Externalism in Philosophy of Perception and Argument(s) from Dreaming

by

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Abstract

A recurrent pattern of debate between the proponents of internalism and externalism over mental phenomena is as follows: externalists pick a target mental phenomenon, say, visual perception, and argue that it has the characteristics it has because of a property that is not possessed internally. Internalists, in return, substitute an analogue mental phenomenon, one that putatively suits their position, to argue that it shows every characteristic that the original target phenomenon shows, thus the allegedly crucial external property plays no ineliminable role. Within these debates a particular analogue phenomenon frequently appears: *dreaming.* In what follows, I discuss the ways in which externalism comes under dispute through dream phenomena. I then investigate the scientific literature to evaluate whether the way dreaming is conceived by internalists is substantiated by the available body of evidence. I conclude that the current state of sleep science does not lend support to internalists' conception of dreaming.

Keywords: dreaming; externalism; embodiment cognition; perceptual experience; constitutive explanation

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This work sprung out from a senior thesis I wrote for my undergraduate at Bilkent University, and since then it kept surprising me how complex and far-fetching the underlying issues are. What value, if any, this work consists of comes from the questions it brings forward, and not from my attempts at answering them.

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List of Acronyms

MST	Minimal Substrate Thesis
EEG	Electroencephalogram
PGO	Ponto-Geniculate-Occipital
AIM	Activation-Input-Modulation
ISTH	Immersive Spatio-Temporal Hallucination
EMT	Embodied Mind Thesis
ENT	Enacted Mind Thesis
EDT	Embedded Mind Thesis
LMS	Larger Mechanism Story
SCS	Special Contribution Story
PC	Predictive Coding
IBE	Inference to the Best Explanation
REM	Rapid Eye Movement
NREM	Non-Rapid Eye Movement
SWA	Slow Wave Activity
AAS	Ascending Activation System

Introduction

There is a recurrent pattern of debate in philosophy and cognitive science between the proponents of internalism (cognitivism, computationalism, representationalism etc.) and externalism (embodiment, enactivism, extended mind etc.), originating from their opposing claims regarding in what way mental phenomena depends on bodily and environmental properties. While internalists claim that nothing essential happens beyond the extent of the brain, externalists claim that a correct explanation of mental phenomena must include the organism's wider brain-body-environment relationships. The pattern of the debate often takes the following form: externalists pick a target mental phenomenon, say, visual perception, and argue that it has the characteristics it has because of a property that is not possessed internally. Internalists, in return, substitute an analogue mental phenomenon, one that putatively suits their position, to argue that it shows every characteristic that the original target phenomenon shows, thus the allegedly crucial external property plays no ineliminable role.

Within these debates a particular analogue phenomenon frequently appears: *dreaming*. As one among many analogues in the debate, use of dreaming does not differ from use of phenomena like hallucination or thought experiments like *brains-in-vats*. Its argumentative impact comes from its *nomological proximity*: dreaming is a natural, non-pathologic phenomenon that occurs consistently in all neurotypical adults. This fact limits the externalists' ability for an argumentative maneuver: whereas there is a logical space of denial for other analogue phenomena, no such space exists for dreaming, or so the internalists claim.

In a recent paper, Jennifer Windt (2017) stated, in passing, that "dreaming is not, in fact, a suitable illustrative example for either the internalist or the externalist" (p.4)[1]. While this might be so, it is interesting that the debate over dreaming between the two camps did not receive any independent discussion. This is all the while dreaming is

[1] ''The resulting framework suggests that dreaming is typically quite different from waking experience, but also subject to a high degree of variability on both the phenomenological and functional levels of description [...] it suggests that dreaming is not, in fact, a suitable illustrative example for either the internalist or the externalist."

consistently brought up in most discussions of what externalism is supposed to explain. The present work attempts to clarify such arguments from dreaming. My primary goal here is to elucidate the ways in which externalism comes under attack by dream phenomena. My secondary goal is to show that internalist claims based on dream phenomena are unjustified. Ultimately, the question I ask is whether dreaming is an analogue phenomenon that can be exploited within the aforementioned debate, and the answer I offer is negative. That is, dream phenomena do not lend internalists an independent support against externalists; though I leave it as an open question whether they lend any support to externalists.

Here's how I proceed. In the first chapter, I aim to clarify what sort of externalism is under dispute and try to settle on a more precise formulation. To do so, I distinguish content externalism from vehicle externalism, explain the reasons for sparing the former, and specify versions of the latter that are under dispute i.e. the views under dispute through dreaming is (a) externalism with respect to vehicles of perceptual processing and (b) externalism with respect to character of perceptual experience. After that, I clarify the scope of vehicle externalism and whether it has a burden of proof to explain dream phenomena. I claim that vehicle externalism has a burden insofar as dream phenomena falls under the domain of ordinary mental phenomena that vehicle externalism is supposed to explain. Finally, I settle on a certain formulation of externalist thesis. In particular, I consider two versions of vehicle externalism: (a) explanatory externalism as defended by Susan Hurley (2010) and metaphysical externalism as described by Ned Block (2005). While I side with Hurley's version, I acknowledge that the claim of explanatory externalism is rather vague. To substantiate it, I introduce the framework of mechanistic explanation.

