential implications" of their own (Quine 1969, 79). Only a sufficiently

large set of theoretical sentences can be verified. This principle is referred to as "confirmation holism" (Quine 1992). When an observation sentence derived from a body of theoretical sentences is rejected, the whole set is falsified, but we don't know which of the theoretical sentences ought to be revised so as to better predict observation. Theory can be "reshuffled" in several ways to fit observation; there is a certain degree of freedom in assigning meaning to theoretical terms. There are no a priori principles for choosing which theoretical sentence(s) must be revised. Quine (1951) called this the "underdetermination of theory by evidence".

> It is that the typical statement about bodies has no fund of experiential implications it can call its own. A substantial mass of theory, taken together, will commonly have experiential implications; this is how we make verifiable predictions. [...] Sometimes also an experience implied by a theory fails to come off; and then, ideally, we declare the theory false. But the failure falsifies only a block of theory as a whole, a conjunction of many statements. The failure shows that one or more of those statements is false, but it does not show which.
>
> Quine 1969, 79

The implication of this approach to knowledge is that "justification" gets a different meaning altogether. The reason for accepting a theory is that it allows to deduce observation sentences that predict sensory stimulation. Our best theories, those that deliver better predictions than their competitors, acquire the label of being "knowledge". Knowledge is thus fallible, since any theoretical sentence or any part of a theory is candidate for revision. Justification, then, doesn't confer certainty, it is a measure of pragmatic success of predictions. In this guise, justification is not meant to be an answer to a sceptical argument. Once an epistemologist finds himself in search for foundational principles, he has already fallen victim to the sceptic's rhetoric (Quine 1975, 67).

Quine's pragmatic stance in "Epistemology Naturalized" has an important consequence for scientific psychology of perception and its relation to (classical) epistemology. It may be summarised as there being no "epistemological problems of perception".

> One effect of seeing epistemology in a psychological setting is that it resolves a stubborn old enigma of epistemological priority. Our retinas are irradiated in two dimensions, yet we see things as three-dimensional without conscious inference.

> Which is to count as observation-the unconscious two-dimensional reception or the conscious three-dimensional apprehension? In the old epistemological context the conscious form had priority, for we were out to justify our knowledge of the external world by rational reconstruction, and that demands awareness. Awareness ceased to be demanded when we gave up trying to justify our knowledge of the external world by rational reconstruction. What to count as observation now can be settled in terms of the stimulation of sensory receptors, let consciousness fall where it may.
>
> Quine 1969, 84

The functional approach to perceptual psychology that Quine proposes rejects the conception of perception in terms of experiences. Hens it also lacks reference to an "intentional object" of perception. He advocates that the language in which descriptions and explanations are couched be purely extensional. Intensional contexts, such as "seeing *as*", are to be treated with suspicion. For Quine they are indicative of "mentalism".

Quine's commitment to extensionality, entails that discussions about the problem of knowledge of the external world simply disappear. How an object is "given" in experience, its appearance, is irrelevant to the relation between theory and evidence. Misperception, illusion and hallucination, the paradigmatic cases where there is "slippage" between the "intentional object" and the referential object don't give rise to epistemological problems because givenness to experience is not taken to be epistemically primitive in the veridical case either. Quine summarises his psychological approach to knowledge—no longer to the "problem of knowledge"—as follows:

> Epistemology, or something like it, simply falls into place as a chapter of psychology and hence of natural science. It studies a natural phenomenon, viz., a physical human subject. This human subject is accorded a certain experimentally controlled input—certain patterns of irradiation in assorted frequencies, for instance—and in the fullness of time the subject delivers as output a description of the three-dimensional external world and its history. The relation between the

> meagre input and the torrential output is a relation that we are prompted to study for somewhat the same reasons that always prompted epistemology; namely, in order to see how evidence relates to theory, and in what ways one's theory of nature transcends any evidence.
>
> Quine 1969, 82-83

4.3.2 A benchmark for the ecological conceptions of perception

Now that we are acquainted with the basics of Quine's radical form psychological approache to knowledge, we are in a good position to see how Shaw et al.'s concept of perception and its relation to knowledge diverges from it. We assume that the converging points of the two approaches—rejection of appearances or sensations as epistemic mediators, an approach to the meaning and truth of theoretical sentences that goes beyond simplistic correspondence, and pragmatic success as the ultimate decision ground between competing theories, the best of which "wins the crown of reality" (Shaw et al. 1982, 199; cited above in section 4.2.4).

We will now address the question as to what kind of a psychological account of perception is possible within the confines of Quine's characterisation of science and knowledge. As said, Quine's rejection of mentalism (and his adoption of physicalism) surely has implications for how perception is or ought to be conceptualised. Foremost, the common sense notion of perception as a (conscious) mental state that is characterised as an openness to mind-independent objects that are experienced as present and as a form of awareness (Crane and French 2015) is unfit to serve as the explanandum of psychological inquiry along Quine's guidelines because the concepts of experience and awareness generate intensional contexts, and descriptions of experience relies on the privileged method of introspection.

Moreover, none of the contemporary theories of experience[29] that attempt to formulate intelligible conceptions of perception in response to the arguments

[29] Crane and French (2015) discuss the sense-datum theory, the adverbial theory, the intentionalist theory and the naïve realist theory. For discussions of Husserl's and Merleau-Ponty's phenomenology

from illusion and hallucination that challenge the common sense notion of perception, seem to fit with Quine's naturalism either, precisely because they take (phenomenal) experience to be a fundamental aspect of perception that a theory ought to account for. Concepts of perception that rely on analysis of experience don't acknowledge "The hopelessness of grounding natural science upon immediate experience in a firmly logical way [...]" (Quine 1969, 74).

> Awareness ceased to be demanded when we gave up trying to justify our knowledge of the external world by rational reconstruction. What to count as observation now can be settled in terms of the stimulation of sensory receptors, let consciousness fall where it may.
>
> Quine 1969, 84

From this we must conclude that the Neogibsonians have quite a different idea of perceptual psychology. As we will see below, awareness is central to their characterisation of perception.

> The ecological treatment of perception defines perception as awareness of the environment and thereby focuses attention on animal's veridical experience. (Where veridical means that an animal's experience of the environment is sufficient to allow the animal to live and reproduce, one might say that the experience is ecologically correct [...]
>
> Shaw et al. 1982, 162

Shaw et al. inscribe themselves, so to say, in the contemporary debate about the "metaphysics" of perception in contemporary analytic philosophy, defending a position *in* the debate. Of Quine, it might rather be said that he rejects the debate since it is tainted by mentalism.

4.3.3 More traces of old epistemology in Shaw et al.

True to empiricism, Shaw et al. maintain that origin of knowledge must be sought in perception. Despite their concept of perception as incorrigible, and their rejection of the meta-evidential principle that says that reasons should be

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they refer to the respective entries on these authors in the Stanford Encyclopedia of Philosophy.

provided to justify perceptual evidence, much of Shaw et al.'s can still be interpreted as a quest for certainty. The comparison, for example, with awareness of one's pain and beliefs is found several times in their text.

> What justifies me in believing that [...] is simply the fact that the meaning of such experience is self-evident and neither requires nor allows appeal to any higher authority [...] perceptual experiences, like the awareness of one's pains and beliefs, are self-presenting facts.
>
> Shaw et al. 1982, 188

Another example of a trace of old epistemology is found in the idea that some aspects or types of perceptual experiences are epistemically basic or primitive such that they can play a foundational role. In particular their appeal to the phenomenon of "noticing" to make credible self-evidence and self-presentation as epistemically basic features of experience suggests that they engage with sceptical arguments instead of just "ignoring" the sceptic. Shaw et al. (1982, 205) consider noticing to be the *logically* most *primitive epistemic* act:

> The noticing of resemblances shares with beliefs held, pains felt, and other "noticings," a privileged epistemic position in that unlike the propositions asserted about other things, they cannot be impeached by argument or by any other source of evidence; for to notice them at all is to notice that they exist.
>
> Shaw et al. 1982, 182

Again, this can easily be interpreted as the quest for certainty through privileged methods.

If the only legitimate goal of a psychological theory of perception is to explain the relation between the available energy arrays and the adaptivity of action related to those energy arrays; between patterns described by ecological optics and organisms' evolved behavioural dispositions, then, from the perspective of strong naturalisation, what needs to be made explicit in the first place is the genesis of that relation. Furthermore this story can and ought to be told extensionally. In our previous chapter we have seen, nonetheless, that Neogibsonian theory insists on the intensional reading of ecological laws. This at least leave open an interpretation of Shaw et al.'s theory that it projects intensional properties onto the world and hence simply assumes what needs to be explained.

On the other hand, Shaw et al. note that perception is characterised as intentional in a "non-Brentano sense", meaning that the concept of perception doesn't entail an "immanent object" that may or may not exist, an object characterised by Brentano as having "intentional inexistence" (Shaw et al. 1982, 203).

But if perception is indeed "non-Brentano intentional", then an extensional account of it should be possible. There seems to be no reason for the intensional reading of ecological laws. Affordances can then be functionalised entirely and described extensionally. Their conceptual role as the intentional object of experience then fades to the background. This is also suggested by the following passage:

> Where the verb grammatically requires direct objects, psychological attitudes logically may require no objects at all. Although respect for grammar has run deep in philosophical analysis, it should not be allowed to lead to false conclusions regarding metaphysics.
>
> Shaw et al. 1982, 179

So, we might conclude that Shaw et al. are ambivalent with regards to the concept of perception. On the one hand they promote a definition in terms of awareness and experience, which implies an act-object structure and a commitment to a priori methods. On the other hand they deny the act-object structure. Mutualism, a relational ontology in which the relation is more fundamental than the relata could support that concept. Shaw et al. nonetheless seem to want it both ways.

4.4 Concluding remarks

The epistemological goal of Shaw et al.'s ecological realism is to dispel sceptical arguments by developing a concept of perception in which there is necessarily a unity of the intentional and the referential objects of perception. Perception is construed as of a "complex particular". The analysis, however, remains indebted to "old" epistemology. As involving self-evident experience, Shaw et al.'s notion of perception partakes in the classic epistemological goal of finding a certain, indubitable basis for knowledge.

We have seen, with Quine, that the quest for certainty is misguided. If certainty is required for knowledge, the sceptic has already won. Instead, Quine takes the understanding of pragmatic success to be the goal of epistemology. The notion of pragmatic success plays an important role in Shaw et al.'s theory too, but for them it is functions on the conceptual level as a means to evaluate the semantics of the term "perceives". In the spirit of Quine, we would argue that "pragmatic success" should figure not so much at the conceptual level, but rather as a crucial notion in the development of a natural history approach to perceiving and knowing.

We saw in chapter one that the natural history approach to psychology was present in Gibson's writings, albeit in underdeveloped form. The laws-centred approach of Turvey and Shaw mainly ignores it. Their ontology of affordances and effectivities doesn't entirely succeed in abandoning dualism. To figure in laws, moreover, affordances and effectivities are given a material basis in "ecological physics", as dispositional properties. This seems to reinforce duality rather than dissolve it. The formulation of laws about affordances also suggests that the explanations they figure in are "proximal" explanations. Although they insist that ecological laws aren't necessary causal laws, the idea that identifying affordances and the optical patterns that "specify" them, entails that explanation ends there. As such, the trivialisation challenge continues to threaten the ecological approach of Turvey and Shaw.

In addition to the quest for certainty, Shaw et al. cite another motivation for their commitment to realism: scientific practice requires that scientist take the phenomena they study to be real things, not products of their minds. This form of common sense realism, also found in Gibson's work as we saw, is compatible with Quine's naturalism, but it takes on a perspectival form.

> The old epistemology aspired to contain, in a sense, natural science; it would construct it somehow from sense data. Epistemology in its new setting, conversely, is contained in natural science, as a chapter of psychology. But the old containment remains valid too, in its way. We are studying how the human subject of our study posits bodies and projects his physics from his data, and we appreciate that our position in the world is just like his. Our very epistemological enterprise, therefore, and the psychology wherein it is a component chapter, and the whole of natural science wherein psychology is a component book—all this is

> our own construction or projection from stimulations like those we were meting out to our epistemological subject. There is thus reciprocal containment, though containment in a different sense: epistemology in natural science and natural science in epistemology.
>
> Quine 1969, 83

Realism, then becomes a matter of perspective: when working on a scientific theory, the posits are taken to be real. When studying how theory is being built, as epistemology does, the posited entities of the theory are 'just' posits, but Quine (1960, 20) wrote earlier: "To call a posit a posit is not to patronize it". Again it remains ambiguous in Shaw et al. whether they would accept a perspectival realism like this. On the one hand, they claim no absolute metaphysical account (Shaw et al. 1982, 168). But on the other hand, their epistemology entails that perception is of necessary facts, leaving little to no room for perspectives à la Quine; Shaw et al. patronize posits after all. Moreover, there are other Neogibsonian publications, *e.g.* Shaw and McIntyre (1974), in which very bold metaphysical claims are put forward. (More on this in the next chapter). In *Direct Perception*, another "foundational" publication in the Neogibsonian approach, their colleagues write:

> The special sciences presuppose the conclusions of metaphysics; they begin where metaphysics leaves off.
>
> Michaels and Carello 1981, 86

We think Quine's perspectival realism suffices for science. Moreover, it offers an interesting analytical tool for "affordances". We could say that from within a psychological theory of perception affordances are real, and from the perspective of theory building (epistemology) they are posits. From the latter, epistemological perspective the analysis of complex particulars may be an interesting proposal. But as Patricia Smith Churchland wrote in the foreword to MIT's new edition of Quine's *Word and Object*:

> Conceptual analysis is not a productive method to address those mechanisms. Suitable clarification is always welcome as a starting point, of course, but forced or phony precision where none exists is counterproductive.
>
> Patricia Smith Churchland 2013, xiv

The mechanism referred to are those that are taken to underlie linguistic capacities. But Churchland's observation applies just as well to the study of knowledge that is not mediated by language, we think: when theorising about the psychological phenomenon of perception, intentional objects—like all results of conceptual analysis and introspection—should be shunned entirely because they are relics of mentalism. From the point of view of psychology, affordances and other posits should be defined extensionally.

An extensional notion of affordances, we think, should include the history of animal-environment transactions because the historical account can help to determine proper function (cf. Millikan, next chapter), as well as account for the resemblance relations of stimulus patterns. We think ecological laws become obsolete in the light of this story. The laws are mere placeholders for the actual history.

That is not to say that the conceptual analysis of "Z perceive X" that Turvey and Shaw offer, with its necessary and sufficient conditions, is phony. Their analysis shows at least that the key to understanding perception is action in the environment, which implies a radical shift away from the folk psychological notion of a psychological attitude that carries a mental content.

James Gibson's position regarding the matter—whether his ecological approach to perception must be characterised as a position in the classical debate about epistemology and metaphysics or whether this old debate should be rejected—is ambivalent too. Costall (1984) titled his review of Gibson's *The Ecological Approach to Visual Perception*, "Are theories of perception necessary?" This is a double reference, Costall writes. First to Skinner's (1950) article "Are theories of learning necessary?" and second to a passage written by Gibson himself:

> When the senses are considered as perceptual systems, all theories of perception come at one stroke unnecessary. It is no longer a question of how the mind operates on the deliverances of sense, or how past experience can organize the data, or even how the brain can process the inputs of the nerves, but simply how information is picked up.
>
> Gibson 1966, 319

This statement indicates that Gibson's could be positioned close to Quine and Skinner. It might be interpreted as saying that concepts of perception, insofar as they are based on theories of experience, as in 'old' epistemology, are obsolete when it comes to empirical psychology, which should be extensional. On the other hand, there are his writings about direct realism too, and a commitment to awareness which speak for an inscription in the analytical debate. Perhaps, the sentence we quote earlier is an expression of what we call perspectival realism:

> The central question for the theory of affordances is not whether they exist and are real but whether information is available in ambient light for perceiving them.
>
> Gibson 1979, 140

One of the most important aspects of Gibson's approach to perceiving and knowing is that it is a naturalisation project (Withagen and Chemero 2009, 363; to be discussed in chapter 5). That is why we think, Quinean epistemology suits Gibson better, with one reservation, that is. Above we cited:

> The relation between the meagre input and the torrential output is a relation that we are prompted to study for somewhat the same reasons that always prompted epistemology; namely, in order to see how evidence relates to theory, and in what ways one's theory of nature transcends any evidence.
>
> Quine 1969, 82-83

Quine refers to "input" and adds that it is "meagre". It should be clear by now that a Gibsonian psychology avoids talking about "input" as it is remnant of sensation-based perception. "Meagreness", on the other hand, is a characterisation that resonates with Poverty of the Stimulus arguments. It is related to Quine's commitment to physicalism—he took physics to be our most successful (predictive) science. But as he wrote himself, any theoretical commitment is up for review, and nothing in his naturalistic epistemology contradicts a more "relaxed naturalism" (Hutto and Satne 2015, 530) that allows for "ecological physics" and "ecological optics", *i.e.* to describe the environment and the organisms that act in it in the terms of those activities. A fortiori, when such posits facilitate better understanding and predictions. Quine also points out

that naturalised epistemology plausibly takes the form of "evolutionary epistemology", referring to Donald T. Campbell (1959).

> In this area there is work by Hüsein Yilmaz, who shows how some structural traits of color perception could been predicted from survival value. And a more emphatically epistemological topic that evolution helps to clarify is induction, now that we are allowing epistemology the resources of natural science.
>
> Quine 1969, 90

This brings us seamlessly to Anthony Chemero and Rob Withagen, who work within Gibson's ecological framework but don't follow Turvey and Shaw's "orthodox" line and the important "evolutionary critique" they develop with regard to the latter.[30] That critique pertains to the naturalistic credentials of specifying, law-based information, an aspect we neglected so far, despite the fact that our first citation of Gibson in this chapter puts information central. Hence we quote again:

> If *invariants* of the energy flux at the receptors of an organism exist, and if these invariants correspond to the permanent properties of the environment, and if they are the basis of the organism's perception of the environment instead of the sensory data on which we have thought it based, then I think there is new support for realism in epistemology as well as for a new theory of perception in psychology.
>
> Gibson 1967, 162

We have just investigated the consequent of this sentence. In the next chapter we'll look at the antecedent, in particular whether the "correspondence" Gibson refers to is a lawful correspondence, what it means to say that such a correspondence amounts to "specification", and how these ideas resonate with evolution by natural selection.

[30] Earlier "dissidents" who diverge from the Turvey and Shaw orthodoxy are, among others, Alan Costall, Edward Reed and Harry Heft.

CHAPTER 5

Evolutionary Critiques on the Neogibsonians

Natural selection is Darwin's solvent of metaphysics. It dissolved Aristotle's final cause, teleology, into efficient cause, and now Leibniz's preestablished harmony as well.

W.V. Quine 1996, 161

5.1 Introduction

In the previous chapter we have discussed Shaw et al.'s (1982) analysis of the relationship between the ecological conception of perception to the supposed epistemological problem of "knowledge of the external world". Their estimation is that if the Poverty of the Stimulus doctrine (PoS) would be true, then it would indeed pose a problem for perceptual knowledge. That is to say that if stimulation is insufficiently rich so as to "specify" its environmental causes, then knowledge about the environment is impossible. This estimation they share with Gibson (1967), we saw. They also share with Gibson the idea that there is empirical evidence that stimulus information *can* be specific to environmental states of affairs or events; invariants in flowing optic arrays can be found that map "one-to-one" onto environmental properties such that their detection suffices to establish "direct" or non-inferential perceptual contact with the environment. Such invariant relations are said to constitute "specifying information". "Can", however, is not equivalent to "necessarily is". Look again at Gibson's central thesis:

> If *invariants* of the energy flux at the receptors of an organism exist, and if these invariants correspond to the permanent properties of the environment, and if they are the basis of the organism's perception of the environment instead of the sensory data on which we have thought it based, then I think there is new support for realism in epistemology as well as for a new theory of perception in psychology.
>
> Gibson 1967, 162

In the antecedent, Gibson writes about a correspondence relation between optical invariants and permanent properties of the environment. Turvey et al. added something to this, as we saw in chapter three, in which we discussed the hypothetical conditional (C):

(C) [...] if affordances were lawfully specified in ambient light, then direct visual perception of affordances would be possible.