In chapter 2, I explain what I mean by dream phenomena. I begin by reviewing the historical and contemporary views on dreaming. I then claim that these views amount to a *standard conception*, and identify the theoretical commitments underlying it. The standard conception is made up of two claims, one mental, characterizing dream phenomenology, the other physical, characterizing sleep physiology. I clarify the implications of these commitments for externalism and mention previous attempts at dealing with them.

In chapter 3 I illustrate how does one launch an argument from dreaming against various externalist views. In particular, I offer arguments from dreaming against embodied,

enacted and embedded views regarding perceptual processing and perceptual experience. After that, I discuss a potential pitfall for these arguments: all externalist theses I review emphasize the crucial role of body and environment in constituting mental phenomena; however, some claim that this role is functional, and if so, it might be possible to simulate it. In particular, I discuss the debate over actual vs. simulated embodiment and its implications for the arguments presented above.

In Chapter 4 I aim to clarify a potential confusion i.e. what exactly is the phenomena to be explained for the externalists? To do so, I distinguish local mental states from global mental states. I then clarify the relationship between these two. I claim that externalists are supposed to explain dream phenomena as *global mental phenomena*. I construct a mechanistically-constitutive supervenience relationship between global-dreaming and sleep neurophysiology. I use this relationship to motivate a sleep-centric approach to deal with arguments from dreaming. I finish by identifying avenues of empirical research that pertains to the debate; I criticize Jennifer Windt over her claim that dreaming is "weakly functionally embodied" because there is input-output exchange with the environment during sleep. I argue that causal history of this or that perceptual experience does not make something 'embodied', even ‘weakly’, since the issue is about constitution, not causation. Instead, I claim that if dreaming is embodied (or not), it is because the underlying sleep physiology (dreaming-sleep) is constituted by mechanism(s) that involve bodily and environmental processes.

In chapter 5 I discuss issues with individuating 'dreaming-sleep', i.e. the stage of sleep where dreaming happens, and highlight the importance of identifying its neural and other correlates. In particular, I discuss the role of the arousal system, which is deeply involved with bodily and environmental processes, by discussing two foundational mechanisms that operate during sleep: (a) information-gating and (b) arousal-threshold mechanisms. I then offer a review of studies on awareness of external stimuli during sleep and sensory incorporation into dream content in order to illustrate the role of these mechanisms in sleep phenomenology. I finish by sketching an alternative conception of dreaming that is more sympathetic to externalist views and would better account the result of these studies. I conclude, however, that for all we know at the moment, dreaming is no more or no less embodied than waking, thus the internalist claims are unsupported.

Chapter 1.

Internalism vs. Externalism

The fundamental internalist intuition is immensely powerful yet ironically elusive. On a first approximation, the internalist believes that the 'I' of the mind is necessarily distinct from the 'World' it happens to inhabit. For the internalist, the existence of a clear boundary between where the 'I' ends and the 'World' begins provides a sort of autonomy, potentially if not actually, over her thoughts, feelings, sensations and volitions -an autonomy without which it does not seem possible to *own* these elements of mental life. On a first approximation then, the internalist believes that elements of her mental life are *located* in her, and that is the only way in which she comes to *author* them. Indeed, there are numerous instances where her intuitions seem to be validated. Most strikingly, she seems to pack an entire world *in* her, one that seems equally captivating, if not more: the *dream world*. Indeed, dreaming is often both the first recourse and the last refuge of an internalist.

The internalist position can be understood as advancing the following claims[2]:

> *Authority Claim*: authority over any mental phenomenon by a subject S that has it depends only on properties internal to S.
>
> *Locality Claim:* the location of any mental phenomenon of a subject S that has it falls within the boundaries of S.

The first thing to note is that these two claims fundamentally differ in their role, and do not necessarily stand or fall together[3]. This eventually leads to two different kinds of internalism that we will discuss in the next section. In particular, *Authority Claim* concerns the justification of (attributing) mental phenomena: it says that only the properties that are internal to S can justify the attribution of a mental phenomenon to S. *Locality Claim* is less straightforward. *Prima facie*, it concerns the distribution of physical entities that ground mental phenomena. On the other hand, there is a major dispute over whether to

[2] See also Hurley (1998), Rowlands (2003) and Carter et al. (2014) for similar characterizations of the internalist position.

[3] This might turn out to be false, however. See Sprevak & Kalestrup 2014.

understand *location* in the literal sense, as in spatial location. As we shall see, some externalists reject this understanding.

Regardless, we should clarify the notion of a boundary between what is internal and what is not. Externalists who deal with the physical basis of mental phenomena -and, in particular, those that claim that mental phenomena depend on non-neural properties- identify the boundary with the brain. The choice here contains some degree of arbitrariness, and there are accounts that suggest taking Central Nervous System (CNS) as the boundary instead. Since our understanding of the role of the spinal cord in cognitive phenomena is still in its early stages, I will ignore this suggestion, though I don't think that this makes a difference in the present context. As such, the internalist's Location Claim can be reformulated as an Embrainment Claim:

> *Embrainment Claim:* the location of any mental phenomenon of a subject S that has it falls within the boundaries of S' brain.

As could be expected, internalists who commit to the Embrainment Claim typically take dream phenomena to confirm their views. With these preliminary remarks, then, I now turn to survey externalist views.

1.1. Varieties of Externalism

All varieties of externalism claim that mental phenomena depend on properties external to the subject who possess them. Within that range, however, they differ greatly. In particular, externalist views differ with respect to (i) what aspect of mental phenomena they consider, (ii) what range of mental phenomena they apply to and (iii) in what way they claim mental phenomena depend on external properties. I discuss each in turn.

Consider these three aspects of mental phenomena. When we talk about the *mental*, we might talk about mental states, or the processes that result in mental states, or the structures/mechanisms that realize the processes which in turn result in mental states. Mental states are individuated by their content, which can be expressed as propositional attitudes, where the content usually follows the 'that' clause. When I believe that the coffee mug next to my laptop is blue, the content of my belief is just this: *that the coffee mug is blue*. Contrast this with mental processes and structures/mechanisms. These are not propositional items: rather, they are vehicles of propositional attitudes:

'things' that make it possible for a subject to hold such propositional attitudes. The differences in these aspects give us two varieties of externalism: (a) content externalism considers whether and how mental states depend on external properties, whereas (b) vehicle externalism considers whether and how mental processes and structures/mechanisms depend on external properties.

Consider further that mental phenomena also have a qualitative aspect. There is something it is like to believe that the coffee mug next to your laptop is blue, which is different from believing that it is gray. Likewise, processes and mechanisms that give rise to mental states could have consequences on the phenomenal character of that state. It is something like to perceive a moving object, which might depend on the particular setup of the visual system in dealing with detection of moving objects. As such, both content and vehicle externalism have phenomenal counterparts

1.1.1. Content Externalism

In contemporary philosophy of mind, the internal/external distinction gained prominence after Hilary Putnam's influential discussion of *semantic externalism* (1975) i.e. the view that meaning of natural kind terms varies with *physical environment*. This view builds up on Kripke's causal theory of reference. Consider the natural kind term *water:* as it so happens, the reference of *water* on earth is H2O. Now consider what it means to say, 'S believes water to be wet'. The way that S's belief is individuated -the way in which it is justified to attribute that belief to S- is by way of anchoring the reference of her use of *water* to a particular world (in this case earth). Suppose S has a doppelgänger, S', on a world that is just like the earth, except the stuff that looks like water is not H2O, but instead XYZ. Even though S', the doppelgänger, is an atom-to-atom copy of S -and so shares all the features internal to S- when S' has the thought 'water is wet', S' means something different than S would on earth.

Notice that Putnam's argument, in the present form, applies only to natural kind terms. In (1979) and (1986), Tyler Burge extends the reach of Putnam's insight. Burge claims that even if two environments are physically identical, due to the way the physical environment is conceptually organized by linguistic use, two speakers belonging to different linguistic communities might mean different things by their use of the very same term. Again, consider S in the linguistic community A and her doppelgänger S' in the

linguistic community B. Suppose that the term *arthritis* is taken to refer to only joint disorders in community A and any rheumatoid disorder in general in community B. If so, then when S believes that she has arthritis, her belief has a different mental content than when S' believes she has arthritis, simply in virtue of the difference in the use of the term *arthritis*. Thus, not only the contents of mental states are dependent on the physical environment, but they are also dependent on the *linguistic community* that one belongs.

In essence, content externalism is the view that, for an agent to entertain such mental states, she must be related to her environment in a certain way. Content externalism is concerned with questions related to justification i.e. what justifies attributing a certain mental state to an agent? How is the mental state in question individuated from other mental states? The answer given by content externalists is that justification has to refer to properties of the natural environment and/or linguistic usage. Because of this, notice that content externalism does not deal with how an instance (token) of a mental state came about. Rather, it is the type of mental states that content externalist views target.

Now, as I said above, mental states are also accompanied by a particular phenomenal experience i.e. that there's something it is like to be when one believes that chocolate is sweet or desires that she has chocolate. In other words, mental states also have *phenomenal character*. Externalism with respect to phenomenal character is a less discussed (and some would say more counter-intuitive) variety in the literature, but it follows from content externalism plus some version of representationalism about experience. Consider the experience of seeing the coffee mug next to your laptop as circular and blue. Representationalism about experience asserts that phenomenal character of an experience is nothing *over and above* the representational properties of that experience. When I look at the coffee mug, the way that the mug seems to me (my phenomenal state) is individuated by the way that the mug is presented to me in experience i.e. as circular and blue. This should not be understood as implying that phenomenal experiences are out there in the world. Rather, the question is what justifies attributing a certain phenomenal experience to a subject: the answer is that it cannot be anything other than the representational properties of that experience[4]. Experience is

[4] That does not necessarily say that phenomenal character is exhausted by semantic content. Rather, what makes a difference in attributing this experience to a subject rather than that experience is entirely a matter of semantic content.

individuated by content. Since content is individuated externally, it follows that experience is individuated externally as well.