Turvey et al. 1981, 238

The Neogibsonians transform "correspondence" into "lawful specification" and adopt the notion of "affordance". Or as formulated by the same authors:

> The fundamental hypothesis of the ecological approach to vision, elaborated at great length by Gibson (1966, 1979) is that optical structure specifies its environmental source and that, therefore, mobile organisms with active visual systems that can pick up this information will see their environments and suitably adjust their activity, if and when they detect that information (and only then).

Turvey et al. 1981, 243

We also commented on their characterisation of "the specificity of information" as "intentional" and "directed to a goal" (Turvey et al. 1981, 294). In the previous chapter we saw that "necessary specification" plays primarily an epistemological role. If it is allowed for perception to use both "specifying" and "non-specifying" information then, Shaw et al. (1982) argue, we would end up with certain perceptual knowledge on the basis of the former but with mere perceptual belief based on the latter. For committed empiricists, however, there is no way to separate the two: an empiricist can't invoke a priori rational principles or processes to distinguish knowledge from potentially false beliefs, nor can any additional perceptual process function as a solid ground for the sought for separation of knowledge and mere beliefs. Securing the possibility of knowledge, Shaw et al. (1982) concluded, is only possible "at a deeper level" where decisions are made about what exists. Hence the realist ontology of complex particulars that keeps together the referent and the intentional object of perception, such that perception is logically "factive" or incorrigible.

We have seen that the Neogibsonians' approach to knowledge is tainted by "old epistemology" in several respects—conceptualising perceiving as experiencing,

the quest for certainty, epistemic primitiveness, first philosophy. Ecological laws are necessary to guarantee the "epistemic bound". We argued, on the other hand, that truly naturalised epistemology as it was conceived by W.V.O. Quine shows that we ought not be concerned with the possibility of knowledge because the idea that PoS undermines that possibility is misguided. Certain knowledge deduced from epistemically first foundations proved impossible for other reasons. Nonetheless, the fact that our best scientific theories of the world offer (some degree of) understanding and allow for explanation and prediction suffices for the idea of naturalised knowledge. For Quine epistemology ceases to be concerned with the pre-theoretical, metaphysical assumptions about reality that might make knowledge possible. A truly naturalistic theory of knowledge should describe and explain the actual, psychological, social (and technological) processes that deliver explanations and predictions. This entails that ontological choices are made *within* the theory of knowledge production; they don't precede theory. There is no first philosophy.

According to this rationale we qualify Shaw et al.'s postulate of necessary specificity as a first philosophy. It aims to describe the necessary conditions for the possibility of knowledge, while the aim of naturalised epistemology is to explain the success of theory building and explanation.

In this chapter we will further analyse some aspects of Robert Shaw and Michael Turvey's first philosophy that was designed to accompany ecological psychology. We will attempt to understand how "necessary specificity" and "specification" are thought because besides their role as a warrant for certainty, they are intended to play an explanatory role too. That role we will question because it entails a view of explanation that is orthogonal to the naturalistic, functionalist view we have committed to in our introduction.

We will highlight that Shaw et al. (1982) deploy two distinct notions of "specific" or "specifying" information, and that they equivocate them. This misconceptions leads to the idea that specification is an explanans in the theory of perception, whereas we will show that it is in fact an explanandum. Shaw and McIntyre (1974), and Shaw et al. (1982, 189) defend that a metaphysical concept of specificity precedes scientific explanation. For example:

> Darwin's theory addresses the question of the algorithmic mechanism by which nature selects from among existing species those that might continue to evolve. By contrast, Leibniz's theory addresses the deeper question of how the existence of such systems might be explained.
>
> Shaw and McIntyre 1974, 324

We will discuss Rob Withagen's (2004) challenge of the idea that allowing for the use of non-specific variables in the scientific conception of perception leads necessarily to the need of positing inferential mechanisms. Then, we'll look at Withagen and Chemero's (2009) further development of their critique on the role of the Neogibsonian notion of lawfully specifying information. They take up Reed's (1996) challenge to the latter, arguing that it is incompatible with evolution by natural selection. They observe that Shaw, Turvey, and others adhering to "the Dominant Neogibsonian program"

> [...] have followed Gibson in claiming that the detection of specifying information is a necessary and sufficient condition for establishing a direct perceptual contact with the environment. All perception, that is, is the pickup of information specific to the aspects of the environment that is perceived. However, they have taken the concept of specificity as being more central to their approach than Gibson did.
>
> Withagen and Chemero 2009, 368

Withagen and Chemero (2009; hereafter referred to as "W&C") argue that one of Gibson's ultimate goals was to develop a naturalistic theory of perception, and that the concept of specificity, as developed by the Neogibsonians, is incompatible with this goal. W&C (2009; also see Withagen 2004, Chemero 2009, ...) provide two main lines of arguments for their incompatibility thesis. The first line of argument consists of pointing out experimental results that show that animals (including humans) in fact use "non-specific information"—energy variables that correspond non-strictly with environmental states of affairs—while performing perceptual tasks. This shows that specificity is not a necessary condition for perceptual contact. The second line of argument is inspired by evolutionary biology. A naturalistically sound theory of perception must treat its subject matter as a biologically evolved function: W&C argue that conceiving perception as an evolved biological function is incompatible with a concept of perception as

the pick-up of *only* specifying information. In a final section we'll see what this implies for psychological theories of learning.

5.2 Specifying information and symmetry

In the context of ecological theory of perception and cognition the principle of symmetry was first expressed by Shaw and McIntyre (1974). They argue for the existence of "invariance laws"[31] that hold between the theories of physics, of biology and of psychology in a way that is not unlike Leibniz's idea of preestablished harmony.

> The compatibility relation that is assumed to hold among the different phases of matter hints at a notion of pre-established harmony not unlike that proposed by Leibniz. This may seem quite far-fetched and an unwarranted metaphysical assumption; yet it is neither, as we will argue in the next section.
>
> Shaw and McIntyre 1974, 324-325

Assumed preestablished harmony between the "phases of matter" (the physical, the biological and the psychological) ensures that there are specifying, informational relations between them. The process of "pick up" of properties that stand in such relations result in knowledge of properties of the other phase. (Shaw and McIntyre 1974, 311). The motivation behind the adoption of the symmetry principle is thus clearly epistemological:

> A final assumption is required, *if knowledge of the world is to be possible*, and this assumption brings us to the highest abstraction in all of science. We must somehow guarantee the compatibility of the various sets of natural laws; they must not only be invariant within their particular phase, but must exhibit conjoint

[31] The idea of "invariance laws" comes from physics. Basically it is a generalisation of the observation that some physical properties remain invariant regardless of the way they are described. In physics invariance laws are uncontroversial. Shaw and McIntyre's idea that invariance laws hold *across* the domains of physics, biology and psychology ("interphasic" or "polyphasic", as they say) has no broad support in the scientific communities. They write: "The compatibility relation that is assumed to hold among the different phases of matter hints at a notion of pre-established harmony not unlike that proposed by Leibniz. This may seem quite far-fetched and an unwarranted metaphysical assumption; yet it is neither, as we will argue in the next section." (Shaw and McIntyre 1974, 324-325).

> invariance across phase boundaries. This highest order of structure among phases constitutes an invariance law or symmetry postulate.
>
> Shaw and McIntyre 1974, 326-327 (emphasis added)

Although the authors note that empirical support for invariance laws must be considered (Shaw and McIntyre 1974, 336), they actually don't consider any. For our purpose it suffices to note that Shaw and McIntyre hold that they are nonetheless decided upon from "metatheoretical" and "metalogical" considerations (ibid.).

Michael Turvey (1987) summarises Shaw and McIntyre's (1974) ideas on the necessity of symmetry and specification for agents' direct relations to intentional contents. (Turvey 1987, 176). He also expands the formal notation of the symmetry principle. We will use Anthony Chemero's (2009, 111) transcription of this formula because it lacks the Φ's and Ψ's of 1974 and the subscripts of 1987, making for relatively easier reading and typing: [(E > I) & (I > P)] & [(P > I) & (I > E)]. Turvey's writes that in full English the two parts of the symmetry principle should be read as follows:

(E > I) & (I > P):

> Since the property of the environment is what it is, then the information is what it is and since the information is what it is, then the property of the environment perceived is what it is.
>
> Turvey 1987, 160

(P > I) & (I > E):

> Since the (intentional) state of the perceptual system is what it is, then the information contained in the structured energy distribution is what it is; since the information is what it is, then the property of the environment is specified.
>
> Turvey 1987, 176

At the end of his article, Turvey notes that besides their role in epistemology and metaphysical realism, these symmetry principles are also necessary to explain perceptual achievements. He adds that:

> Efforts to answer the foregoing why question [as to why particular energy properties are informative about particular environmental properties; JVE] strictly in terms of evolutionary, developmental, or learning processes will, I fear, fall short of the mark.
>
> Turvey 1987, 178

This is just one instance in the "ecological psychology as first philosophy" literature that explicitly denies the adage we borrowed from Quine, with which we started this chapter:

> Natural selection is Darwin's solvent of metaphysics. It dissolved Aristotle's final cause, teleology, into efficient cause, and now Leibniz's preestablished harmony as well.
>
> W. V. Quine 1996, 161

Other, similar denials can be found in Swenson (1992), Swenson and Turvey (1991), Shaw and Kinsella-Shaw (2012) and in various other contributions. Instead of seeing natural selection as an explanatory principle that explains away or makes unnecessary the ideas of preestablished harmony and teleology, they state precisely the opposite: that in order for natural selection to be possible and understandable, a metaphysical postulate of preestablished symmetry and/or teleology.

This idea is based on a particular interpretation of the Second Law of Thermodynamics that attributes an agent-like force to entropy: the entropy of the world *strives* to a maximum (Martínez-Kahn and Martínez-Castilla 2010, 72; see also Swenson and Turvey 1991, 330; Swenson 1992, 1997). For life and evolution to be possible, these authors feel compelled to postulate a countering "negentropic" force, so as to restore symmetry in the universe.:

> The possibility is entertained that physical intelligence was distributed throughout the warp and woof of the cosmos by the Big Bang, and being synonymous with intentional thermodynamics, it would be truly abiotic—existing, as it were, from the very beginning of all things physical.
>
> Shaw and Shaw-Kinsella 2012, 89

This interpretation of thermodynamics and the response to it on behalf of the Neogibsonians is a violation of the Muggle principle and the explanatory principles we laid out in our introduction on the basis of Chiesa's (1992) reflections on functional, causal explanations. In spite of Gibson's and their own advocacy of a non-mechanistic account, the Neogibsonians interpretation of the Second Law is not as a description of a functional relation. They read into it that there is an agent-like force, a ghost in the machine, that performs the function.

In addition, there is a pragmatic, methodological issue regarding the assumption of necessary specificity. James Cutting (1991, 1993), Hancock and Manster (1997), and James Tresilian (1999) have argued against the necessity of specifying information on the basis of empirical results. Each of these authors demonstrate that humans and other animals in fact use multiple energy (optical) invariants to guide their behaviour, and importantly, that the invariants don't always stand in strict correspondence to the environmental states of affairs. These results support the thesis that specificity—unique, lawful correspondence—is not necessary for the psychological concept of perception. Multiple "sources" of information are shown to be exploited, countering the uniqueness aspect of specifying information. Non-strictly co-varying variables are found to be perceptually exploited too, countering the idea that perception consists exclusively of the pickup of information based on lawful correspondence. In response to these findings, Turvey and Shaw reply:

> [...] any conclusion that a patterned energy distribution underspecifies the environment must be viewed with circumspection. In particular, failure to find specificity does not give the scientist license to hypothesize specialized brain and/or cognitive mechanisms *sui generis* that resolve the ambiguity. On the contrary, such failure identifies an inadequacy or incompleteness in the physical and mathematical characterization of the patterned energy distribution. The failure implies the need for a deeper mathematical-physical analysis coordinate with a sharpening and refinement of the descriptors of the animal-environment system.
>
> Turvey and Shaw 1999, 103

We agree with the admonition that failure to find specificity licenses positing mental representations. The idea that better mathematical-physical description

ought to be sought has the naturalist's sympathy. The question is where does it stop? At some stage, when all theoretical sentences have been rewritten, so to say, the principle of necessary specification itself is on the table when confronted with recalcitrant observations. But in practice, the Neogibsonians treat the principle as if it is immune to falsification. Moreover, one might ask whether "necessarily *x*" qualifies as an empirical statement at all.

5.3 Critical analysis of "specifying information"

In this section we will show that the ecological literature is ambiguous with regards to what their definition of specifying information really encompasses. The Neogibsonians use the terms "specific", "specificity", "specifying" and "specification" as if they are interchangeable. They are all qualifiers of the term "information", conceived as the result of an ecologically lawful relation.

It has been pointed out (Fodor and Pylyshyn 1981, Millikan 2000) that the fact of "being informative" is not a property of a correlate that is lawfully connected to a property of another correlate. Correspondence, constrained by law or not, is not directional, whereas one of Turvey et al.'s defining features of "specifying information" is that it is intentional:

> [...] the *specificity of information* involves two relata, one that must exist and one that in extraordinary circumstances may not exist—a property of a propertied thing E and a property of a propertied thing *X* (a piece of the environment)—and therefore *is intentional.*
>
> Turvey et al. 1981, 294

By intentionality Turvey et al. (1981, 293) mean "directedness" towards an object or a goal. Although we agree with their criticism that intentional directedness ought not be reduced to representationality, postulating intentional, specifying information doesn't sit well with a naturalistic framework, particularly not with a Quinean one, if it is considered to be a primitive notion.

Perhaps, a little bit of ordinary language philosophy helps to elucidate the point we wish to make in this section: think of the pairs of terms "specific" and "specificity" versus "to specify" and "specification". Now add the simple

preposition "to" to all of them. "Being specific to" appears as a two-place predicate: X is specific to Y. "Specificity" denotes this two-place relation that is often referred to as the "one-to-one" relation, as "strict correspondence" or as "lawful correlation". Yet, as noted above specificity is not directional *sui generis*. It is an abstract, objective[32], ontological notion. Specificity exists independent of agents and their sensitivities. For example, structures of electromagnetic radiation that are out of our visible range may be specific to some other states of affairs we don't know of. We (or any creature) needn't ever discover these relations for that specificity to hold.

Adding "to" to the second set of terms—that is, to "to specify" and to "specification"—shows that something quite different is going on: "to specify … to …" appears as a three-place predicate. "X specifies Y to Z" refers to an event involving one or more agents or (agent-dependent processes), namely Z. This shows that only in the three-place predicate the idea of directionality or intentionality emerges. In order to speak of "specifying information"—which in the remainder of this chapter will adorn with a (3) to indicate we're referring to the three-place predicate as distinct from "specific" (2)—the ability of an agent Z needs to be incorporated. That ability has been described as a form of "awareness of" (Chemero 2003b) or the result of "attunement to" (Gibson 1979) the constraint(s) that relate X to Y. Crucially, the notion of "specifying information" (3), is thus conceptually dependent on the notion of an organism's ability. (Or, in the ecological approach, on an organism-environment mutuality relation that can be analysed in terms of the dual pair of affordances and effectivities). Chemero and Turvey (2007) develop a conceptual defence of this approach, based on the idea of "impredicative definition". An analysis of this idea—toward which we are not necessarily unsympathetic—would take us too far for our current purposes.

A problem does occur, however, when conceptual analysis is traded for a naturalistic approach that accepts no postulates from first philosophy. If the idea

[32] It has been noted that the specificity relation is sometimes reified. Fodor and Pylyshyn (1981) noted this first of Gibson's use of "information". Later Chemero (2003b) and Withagen and van der Kamp (2010) formulated definitions of ecological information free of reification.

of specifying information (3) isn't accepted as a primitive fact, it becomes an explanandum of a theory of intentionality. Only after specification (3) has been explained naturalistically, it can serve a further role in a scientific theory of perception. We think that as a postulate, specification (3) is not conducive to better understanding because it assumes on a more "fundamental" level what one wants to explain on the level of (ecological) psychology or biology; by making the notion primitive, it is assumed that further explanation is impossible. Although this is not (often) stated explicitly, the postulate is certainly not conducive to provoke attempts at better understanding intentionality or the "directedness" of ecological and other systems. This, we think, is the core problem of Neogibsonianism.

Withagen and Chemero (2009; see below) point out that the (undifferentiated) notion of specification played a less central role in Gibson's publications than it does in the dominant Neogibsonian school. The latter placed it centre stage. To illustrate the perpetuation of the conflation a few passages from Turvey (1987) are briefly discussed below.

> The point is that conceptions of information that address how to distinguish among and how to represent propertied things are inconsequential if they are not nested within a conception of information that addresses how there can be awareness of those propertied things in the first place.
>
> Turvey 1987, 173

Here, Michael Turvey points out, like we did, that the concept of "specifying information" (3) conceptually requires the notion of awareness, that is an ability of an organism. But in what follows in Turvey's address of the natural origins of awareness, he switches to the notion of specificity (2) as lawful correspondence:

> How can this desideratum be fulfilled? Gibson's (1966, 1979) answer [...] is to relate the notion of information to lawful regularity. [...] What I would call the ecological conception of information is founded on the assertion that *invariant relations exist between layout properties of general significance to the governing of activity and macroscopic, non-inertial properties of structured ambient energy distributions.*
>
> Turvey 1987, 173

We contend that referring to lawful regularity to account for the directedness of attention or awareness is entirely inadequate. Defining information as Turvey does as a lawful relation between light properties and environmental features "of general significance" to behaviour amounts to "specificity" (2), the objective notion we discussed above. But such a relation cannot, by itself, account for its significance or usability. Specificity (2) may play a role in accounting for the usefulness of a correlation, as compared to the lower usefulness of a non-specific correlation, given their different rates of reliability. But their differential usefulness presupposes the *usability* of both, which requires an independent explanation. While Turvey's foundation of information on law is a-historical, we think a naturalistic account of usability—literally, how it came about that animal or species Z acquired the ability to exploit a particular correspondence relation—requires a historical approach. A logical consequence of this natural history, if it is taken to account for "specification" (3), is that it might show that specification (3) doesn't require specificity (2) at all. If a story can be told on how an agent acquires the ability to exploit a non-specific (2) correspondence, then one can, rather paradoxically, say that a non-specific (2) variable has come to specify (3) this or that.

Anthony Chemero (2009) critically analyses the symmetry postulate and comes to the conclusion that it is actually not symmetrical at all. He interprets the first part, (E > I) & (I > P), as denoting causal relations, whereas the second part, (P > I) & (I > E), expresses normative relations. (Chemero 2009, 120-121; "E" stands for environment; "I" for the informative (energy) variable and "P" perception). We will briefly discuss how Chemero's analysis supports our distinction of specificity (2) and specification (3). (E > I) is causal if it is taken to refer to fact that the layout of environmental surfaces and the (moving) position of focal point of the ambient array cause the invariant patterning of the array. This relation is governed by the laws of optics and can thus be "specific" (2), or lawfully correlated, especially when purely spatiotemporal properties of the environment E are considered. (E > I) can be nonspecific too if one considers other properties as well. Let, for example, E_1 be a glass of water and E_2 a glass of white vinegar. The resulting optical I_1 and I_2 are indistinguishable, non-specific with regards to E. (I > P) is causal insofar as the optical variable that is "picked up" plays a causal role in the

perceptual process. This relation can be either specific or non-specific as we will see in the next section. Note that this interpretation of (I > P) identifies I as a proximal cause.

Chemero's normative interpretation of the second part of the formula, (P > I) & (I > E), reflects our analysis of specification (3). Perception, understood as a biological function or ability has a normative dimension that stems from its history of natural selection. (see Millikan 1984, 2000; Chemero 2003b). A mechanism or disposition that has been selected by evolution because of its beneficial result, can be said to perform a "proper function". In this sense, a selected perception-action system constitutes a function or an ability because it is shaped by the results of historical transactions and their consequences and thus, one can say that perception-action history selects which correspondences are exploited in order to execute proper functions: the history of selection and shaping thus explains the functioning of a perceptual system, and that way of functioning imposes constraints, norms, on what type of variables it picks up. But one must be aware that the statement "perception specifies information" (P > I) is only a phrase that summarises the result of the evolutionary-developmental story. By itself (P > I) explains nothing, nor ought it to denote a metaphysically fundamental relation.

Finally, the meaning of (I > E) also depends on the evolutionary-developmental explanation of the biological or psychological function. This is denied by Shaw and Turvey, who claim that evolution by natural selection can never account for (I > E)-specification (for example Turvey 1987, 178; cited above in section 5.2). Swenson and Turvey (1991, 342) go even further. They stipulate that opportunities for being informed are independent of living creatures. That means that even in a dead universe there are opportunities. Their "opportunistic physics" (S&T 1991, 317) entails that water presents an opportunity for salt to dissolve. This, we think, is a category mistake that shows that their theory can never explain agency because it just assumes agency on the level of physics. Opportunities for action, we think, are tied to agency. And both are explananda of evolutionary biology and psychology.

5.4 Implausibility of symmetry and specification

Rob Withagen (2004) cites several experiments that were conducted in the ecological modus operandi. Withagen points out that, in those experiments, "non-specific" variables are found to be used by the experimental subjects. Being an ecologically oriented psychologist himself, he accepts that sometimes "specifying information" is used, but he questions whether *only* such information is, or can be, used in perception; thus, that perception ought to be defined as pickup of specifying information, excluding the pickup of "non-specific information".

One of the experiments referred to by Withagen inquired into test subjects' estimations of how far they could reach with a rod, *i.e.* the rod's "reaching affordance". The subjects' estimates were found to correlate strongly with the moment of inertia of the rods—that is the rod's resistance to angular acceleration (Withagen 2004, 238; Solomon and Turvey 1988). Rods of different lengths and masses, however, can have the same moment of inertia and thus, moment of inertia is not specific to—doesn't correspond strictly to—the distance that someone can reach with a rod. This is, obviously, a case of Poverty of the Stimulus. The variable that is exploited is ambiguous with regards to the affordance. Withagen proceeds by questioning the assumption that a conception of perceiving that allows for pickup of such ambiguous information necessarily entails that it involves inferential mechanisms or abilities. Many Establishment Theorists and Neogibsonians seem to agree on this premise. The former endorse it and postulate mental inference, the latter endorse it but in response reconceive perception as pickup of specific information only so that they don't need to postulate inference.

Withagen develops two arguments against the premise shared by Establishment and Neogibsonian theorists. The first argument concerns the concept of perception in so far as psychological (evolutionary) explanation is at stake. The argument states that there are many correspondence relations in nature that are not strict, some even despite that natural laws are responsible for the co-variance. For example, different combinations of forces can result in the same net force, causing an object to accelerate. The acceleration is then not specific to any of the possible combinations (Withagen 2004; Jacobs 2001). Among the (behaviourally relevant) features of the environment of an organism, it is thus

likely that some of them correspond non-strictly to the properties the organism can detect. And, crucially, Withagen adds, from an evolutionary point of view, relying on nonspecific information may be beneficial to an animal. Evolution, moreover, doesn't work as an "optimising agent". Even if for some affordance a specific energy variable would exist, an animal might rely on a non-specific one if or because evolving or developing a pickup ability for the specific variable would be too costly. That is particularly the case when the non-specific correspondence relation is reliable enough (Withagen 2004, 242), and when reliance upon it in the "bad case"—on the occasion when correspondence doesn't hold—is not lethal or too disadvantageous.

Withagen's second argument is concerned with the notion of perception as "epistemic contact". He argues that pickup of non-specific variables might still be labelled as "direct", but that this epistemic relation can be more or less strong, depending on the strength of the informational correspondence.

> In other words, the idea of a continuum of contact entails that an animal is in direct epistemic contact with a particular affordance, regardless of whether a specifying or nonspecifying variable is exploited.
>
> Withagen 2004, 248

Withagen concludes that a new concept of information is needed, one that allows for the inclusion of the non-specific correspondences that were excluded by the Neogibsonians. Such non-specific correspondence relations are not information by definition, for the latter. Withagen refers to Millikan's (2000) notion of "informationC", in which the "C" stands for correlation. Millikan characterises "informationC" is a mere statistical correlation between variables. Yet, she argues, they can be used by organisms to stay in touch with their surroundings. A rodent, for example, might rely on the correlation between a shadow shape moving over the ground and a predatory bird flying overhead. The correlation is statistical and weak because 1) it is not always sunny and therefore there may be hawks flying overhead when no shadows are cast, and 2) the shadow projected by a duck may resemble a hawk's, so when that kind of shadow is cast, the presence of a predator is not guaranteed. Millikan contrasts "informationC" to "informationL", the latter of which are correspondence relations that exist in

virtue of natural (physical but non-ecological) laws—in a sense this is the same as the Neogibsonians lawful information, but we will see that in another sense it is totally different. (Withagen doesn't treat "informationL"). Importantly, Millikan points out that exploiting "informationL" is not self-explanatory:

> InformationL is everywhere, but the problem, of course, is to interpret it. For no signal that makes up only part of the world can carry the informationL that its own channel conditions hold. And that means that it cannot carry the information that it carries informationL, nor what code this information is in. This opens the question why an organism could possibly care whether or not it ever encounters any of this ubiquitous but uncommunicative informationL. What good will it do an animal to have informationL?
>
> Millikan 2000, 223

This, of course, is the same argument as the one by Fodor and Pylyshyn we discussed in chapter 2: the property of an optical variable of being lawfully correlated to an environmental variable is not a projectible property. For Millikan, both informationC and informationL require some form of "interpreting". For her, all interpreting involves mental representations: both informationC and informationL are taken to deliver content to mental representations.

From Millikan we take home the lesson that exploiting neither types of information is self-explanatory: existence of correspondences, lawful or loosely constrained in no way elucidates or explains how pick up proceeds. Withagen agrees with Millikan, contra Shaw and Turvey, that animals can and do rely on informationC—*e.g.* non-strict correlations that hold between shadows and hawks—because being able to rely on it, albeit only in sunny conditions, has a differential benefit compared to not being able to rely on it at all. The cost, so to speak, of (occasionally) hiding when a duck flies overhead doesn't outweigh the benefit of the ability to hide from hawks, relying on non-strict correspondence, when the sun shines. Being a (critical) ecological psychologist, Withagen, of course, disagrees with Millikan on the way to cache out "to interpret" (cf. Millikan's quote above). Perception, whether involving informationC or informationL, is always direct, *i.e.* non-inferential, Withagen argues. Instead of "interpreting" or "enriching" stimulus information, ecological theorists believe

that perceiving is a matter of "differentiation" on the basis of the available information.

Withagen concludes with a list of implications for ecological psychology that follow from his idea of a "continuum" (Withagen 2004, 248). He asserts that the idea is consonant with Gibson's assumption of direct realism. Second, the continuum thesis, (supposedly) offers a way to conceptualise perceptual learning and, third, perceptual mistakes. Fourth, that it shows there is a need for a new conception of perception as "epistemic contact" that accommodates the empirical findings in dynamic touch and learning studies which have shown that nonspecific information is used too. Fifth, it implies that a new notion of ecological information that suits the requirements of the epistemic contact continuum is necessary. The continuum thesis thus requires that the "symmetry postulate" is abandoned, according to Withagen.

Yet, we must add that Withagen's argument doesn't distinguish between psychological directness, which means that no inferences take place in the process, and on the other hand, epistemic directness. The latter entails that no *epistemic* mediation occurs, but epistemic mediation is not necessarily inferential.[33] Although Withagen modifies the Neogibsonian idea of perception as a "direct epistemic relation", so that it is no longer a relation characterised as "epistemic certainty" but as a continuum, Withagen uses the terms "specific" and "specifying" as interchangeable. In the next section we will further analyse this. Withagen's second implication, regarding the ecological concept of learning will be treated at the end of this chapter.

5.5 Objections from evolutionary thinking

5.5.1 Naturalising perception

In their 2009 article "Naturalizing Perception" dissident ecological theorists Rob Withagen and Anthony Chemero (hereafter referred to as "W&C") extend Withagen's (2004) critique, which we outlined above. They grant that the

[33] Take, for example, divine mediation à la Malebranche (Schmaltz 2017).

dominant Neogibsonian school, personified by Michael Turvey and Robert Shaw, has the merit of developing further James Gibson's ecological theory of perception, and of putting it on the map as a serious contender in the general field of the psychology of perception. But, they reject some of the ways that development took, because it raises serious concerns with regards to the goal of understanding and explaining perception as a natural and evolved capacity of organisms.

> We believe that one of the most important aspects of Gibson's ecological psychology is his attempted naturalization of perception, that is, his attempt to place perception in the context of evolutionary theory. However, the dominant neo-Gibsonian approach to perception has been criticized for being inconsistent with evolutionary theory.
>
> Withagen and Chemero 2009, 363

W&C augment Withagen's (2004) argument against the necessity of specificity and/or specification—they don't disentangle the two—by assessing the Neogibsonian concepts of perception and information with regards to their biological plausibility (W&C 2009, 365). They refer to the work of Reed (1996, 187), among others, who made statements in the same spirit. The central question in they ask in their article is:

> Does the prevailing neo-Gibsonian theory of perception run counter to evolutionary considerations?
>
> Withagen and Chemero 2009, 365

They answer this question positively: the Neogibsonian approach is, indeed, incompatible with evolution by natural selection. As the main reason for this assessment W&C state that the protagonists of the dominant Neogibsonian approach, Shaw and Turvey

> [...] have followed Gibson in claiming that the detection of specifying information is a necessary and sufficient condition for establishing a direct perceptual contact with the environment. All perception, that is, is the pickup of information specific

> to the aspects of the environment that is perceived. However, they have taken the concept of specificity as being more central to their approach than Gibson did.[34]
>
> Withagen and Chemero 2009, 368

Before we discuss W&C's arguments for their conclusion that Neogibsonian theory is incompatible with evolution, we must look briefly at some of their characterisation of that Neogibsonian approach. W&C (2009, 369) write, referring to Michaels and Beek (1995) that the Neobisonian, law-based definition of information, and the concept of perception they build on that, entails an absence of variation in what energy variables are used by an animal to guide its activity. W&C (ibid.) conclude from this that, according to such a definition of perception, all members of a species use the same informative variable. That is so because "specifying information" is supposedly based on ecological laws, which W&C go on to characterise as "exceptionless regularities that hold whenever appropriate conditions are met" (W&C 2009, 368). W&C (2009, 368) note that Gibson's main point of focus was on the specificity relation between environment and information and that, to their knowledge, he did not posit a specificity relation between information and perception as well. They claim that (I > P), that "the optical invariant specifies perception", is not found in Gibson. They refer to the following passage in Gibson (1966) to indicate that he denied such a relation:

> But in a *kinetic* array, which is the prevalent stimulus for men and animals, edge-depth is specified without ambiguity by wiping and shearing. In a stationary array, to be sure, edge-depth is usually also specified by an abrupt increase in the density of texture at a border, as well as by an intensity difference; but the best specification, with the best ecological validity, is provided by the phenomena of kinetic occlusion.
>
> Gibson 1966, 203-204

W&C understand Gibson's passage as saying that environmental features (edge depth) can be "specified" by multiple information variables. And that, if there are multiple variables, that is multiple "I's", then it might be the case that agents can

[34] In this quote it is clear that W&C (2009) use as if interchangeable "specifying", "specific" and "specificity". This is the case throughout their article.

exploit more than one of them so as to perceive edge depth. Thus, (I > P) doesn't obtain necessarily. W&C (2009, 368) add that this variability, even if it is empirically demonstrated, is denied by Shaw and Turvey's paradigm because the latter hold that the variables used are different manifestations of a single underlying invariant. They note that in the experimental Neogibsonian literature one often encounters questions like:

> What is *the* informational variable that humans exploit to perform this task? [...] the assumption of a single specifying informational variable that is exploited by all members of a species in the performance of a task figures prominently in most studies on visually guide actions, [...]
>
> Withagen and Chemero 2009, 369

See also Turvey and Shaw (1999, 103) as cited above in section 5.2. We will return to these characterisations of Neogibsonianism after we discuss W&C's evolutionary considerations.

W&C (2009, 372) first analyse the aspect of the symmetry principle that states that there is a relation of specificity between information and perception, (I > P). They contend that variability of perceptual performance is a prerequisite for the evolution of visual systems. After all, natural selection only occurs when there is (heritable) variability within a population that leads to differential reproductive success. Thus, if all members of a population would perceive in the same way—all their perceptual systems rely on a single optical variable when performing a certain action—none of their differential successes could be attributed to the functioning of their perceptual systems. Hence evolution by natural selection of perceptual capacities cannot occur. Therefore, W&C conclude that, if it is believed that perceptual systems are naturally evolved systems, variation of perceptual use of optical variables within a population must be the case. Or at least: it must, at some stage, *have been* the case—natural selection (or development) may have resulted in a convergence of information variable use so that "now" all species members in fact do use the same variable. Anyhow, lawful specificity or specification that supposedly exists between optical information and perceiving cannot exist universally if perceptual systems evolve or have evolved.

W&C too, cite experimental data that demonstrate the variability of the use of informational variables. That is, studies by Jacobs et al. (2000; 2001), Michaels and de Vries, (1998), Withagen and Michaels (2007), Withagen and van Wermeskerken (2009) not only show that different members of a species use different informational variables, but also that on different occasions individuals use different variables. These empirical findings are strong evidence against the existence of the (I > P) part of the symmetry law.

Following their discussion of the biological implausibility of (I > P), W&C analyse the possibility and necessity of the specific relation between ambient energy variables and the environment, (I > E) that is assumed by the Neogibsonians. W&C argue that it is unlikely that only animals that are able to exploit such specific information evolve. Their second evolutionary argument states that reliance on suboptimal correlations between environmental states and energy variables often suffices for survival and reproduction. The consequences of guiding behaviour based on less than perfect correlations aren't necessarily lethal. On the contrary, an organism that can exploit only information variables that are "specific" to environmental features may even be at a disadvantage compared to those who can exploit bot specific and non-specific variables. Moreover, developing perceptual systems that exploit specific information exclusively may be unlikely or impossible in some environmental circumstances:

> As many evolutionary biologists have stressed, the variation on which natural selection can operate is not "limitlessly rich" [...]. There are many constraints on the evolutionary process, which set severe limits on what systems can evolve [...]. Hence, the *best possible* biological system might not be available in the evolving population. Indeed, evolution often yields suboptimal solutions [...], and there is no reason to assume that this does not hold for perception.
>
> Withagen and Chemero 2009, 375

So, W&C don't imply that specific information doesn't exist, nor that it is never used. One-to-one correspondences between states of affairs and light structures may indeed be very useful for perceivers because, since they are very reliable. Nevertheless, one-to-one mapping of the energy variables to environmental states is a not necessary condition for potential exploitation by organisms. It is,

on the contrary, very unlikely that *only* animals that use specific information evolve.

On the basis of these arguments, which we find compelling, W&C formulate recommendations for the further development of a naturalistically sound ecological perception theory. One recommendation we have briefly discussed above, is that of defining information not on the basis of natural or ecological law, but on the notion of "constraints". Constraints can be laws, but they can also be conventions. Cf. Millikan (2000) and our notes on "informationL" and "informationC" in section 5.3.1). W&C's main conclusion is that evolutionary concepts must be at the core of the concept of perception and information, and consequently at the core of a naturalistic explanation of perceptual abilities. We think their formulations needn't be paraphrased:

> The ubiquitous variation in the information that is used, then, implies that a naturalistic theory of perception should not make any universal claims about what information members of a species exploit in the performance of a task. Instead, such a theory should explain the variation in what information is used.
>
> Withagen and Chemero 2009, 379

> [A] naturalistic theory of perception must explain the individual differences in what information is exploited in terms of the interplay of multiple organismal and environmental factors.
>
> Withagen and Chemero 2009, 379

Naturalizing perception, thus, entails that a theory of perception takes on the guise of a theory of evolved or evolving information use. Such a theory is explicitly historical in nature, W&C advocate: explaining what variables are being used, and how they have come to be used, entails an account of historical factors and interactions that have led to the current perceptual abilities of a creature.

5.5.2 Two reflections on W&C's evolutionary critique

Although we agree with the evolutionary arguments just summarised, we wish to bring to the attention two issues that require further investigation. First, it

might be the case that W&C are attacking a straw man. Second, W&C perpetuate the idea of perception as an “epistemic” relation.

First, it is not so evident whether W&C’s rendition of Neogibsonian theory is entirely accurate. Searching for *the* specifying variable has certainly been a research strategy of Neogibsonians and indeed Turvey states that direct perception

> is not, in my view, an hypothesis to be tested as much as it is a point of departure for understanding some particularly difficult aspects of nature.
>
> Turvey 1987, 158

We grant that, in many instances, Neogibsonian theorists and experimentalists adhere to the symmetry postulates rather dogmatically. For example, Burton and Turvey’s (1990) insistence that two experimentally found variables must be superficial manifestations of one, yet to be discovered, higher order invariant. On the other hand, the foundational texts (Turvey et al. 1981; Shaw et al. 1982) of the Neogibsonian program denies that variability of information use within species is impossible. Shaw et al. allow for variability within an individual species member at different occasions:

> There is considerable evidence showing that various species of percipients do not perceive the same objects in the same way, and that even the same percipient does not perceive the same object in the same way on different occasions. Perception does not seem to be so cut and dried an activity but one that is modulated by evolution and by experience (what Gibson (1966) has called genetic preattunement and the "education of attention," respectively).
>
> Shaw et al. 1982, 210

Perhaps this discrepancy in the Neogibsonian realm is due to the fact that Shaw and McIntyre (1974), Turvey et al. (1981) and Shaw et al. (1982) are very densely written texts. The crucial point is that these early texts left room for variability whereas the later ones don’t; the 1982 consideration just cited gave way to the more dogmatic stance of the nineties. W&C’s analysis certainly applies to that dogmatic stance.

The second issue we wish to address is the fact that W&C seem to adopt Gibson's (1967) and the Neogibsonian's idea that perceptual contact is a form of epistemic contact, despite their lamentation that

> Many post-Darwinian theories of perception follow pre-Darwinian theories both in their conceptualization of perception and in their basic idea of how perception comes about.
>
> Withagen and Chemero 2009, 264

We refer to our analysis of the implications of naturalised epistemology for the concept of perception in the previous chapter: if there is no problem of knowledge of the external world, there is no need to qualify perception as epistemic contact. To be fair, like Withagen (2004), W&C (2009, 381) use the term "epistemic" in a deflated sense that lacks the connotation of certainty, and they dropped Withagen's (2004)—albeit hesitant—endorsement of direct realism.