Phenomenal externalism is essentially a relational view. The main proponents of this position include Fred Dretske (1995) and Michael Tye (1995). Under this view, a brain state give rise to a certain experience in virtue of the causal connection between the occurrence of the state in question and the object of its cause. As such, just as the existence of water in the world is necessary for having mental states whose content involves water, phenomenal externalism asserts that existence of, say, color properties in the environment are necessary for having color experiences in the first place. Again, consider the issue with respect to justification: what justifies attributing a certain experience with such and such content to a subject? The answer given by phenomenal externalists is that, a sensory representation counts as the mental state of, say, color experience, because color properties are its normal cause (wherein which 'normal cause' can be determined through evolutionary history of color vision in that species, for instance). This means that, like content externalism, phenomenal externalism deals with types of mental states, not their tokens.

Now, dreaming doesn't seem to challenge either content externalism or its phenomenal counterpart. There are a number of ways to see this, but before that, at least two things about dreaming must be acknowledged. First, *global dream skepticism* is false; it is not the case that all my life is a dream -dreaming is a temporal sleep phenomenon. Second, the *Continuity Hypothesis*, or some version of it, is true: dreams are simulations that re-enact the subject's existing concepts and concerns, and so the contents of dreams are drawn primarily from memory. Given these two facts, it follows that dream content is parasitic on waking content. Indeed, as soon as Descartes makes his skeptical challenge, he writes that:

> we must at least confess that the things which are represented to us in sleep are like painted representations which can only have been formed as the counterparts of something real and true, and that in this way those general things at least, i.e. eyes, a head, hands, and a whole body, are not imaginary things, but things really existent. For, as a matter of fact, painters, even when they study with the greatest skill to represent sirens and satyrs by forms the most strange and extraordinary, cannot give them natures which are entirely new, but merely make a certain medley of the members of different animals; or if their imagination is extravagant enough to invent something so novel that nothing similar has ever before been

> seen, and that then their work represents a thing purely fictitious and absolutely false, it is certain all the same that the colours of which this is composed are necessarily real. And for the same reason, although these general things, to wit, [a body], eyes, a head, hands, and such like, may be imaginary, we are bound at the same time to confess that there are at least some other objects yet more simple and more universal, which are real and true; and of these just in the same way as with certain real colours, all these images of things which dwell in our thoughts, whether true and real or false and fantastic, are formed. (*Meditations, 1996*)

Likewise, in a note to the *Refutation of Idealism* in the *First Critique*, Immanuel Kant emphasizes the primacy of memory over dream content, and so the necessary existence of independent outer objects to be perceived first in order to be able to dream at all:

> Such representation is merely the product of previous outer perceptions, which, as has been shown, are possible only through the reality of outer object.

Now, one way to see how and why dreaming does not challenge either the content externalism or its phenomenal counterpart is to look at a distinction made in Clark & Chalmers (1998). The authors distinguish their version of externalism as *active externalism,* as opposed to *passive externalism* of Putnam's and -possibly- Burge's. The difference is roughly this: in active externalism, the environmental factors that partly determine mental content are active elements of the cognitive system of the subject i.e. they actively take part in those cognitive processes; whereas in passive externalism, these environmental factors do not directly enter into a relationship with the cognitive system; their influence is indirect, on the ways in which we *talk* about these cognitive processes. Recall Putnam's twin-earth thought experiment. While the thought experiment concludes that S and her doppelgänger S' would mean different things by the proposition 'water is wet', notice that this difference does not entail a difference in their behavior. That is, while they have different mental contents, these different contents are functionally equivalent in terms of causing behavior i.e. both will attempt to drink the substance they refer as 'water' when they get thirsty. For active externalism, this is because the environmental factors related to 'water' do not directly partake in cognitive processes.

In general then, content externalism primarily concerns the 'mental history' of the subject, and as such, a subject isolated/detached from her environment at time t can still have mental states with content at time t+1, as long as the history of the subject until the instant

of separation is of the 'right kind'. Indeed, under any plausible notion of dreaming i.e. a notion of dreaming that is empirically sound, this is what happens when we dream. Ergo, dreaming doesn't seem to challenge either the content externalism or its phenomenal counterpart.