A distinction, as we made, between specificity (2) and specification (3) could help to abandon entirely this relic. Both notions can be understood as referring to extensional and intensional relations. Specificity (2) understood extensionally entails strict correspondence between (sets of) objects: whenever an object belongs to a set A, then another object belongs to a set B. Understood intensionally (cf. Dretske 1977) it entails a strict correspondence between properties (intensions, types, "forms" in the Aristotelian sense). A property A is instantiated, whenever a property B is instantiated. As Fodor and Pylyshyn note (cf. chapter 2) neither the extensional nor the intensional idea of specificity have epistemological import. That is so because in order to use A to get to know something about B, one already needs to know about the correspondence relation.

Specification (3) can be conceived extensionally and intensionally too. The Neogibsonians rely on the intensional reading for their realism in epistemology. Perception is of real environmental features because it defined as the pickup of specifying information. Specifying information exists when a property *A* can be used by an agent to come to know something about property *B*. Perception is thus defined as the pickup of property *A*. The idea of specification, we think, entails nothing more than the idea that whenever perception takes place, there is pickup

of a property A that the agent is able to use to guide her action with regards to *B*. Formulated like this, it becomes a trivial epistemological principle. Specification only says that perception can happen when a perceptual ability exists.

The lawfulness of specification, in addition, serves to exclude misperception and epistemic uncertainty. Yet, to allow for an optical property *A* (remember *e.g.* the optical invariant corresponding to the property of being a plant stem) to specify "climbability" or "obstacle to avoid" to a snail, the Neogibsonian concept of perception involves the "occasion" variable *O*. Lawful specification is tied to occasions. It ensures epistemic contact in virtue of constraining the semantics of "perceives". The occasionalist notion also serves to allow for variability in the use of energy variables. One need only to postulate another occasion such that another law governs the agent-environment transaction. This is not to say that the Neogibsonians' occasionalism is a priori incompatible with evolution by natural selection. The problem is that they don't have a theory as to how occasions "select" laws that underlie specification.

We think, in accordance with Withagen and Chemero, that this is the true task of an ecological theory of information and perception. What Withagen (2004) and W&C (2009) have shown is that a historical/evolutionary account of perceptual abilities can and probably must involve non-specific correspondences. In other words, that a notion of "specifying information" (3), when rid from its Neogibsonian task to secure the certainty of perceptual knowledge, need not be based on laws. As an explanandum of perceptual theory it raises the question as to how it came about that on such and such an occasion, an agent is able to use a variable to perform an action. Withagen and Chemero put it like this:

> [...] instead of postulating specificity relations, a theory of the use of information should follow theories that explain other variable organismal features such as muscle strength, height, and so on. That is, a theory of the use of information should reveal how multiple environmental factors interact over time to determine what informational variable(s) particular animals exploit in particular perceptual and action tasks.
>
> Withagen and Chemero 2009, 382

Perceptual contact as such remains psychologically direct since it doesn't involve inference. "Epistemic directness" is no longer an applicable epithet to the fully

naturalised concept of perception. Evolutionary epistemology, as a chapter of psychology that is allowed to use the resources of all natural science, should then attempt to explain the successes and failures of perceptual abilities, instead of metaphysically securing epistemic success and ruling out epistemic error.

5.5.3 The paradox of learning and realism

The concluding remarks of both Withagen (2004, 243; 248) and Withagen and Chemero (2009, 378) reference is made to "On the apparent paradox of learning and realism" an article by Jacobs and Michaels (2002). It describes the apparent paradox that arises from the consequences of the assumption of realism, combined with empirical results on information use. Accepting realism—contra idealism and skepticism—Jacobs and Michaels (2002, 128; see also Turvey et al. 1981; Shaw et al. 1982) write, amounts to assuming that the world exists and that it can be known at least in part. For empiricists, who believe that perception is the only source of knowledge, realism demands that perception is veridical, meaning that the perceptual process cannot, in principle, deliver falsehood. This, in turn, implies that the information perception relies on, defined as patterns in the ambient energy array, must correspond one-to-one to the to-be-perceived environmental properties. Perception defined as detecting such specifying information then is a reliable source of knowledge.

The paradox arises when the empirical results of perceptual learning studies are considered. Test subjects, especially novice perceivers, have been found to rely on non-specifying ambient variables that don't correspond one-to-one to the environmental properties. When the experiment progresses they learn to exploit more useful, reliable variables. These variables correspond better to the environmental feature, but still not strictly. Users converge towards such variables and some progress to using specific information that does correspond strictly. The paradox resides in the fact that perception on the basis of non-specific variables occurs while the assumption of realism implies that this is ruled out a priori because it is taken to undermine perception's assumed veridicality: when a non-specifying variable is used, the worldly property could not be there after all. (Jacobs and Michaels 2002, 132). Jacobs and Michaels' strategy to defuse

the paradox follows the line of Neogibsonians Shaw and Turvey, arguing that the use of non-specifying variables poses no threat for epistemology if there are (must be) "underlying", or higher-order, specifying invariants for learning.

The motivation for this strategy derives from the attachment to "certainty". Knowing, according to the Neogibsonians, is associated with the absence of doubt. (Jacobs and Michaels 2002, 128; 129). We advocate another resolution. On Quine's naturalised approach to knowing, no paradox occurs because it shuns a priori postulates to secure realism in epistemology. The empirical findings of variability of perceptual use of informative variables falsifies the theory in which lawful specification was a hypothesis. But taking the ecological principles of realism and specificity as indeed falsifiable (contra Jacobs and Michaels 2002, 133) poses no threat to a naturalised account of knowledge. The epistemological spirit we're after is illustrated—perhaps rather paradoxically too—by the Quine as follows:

> Even telepathy and clairvoyance are scientific options, however moribund. It would take some extraordinary evidence to enliven them, but, if that were to happen, then empiricism itself—the crowning norm, we saw, of naturalized epistemology—would go by the board. For remember that that norm, and naturalized epistemology itself, are integral to science, and science is fallible and corrigible.
>
> Quine 1992, 20–21

Jacobs and Michaels (2002, 137) resolution of the apparent paradox—making the principles of "knowledge of the real world" and the principle of convergent learning relative to the (time) scale of the respective phenomena—is an a priori metaphysical fix. Such fixing is unnecessary on the naturalistic stance. The idea of mutually containing perspectives of scientific ontology and naturalised epistemology is compatible with the form of non-metaphysical, common sense realism that is also present in Gibson. That is so because, according to Quine science is an extension of common sense.

5.6 Concluding remarks

In this chapter we have seen new arguments—in addition to the ones offered by Fodor and Pylyshyn (1981) which we discussed in chapter 2—as to why "specificity" (2)(strict/lawful correspondence) can't, by itself, explain perceptual activity. The new arguments by Withagen (2004) and Withagen and Chemero (2009) are based on evolutionary considerations. They show that specificity is not necessary for perception given the evidence that there is variability, and that perception defined as based on specific (2) information is implausible if a naturalistic explanation of evolved perceptual capacities is on the agenda. Variation in the perceptual abilities in a population, and thus variation of the variables these abilities exploit, is necessary for evolution by natural selection. And, since evolution is not an optimisation process, and since exploiting non-specific variables may be beneficial for organisms' survival and reproductive success, exploitation of such non-lawful, non-strict correspondences are to be expected.

Since "specifying information" no longer plays the role of guaranteeing epistemological certainty, its lawful character, that followed from the symmetry postulate, can be abandoned. "Specifying information" or "specification", then, becomes itself an explanandum of naturalistic theory of perception. Since "specificity" is neither necessary nor sufficient for "specification", a naturalistic explanation of "specification" can't be an explanation in terms of natural (or ecological) laws. In this respect, we think the Neogibsonians who insist on law-based explanation violate their own motto:

> However, to presuppose the very thing that is to be explained is a move that no serious science of cognition can abide.
>
> Turvey and Carello 1981, 314

We agree with the analyses of Costall (1984), Withagen and van der Kamp (2010), among others, that considering specification as an explanans amounts to a reification: the invention of a construct with exactly those properties that are needed to explain perceptual abilities, which is then projected into the natural environment.

We have seen too that naturalised epistemology urges to caution with regards to intentional objects as part of the concept of perception. They too are pre-theoretical posits, the naturalistic merits of which remain unaccounted. Intentional objects fuelled the old debates of the epistemology of perception about the different forms of realism which, so to say, spilled over into the attempts of ecological (as well as cognitive) psychology that strives to develop a scientific account of perception. We think the influence of traditional epistemology of perception induced perhaps Gibson, but certainly many in his footsteps, to treat "affordances" as the new intentional objects that might resolve the old problem of direct vs. indirect realism. Intentional objects may have their place in descriptive phenomenology of perceptual experience. They have had their place in philosophy of perception since antiquity, but this doesn't necessarily entail that the scientific concept of perception should have a similar structure. (Costall 1984). Costall and Leudar note:

> The serious gap we identify in Gibson's theory arises from an abstracted, reified treatment of affordance, and we attribute this to his retreat not so much to physicalism but to traditional realism. According to such realism, the 'real' is defined by its independence of the 'knower', with the implication that 'knowing' occurs outside the 'real'.
>
> Costall and Leudar 1998, 168

These authors propose an alternative reading of Gibson's theory of affordances, "namely as challenge to the traditional theoretical schema of 'perception'" (Costall and Leudar 1998, 165). The challenge to the traditional schema of perception, tainted by the dualist object-subject structure in response to skepticism, has not been picked up by the Neogibsonians. Their critics, discussed in this chapter, do take up the challenge by emphasising Gibson's naturalistic goal of explaining perceptual activity, rather than his (earlier) epistemological commitment to realism.

Now that the epistemic role that Neogibsonians attribute to affordances—as the intentional object of the (classical, aimed at certainty) epistemological concept of perception—has been ousted, we're ready to look at its possible role in an evolutionary theory of perception after. We will see that Charles (2017) takes affordances as one of four essential elements in such a theory, namely as a

descriptive concept that serves as a methodological constraint in the study of the historical process of “attunement” of an agent’s perceptual system on multiple timescales.

CHAPTER 6

Towards Evolutionary-ecological Explanations of Perceptual Abilities

What thus goes for a naive physics may, if I am right, go for a naive psychology too. Just as the mobile need to know about support, so must the socially mobile know about the mental states (beliefs, desires, motivations) of their peers. For a sound psychological understanding of others must surely make an important contribution to the overall fitness of a social animal.

Andy Clark 1987, 145

6.1 Introduction

This chapter approaches perception and cognition from a different angle than the previous ones. We will develop an argument starting from Andy Clark's idea that (some) social skills of animals are similar in nature to (some) of their physical skills, as cited above. We think this intuition is correct. We will argue that it follows then, that the same kind of explanation ought to be sought for both types of skills. A kind of explanation that differs, however, from the kind that is proposed by Clark (1987) and Clark and Toribio (1994; hereafter referred to as 'C&T').

The first task is to analyse the kind of explanation that Clark and C&T have in mind, as well as the role of their references to the case of rhesus macaques' "cognitive" abilities (Harcourt 1985). Clark and C&T argue that explaining these monkeys' group dynamics and the abilities that allow them to function in social hierarchies, necessitates positing "mental representations".

In order to do that we will rely on William Ramsey's (2007, 2017) analyses of the uses of "representations" as explanatory posits. Ramsey's conclusions—that neither the folk-psychological propositional attitudes, nor the connectionist

notion of representation have explanatory power—will guide us in an evaluation of Clark's and C&T's defence of representational explanantia. Using Ramsey as an analytical tool, we will see that the mode of explanation advocated by Clark and C&T is similar to that of Fodor and Pylyshyn: they share the assumption that the mind is essentially a computational or information processing device. They differ from F&P, however, with regards to the way they believe the representational posit should be cached out. Clark and C&T can thus be situated within the Establishment approach to perception and cognition, and it is unlikely that the kind of explanations they propose will resonate well with the ecological approaches[35] because all of the latter rejects representational posits. The result of our analysis of representational explanations constitutes a negative argument: why one "can't have"[36] a solid naturalistic explanation in terms of representation.

Nonetheless, Andy Clark (1987, 145; quoted at the beginning of this chapter) formulates an interesting intuition about what he calls "naïve physics", the practical 'knowhow' regarding movement, support, gravity, etc. that enables animals to get about in and cope with the physical aspects of the environments they inhabit. For example, the fact that animals seldom attempt to jump gaps they cannot possibly cross, attempt to walk on water, lift items of disproportionate sizes, etc. suggest that they somehow "know" they can't do these things. The (exercising of that) knowhow or skill is called "naïve physics". Our bracketing already shows that there is a dispute with regards to the description of the explanandum: what are the natures of knowhow and the exercising thereof, and how do they relate to one another, or might they be identical?

Naïve physics, Clark's intuition says, is similar in nature to what he calls "naïve psychology", the practical *social* knowhow that is associated with the kinds of skills displayed by social animals, like the rhesus macaques. Contrary to the general gist of his theoretical commitments, this intuition of Clark seems to be compatible with at least some forms of the ecological approaches. Gibson (1979,

[35] Gibson's, the Neogibsonians', and what we call the "evolutionary-ecological approach" that is being built as an alternative to Shaw and Turvey's 'orthodoxy', and to which we aim to contribute with this dissertation.

[36] The "can't have" and "don't need" vocabulary was coined by Hutto and Myin (2013, xv).

42) states, in spite of profound hesitation[37], that the social environment of humans and animals are among the scope of the ecological approach. Costall (1995) makes a case for the idea that for animals all affordances might be social, given the fact that (nearly) all are reared by parents, and (nearly?) all seek mates to reproduce? At least, the idea of a continuum of, for lack of a better term, 'non-social nature' and the social environment is present in the broad ecological psychology movement.

We will develop an ecological argument along the line of Clark's intuition. It runs as follows: if the experimental cases published by ecological psychologists, like Warren's (1984) study of stair climbing, qualify as non-representational explanations of naïve physics, and if the explanantia of such cases have suitable counterparts in cases of social knowhow, *e.g.* in the macaques' social skills, then these social skills too may be explainable along ecological lines—that is, without relying on representational posits. It will be argued that such explanations can be successful if the ecological approach is developed along the evolutionary, natural history approach we have explored in the previous chapters. And thus, if the type of account we envision is successful, then representational posits are not necessary for these kinds of social skills. In other words, at least some of the skills identified by C&T (1994) as "representation hungry" may be understood without representations. If this argument is successful, it constitutes a "don't need" with regards to representations as explanatory posits. It will also lead to an additional reflection on a commonality between the representational and the Neogibsonian theories with regards to the way they deal with Poverty of the Stimulus arguments.

The presented argument and analyses are intended to pave the road for a case study that will be developed in the addendum to this chapter. In the addendum we will apply the evolutionary considerations discussed in the previous chapters to outline an explanatory framework for the perceptual abilities involved in the social behaviours of animals. The case study will serve as a "proof of concept",

[37] See Costall's (1995) "Socializing Affordances" for an analysis of Gibson's hesitation with regards to social affordances, and his progressive evolution towards their inclusion.

adding force to our claim that we "don't need" mental representations to explain these cases, contra Clark and C&T's central claim for their necessity.

6.2 Ramsey's representation reconsidered

The goal of this section is to prepare the analytic tools that we will use to assess Clark's and C&T's appeal to representational posits. We have introduced their idea that explanations of certain social cognitive skills necessitate positing representations as explanantia. This section, short as it may be—the anti-representational literature is vast—offers a quick and dirty "can't have". It provides reasons why representational explanations don't work, in general.

Ramsey (2007) critically analyses the use of the term "representation" as an explanatory posit in the cognitive sciences. The starting point of his book consists of an analysis of the "Standard Interpretation" of the Classical Computational Theory of Cognition (CCTC).

The standard interpretation starts from the assumption that Folk Psychological (FP) notions like "belief", "desire" and other "propositional attitudes" are useful terms for a cognitive theory. This means that they are held to be suitable (heuristic) tools to start characterising the *explananda* of cognitive theory. Further analysis of the how the propositional attitudes play their role in our lives supposedly yields a more technical description, a state with such and such function that represents this or that proposition—its "content" or "truth condition". The standard interpretation of the CCTC then constructs a computational model, that mirrors the function and structure of the explananda. At the same time, "computation" is assumed to imply "representation" (Fodor 1975). The computational variables posited in the model are explicitly taken to be symbols that specify the world to be in a way in which it can be actually, or fail to be. There are thus truth conditions for the computational tokens; these are the representation al posits, the explanantia. The computational operations performed upon them are syntactically defined over the shape of the symbols. The standard interpretation entails that symbols are literally copied, pasted, erased, etc… Many theories have been formulated to account for the semantics

of internal representational posits, but Hutto and Myin (2013) doubt that any have succeeded.

Ramsey analyses two lines of critiques on the standard interpretation. Searle's (1980) Chinese Room argument is discussed first (Ramsey 2007, 45). The argument, very roughly, maintains that mere "symbol shuffling", by itself, never suffices to establish the kind of intentionality that the common sense notions of belief and desire are considered to possess: the symbols manipulated in the Chinese Room, like the symbols manipulated by computational systems, remain meaningless to the system itself, whereas our beliefs and desires mean something to us: they represent the world to us. Searle concludes that this is reason enough to reject the CCTC. Note that Shaw et al. (1982, 170) make a very similar argument (cf. section 4.2.2). Shaw et al. conclude that a general theory of "specification" is required before representation can be understood.

Ramsey also discusses Steven Stich's (1983) critique of the standard interpretation of CCTC. Stich's critique of the standard interpretation of CCTC is of a very different nature than Searle's. He takes the folk notions like beliefs and desires to be fundamentally misguided. (More on this in the next section), but concludes in favour of a form of CCTC without the standard idea of symbolic representations aimed at underpinning the folk psychological notions.

In response to these critiques, Ramsey defends a non-standard interpretation of the CCTC, embracing the plausibility of representational posits. He does this by identifying two families of uses of "representation". One family meets what he calls the "Job Description Challenge". This separates it from the other family, which use "representation" in a way that doesn't meet the challenge. The Job Description Challenge stipulates a demand that must be met for a theory to use the term "representation" in a valid sense, and to count as truly a "representational" theory. Basically, the Job Description Challenge is met when there is a clear notion of how a posited token *functions as a representation for* the system.

> [...] a representational theory of cognition should provide, at a bare minimum, an explanation of how something serves as a representation in such a way that, at

> the end of the day, we still have a *representational* theory, instead of a non-representational account of a psychological process.
>
> Ramsey 2007, 31

This means that the kind of representationality demanded by Ramsey is decoupled from the idea of the representationality of beliefs and desires. Ramsey's proposal, on the other hand, entails an independent, empirical criterion based on the functions of the posited tokens.

In the first family of theories, two types of explanatory posits meet the Job Description Challenge according to Ramsey (2007), such that they may truly be labelled "representational". He calls them "IO-representations" (p. 68) and "S-representations" (p. 77). IO-representations hinge on the idea that cognitive functions are often defined in terms of their Inputs and Outputs, and that these inputs and outputs are representations in an unproblematic way. For example, a person performing a multiplication receives numerals that represent numbers as inputs and delivers numerals representing numbers as outputs. This indeed an unproblematic characterisation since numerals are public symbols humans use to represent numbers. Ramsey's IO-representations exploit this sense of representationality. To make his idea of IO-representations intuitive, he describes a computational model of a "multiplicator" that relies on a subsystem for addition. Ramsey claims that the inputs and the outputs of the adder systems function as inner representations to the multiplicator in the same sense that the inputs and outputs of a calculator are representational to the calculator's human user. In the computational model, the tokens are not representations for the adder itself, provided that the adder has no sub-processes of its own.

We think Ramsey's IO-representations are vulnerable to serious critique. The force of his argument relies on the idea that we, humans who are skilled users of public symbols, can recognise as representations the numerals that the multiplicator passes on to and receives from the adder sub-unit. Hence IO-representation remains parasitic on the representationality of "external", public symbols fed into the system by its human user. It has been contended, however, that by Ramsey's own Job Description Challenge, the tokens exchanged between multiplicator and adder don't function as representations for the multiplicator at

all. All that matters, and all that is needed for explanatory purposes is that the inner inputs and outputs stand in systematic relations to numbers. Yet this is possible without the assumption that that the inner inputs and outputs represent numbers. In other words, Ramsey's claim that a representational description of a multiplicator has an explanatory edge over a purely syntactic description à la Stich, isn't convincing. See Tonneau (2011) for the extended version of this argument. The representational gloss may make the causal-mechanical description of the system more *intuitive* to us, but that is insufficient for a commitment to realism about representationality of such computational processes.

The second type of representations that meets the Job Description Challenge according to Ramsey, are the so-called "S-representations" (Ramsey 2007, 77-92; "S" from "Structural"). These are inner models in a system that are structurally isomorphic with external features, the "environment" of the cognitive system. Ramsey holds that their functional isomorphism suffices for representationality. When Bob uses a map to navigate the London tube, he clearly is the user of a token that is structurally isomorphic to the London tube. For Bob, the structures on the map "stand for" the London tube lines. Ramsey, however, stretches the notion of a user too far, we think. He devises an example involving a toy car that has built inside it a surface on which there is an S-shaped groove that is structurally isomorphic with the race track on which it drives (Ramsey 2007, 196). Although a mindless mechanism, Ramsey holds that the car exploits the S-groove to steer the track successfully and that, therefore, the S-groove "stands for" the S-shaped circuit track, *for* the toy car, because of the functional role it plays. Tonneau (2011) argues that there is no sense in which the car "uses" its internal isomorph, applying Ramsey's own argument that it is merely a causal relay system, and that mechanisms are never representational just in virtue of functioning as a causal relay. (Cf. below)

A critique on representationalism similar to Tonneau's analysis of Ramsey's S- and IO-representations is found already in Shaw et al. (1982). They (Shaw et al. 1982, 170) propose to differentiate between "representation for", the notion of representation that implies a user, and "representation by" which denotes

functional isomorphism.[38] Shaw et al. argue, like Tonneau, that the functional isomorphism notion is insufficient for establishing propositional knowledge because isomorphism without a user has no truth conditions. Therefore, a theory that takes userless isomorphism to be representational becomes homuncular. Shaw et al. rightfully conclude that "representation *by*"

> [...] involves an intentional slurring of the notion of the representation user and the vehicle so as to hide its homuncularity.
>
> Shaw et al 1982, 170

Ramsey (2007, 87) however, defends that "S-representations" not only "stand in for" something else (Hutto and Myin 2017). They also "stand for" something else. He attempts to make the user notion as thin as possible by describing it as a mindless mechanism, but this goes at the cost of the idea of "performance" or "success" of the car with the S-shaped internal token. The notion that it "manages" to make its way, is ultimately either homuncular or dependent on human attribution; for the mechanism, there is no success and hence, no representation *for*.

The second family of use of "representation" in Ramsey's analysis—we remind the reader that the first family comprises "IO" and "S-representations"—consists of two, yet other uses of the notion of representation as explanatory posits: the "receptor" notion and the "tacit" notion. According to Ramsey both fail to meet his Job Description Challenge. The receptor or detector notion fails because it is assumed by its proponents that reliable covariance of a detector state with the feature it detects suffices to represent that detected feature.

> [...] a common fundamental conviction that, roughly, an important type of cognitive representation results when some sort of internal state reliably responds to, is caused by, or in some way nomically depends upon some external condition. When this occurs, such a state [...] is viewed as having the role of

[38] To rule out any confusion: we agree with Tonneau that Shaw et al.'s "representation by", as it denotes functional isomorphism, ought not to be called representation at all, because it doesn't meet the Job Description Challenge. See Hutto and Myin (2013, 62) for more discussion.

> representing that external condition because of this causal or nomic dependency relation.
>
> Ramsey 2007, 123

> Their actual stated functional role – reliably responding to some external condition – is not, by itself, a role sufficiently representational in nature to justify treating some state or structure as a representation.
>
> Ramsey 2007, 125

Being reliably caused by, reliably responding to, or reliably co-varying with something is not sufficient for something to play a representational role. Many things function as reliable causal relays, but this alone is not a reason to treat them as representations (Ramsey 2007, 126). Ramsey points out that if the contrary would be true pan-representationalism would ensue; given the fact that there are reliable causal relations connecting nearly all aspects of the universe in some way, nearly anything would represent anything. (The critique on S-representations we formulated above partly boils down to the idea that structural isomorphism is a form of reliable co-variances, and that therefore S-representation fails to meet the Job Description Challenge for the same reason as the detector notion).

A similar verdict is reached with regards to "tacit representations", Ramsey's label for how the term representation is used in connectionist modelling and in some neuroscientific theories. By "tacit", Ramsey means that the representation is not recognisable as an explicit symbol or a sentence-like token. Instead, representationality, in these theories, is attributed to the distributed activity patterns and/or to the dispositional states of the nodes in a neural network. Ramsey convincingly analyses that such states or patterns don't meet the Job Description Challenge:

> While the actual nature of dispositions is often the subject of philosophical debate, there is no analysis that suggests that mere dispositions are, as such, a form of representation. [...] Why, then, should we suppose that by virtue of having the disposition to generate certain kinds of output, a cognitive system's functional architecture thereby embodies a type of representation?
>
> Ramsey 2007, 167

Contra Haugeland (1991), Ramsey argues that *know-how*, embodied by connectionist networks, or by any entity or process, doesn't require some form of representation (Ramsey 2007, 168). He favours Ryle's (1949) conception of know-how, as being structured (designed, evolved) so that the capacity arises to perform some job. The committed representationalist would interject that Ramsey only shows that know-how doesn't require *explicit* representation. This argument is rejected, because then any system having a certain capacity in virtue of its dispositions and architecture would be representational. Even a rock, being disposed to roll down a steep hill (ibid., 173). Moreover, describing the dispositional properties of a system in representational terms yields no better understanding of its behaviour.

> [...] there is no helpful sense in which the wave of activation can be viewed as an information-extraction or look-up process.
>
> Ramsey 2007, 182

Now that we have Ramsey's analysis ready at hand and completed it with Shaw et al.'s and Tonneau's remarks, we are ready to apply them to Andy Clark's references to the social (perceptual) skills of rhesus macaques.

6.3 Naïve psychology

Andy Clark (1987) reconsiders the usefulness of the folk psychological notions of belief and desire for cognitive science. Folk Psychology (FP) is the practice of attributing beliefs and desires to others in order to make sense of their behaviour. As we have seen with Ramsey, the standard interpretation of the Classic Computational Theory of Cognition (CCTC) is aimed at vindicating the FP notions by giving them a naturalistic underpinning in the form of information processing, *i.e.* physical symbol manipulation. It has been questioned, however, whether these common sense notions like beliefs and desires are good starting points for scientific, psychological explanations of the ability to understand others. This question is answered in the negative by so-called *eliminativists*, whose arguments against FP we'll look at first.

Most notably, Paul Churchland (1981) and Stephen Stich (1983) have argued that such folk notions are deeply misguided, and that they can and should be eliminated from scientific discourse. That is so because FP is considered to be a bad theory, on a par with alchemy, ancient cosmology and the likes. Churchland argues that FP is an empirical theory indeed because it

> [...] brings a simple and unifying organization to most of the major topics in the philosophy of mind, including the explanation and prediction of behaviour, the semantics of mental predicates, action theory, the other minds problem, the intentionality of mental states, the nature of introspection, and the mind-body problem.
>
> Churchland 1981, 68

Churchland holds that the role played by the posits of FP, the "propositional attitudes", is very much like the roles played by theoretical posits in the natural sciences. They form, together with common sense folk psychological law-like generalisations—such as, "if *x* fears that *p*, then *x* desires that ~*p*"—an explanatory hypothesis. It is, hence, an empirical theory. That it is such, Churchland continues, opens up the possibility that it is a false theory; that its posits have no referents and that the generalisations it promotes to hold do not reflect the mechanisms or organisations that underlie actual psychological phenomena. The resistance against the elimination of FP is understandable, though, because it does have some practical, explanatory and predictive power (Churchland 1981, 72-73). In response, Churchland develops a three-tier strategy to show the falseness of folk psychological theory.

> First, we must reckon not only with FP's successes, but with its explanatory failures, and with their extent and seriousness, Second, we must consider the long-term history of FP, its growth, fertility and current promise of future development. And third, we must consider what sorts of theories are *likely* to be true of the etiology of our behaviour, given what else we have learned about ourselves in recent history. That is, we must evaluate FP with regard to its coherence and continuity with fertile and well-established theories in adjacent and overlapping domains—with evolutionary theory, biology and neuroscience, for example—because active coherence with the rest of what we presume to know is perhaps the final measure of any hypothesis.
>
> Churchland 1981, 73

As for the first level of Churchland's attack on FP, he lists some important mental phenomena that FP fails to address: mental illness, creative imagination, individual differences regarding intelligence, the psychological functions of sleep, perceptual-motor coordination and 3D-vision, illusions, memory and the pre- and non-linguistic learning processes. This shows that FP is at best partial and superficial. The second level argument consists of an analysis of the history of folk theory. That history is one of retreat and infertility, Churchland writes. In ancient times many aspects of the world were understood in intentional terms: angry wind, a jealous moon, the generosity of a river, etc. Not so long ago, the movement of objects was explained in terms of their desire to fall downward. Only recently the attribution of intentional attitudes has retreated into the realm of the psychology of higher animals. Moreover, in this realm of human psychology, FP has been stagnant: Sophocles application of FP was as good as ours today. Third, the longstanding lack of a theory of mental content makes it so that FP's categories stand alone in the wider scientific fields that encroach upon it. Evolutionary, biological, physiological, neuro-scientific research progressively captures the explananda that FP claimed for itself. FP is not part of the growing synthesis of these sciences. On the contrary, it reminds us of how alchemy and Aristotelian cosmology has fared in the light of the modern sciences (Churchland 1981, 75).

In response to Churchland's and Stich's eliminativism Andy Clark (1987) proposes a reconceptualization of FP that meets at least two of Churchland's three lines of objections. Clark resists eliminativism because he finds "non-intentionalist" explanations of psychological phenomena inconceivable.

For Clark, FP differs from alchemy and early cosmology in several respects. First, we have no reason to believe that it was ever literally and speculatively developed or proposed as a theory on how to explain people's actions. Clark (1987, 141) argues instead that it is at most an "implicit" theory, the content of which—its posits and laws or principles—was never stated explicitly. Its theoretical content can only be inferred from its use, namely when explanations and predictions are explicitly formulated. In this respect FP should be seen as is similar in nature to the notion of naïve physics.

Naïve physics is the ability displayed by mobile animals to cope with the physical aspects of their environments, such as the (un)supportiveness of surfaces, the limitations velocity poses to avoiding obstacles or avoiding (the consequences of) falling. Clark says that mobile animals that manifest such physical skills have an implicit theory. This means that it is not ever formulated for, or speculated about by the animal, but that *we* can infer it from the consistency of their actions, and attribute it to them. From its resemblance to naïve physics, Clark labels the implicit FP he defends—that is, the ability to successfully get about in a social environment—"naïve psychology" (Clark 1987).

The second reason Clark offers for the difference between naïve psychology and explicitly false folk theories like alchemy, draws on the fact that evaluating the soundness of naïve psychology ought to occur differently from evaluating the soundness of explicit theories. Since naïve psychology wasn't ever developed as a theory, its soundness shouldn't be judged as if it was. Hence, Clark argues, Churchland's qualifications of naïve psychology as a theory in retreat lacking fertile developments entirely misses the point. FP understood as naïve psychology should instead be evaluated in the same way naïve physics is evaluated. The standard we use to evaluate a monkey's coping with distance and the flexibility of branches, its ability to navigate up and down, all in the service of jumping from one tree to another, is the success of its jumps. And so naïve psychology should be evaluated too, Clark maintains, in terms of the success that our "grasp" of it allows us to live in complex societies, as we do.

Clark (1987, 145) attempts as well to bring his notion of naïve psychology in line with the contemporary sciences in general. Counter to the eliminativists' idea that FP originated as campfire speculations, Clark claims that it is more likely that naïve psychology is a naturally evolved skill. Those who were able to predict their peers' behaviour better because they developed a disposition to attribute quasi-beliefs and quasi-desires—that is, intentional attitudes held to have implicit contents—simply had a better chance to flourish. The evolved skills that constitute naïve psychology form what Clark calls a "bedrock theory", and he adds that, although bedrock theories aren't infallible, the fact that they have been "tested" by the evolutionary demands of social conditions, it is unlikely that their core is radically misguided.

Clark (1987, 149) acknowledges that all evolution cares about is usefulness, and not truth. This makes the status of implicit content even more peculiar. The only way that an evolved cognitive capacity like naïve psychology can ever be useful, Clark thinks, is if it involves something like the ascription of contentful mental states. Understanding one's peers' (social) behaviour necessarily involves attributing to him an internal representation of the world and what he wants in that world. A functional structure akin to the belief-desire framework is forced upon us, Clark holds. A non-intentional, contentless framework performing a similar function is just unimaginable for Clark.

> Insofar as we seek to understand the causal role of others' mental states, perhaps we must do so by some kind of twin factor analysis. Something very like a belief/desire psychology being thus compulsory, it should occasion no surprise if nature responded by making it easy by "wiring" it in.
>
> Clark 1987, 149

The question that arises naturally then concerns how the "implicit content" of naïve psychology is to be understood, and what role it plays in the explanation of psychological phenomena. Clark's (1987) approach broadly resembles Ramsey's defence of S-representations: Both accept the classical computational theory of cognition. Both reject its standard interpretation, and its goal to vindicate the traditional conceptions of FP. But they face the same problem. Both defend ascription of representationality, *i.e.* mental content, based on the functional role of some physical token, yet fail to demonstrate the explanatory surplus of such an ascription, and they both fail to deliver a plausible story that allows us to individuate the supposed content.

Clark's view seems to involve an unjustified reification. From the fact that our thinking about action in terms of reasons—that is, belief and desire combinations—is useful for us humans, he infers that beliefs and desires are actual things that play a causal role. In other words he takes for granted that the structure of reason-explanations is isomorphic to an underlying causal structure. This way of reasoning is prone to be a form of what is known as the

"psychologist's fallacy" (James 1892).[39] It is the mistake of taking the result of one's experience or analysis of a psychological phenomenon—in the case of naïve psychology, its inferred, implicit content—to be the cause and explanation of the phenomenon.

With respect to the need Clark expresses for some form of intentionality at the basis of actions and our understanding of others' actions, we concur but with an important reservation. His assessment that a non-intentional explanation of intelligent behaviour is unlikely, seems correct. But his idea that, therefore, the explanation must involve contentful mental representations, is not (Hutto and Myin, 2013). That would only be the case if all intentionality is of one, content-involving kind. But that has not been established—if, as Hutto and Myin (2013; 2017) argue, a radical, non-representational of account of intentional cognitive abilities is forthcoming, there is an intentional, but not content-involving account.

As said, Clark refers to Harcourt's (1985) review article on rhesus monkeys' sophisticated social behaviour to illustrate his view of naïve psychology. Harcourt describes that social status is a central factor to the outcome of conflicts among the macaques, rather than age, size or physical strength, as one might expect on the assumption that they are brutes rather than tactical players. High ranking monkeys pick and win more fights, *e.g.* over food, than low ranking ones. This is so because high ranking animals are supported by others significantly more often than their lower ranking rivals. Moreover, young females inherit their social status from their mother. This results in these young monkeys often getting the upper hand in conflicts with older and larger animals who rank lower than themselves. The young rascals quickly learn that they wield such power, and lower ranking monkeys quickly learn that it is useless to pick fights with higher ranking ones, and that it is smarter to cede the item that is fought for. Harcourt, at the end of his article, speculates that these monkeys—showing these remarkable skills of learning and remembering who ranks how high, and of

[39] Costall (2004a, 191) cites Dewey on the psychologist's fallacy.

picking their battles accordingly—"decide" whom to engage, and whom not, by "conscious calculation" (Harcourt 1985, 36).

An additional factor in the social dynamics of the rhesus macaques is the practice of "competitive grooming", also described by Harcourt. It has been observed that macaques compete to groom the high-ranking females. Having groomed such a female often leads to her support when the groomer subsequently has a conflict with a third monkey. Third monkeys are also observed to avoid conflict with those who have recently groomed high ranking females. Clark argues that such capacities require some sort of understanding of behalf of the monkeys:

> It does not seem unduly generous to describe the knowledge mediating observations (of grooming etc.) and predictions of future behaviour as involving some primitive understanding of the motivational states of other members of the group [...].
>
> Clark 1987, 145

But Clark (1987, 152) has a very particular view of what such "primitive understanding" is. According to him it involves "something like a representation of others' knowledge-states (quasi-beliefs) and current goals (quasi-desires)" which has *implicit* content. He writes rather little about the "implicit content" of such "meta-representations". All he does is suggesting two categories of implicit content:

> [...] theoretical commitments which we tend not consciously to articulate are of two broad kinds. There are those commitments which, though perhaps once explicit, have now become engrained in our talk and culture (e.g., some moral and sexual taboos and practices). And-more interestingly—there are those commitments which we cannot help but make, courtesy of our biological nature and physical environment (e.g., the "commitment" to the use of texture gradients as indicators of surface orientation).
>
> Clark 1987, 142

He remarks that the former category describes how the eliminativists understand FP: though perhaps now implicit, it was once a consciously articulated theory that came about through speculation and served some explicitly formulated purpose. This obviously can't apply to the rhesus monkeys because they were never

campfire speculators. The latter category reflects Clark's own conception of naïve psychology. This one is of particular interest for us because the example he chooses, the use of texture gradients for guiding action, are precisely the kind of things Gibson and ecological psychology in general study. They are what can be found in the ambient optic array. The ecological approach takes such texture gradients to play a crucial role in an intentional, though not representational, explanation of perception and action that also relies, or ought to rely, on our biological nature and physical environment. Moreover, the use of texture gradients to coordinate one's actions with regards to surfaces is a good example of naïve physics.[40] However, the commitment, as Clark expresses it, to use texture gradients is in no sense a theoretical commitment on the ecological view.

Nonetheless, if Clark's intuition about the similarity of naïve physics and naïve psychology is right, and if the ecological approach succeeds in a non-representational approach of naïve physics, then it may also succeed in a non-representational explanation of naïve psychology. It may thus be equipped to deal with the rhesus monkey case, without positing mental content, implicit or explicit. The remainder of this chapter will serve to make this argument more concrete. First, let's look at a second article, by Andy Clark and Josepha Toribio, that can be considered as a follow up on Clark (1987).

6.4 Doing without representing

Clark and Toribio (1994; C&T) aim to defend the explanatory value of the notion of "representation" against radical, empirically motivated anti-representationalism. We discuss their article not only because they use Harcourt's monkeys as an illustration too, but also because if their defence of the

[40] One might object that texture gradients are "input" or "information" for vision only, and not for action per se, therefore falling outside the scope of naïve physics. But if we take seriously Gibson's thesis that perception should be understood as "exploratory activity", and that perceptual systems are action systems, then the idea that use of textural properties to orient oneself falls plausibly within the realm of naïve physics.

necessity of representational posits is solid, it could pose a problem for our attempt to develop a non-representational account of naïve psychology.