1.1.2. Vehicle Externalism

Mental states result from *mental processes*, which are, in turn, realized by *mental structures* or *mechanisms*[5]. Consider the cognitive state I'm in when I believe that there is a blue coffee mug next to me, and the particular perceptual experience that accompanies it. I'm in this cognitive state because of the cognitive process of perceiving the coffee mug. The process of perceiving, in turn, would not have been possible if I did not have the sort of structures or mechanisms that can process visual information (light intensity, wavelength etc.). Mental states, thus, are realized by sub-personal level machinery -be it neural or extra-neural. That machinery is said to be the *vehicle* of mental contents[6]. Externalism with respect to vehicles of mental content asserts that mechanisms that realize the content of mental states, like beliefs, are constituted by parts and processes that are external to the subject.

Consider visual perception as a cognitive process. Traditional accounts of perception in vision science are internalist ones: light reflected from objects produces a pattern of stimulation on the surface of retina. Retinal ganglion cells encode the electro-magnetic energy into neural signals to create an array that stores intensity luminance information of the scene. These signals then are propagated through the optic tract up to the visual cortex, where they undergo various stages of processing to eventually form a representation or an 'image' of the 3D scene. The account is internalist for a number of reasons. For one, the account suggests that perception is the end result of processing internal stimulations. For another, nothing in the explanation of perception refers to parts or processes outside the boundaries of the brain. In contrast, consider James Gibson's account of ecological perception. Unlike the traditional story above, perception for Gibson

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[5] A possible confusion here: while I call these mental structures or mechanisms, the label is to denote their function, not their nature. These entities are indeed physical.

[6] Vehicles of mental content originally denoted representing neural structures (Dennett 1991). I am neutral here with respect to the debate between representationalism vs. non-representationalism. The use of the notion of vehicle here is limited to what subpersonal level mechanisms enable or realize personal level mental contents.

is a matter of exploiting the information readily available in the environment, as opposed to an end-product of processing of internal stimulations. Foundational to ecological perception is the notion of an *ambient optic array* i.e. the structured arrangement of light information from a certain point of view. Gibson claims that there is enough information in the ambient optic array for discriminating the details of the environment, for the information contained in the ambient optic array varies in a lawlike manner with the regularities in the physical environment -what he refers as *optic flow patterns*. An organism, then, can exploit these regularities to navigate the environment; it need not deduce these from complex processes involving low-level sensory stimulations. As such, the ambient optic array is ultimately a medium of information external to the observer. Another foundational notion in Gibson's ecological perception is *active sampling*. Unlike laboratory experiments, observers in daily life are rarely stationary. Depth perception, for instance, can be achieved by moving the body/head; distant objects vary slower than proximal objects through movement. Thus, Gibson claims, further information about the environment can be obtained by manipulating one's relationship to the ambient optic array through bodily actions. These actions are not internal properties of the observer, in the sense that their effects are relational to the environment the observer is in and acts on.

Now, unlike content externalism, vehicle externalism deals with tokens of mental states i.e. it aims to explain a particular episode of mental activity with the organism's capacity for such activities. These capacities then are identified with mechanisms involving parts and processes that span over the brain-body-environment continuum. Thus, in order to have such a mental activity at time t, the organism must have the capacity for that mental activity at time t i.e. the capacity must be 'online'. It is this property that makes vehicle externalism susceptible to arguments from dreaming.

1.1.3. Externalism and Its Scope

The difference of scope between internalism and externalism should be noted. Internalism advances a universal claim i.e. *all* mental phenomena are internal to the subject. Externalism, on the other hand, advances an existential claim: *some* mental phenomena are external to the subject. Thus, one can find accounts of mental phenomena as extended to the peripheral nervous system (Aranyosi, 2013), immediate environment (O'Regan and Noe, 2001), artefact and tool use (Clark and Chalmers, 1998) and etc. While this difference of scope is sometimes mentioned by externalists as a virtue, in the sense

of having less of a burden of proof, in practice externalism should be committed to the claim that mental *phenomena of an ordinary sort* depend, in part, on properties external to the subject, in order to be a significant alternative and/or adversary to internalism. Here, 'phenomena of an ordinary sort' is arguably a vague label, but the general idea is intuitive: an organism's capacity for mental phenomena evolved so as to involve dependency relationships between brain-body-environment, yet under special (say, pathologic) conditions or through artificial (say, prosthetic) interventions, it can be liberated from such dependencies, at least to some degree. Thus, when externalism advances an existential claim as opposed to a universal claim, it should be understood that it does not categorically reject internalism. In other words, externalist theses should be formulated along the lines of generics -statements like *cats have four legs*- instead of universals -*all cats have four legs*.

Now, one might object that, while vehicle externalism should explain mental phenomena of an ordinary sort, dream phenomena are not necessarily ordinary mental phenomena. However, there are good reasons to suppose that they are: dreaming is universally present, and unless 'ordinary' is question-beggingly restricted to waking, it seems there are no principled reasons not to count dreaming as 'ordinary'. If this is so, however, externalism would lose a major ground in the debate to internalism if it cannot provide an explanation. Notice that internalism of the naturalistic sort is committed to the *Minimal Substrate Thesis* (MST): brain states and processes alone suffice for visual conscious experience. The putative fact of dreaming, as such, confirms MST. If dreaming truly confirms MST, however, then one needs nothing essential further to explain the phenomenological properties of perception that a subject enjoys beyond what is and what occurs within that subject's brain. As such, MST and dreaming, when taken together, have a significant import: while from the outset the debate between internalism and externalism seem to put the burden of proof on the shoulders of internalists given their universal claim, the truth of MST shifts the burden to the externalists, as internalists now have an empirically plausible common mechanism for visual phenomena with dreaming. In essence, this is the main threat posed by an argument from dreaming in philosophy of perception.