Empirically motivated anti-representationalism distinguishes itself from its arm-chair-philosophy cousin—personified by Heidegger (C&T 1994, 402)—because its rejection of representations as explanantia aren't based (exclusively) on conceptual reasons. The empirically motivated theorists (Brooks 1991; Beer 1995; among others) reject representation as an explanatory posit because they believe their empirical research on intelligent systems shows that much or all intelligence can be accounted for without representation. Obviously, the ones who believe *all* of intelligence is representation-free, are the more radical ones. C&T argue that the theoretical reach of the non-representational approach is heavily overstated because the cases developed by the anti-representationalists—for example, Rodney Brooks' robot, Beer's insect-like "mobot"—all constitute intelligent behaviour in situations where the information necessary to successfully complete the task is available in the system's environment and accessible directly.

C&T grant that non-representational accounts are possible for certain behaviours in "informationally rich" circumstances, but that these represent only a small portion of cognitive life in general. They claim that the cases developed by anti-representationalists all fall in this category of information sufficiency, but that there are problem domains beyond that, characterised by insufficiency of environmental information. Such cases, where the Poverty of the Stimulus argument supposedly applies, C&T label "representation-hungry". The fundamental claim of C&T is that the successful cases of non-representational explanations don't scale up to the representation hungry ones.

The representation-hungry domain is demarcated by two conditions; application of one of the two conditions suffices for a phenomenon to qualify as representation-hungry. The first condition states that the problem domain involves reasoning about—or "coping with", to state it more neutrally—absent features, non-existent objects or counterfactual states of affairs (C&T 1994, 419). The second condition is a requirement on behalf of the agent to be selectively sensitive to complex or unruly environmental features, sometimes referred to as "the abstract" (C&T 1994; Degenaar and Myin 2014). The complex and unruly

condition includes sensitivity to open-endedly disjunctive features of the environment, so C&T (1994, 419) write. We remind the reader that we have encountered such features when we discussed the case of the marsh periwinkle our third chapter (Turvey et al. 1981). We saw that Turvey et al.'s version of the ecological approach proposes specificity of information, so that effectively no cases qualify as representation-hungry under the second condition of C&T. It would be responded that higher order invariants will always be discoverable for features that prima facie look complex or unruly. The evolutionary strand in ecological psychology that we want to deploy in a non-representational account of naïve psychology, as we have seen, rejects specifying information. Thus it can't, of course, offer the kind of response Turvey proposes.

Nonetheless, the case of the monkey we have before us contains both conditions, the "absent" and the "abstract". Monkeys who are temporarily removed from their group fit in right away when reintroduced, although they had no access to the optical patterns that correspond to the groups ongoing dynamic interactions that went on when they were away. They were "de-coupled"; the possibility for permanent tracking was interrupted. The case also involves an abstract feature: the social hierarchy is transitive: if A ranks higher than B, and B ranks higher than C, then A ranks higher than C. But the interactions between these pairs take place at different times and places so that the visual patterns that correspond to them aren't readily available. And even if they were, "transitivity" could be thought of as requiring an abstraction from the available information. The approach we're about to sketch ought to be able to cope with these features.

Before we get to that, let's consider a second argumentative line that is developed by C&T. It is based on the idea of "connectionist" models in the CCTC, and the conviction that connectionist explanations involve a distinct type of representationality.

> [T]he radical anti-representationalist case fails adequately to address [connectionist approaches] insofar as they are deeply representational, yet eschew the use of traditional explicit representations.
>
> C&T 1994, 403

C&T argue that radical anti-representationalists mistake the general notion of representation, which includes the connectionist definition, with the classic, symbolic view on representation. They aim to show that the arguments offered by anti-representationalists are applicable only the explicitly symbolic form. This, then, leaves room for connectionist-style, "sub-symbolic", representational explanations of cognitive phenomena; the arguments against representational theories apply to the standard interpretation of CCTC only, but not to "connectionist" explanations which are inherently representational too, according to C&T. Connectionism, which they take to be a variety of the computational view of the mind, differs from Fodor's classic computationalism insofar as the representational content posited by connectionism doesn't correspond to discrete symbols or language-like structures. A fortiori, connectionism claims that representational vehicles are distributed over the nodes of a trained (neural) network, as well as over the processes the network embodies. C&T (1994, 403) hold that the overall functioning of a connectionist network within a wider system suffices to claim that it meaningfully represents the 'know-how' it embodies.[41]

However, if Ramsey's reasoning is right—and we believe it is, cf. section 6.2—that neither the processes nor the nodes in connectionist models of cognition function as representations for the system, then connectionist style "representations" are not a sub-class of the "general notion of internal representations" at all, as C&T (1994) claim. What is then left of the "general" notion of internal representation roughly just is the explicitly symbolic concept as classically defended by the cognitivist Establishment (*e.g.* Fodor 1975). This means that there is no conflation of the general notion of representations and the explicit/symbolic type of representations. Hypothetically, there might be another notion of representation sitting in between full blown propositional attitudes and non-representing

[41] Unlike Clark (1987), C&T (1994) don't defend the idea that the supposed distributed representations have a functional organisation that is similar to that of FP. The common sense notions of belief and desire as starting points for cognitive science are abandoned, they aren't mentioned once in C&T's (1994) text.

connectionist nodes, but C&T don't specify what such a notion might be either. Ramsey analyses this idea but comes to the following conclusion:

> What I am denying, however, is that there is an intelligible third possibility—that the dispositional nature of the cognitive architecture is itself playing a representational role. Thus, when cognitive scientists claim the brain uses these sorts of states, they are making a fundamental error in their accounting of cognitive processes.
>
> Ramsey 2007, 185

Since conflation of the general notion of representation with the supposed implicit notion was the crux of C&T's argument, one may conclude that the radical claim of anti-representationalism can be valid indeed: internal representation, without further arguments, simply doesn't explain things better, and the cases developed by the empirically driven anti-representationalists may hold greater explanatory potential regarding cognitive phenomena than C&T take them to.

So, what does this analysis entail for our understanding of macaques' grooming behaviour? C&T interpret literally Harcourt's description of the monkeys *remembering* who groomed whom as well as their *reasoning counterfactually or anticipatorily* about the outcome of fights they might pick on the basis of their *knowledge* of group members' social ranking. In some sense this is correct, provided it is kept in mind that the italicised terms are our own descriptive tools to render the monkeys' behaviour. The descriptions may be thought of as not implying a commitment to the way these capabilities are to be understood in a theory. That, however, is not how C&T intend the terms to be understood. They are committed to a representational understanding a priori. They refer to a *prima facie* need for some internal resource, for example in their description of the monkey's social skills:

> In combat situations, support from a high ranking female is often decisive. Monkeys who groom such females tend to receive such support. Hence, it is wise to avoid contests with macaques who have been seen grooming these females. Such avoidance behavior is indeed often found, and persists long after the visual stimulus (witnessing the grooming event) has ceased. Knowledge of the likely behavior of the high-ranking female in combat situations that have not yet arisen

> thus seems essential to the social organization of the group (see Harcourt, 1985). Yet a good explanation of such behaviors will *prima facie* need to acknowledge some kind of internal representation of positions in the social hierarchy, and storage in memory of knowledge concerning past grooming events.
>
> C&T 1994, 419

Such expressions as "need", "must" and "surely" in reference to the representationality of the explanantia of intelligent behaviour—usually hedged by "prima facie" or "seems"—are abundant in their text. But instead of demonstrating the supposed need or the explanatory benefit of representational posits, C&T stipulate the representationality of whichever entity internal to an agent that plays the explanatory role they have in mind for it:

> The ability to track the distal or the non-existent requires, prima facie, the use of some inner resource which enables appropriate behavioral co-ordination without constant ambient input to guide us. *Whatever plays that kind of inner role* is surely going to count [...] as some kind of internal representation.
>
> C&T 1994, 419 (emphasis added)

C&T insist on ascribing representationality to connectionist activation patterns and/or node states despite their (C&T 1994, 413) statement that "there is no-one except the external modeller to whom the inner structures will appear representational." To circumvent the threat of homuncularity, C&T (1994, 413) assert that within a cognitive system, the structures to which the external modeller may assigns content function in a purely causal way. But if the structure functions causally only, a purely causal explanation of the system within which it operates must surely suffice. Nevertheless C&T repeat

> To the extent that our (external, theoretic) best understanding of their cognitive role involves assigning representational contents to them, they are (it seems to us) as full-blooded and genuinely representational as any (non-homuncularist) adherent of a representational / computational theory of mind ever supposed.
>
> C&T 1994, 413

This, we think, is a plain falsehood. There is no reason to accept that causal mechanisms are explained better when representationality is ascribed to them. Nor for the idea that ascription of representationality suffices to make a system

representational. Yet further in their text, when they make more explicit what are the conditions for ascribing representationality to structures that perform cognitive functions, the notion a content user is re-introduced obliquely:

> Rather, it is just the fact that incoming information is divided into distinct signals (carrying different types of information—e.g., about shape, color and motion. [...]) and that the routing, transforming and efficient integration of those signals succumbs usefully to a computational depiction. Such a depiction is at least modestly representational since (1) it involves the *semantic interpretation* of the kinds of information carried by different signals and (2) the strategies of routing and integration are evolved precisely so as to enable the overall system to track and respond to salient objects and states of affairs in its world."
>
> C&T 1994, 415 (emphasis added)

Although the context of this passage suggests otherwise, C&T might be able to maintain that "the semantic interpretation of incoming signals" refers not to an activity performed by the cognitive system that is under study, but to an activity of the modeller of the system. So, either the semantic interpretation is carried out by the system and an account is required as to how a physical signal processing becomes semantic, or the interpretation amounts to content ascription by the modeller, which raises a question from a broader perspective: the notion of content ascription by a modeller depends on modellers' ability to ascribe content, which in itself requires clarification too, as it was pointed out by Hutto and Satne:

> What is needed is an explanation of how content ascribing stance-taking capacities could have arisen without presupposing the existence of content in the telling of that story.
>
> Hutto and Satne 2015, 526

In other words, if C&T mean that semantic interpretation—that is, to evaluate content—is done by the theorist or modeller, and not by the modelled cognitive system, an explanation is required of the modeller's ability to take up the ascribing stance.

C&T's (1994, 426) proposal to let representationality come in degrees adds to the deflation of their use of "representation". In fact, allowing for degrees of representationality constitutes the denial of the need or desirability of a Job

Description Challenge for representation. Playing a clearly identifiable representational role in a system is not a requirement of an entity to be labelled as a representation. In their final description C&T propose another criterion to discern representationality:

> Any process in which a physically defined input space is thus transformed so as to supress some commonalities and highlight others is, we claim, an instance of modest representation. The greater the computational effort involved in effecting the transformations (…), the *more representational* the solution.
>
> C&T 1994, 426

This, we think, makes the deflation complete because representation hungry domains now coincide with "computational resources hungry" domains. The amount of complicated machinery and energy expenditure becomes the measuring stick but "representation" in this sense is disconnected entirely from the public tokens that are used as standing for something else. Consequently, it also loses the explanatory promise it seemed to have had in virtue of its resemblance to the notion of public representation.

To conclude this section, let's reflect on a commonality shared by C&T and the dominant neo-Gibsonian approach. Both assume that the Poverty of the Stimulus (non-specific, ambiguous information) poses a serious problem for theories of perception/cognition. But their respective ways of dealing with this problem differs fundamentally. According to C&T, accounting for "intelligent" action with regards to absent or abstract features requires "inner resources" that abstract from and enrich information that is directly available in the environment. These information processes are held to be computational in nature but we have seen that representationality of C&T's inner resources is deflated to the point where they lose all explanatory force. This could imply one of two consequences: If PoS poses a real problem—that is, if it entails real representation hunger—then C&T's connectionism is inadequately equipped to deal with such a problem domain. Or, PoS poses no real problem and a non-representational account can deal with the absent and the abstract. The neo-Gibsonian approach fears PoS too. So much so that they postulate "specification" by ambient energy array structures, or "necessary richness". Regarding absent features they may be able to uphold their claim by invoking extended temporal structures. But specification of abstract

properties is paid for with heavy metaphysical currency: the projection of content or concepts onto the environment (see section 4.3.3).

C&T (1994, 420) refer to Van Essen et al. (1994) as a good example of a neuroscientific application of connectionist modelling. They cite these authors stating that information should be treated as a commodity:

> … a system designed to treat information as an essential commodity, much as an efficient factory is designed for optimal handling of the physical materials that traffic across its floors. In both cases the raw materials that enter the system generally represent only a small fraction of the final product. The production process involves careful selection of useful materials, discarding of excess or unnecessary materials, and transforming and repackaging of the desired materials in an appropriate configuration for the particular applications for which the product is intended.
>
> Van Essen et al. 1994, 28

Besides the fact that nothing in the analogy warrants that what goes on in the described production system is essentially representational, we wish to point out that the "commodity view" of information is rejected by many. We saw that Gibson argued explicitly for the opposite view: information (for perception) ought not to be seen as a commodity. Yet he was criticised by F&P (1981, 167; as we have seen in chapter 2), based on a solid argument, that he didn't do justice to his own non-commodifying notion of information; that there remains a sense of reification in his treatment. Gibson's view of information starts correlational, F&P argue, but ends with the pickup of (a property of) a reified correlate. But if the commodifying view of information is a bad thing for ecological psychologists, then it is likely to be a bad view for connectionism too.

Finally, C&T suggest that the commitment to representational explanations is the natural one, and that you need very good arguments to abandon that commitment.

> [U]nless you believe that human cognition somehow operates without re-coding gross sensory inputs so as to draw out the more abstract features to which we selectively respond, you will already be committed to a story in which the state spaces themselves are properly seen in representational terms.
>
> C&T 1994, 423

Besides the vagueness of what is actually meant by "re-coding"—cf. Ramsey's assessment of the connectionist notion of representation; and the ensuing debate on whether (en)coding or computation is essentially representational—C&T, we think, turn the world on its head by making the commitment to representational theory the default position, while theories that don't posit "coding processes" supposedly need extra argumentation. But the representation posit is costly of the undischarged homunculus problem, and the need for a theory of mental content it generates. Hence, explanations that do not involve it are more parsimonious, and should be considered as the default position. Only for very good, additional reasons one should commit to mental representation. With Ramsey, we have seen that Clark (1987) and C&T (1994) don't provide such reasons.

6.5 Concluding remarks: from stair climbing as naïve physics towards an ecological account of naïve psychology

So far we have discussed in this chapter that the role of representations in explanations of perceptual and cognitive phenomena is highly contentious. But, as the reader remembers, Andy Clark (1987) also argues that naïve psychology, roughly understood as the ability to intelligently deal with social situations, is similar in nature as naïve physics, the ability to act in accordance with physical principles such as the effects of gravity, up and down, apertures, locomotion and inertia, etc., *i.e.* the ability of organisms to cope with a physical environment in the very basic sense of not falling to their deaths, not bumping into obstacles all the time, not trying to walk on water, on vertical surfaces or on ceilings (mutatis mutandis).

> [A] roughly accurate grasp of some basic *physical* principles is vital to a mobile organism, so too will some roughly accurate grasp of basic psychological principles be vital to a *social* organism."
>
> Clark 1987, 140

This idea we take seriously. As discussed at the beginning of this chapter, part of Clark's (1987) defence of naïve psychology relies on its genesis. Unlike alchemy and folk cosmology, naïve psychology is not the result of speculation in the literal

sense. Naïve psychology was on the scene long before (human) folk psychologists formulated explicit hypotheses that might explain why someone did what he did. Clark (1987, 145) states that "there will always be substantial evolutionary pressure on social animals to become more efficient "natural psychologists"." and that "we are indeed "pre-set" by the evolutionary process so as to become adept "natural psychologists"." (1987, 151).

> What thus goes for a naive physics may, if I am right, go for a naive psychology too. Just as the mobile need to know about support, so must the socially mobile know about the mental states (beliefs, desires, motivations) of their peers. For a sound psychological understanding of others must surely make an important contribution to the overall fitness of a social animal.
>
> Clark 1987, 145

In chapter one we briefly introduced the research on stair climbing and the perception of stairs by ecological psychologist Warren (1984). We will now make a case for taking his experimental results as a starting point of a non-representational approach to naïve physics.[42] Warren aims to explain subjects' ability to see whether stair risers are climbable or not. The explanation rests on the one hand on the dynamics of stair climbing: energy expenditure while climbing stairs is determined by, among other factors, the ratio of the length of ones legs to the height of the riser. An optimal ratio yields minimal energy cost. On the other hands, the physical build of the human body makes it so that the optic array available to subjects in front of stairs manifests an optic invariant that corresponds to the leg/riser ratio, so that minimal energy expenditure is reliably correlated with a particular optical variable. (Given some deviation, leg length co-varies with eye height. As such the optical invariant corresponding to minimal energy is the same for people of different heights, although this is not investigated in Warren's 1984 study). Sensitivity (attunement) to the optic invariant then accounts for the stair climbers ability to visually detect which risers allow them

[42] Lee and Kalmus's (1980) research on optic flow, and particularly their follow up on gannets' (Lee and Reddish 1981) use of optic flow invariants to guide their dives into the sea should also be understood as a mastering of naïve physics of this type.

to climb stairs with minimal effort, *i.e.* their disposition to choose the most energy-efficient staircase when given the choice.

Warren's experimental results support the Neogibsonian[43] idea that there is a lawful or reliable correlation between the dynamics and the ecological optics of the situation. The lawful or law like correlation is assumed to suffice for the explanation of the ability. But since such ecological laws aren't held to exist universally and indefinitely they require further examination, as we have seen in earlier chapters. It needs to be demonstrated that the particular law invoked applies to the case under study. The way to do this, we advocated, is to account for the acquisition of the sensitivity (attunement) to the optic invariant by natural history.

Warren's argues that his account of perception of stair-climbing-affordances in terms of an ecological law can be generalised, pointing out the possibility of

> [...] a lawful account of perceptual categories without an appeal to mediating constructs such as mental categories or concepts. [...] many category boundaries may be perceptual in origin, having a basis in information that specifies critical points in affordances and other natural systems.
>
> Warren 1984, 691

In this section we won't reopen the debate on the use of "specifies" since it has been dealt with sufficiently in previous chapters. What we want to focus on now is Warren's suggestion that a law-based ecological account is applicable to a range of perception-action phenomena, most of which fall within the domain of naïve physics. He enlists the following activities as candidates to be dealt with using his approach:

> The material and informational bases for such activities as reaching, grasping, lifting, sitting, passing through apertures, stepping down ledges, jumping gaps,

[43] To be fair: Warren has conducted many experimental studies, including several with regards to (perceptual) learning. We think it is fair to situate his 1984 stairs climbing research in the Neogibsonian paradigm because it explicitly aims to identify lawful relations, and Warren advocates that the law-based approach of this study might be generalizable. But this assessment doesn't necessarily apply to Warren's other studies. Cf. Warren (2006).

> locomotion over surfaces with varying properties, foraging and food selection, and so on are amenable to such an analysis.
>
> Warren 1984, 700

The last example, "foraging and food selection", is somewhat different from the other examples because it goes beyond naïve physics. *Prima facie* all but that last examples involve only variables of the spatio-temporal and kinematic dimensions, like size, distances, time, speed. "Foraging and food selection", however, is more complex because it involves other variables in other "modalities": olfaction—tasting and smelling involves chemical variables which may be "irreducible" to kinematics—is of crucial importance for it. Moreover, olfactory qualities notoriously resist measuring and mathematical description.[44] Hence a mathematical description of ecological laws relating chemical invariants to affordances seems unlikely. For "foraging and food selection" the regularity must thus be accounted for directly in terms of the historical interactions that led to adaptation. We think this shows that an evolutionary approach to ecological regularities does the real explanatory work. It is important to recognise that the (apparent) laws in Neogibsonian accounts are the result of this process, and only shorthand placeholders for history.

The self-imposed mathematical austerity—the aspiration to express ecological laws mathematically—is found mainly in experiments inspired by the Neogibsonian framework, which takes the explanatory style of physics as a role model (Turvey 1987). This aim derives from a particular interpretation in Gibson (1979):

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[44] The idea of an olfactory array hasn't been explored much. There is however an obvious sense in which olfactory arrays can be informative about the whereabouts of prey animals. Predators literally explore the olfactory array. Covering considerably large portions of terrain enables some to track a prey kilometres away. In this sense there clearly are a spatio-temporal informative properties in olfactory arrays that can be expressed metrically, the exploitation of which by animals could be counted in as forms of naïve physics. For other informative properties for olfaction metric representation seems unlikely, *e.g.* for the distinguishing olfactory properties of ripe vs. unripe fruits, different states of decomposition of offal, or the various scents associated with fertility cycles mating candidates. Non-inferential use of such informative properties may be labelled naïve chemistry. Cf. Auvray and Spence (2008) for a Gibsonian reflection on taste and smell.

> [T]hey [experimenters] do not have to quantify an invariant, to apply numbers to it, but only to give it an exact mathematical description so that other experimenters can make it available to *their* observers. The virtue of the psycho-physical experiment is simply that it is disciplined, not that it relates the psychical to the physical by a metric formula.
>
> Gibson 1979, 141

Our interpretation is that mathematical description is a methodological desideratum because it has the virtue of discipline. When possible—that is, when experiments are conducted to identify energy invariants that correspond to affordances for movement or other quantifiable activities, *e.g.* moment of inertia as "invariant" information for the reach of a rod—mathematical expressions are very precise and preferred. In Neogibsonian theory, however, the desideratum is not methodological in nature but metaphysical, as we have seen.

There is a serious downside to such a zealous fixation on quantification: Focussing exclusively on mathematically expressed invariants and the ecological laws that relate them to affordances hold the risk that the discovered regularities are taken as ultimate explainers so that the question as to why such regularities exists may disappear out of the theorist's purview. The air of exactness is deceptive. That is to say that if an ecological invariant or law is taken to as the end stage of explanation, one might fall into the same trap as the representationalist theory: explanatory properties are conferred to entities or relations which they can't possibly have of themselves. Second, just because some laws (invariants) can be described mathematically in ecological discussions of naïve physics, that doesn't mean that invariants explaining animals' or humans' capacities in other domains must necessarily be expressed or expressible in the same way. Like Chemero (2009) and Withagen and Chemero (2009) argued[45]: regularity is better thought of in terms of constraints, including non-necessary

[45] There is relatively broad support for this approach. See for example the works of Costall already referred to, Warren (2006), Withagen and van Wermeskerken (2009, 2010), Withagen and van der Kamp (2010), Dotov, Nie and de Wit (2012), van Dijk and Withagen (2016). Interestingly, Clark (2005) criticise his own earlier views and moves towards an evolutionary-ecological position.

natural correlations and convention. Then, accounts of the perceptual aspect of activities like foraging and social dynamics aren't excluded.

Adopting the historical stance diminishes the risk of assuming that a perceptual phenomenon is explained when a law is discovered. The ecological approach, we argue, must draw on evolutionary ecology more extensively in its theoretical developments and not merely as a means to define the semantics of "perceive". Cf. our conclusions about Turvey et al. (1981) and Shaw et al. (1982). If the fixation (of some) on mathematical description and law-based explanation is released, the ecological approach's target explananda can be extended to the social (naïve psychology) and cultural domain (naïve semiology/semiotics *c.q.* the ability to unreflectively attune to the use of signs and symbols).

An Evolutionary-ecological RECtification[46] of Transitive Inference among Chickens

How would they know for sure that someone watching them wouldn't think the stupid chickens had started all this and they were just following?

Jim Heynen
The One-Room Schoolhouse. Stories about the Boys 1993, 25

6.6 Case analysis: thinking chickens

A behavioural pattern very similar to the rhesus monkey's social hierarchy has been observed in other animals as well, such as ravens and chickens. Flocks of chickens have a so-called "pecking order". Interestingly, the pecking order is transitive: if chicken A is dominant to B, and B to C, then A is extremely likely to dominate C too. This has been experimentally tested by Hogue et al. (1996). These researchers studied chickens' ability to use what they refer to as "observational information" to adjust their behaviour with regards to the flock's pecking order.

We will use the chickens' case, instead of the monkeys', to illustrate the type of evolutionary-ecological rationale that might explain this ability. The illustration is aimed to be compatible with, and contribute to the ecological line of research we associated with Rob Withagen and Tony Chemero, among others.

There are at least three reasons to talk about chickens instead of monkeys. First, well-established and straightforward experimental data are available about chickens' dominance attitudes; Hogue's data set being just one of them. Second, the chicken flock dynamics are slightly less complex compared to the monkeys' because there is no analogue to competitive grooming. Also, it is plausible to

[46] RECtification is Hutto and Myin's (2013) word play that refers to the rectification of mainstream cognitive science via their concept of Radically Enactive Cognition.

assume that chickens' ability to regulate their dominance/submissiveness based on visual information has its roots in innate dispositions. This is so because so-called "feral chickens"—animals sprung off of generations of captive chickens that have been set free—spontaneously form flocks and (social) behavioural patterns that are indistinguishable from their truly wild cousins'. This fact allows for a minimisation of the ontogenetic component of the evolutionary-developmental complex. And third, the data have recently been interpreted by Marino (2017) as if they necessitate and warrant the attribution of mental representations over which the chickens (or their brains) supposedly execute a transitive, inferential process. The chickens' case is thus a somewhat simpler version of the monkeys', but it shares all the relevant features with it, including a "representation hungry" interpretation. This makes it a nearly perfect mirror of Harcourt's monkeys who are thought to engage in "conscious calculation".

> The results of this study are consistent with the idea that the hens were making self-assessments based upon the logic of transitive inference. They also show that, while simple processes can sometimes be the basis of complex-looking behavioral phenomena, sophisticated logical reasoning may underlie what is perceived to be a rather simple behavior—the pecking order.
>
> Marino 2017, 8

For their experiment Hogue et al. first assembled a group A of chickens on the basis of their submissiveness to another chicken, which was then put in group B. The next stage of the test consists of letting individual A-chickens witness from behind bars a confrontation of their "corresponding" B-chicken with a "stranger" from a third group of chickens, group C. After *B* and *C* have established who's in charge and who submits, *B* is removed. Then the bars that physically, but not visually, separated *A* from *B* and *C* are removed too. The experiment establishes that *A* is then able to modulate its behaviour towards *C* on the basis of what it just witnessed: if *C* was dominant to *B* then *A* instantly acts submissively with regards to *C*. In the other scenario, *C* being submissive to *B*, then *A* and *C* perform the hierarchy-establishing routine anew. These results establish that the dominance/submission relation is characterised by transitivity. Transitivity is corroborated by performing the same routine with a control A*-group and B*-group. Of these groups the dominance relation was not established prior to

confronting them with C-chickens. The control procedure excludes that A*-chickens just submit to any C-chicken it just witnessed to dominate a B-chicken, regardless of the A-B relation.

The we want to address is how the emergence of such transitive relations is to be accounted for. Hogue et al. suggest this question might be answered by postulating a

> [...] capacity to use [...] information coherently in order to anticipate conduct or choice in situations not yet realized [...]. Such a cognitive process, which enables an individual to retain information for further use and that contributes to transitivity, is called transitive inference.
>
> Hogue et al. 1996, 242

While the first sentence of this quote is an accurate and neutral description, the second betrays a pre-theoretical commitment. Although Hogue et al. (1996, 242) write they use the term "transitive inference" in a deflated sense, "i.e., without reference to the nature of the mechanism allowing the resulting inference to be transitive", the use of the term "transitive inference" is heavily loaded for at least two reasons.

First, for Hogue et al. (1996, 242) one of the defining features of "transitive inference's" is that it is a cognitive process that "enables an individual to retain information for further use" (Hogue et al. 1996, 242). This description entails a covert shift from a dynamic group phenomenon in which visual information plays an important role in the unfolding dynamic towards a process that takes place *within* the individuals. Retained information, as discussed above, is commodified information. Moreover, calling that individualised process "transitive inference" suggests that transitivity is a characteristic of the process that goes on in the individual. Consequentially, the term "resulting inference", as used in the hedging claim about the nature of the mechanism, doesn't refer to the unfolding dynamic pattern of the flock's transactions; the unfolding pattern that manifests transitivity. "Resulting inference", because of the implicit theoretical commitment to inferential capacity of the individual, refers to a resulting state within the individual.

Second, individualised, internalistic "inference" is a process that involves premises and the application of rules so as to deduce a conclusion. The important issue here is that rules for inference are normative in a semantic sense. For a process internal to an individual, the nature and source of this semantic normativity is problematic (Hutto and Myin 2013, 2017).

For these two reasons "transitive inference", although perhaps meant as an ontologically neutral description of a dynamical social phenomenon, is laden with theoretical commitments of the classical computational theory of cognition. It is therefore easily taken to be a representation-hungry process that supposedly "underlies" the transitive social dynamic. Accounting for transitivity on the group behavioural level is taken to require an explanation that involves an underlying process that takes place in the animal's internal cognitive machinery, and that is itself transitive in nature. We would call this another instance of the psychologist's fallacy; transitivity is a concept we, human analysts, apply to the flock's structure as a result of our analysis. The fallacy consists of the assumption that transitivity is a (causal or conceptual) factor in the process itself, or a property of one of its constituents.[47]

6.7 Evolutionary-ecological reconstruction of transitive inference

According to Charles (2017, 199) any evolutionary explanation should contain *i)* a starting point before a particular trait appeared on the scene, *ii)* a description of the environment, and *iii)* a mechanism that explains the survival benefit of the evolved trait. Evolutionary explanations that aim to account for psychological phenomena require four more essential elements, Charles writes:

> These essential elements include (a) an ecological analysis of ambient energy and the specification therein, (b) a comparative understanding of the perceptual

[47] It has also been called the "first-order isomorphism fallacy". Turvey et al. (1981, 291) write: "For Z to see, detect, register, perceive or whatever, property *x* of X, Z must *have* property *x in some sense*, neurophysiologically or conceptually. (This tendency to proliferate properties by unwarranted duplication has been referred to as the *first-order isomorphism fallacy* (see Summerfield et al., 1981, for a discussion).)"

> abilities of different species, (c) an interactive understanding of organism–environment dynamics as essential for perception, and (d) an understanding of perceptual attunement based on the concept of affordances.
>
> Charles 2017, 201

We will lay out our reinterpretation of the case by discussing these four essential elements.

a) ecological optics

Charles connects the ecological analysis of ambient energy, what Gibson called "ecological optics", to the analysis of energy arrays in relation to agents' movements: movements generate invariant patterns in the ambient array. If perceptual activity is conceived as the coordinated search or hunt for invariants, then it is not a one way relation between sensory input to behavioural output. The reverse relation is equally important: "input" is also a function of "output". Perception-action cycles constitute a tight unit in which the environmental, anatomical/physiological and behavioural functions are to be considered together.

It is plausible to assume that the routine performed by two chickens while establishing their dominance relation generates a temporally extended, identifiable, optical pattern. As opposed to Hogue et al.'s experiment, a lot more of optical variables are available for use in a real life flock: every time a hen approaches another it "shows" from the way they behave towards one another who has the upper hand. That permanent availability of optical patterns offloads a lot of the information retention requirement to the environment. Importantly, there is a clear sense in which some of the optical patterns are propriospecific. The stimulus information available to *A* when *B* and *C* perform the routine differs significantly from the information available to *A* when it, itself, performs the routine with *C*. The latter can be said to have a greater propriospecific aspect and import. The abundance and richness of stimulus information alleviates much of the need to "retain information" about the hierarchical relationships. All that can be tracked visually mustn't be retained.

Yet, chickens temporarily removed from their flock seem to "remember" their status—when reintroduced they take up their place as if never been gone. This phenomenon involves the "absent", a sufficient condition for C&T's (1994) qualification of the "representation hungry" domain. While it is absent, the removed chicken can no longer track its peers "online" so as to continually identify them individually, nor can it track their dominance relationships based on environmental information when it is away.

Interrupted tracking, however, is possible without positing representations. Gibson (1979, 195) discussed examples that involve detached objects moving behind a screen and then coming into view again. He argues that the optical pattern of "deletion" and "accretion" of texture when objects move behind one another are fundamentally different from those corresponding to objects literally vanishing (*e.g.* evaporating) or being destroyed. This implies that there is visual information for discriminating between going out of view but persisting and disappearing non-persistently, so that there is no need for the formation of the concept of object permanence so as to explain differential responses (Gibson 1979, 208-209; van Dijk and Withagen 2016)).

The idea behind this is that "object permanence" is a regularity in nature. Very few things just vanish; evaporating, melting and burning up are the exceptions described by Gibson (1979). Hence, perceptual systems that have evolved in environments characterised by permanence are likely to be adapted to this fact. Empirical evidence for this hypothesis was gathered by van de Meer, van der Weel and Lee (1994) in a study on baby's, discussed in E.J. Gibson and A. Pick (2000, 96; 101–2). Infants as young as 3 to 5 months were found to anticipate the reappearance of temporarily occluded moving objects, arguably long before concept formation starts. These data cast doubt on the assumption that (expectation of) permanence requires storing of information—if tracking that is interrupted briefly can occur without information storage, so might tracking that is interrupted for longer periods (see also Gibson 1979, 208-209). An account of the ability of interrupted tracking might be fashioned after Orlandi's (2013; 2014) work on uninterrupted[48] tracking: a system relies on regularity in the world

[48] We are aware that according to Orlandi interrupted, "decoupled" tracking is representation hungry

instead of representing assumptions about the world. Regularly, objects that move freely, like a running rabbit or a flying duck, and that become occluded behind a tree, continue moving and reappear on the other side of the tree. There is a simple reason for this regularity: kinetic energy. Stopping it in its course requires a considerable force. (Squirrels—who are lightweight; holding far less kinetic energy—smartly deviate from this regularity by turning sharply and climbing up the tree).

A similar regularity is present in a chicken flock: the dominance relationships are relatively stable, upset only when strangers are introduced. Tracking the relationships thus doesn't require constant monitoring. This might be further worked out via Ramsey's (2007, 119) detector/receptor notion which, we remind the reader, doesn't qualify as representational. What is required is that a "sufficiently specific" optical property of a chicken, *e.g.* a feather pattern or its gait, is detected and that this detection causes some change in another chicken. This lasting physical change that plays a causal role in the chicken's consistent responses to a unique individual ought not be considered "stored information" if the purely causal relay system's functioning suffices to account for its consistent behaviour (Ramsey 2007; see our section 6.2). The change, be it in the brain or hormonal doesn't "stand for" the other chicken but merely co-varies with it. There is no sense in which it can be false or inaccurate. Neither does the "recognising" chicken "use" its inner state in the sense that (public) representations are used.

b) comparative understanding of perceptual abilities

According to Charles (2017, 205) an evolutionary explanation is only truly evolutionary if it is to some extent comparative between different (sub)species. A precise description, for example, of which optical variables are used by chickens and how their perceptual systems accommodate this, benefits from a comparison with rhesus monkeys and/or ravens, who show similar social

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indeed, yet we contend that her account of "coupled" tracking contains all the elements to account for its decoupled variant.

perceptual skills. Each of these species may have adapted in response to different circumstances, yielding adaptive benefits of a different nature, resulting in different mechanisms or dynamics. The outline we're sketching here would certainly benefit from an interspecies comparative approach, but it would take us far away from the philosophical aspects we wish to discuss.

Hogue et al. (1996, 242), nonetheless, elaborates briefly on the comparative evolutionary benefit of hens' abilities from which social hierarchy emerges. Flocks in which dominance relations are somewhat stable provide to the individual the benefit of not having to engage in fights, risking injury, presumably resulting in lower reproductive success. A plausible addition is that the establishment of a stable pecking order without fighting reduces stress. Since it is commonly known that stressed out chickens lay fewer eggs, the stress reduction factor may result in group selection rather than natural selection of individual chickens. Groups that possess a stress reduction dynamic comparatively outcompete groups that don't.

c) interactive organism-environment dynamics

Dynamic interaction with other chickens is clearly an essential component of the account of their perceptual ability we propose. A chicken that has visual access to a flock but that is prevented from interacting with it is likely to perform worse than fully integrated chickens. Note the analogy with Held and Hein's (1963; E. J. Gibson and Pick 2000, 113) experiment on kittens. They paired neonatal kittens in a yoke so that only one of the pair could produce movement, but that both obtained the same visual information. The experiment yielded that self-produced movement is crucial for the development of action-perception competence. The kitten that was wheeled around passively showed "debilitated" development of perceptuo-motor skills.

A similar importance of self-initiated interactions can be expected in chicken flocks. The importance of interaction with the social environment is illustrated by the fact that newly introduced chickens upset the flock; fights occur significantly more often shortly after the introduction of strangers. This shows that interaction is essential to reach stability. A chicken learns about or attunes

to the group precisely through these interaction, so the interactions must be considered integral part of the perceptual regulation process, *i.e.* the education of attention (Gibson 1979, 235-243). Engaging in a fight creates an optical pattern that cannot be obtained in any other way: the head-on confrontation followed by the optical, acoustic and perhaps chemical invariants that correspond to overpowering the other or being overpowered. Charles (2017, 206) refers to a study of parent squirrels engaging snakes so as to familiarise their young with the ecological energy structures of angry snakes, in order to educate their snake-fighting skills. Apart from the teaching aspect, there is a strong parallel between how young squirrels learn how to see a snake and how chickens learn how to see the flock dynamic.

d) perceptual attunement to affordances

Charles (2017, 208) writes that affordances—opportunities for action an environment presents to an agent—are not the subjects of first principles. The usefulness of the concept is not motivated by epistemology but by the explanatory goal of a naturalistic, evolutionary approach to psychology. If it is accepted that evolution by natural selection occurs and that perceptual systems are among the things that evolve(d), then one might *conclude* that that evolution occurred as a consequence of those aspects of the environment that are relevant to the animals' actions. Furthermore, from the assumption that information (specific or non-specific correspondence between affordances and energy patterns) exists, it may be concluded that perceptual systems evolve and develop such that information that corresponds to the relevant environmental features can be detected.

> The concept of affordances thus connects perceptual development and evolution with organisms becoming more accurate at discriminating the environment in ways directly relevant to the organism's short-term and long-turn success. As organisms learn to perceive better, they are inherently learning how to act better, and vice versa.
>
> Charles 2017, 208

Natural selection is the result of a process, not an active ingredient of it. Like "selection pressure", a metaphor that makes the result of a complex process intuitive, but by no means an actual "force" or "pressure", "affordance" is not a concrete thing or a causal agent. Charles argues that reified affordances, falsely taken as a fundamental ontological category, are entirely without explanatory implications (see Myin 2017 for a similar analysis of misuse of affordance).

In this spirit, attributing to a chicken some property such that it affords domineering to its colleague, and looking for an optical pattern that specifies this property, is the wrong starting point if one wants to understand the flock's transitive relationships. Keeping in mind that the evolution of chickens' social perception-action repertoire resulted in the comparative advantage of a "relatively peaceful flock" the affordance, we think ought to be situated on the flock level; not properties of individual chickens, nor the relationship between two individuals detached from the perceiver.

In our case, it may be said that "transitivity" is a property or aspect of the affordance that results from the dynamic interactions of the chickens. If this is feasible, it holds the key to dissolving an important remaining issue. Approaching the phenomenon of "transitive inference" as an internalistic computational problem creates the problem chickens' ability of "self-assessment". Assuming an inferential process takes place naturally leads to an "I" or "me" variable.