1.2. Varieties of Dependence

Aspects of disagreement between internalists and externalists cannot be made clear without employing more technical terms than *dependence*. Moreover, the ways in which externalist views formulate their dependency claim gives us different varieties of externalism: with respect to vehicle externalism, I discuss two such ways: Block's metaphysical variety and Hurley's explanatory variety.

The first concept is *supervenience*. Externalist views, in particular content externalism, are often cashed out in terms of supervenience thought experiments. The general strategy is to hold internal properties of the subject constant while altering the external properties. It is then followed by a claim that subject's mental states wouldn't be the same if the external properties are not the same, thus properties of mental states supervene not only on internal properties of the subject, but also on external properties of her environment. Supervenience relationship is a relationship of covariance. Variation in one set of properties (A) require variation in another set of properties (B). In other words, a unique distribution and variety of properties in set B determines the unique distribution and variety of properties in set A. A properly formulated supervenience relationship also entails ontic dependence[7]; in order for a property to be instantiated, another property also needs to be instantiated. Consider color and extension: whenever a color property is instantiated, an extension property is also instantiated, and if the latter does not, the former cannot. The disagreement between internalists and externalists, then, can be rephrased as such: internalism says that no mental phenomena supervene on extra-neural properties i.e. no extra-neural property needs to be instantiated for a token mental phenomenon M to exist, and the phenomenal character of a M is not determined by any extra-neural property. Externalism rejects these claims. For instance, in criticizing Noe's variant of vehicle externalism for perceptual experience, Block (2005) writes:

> The issue of the constitutive supervenience base for experience is the issue of what is— and is not—a metaphysically necessary part of a metaphysically sufficient condition of perceptual experience. That is, it is the issue of what is—and is not—part of the minimal metaphysically

[7] Yoshimi in (2007) offers one such formulation: A-properties supervene on B-properties if anything that has an A-property has some B-property such that anything that has that B-property also has that A-property (p. 115).

> sufficient condition for perceptual experience (the minimal supervenience base) (p. 264)

But why does the supervenience relation hold in the first place? Here the discussion often seeks recourse in the concept of *constitution*. The supervenience relation holds, putatively, because the properties in question are constituted, in part, by properties external to the subject (with respect to the chosen boundary). Hence the term, *constitutive supervenience*. But what it means to say that X is constituted, in part, by Y? The notion of constitution often employed by externalists is not the one often employed in ontological debates. In particular it should be distinguished from *material constitution*. Consider a clay statue. What is the relationship between the statue and the clay? Arguably, the relationship is not of identity, since there are certain truths about the clay that do not hold for the statue. For instance, there is a time t where the clay existed but the statue did not. Rather, then, the clay is a *constituent* of the statue, or more precisely, a *material constituent* of the statue. There are at least two conditions for an x to be a material constituent of y. First, material constitution requires spatial coincidence: x constitutes y at t only if x and y have the same spatial location at t. Second, material constitution requires material coincidence: x constitutes y at t only if x and y share all the same parts at t (Wilson, 2007, p. 5). In the quote above, Block seems to be relying on an understanding of constitution similar to material constitution. He writes: “the minimal supervenience base for an experience that occurs at time t is an instantiation of a physical property at t – according to the orthodox view” (p. 265). Call this the *Metaphysical Formulation*:

> Vehicle externalism is true iff an external property is part of the MSB for a mental phenomenon M.

Externalists, however, do not necessarily endorse this understanding of constitution. This is because externalists are in general pragmatists (or deflationists) about ontology. Hurley (2010) states that debates between internalists and externalists are primarily debates over the correct explanation of mental phenomena, which is going to be revealed by bottom-up science rather than top-down metaphysics. Call this the *Explanatory Formulation*:

> Vehicle externalism is true iff an external property is part of the explanation of a mental phenomenon M.

Now one might have a legitimate concern over the vagueness of this formulation. That is, one might say that Hurley is simply avoiding a legitimate demand for precision by

appealing to the authority of scientific practice. As such, explanatory formulation seems to require, or would benefit from, some concrete account of explanation at the very least. Is there such an account? I discuss this next.