> As Hogue et al. (1996) showed in their study of transitive inference, chickens can observe the interactions of an individual of known status with an unknown individual and *infer their own status* in the social hierarchy relative to the unknown individual and respond appropriately (e.g., dominantly or submissively) in future interactions.
>
> Marino 2017, 9 (emphasis added)

On Marino's interpretation, for a chicken to modulate its actions with respect to the group, it would have to perform an inference of the form [B dominates "me"] and [C dominates B] hence [C dominates "me"]. When considered as attunement to affordances on the basis of optical information, there is no "me" because becoming attuned to the relationships simply means responding appropriately on the basis of the available information.

> [...] individuals can respond to the environment and each other in ways that allow for emulation, imitation, and regulation of what they target and attend to in ways that make basic forms of social learning possible. There is no reason to suppose that the cognition at play in such social engagements and interactions must be grounded in representationally based rules of any kind. Rather, all that needs to be assumed is that normally developing participants in such practices are already set up, nonaccidentally, to target and tune into the expressively rich intentional attitudes of others.
>
> Hutto and Myin 2017, 140

We hope to have made it clear that the non-accidental setup of chickens' social-perceptual ability, is better accounted for in an evolutionary-ecological framework. Exercising these embodied, non-representational abilities account for the transitivity of the relations between the chickens as the attunement to the affordance of a peaceful flock; and that on the basis of spatiotemporally extended dynamical optical patterns that possibly encompass multiple interactions between individuals. This approach is more parsimonious than positing an internalistic inferential process that executes transitive computations.

Finally, Charles' analysis sheds a new light on the debate about what kind of things affordance are. That debate is summarised by Tony Chemero (2003). Essentially it revolves around two questions: First it is asked what kind of things affordances are. Are they properties or are they relations? Or "relational properties"? The "properties" answer spikes the next question: what kind of properties? Turvey et al. (1981), Michaels and Carello (1981), Turvey (1992) and Stoffregen (2000a, 2000b) opt for dispositional properties, whereas Reed (1996, 17) holds that affordances are resources in an animal's environment. The "relational camp" then debates the precise nature of the relata. For Chemero (2003a, 2009) affordances are relations between environmental features and organismal abilities; Stoffregen (2003) argues for viewing them as emergent relational properties of animal-environment systems; Rietveld and Kiverstein (2014) advocate affordances as relations between environmental features and "life forms", *i.e.* sociomaterial practices that go beyond individual abilities. An implication of Charles' (2017) analysis is that much of the ontology-of-affordances

debate has an air of scholasticism[49] in so far as it is divorced from the goal on an evolutionary-ecological account of perception-action systems.

[49] A similar conclusion is presented by Chemero and Silberstein (2008).

Conclusion

We have investigated two motives for thinking about perceiving that have played central roles in the three ecological approaches we have discussed; the naturalistic and the epistemological motive. Gibson (1967) envisioned that his new concept of perceiving as the pickup of ecological information made possible a new naturalistic and scientific account of the achievements of perception-action systems, as well as a new philosophical position with regards to the epistemological problems of perception. In 1979 Gibson had already left traditional epistemology behind him. Truth and justification were traded for evolutionary success as the benchmark for an ecological notion of knowledge.

Successful perceptual activity was then defined as the result of "attunement" of animal-environment systems: the exercising of an ability to coordinate one's behaviour as a function of the ecological information that exists in environmental niches, which include the perceiver. That ecological information is understood as co-constituted by, or as a function of, the animal's movements and actions. Gibson conceived information as "rich": invariant patterns in the energy arrays that surround animals—not "punctate" stimuli, but spatially and temporally extended structures—that correspond to the behaviourally relevant features of that environment. Stimulus information differs from physical stimuli of sense receptors. The latter are measurable and subject to the law of conservation of energy. Stimulus information, according to Gibson, is neither. The structuring of ambient energy exists and unfolds along with the activity that is performed. "Pickup" of the structure is not equated to transduction of energy by sense receptors.

The naturalistic ambition of Gibson also materialised in stages. In 1966, in *The Senses Considered as Perceptual Systems* he pursued a mechanistic explanation, promising an answer to the question how the pickup of information by perceptual systems works, by decomposing them into subsystems, localising the parts and describe how they function. Gibson's 1979 approach, on the other hand, suggests a natural history account in which the metaphors like "attunement" and the "education of attention" point towards a form of evolutionary psychology of

co-evolved organism-niche systems. The organismal and environmental aspects (not parts) of these systems are described in mutual reference: ecological description of the environment is couched in terms that refer to how an animal lives; descriptions of animals are set in terms of the activities they (are able to) perform in their particular niches.

The epistemological motive in Gibson's work had a classical philosophical angle in his 1967 article "New Reasons for Realism". For Gibson, rich stimulus information was the antidote to Poverty of the Stimulus arguments that troubled classical empiricism. According to the latter, impoverished stimuli can only result in uncertain knowledge about the world because their distal causes need to be inferred, while the truth of the propositions that mediate the inference is uncertain too. That is so because for empiricists the origin of that prior knowledge must be perceptual too. Stimulus information that is rich by definition supposedly alleviates this problem of classical empiricism.

The conceptualisation of the environment in terms of affordances, possibilities for action, aimed to overcome mind-body and/or mind-world dualism. Gibson's perceptual systems were thus to figure in both the scientific approach to psychology as well as the philosophical defence of direct realism.

In 1979, the idea of securing knowledge against sceptical attacks faded to the background in Gibson's work. He no longer aimed to conceive perception in order to facilitate justification of knowledge. Rather, he saw perceiving as a *form* of knowing. *The Ecological Approach* reserves the term "direct" to characterise the scientific, psychological concept of perception, in the sense of not mediated by inferential mechanisms. New notions of memory, expectation, knowledge and meaning were to be included within the concept of perception (Gibson 1979, 255). Perception is thought to be a function of past activities of the animal-environment system, obviating memory conceived as retrieval of stored information.

The idea of explaining perception in terms of natural laws maintained a certain prominence in Gibson (1979) nonetheless. This line of thought was attacked by Fodor and Pylyshyn (F&P 1981), the self-proclaimed defenders of the cognitivist Establishment theory. We have seen that they cherry-picked those aspects of the ecological approach to vision that were vulnerable to trivialisation. In particular,

they framed Gibson's notion of pickup of information as nothing more than transduction of ambient energy, and argued that constraining transduction mechanisms via ecological laws is unfeasible.

Gibson (1979) sometimes equated stimulus information and the invariant structures of energy arrays, while on other occasions he advocated a functional, relational concept of information. This allowed F&P to challenge his ecological notion of information: the fact that an invariant structure is, or can be, informative about an environmental feature is not itself a kind of property that can be detected by transducer mechanisms. Inferential mechanisms, in which physical symbols that represent rules *about* those informational relations are instantiated, remain a necessity, according to them. Only such intermediary mechanisms can account for the causal relation between pickup by sense receptors and the resulting perceptual achievement, F&P conclude.

Had Gibson intended *The Ecological Approach* to be read in the way F&P did, their criticism would have been valid. Yet there is reason to believe that F&P's interpretation is not the only possible one, nor the best. Importantly, all cues that could lead to an investigation of Gibson's non-mechanistic explanatory model were put aside without argument by F&P. First, Gibson's actions-based, relational ontology is ignored. The Establishment theorists don't even begin to question the basis for their own commitment to physicalism—the ontological doctrine that only the entities posited by the physical sciences are "real"—in spite of Gibson's (and others') diagnosis that cognitivism entails homunculi that interpret physical nerve signals. Second, the relational notion of information that is present in Gibson's 1979 work, too, is ignored by the Establishment. Although Gibson stresses that his notion of information is not a commodity that is transmitted through nerve bundles, F&P treat it as if it is just that. With regards to this matter, there are mitigating circumstances: Gibson's positive characterisation of the relational notion remains vague. His idea that optical invariants "specify" affordances is insufficiently worked out. Third, Gibson's hints at a natural history approach to evolving animal-niche systems, metaphorically characterised as "attunement", are left unexplored by the Establishment. They dismiss the metaphor of attunement as "little more than whistling in the dark" (F&P 1981, 150).

With regards to the so-called epistemological problems of perception, F&P write that psychology and/or cognitive science can proceed without taking into account the old philosophical puzzles posed by scepticism. They aim only to conceive perception so as to allow for scientific treatment: to explain how the process works and fails in terms of the mechanisms—transduction and inference, *i.e.* information processing devices—that "realise" it. They put aside the matter of justification or warrant for perceptual belief or judgement.

F&P rightly attribute epistemological realism not so much to Gibson (1979) but rather to Turvey (1977) and Turvey and Shaw (1979), who believe that a concept of perception is needed that secures the possibility of knowledge. They take up the Cartesian quest for certainty. For this they are willing to sacrifice the naturalistic credentials of the concept of perception. Instead they argue for a science of psychology based on first principles. In order to avert the sceptics' attack on empiricism, Turvey and Shaw postulate "lawfully specifying information". This notion is worked out in Turvey et al. (1981) on the basis of Dretske's (1977) conception of natural law; in Shaw et al. (1982) on the basis of a "symmetry postulate" that is "not unlike Leibniz' pre-established harmony". Knowledge is secured, in their view, because the postulated symmetry laws epistemically bind agents to their environments.

We analysed the Neogibsonian first philosophy, using Quine's (1969) 'Epistemology Naturalized' as a benchmark for the former's naturalistic credentials. Our assessment yielded that their possible worlds semantics for the predicate "perceives", shows many traces of old epistemology. In particular, the idea that some forms of noticing or experiencing are epistemically primitive is reminiscent of a foundationalist epistemological program. They design the concept of perception in such a way that it is "incorrigible" or "infallible", providing it with a possible worlds semantics that stipulates the conditions under which the predicate "perceives" applies "legally" to a situation. As a consequence, perceptual error doesn't exist by definition.

For adherents of old epistemology, who seek an indubitable basis to secure knowledge, the Neogibsonian construction of the predicate "perceives" as a function of a complex particular that encompasses an agent-related variable, an environmental variable and a contextual occasion variable may be acceptable.

Especially so if it is believed that philosophy and science are discontinuous, and that philosophy's claim to "privileged methods" is warranted. This may be a respectable position but it is not compatible with naturalism à la Quine. Our analysis of Shaw et al. (1982) has shown, however, that it can't be theirs either. They claim to develop a scientific, *psychological* approach to the problem of knowledge. The result is a theory of perception that claims to be both naturalistic *and* based on a priori first principles. The first principles they invoke are presented as having empirical content, yet at the same time they are treated as if immune to experimental falsification. The upshot of a truly naturalised epistemology—contrary to Shaw et al.'s quasi-psychologism—is that the concept of perception must no longer be tailored to the needs of old epistemology, since the Cartesian quest for certainty is abandoned.

Besides an epistemological role, the Neogibsonian theory intends that the postulate of lawfully specifying information plays an explanatory role too. They claim that the symmetry law, on which specifying information is based, is a necessary assumption to account for life and evolution in general. Their Aristotelian interpretation of the Second Law of Thermodynamics as a striving force towards disorder induces them to postulate a counterforce so as to re-establish harmony. We argued that the role of the symmetry laws in the Neogibsonian model of explanation is not functionalistic in the sense we have laid out in our introduction. The kind of functionalism we commit to entails a notion of causality that is purified of agent-like striving powers that produce change (Chiesa 1992, 1289).

The symmetry law that underlies specifying information qualifies as a relation that implies such a notion of agency. This we have pointed out with our analysis of the Neogibsonians' equivocating use of the terms specific and specification as two-place and three-place predicates. They take the two-place relation between energetic invariants and affordances to do the explanatory work. We argued, nonetheless, that two-place specificity is unnecessary and insufficient to perform that job. It's insufficiency was demonstrated by Fodor and Pylyshyn (1981) and Millikan (1984): using lawfully corresponding variables as information is not self-explanatory. An agent must come to "know" about the correspondence first.

Yet, Shaw and Turvey provide no account for the process that establishes this ability. Lawfully specifying information, according to them, is not a function of anything, but a primitive notion that supposedly underlies all function. Their qualification of specifying information as intentional in virtue of the symmetry principle underwrites our analysis that their theory is explanatorily empty. Moreover, we think it violates the Muggle constraint as it invokes intentionality at the level of physics.

Furthermore, the theory of lawful specification is unnecessary. If information is defined as a function of not only current behaviour, but also of the aggregation of past behaviour, no law is needed to account for an animal's ability to exploit it. The functional, natural history approach has the benefit that it can also explain how organisms have come to be able to exploit more loosely constrained non-lawful correlations, opening a window of opportunity to extend the ecological approach into the social and cultural domain.

As we saw with Withagen and Chemero (2009), lawful specificity also poses a problem, insofar as it implies absence of variability. Conceived as a "one-to-one-to-one" relation between Environment, Information and Perception, specificity is incompatible with evolutionary theory for two reasons. First, evolution of perceptual abilities by natural selection presupposes that there is variability among perceptual systems, such that some have a benefit over others. And second, evolution is not an optimisation engine that perfects organisms in such a way that they exploit only 100% reliable information.

The Neogibsonians circumvent these problems by allowing for regional ecological laws that are bound to restricted niches, and "occasions" that supposedly govern which affordance is specified by an invariant. This solution we deem to be ad hoc. The occasion variable "*O*" serves only to specify the semantics of "perceives (*Z*, *X*, *O*) = affordance *Y*", telling *us* when "perceives" may be predicated "legally". What is absent in the Neogibsonian account is how occasions themselves *become* diversified. We are told that all organismal activities are "nested" and thus that the laws that supposedly govern the perceptual aspect of those activities are nested too. We think that understanding perception requires an account of how the nearly infinite amount of levels of occasions relate to one another. This requires a history of diversification of

niches and occasions. In addition, it shows that specification is an explanandum in the theory of perception. So, instead of semantically constraining perception as the Neogibsonians do, we propose to describe the emergence of regularities via a counterfactual history of occasions. Not principled, pre-established harmony, but the factual establishment of temporary local equilibria provides a strong footing for naturalistic explanation.

We concluded by elaborating this dissertation with a reflection on an intuition formulated by Andy Clark, that "what goes for naïve physics may, if I'm right, go for naïve psychology too" (Clark 1987, 145). We developed the following argument: if the experimental results published by ecological psychologists, like Warren's (1984) study of stair climbing, qualify as non-representational explanations of naïve physics, and if the explanantia of such cases have suitable counterparts in cases of social knowhow, *e.g.* in the macaques' social skills, then these social skills, *i.e.* naïve psychology, are explainable too along ecological lines—that is, without relying on representational posits.

We substantiated the argument by first reflecting on Ramsey's (2007) Job Description Challenge which stipulates that a theory is rightfully called representational if and only if its explanatory posits unequivocally function as representations *for the cognitive system*. With Ramsey's analytic tool in hand we dissected Clark's (1987) and Clark and Toribio's (1994) accounts of social skills, and concluded that neither Clark's (1987) representational posit, nor C&T's, in fact meet the Job Description Challenge. Our next step was to supplant Warren's experimental results with our natural history framework so as to show that the same kind of explanantia are available for both naïve physics and naïve psychology. We argued that the virtue of mathematical expressions of regularities that are informationally exploited by organisms lies in its exactness, and not in its supposed fundamentality. Once this is recognised, variables that are not necessarily quantifiable can be incorporated into the ecological-evolutionary approach.

We illustrated what the evolutionary-ecological approach might look like by reinterpreting chickens' apparent ability to perform transitive inferences so as to determine their position in the "pecking order". We concluded that "affordances" ought to be understood as the results of the process of attunement, rather than

things that play a causal role in that process. Descriptions of an animal-environment dynamic in terms of affordances thus serves as a heuristic tool to reconstruct the historical path that led to today's regularities and diversities of informational sensitivity.

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Abstract

In *Ecological Psychologies as Philosophies of Perception* two perspectives on the concept of perception are discussed. The naturalistic perspective, which aims to conceive perception in such a way that it is amenable to naturalistic, scientific explanation is analysed. It is contrasted with the epistemological perspective that constrains the concept of perception such that it might support empiricism, the idea that all knowledge ultimately originates in perception.

These two perspectives play defining roles in Ecological Psychology, the approach to the psychology of perception founded by American psychologist James J. Gibson. Three Ecological Psychologies are distinguished. First, there are the works of Gibson himself. Second, there is the branch of Ecological Psychology led by Michael Turvey and Robert Shaw, which is referred to as "Neogibsonian". And third, there is a modest but growing branch of research that takes its inspiration from Gibson, but rejects aspects of Neogibsonian orthodoxy. These rejections are fuelled by diverging assumptions about naturalism and epistemology, and the roles they play for the concept of perception.

The philosophy of Willard V. Quine is used as an analytic tool to assess the concepts of knowledge that shape the epistemological perspectives in the three ecological approaches, as well as to assess their naturalistic credentials. It is argued that the epistemological perspective in the Neogibsonian branch is coloured by a concept of knowledge that comprises the idea of "certainty". The decisiveness with which this view is advanced by the Neogibsonians entails a demotion of the naturalistic perspective. The third, heterodox branch of ecological research—we focus on the work of Alan Costall, Rob Withagen and Anthony Chemero—attributes more weight to the naturalistic perspective, including considerations from evolutionary biology, and it minimises the role of traditional epistemological concerns. This dissertation aims to contribute to the philosophical support for this "evolutionary-ecological" approach.

Samenvatting

Ecologische Psychologie als Filosofie van Waarnemen bespreekt twee perspectieven op het begrip "waarnemen". Het natuurwetenschappelijke perspectief dat tracht waarnemen te definiëren zodat het op een naturalistische, wetenschappelijke wijze kan worden bestudeerd en verklaard, wordt geanalyseerd. Daarnaast neemt het het kentheoretische perspectief onder de loep. Dat perspectief bakent het begrip van waarnemen af zodat het de stelling van het empirisme—dat alle kennis zijn oorsprong vindt in waarnemen—kan ondersteunen.

Deze twee perspectieven spelen een bepalende rol in de Ecologische Psychologie, een benadering binnen de waarnemingspsychologie, in het leven geroepen door de Amerikaanse psycholoog James J. Gibson. Drie vormen van Ecologische psychologie onderscheiden zich. Ten eerste, de werken van Gibson zelf. Ten tweede, de tak binnen de Ecologische Psychologie, aangevoerd door Michael Turvey en Robert Shaw, die als "Neogibsoniaans" wordt aangeduid. En ten derde is er een bescheiden maar groeiende tak van onderzoek naar waarnemen, die haar inspiratie ontleend aan Gibson maar bepaalde aspecten van de orthodoxe Neogibsonianen verwerpt. Deze afwijzingen vinden hun grond in onenigheid over de aanspraken die het naturalistische en het kentheoretische perspectief kunnen en mogen maken op het begrip van waarnemen.

De filosofie van Willard V. Quine wordt ingezet als een analytisch instrument om te verduidelijken hoe "kennis" wordt begrepen in de kentheoretische perspectieven van de drie ecologische benaderingen, en tevens om hun naturalistische geloofsbrieven te evalueren. Het resultaat van deze analyses is dat het begrip van kennis dat het Neogibsoniaanse denken kleurt, wordt bepaald door de notie van "zekerheid". Uit de vasthoudendheid waarmee het deze gedachte verdedigt, volgt dat de Neogibsoniaanse benadering op gespannen voet staat met het naturalistische perspectief op waarnemen. De derde, heterodoxe strekking binnen het ecologische veld—belichaamd door onder meer Alan Costall, Rob Withagen en Anthony Chemero—hecht meer belang naturalistische overwegingen, met name aan argumenten uit de evolutionaire biologie. Mede

daarom beperken zij de rol van het klassieke kentheoretische perspectief in hun begripsvorming van waarnemen. Dit proefschrift heeft als doel deze evolutionair-ecologische benadering wijsgerig te schragen.