1.3. Varieties of Explanation

How does constitution relate to explanation? As stated, internalists and externalists differ in their characterization of the role of body and environment in the explanation of mental phenomena. Externalists claim, while internalists deny, that the body and environment are constitutive elements of the explanation of the mental. Internalists do not deny any role to external factors of course: rather, they maintain that these factors are only relevant as elements of a causal explanation. Causal and constitutive explanations have different *relata*. The former aims to explain the phenomena in terms of its behaviour -as the relationship between events that leads up to the observed behaviour. In other words, a causal explanation aims to show how the phenomenon fits into a causal nexus of preceding and following events. What is expected from a constitutive explanation, however, is an answer to why the phenomena shows that behaviour i.e. why it exhibits those causal relations[8].

A fundamental difference between causal and constitutive relations is that, in the case of the former, the cause and effect are taken to be distinct entities, whereas in the case of the latter, elements of a mechanism cannot be understood as distinct from their causal capacities i.e. the behaviour they exhibit. This has an important consequence for the debate; internalists endorse, while externalists deny the *Separability Thesis*: properties of mental phenomena do not depend on and are not determined by features of their (physical) implementation (Shapiro, 2018). Indeed, for the externalist, to say that mental phenomena extend beyond the subject's brain is to say that explanation of mental phenomena cannot be made without referring to properties that are typically taken to be external to the subject[9].

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[8] See Ylikoski 2013 for a thorough discussion.

[9] Take, for instance, embodied cognition. It claims that the implementation of an organism's sensorimotor system and the environment that this system is embedded in determines what these operations and their effects are. If so, however, a further consequence follows. If it is plausible to expect that the phenomenal character of the experience of an observer depends, to some degree, on the operations of her mind, then, since the externalist rejects the Separability Thesis, it follows

There's a certain account of constitution that explanatory externalists can benefit from. Notice that dream phenomena are phenomena to be studied within the cognitive sciences. Philosophers who work on life sciences have long advocated that explanations in life sciences, such as those in biology, are mainly tasked with articulating mechanisms (see Craver and Darden, 2013). Mechanisms are structures "performing a function in virtue of its component parts, component operations, and their organization", and the observed natural phenomenon is the result of "the orchestrated functioning of the mechanism" (Bechtel and Abrahamsen, 2005). Craver (2007) illustrates the relationship between these four components -the phenomenon, the parts, the processes and the organization in the following way:

Some externalists have already adopted the mechanistic framework to clarify the notion of constitution (See for instance, Kirchhoff 2014). The question is how to determine if some property is constitutive of some phenomena or not i.e. if some property is constitutively relevant to the explanation of some phenomena. Craver in (2007) offers one account:

> The collection of those entities and activities that are constitutively relevant to a phenomenon P make up the constitutive mechanism M for P. In this case, the M is said to constitute P (p. 139)

Craver's account is further qualified with two conditions. To say that X is constitutively relevant to Y is to say that:

(a) X must be a part of Y.

(b) behaviour of X and behaviour of Y must be *mutually manipulable*.

Mutual manipulability condition has been disputed by some, though neither the condition nor the dispute is relevant to our purpose at the moment[10]. Parthood condition

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that the phenomenal character of the experience of an observer is constituted, to some degree, by the contingencies of the implementation of those operations. For instance, when one spins around, the visual field moves as it does because of how vestibular sensations, arising from the moving body, interacts with the change of visual field arising out of movement. Taken together, that just is the perceptual experience of spinning around. Since these aspects of visual processing are dependent on the physical implementation of the cognitive structure/mechanism of the observer, it follows that the phenomenal character of the observer's experience is likewise dependent on the contingencies of that physical implementation.

[10] See Baumgartner and Casini (2017). The authors find the mutual manipulability (MM) condition inapplicable to actual scientific practice. Craver's motivation for MM seems to be about how would

(a) must be clarified though. In particular, parthood can be understood as spatial parthood or temporal parthood. Externalists like Clark and Chalmers (2010) have long resisted the claim that spatial parthood is necessary to identify constituents of mental processes. In (2016), Kaiser and Krickel distinguish componency from parthood: the conditions under which something is a component in a mechanism differ from the conditions for being a part of an object.

> The centrioles, for example, are parts of the cell, but not components in the mechanism for protein synthesis because their activity is irrelevant to the synthesis of proteins, but relevant to another characteristic behaviour of the cell, namely cell division (Kaiser and Krickel 2016, p. 29).

As such, the authors claim that for something to count as a component of a mechanism, it need not be a spatial part of the object of which the mechanism aims to explain. This understanding of componency seems to be more faithful to how externalists see external properties relevant to explanation of mental phenomena. I will refer to this understanding of constitution as *mechanistic constitution*. In order to derive explanation from mechanistic constitution, however, the mechanism should be described at a lower level than the phenomena it constitutes. That is, if some E explains some P by positing some mechanism M as its constituent, then M should be described at a lower level than P (e.g. a chemical reaction is explained by interactions of atoms and molecules). Call this the *Adequacy Condition*:

> A mechanism M is explanatorily adequate for phenomenon P only if M is described at a lower order than P.

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scientific studies discover a constitutive relationship, as opposed to a causal relationship. Causal relationships are discovered by intervention. A variable in an experimental setup is manipulated; if a change in another variable is observed following that, one can make the inference that the first variable is causally related to the second variable. Further such interventions can clarify the direction of causation. However, causal relations are uni-directional whereas constitutive relations are taken to be bi-directional. As such, the same approach would not reveal any constitutive relationship. This is the reason for Craver's mutual manipulability condition i.e. there is a constitutive relationship between two phenomena (higher order phenomena to be explained and the lower order mechanism that explains it) if and only if manipulation on the former result changes on the latter and manipulations on the latter result changes in the former. Baumgartner and Casini (2017), however, claims that such manipulations are not possible in practice, and so constitutive relationships are inherently underdetermined by experimental evidence (p. 2). Instead, the authors offer an abductive theory of constitution i.e. higher order and lower order phenomena can only be manipulated through common causes, and the best explanation for this condition is because higher and lower order phenomena are "unbreakable common cause couplings" -hence, a constitutive relationship. Notice that this account is potentially compatible with dynamical systems approaches that vehicle externalists highly favour.

This mechanistic framework is useful in understanding externalists concern over explanation of mental phenomena. When externalists claim that bodily and environmental properties are constitutively relevant to mental phenomena, their claim can be understood to mean that these properties are constitutive of mechanisms whose orchestrated functioning results in the observed phenomena. This approach might still lack the level of preciseness that some opponents of externalism demand, but it will suffice for the moment. Mechanistic explanation literature is still undergoing major debates, and any attempt to settle on a precise formulation would be premature at this stage. What is important for our purpose here is that, there is potentially an account of constitution that externalists of the explanatory bent can rely on, and this account of constitution will be provided along the lines of mechanistic explanation.

Chapter 2.

The Concept of Dreaming

Before discussing arguments from dreaming against vehicle externalism, we need to settle on a concept of dreaming. This chapter aims to do that. The chapter begins with a brief survey of the historical and contemporary understanding of dreams. It then identifies two components underlying these views: a mental component (henceforth *m-component*), characterizing dream experience, and a physical component (henceforth, *p-component*), characterizing sleep physiology. Together, they make up what I refer as the *standard conception of dreaming*. The standard conception, in return, will allow us to launch the aforementioned arguments.

2.1. What is it like to Dream?

A fundamental issue in characterizing what is it like to dream is due to the unique status of dream experience. The issue can be characterized as a conflict between two aspects of dream experience: on the one hand, dream experience, like all experience, is *immediate*. As such, dream experience allows or suggests first-person authority over the phenomenon, thereby granting *prima facie* legitimacy to accounts of dreaming on the basis of personal experience. On the other hand, dream experience, unlike other experiences, is doubly *inaccessible* to observation. Now, under a popular notion of *experience*, all experience is inaccessible to third-person observation. Take perceptual experience for instance. Study of perceptual experience is *removed in space* from observation; the phenomenal space of perceptual experience is not accessible from the objective space of science. As such, perceptual experience is studied on the basis of behavior, often verbal behavior. Unlike perceptual experience, however, dream experience is also inaccessible to first-person reflection in real time[11]. That is, dream experience is *removed in time* from reflection, as one becomes aware of having dreamt only after awakening -that is, one is aware of dreaming on the basis of memory (with the notable exception of lucid dreaming). Indeed, this condition underlies the anti-realist

[11] This is, again, valid under a popular notion of experience. Someone like Dennett in (1991) would say that the same could be said for waking experience as well.

stance toward dream experience in philosophy, found primarily in Ludwig Wittgenstein (1953), Norman Malcolm (1956; 1959) and Daniel Dennett (1976). As such, there's legitimate room for debate in characterizing what dreaming is like. In the next section, I review historical and contemporary accounts of dream experience with the aim of settling on a shared view.

2.1.1. Dreaming in Historical and Contemporary Accounts

Philosophy's fascination with dreaming dates back to antiquity. Plato depicts Socrates as asking to Theaetetus (2003):

> […] what proof you could give if anyone should ask us now, at the present moment, whether we are asleep and our thoughts are a dream, or whether we are awake and talking with each other in a waking condition (158b-c).

Theaetetus' answer, in return, is perhaps the most compact form of the *received view* – a loose collection of biases throughout history regarding what it is like to have a dream:

> Indeed, Socrates, I do not see by what evidence it is to be proved; for the two conditions correspond in every circumstance like exact counterparts (158c).

Similar remarks continued to appear during the ancient and medieval periods. In Modern philosophy, Descartes' *First Meditation* (1996) echoes the ages-old puzzle:

> How often have I dreamt that I was in these familiar circumstances, that I was dressed, and occupied this place by the fire, when I was lying undressed in bed? […] and, attentively considering those cases, I perceive so clearly that there exist no certain marks by which the state of waking can ever be distinguished from sleep.

Indeed, this puzzle lays the foundation for Descartes' dream argument. Things won't change much for the next few centuries. For instance, we see Russell's reception of the phenomenon is not so different than Descartes':

> Dreams and waking life must be treated with equal respect; it is only by some reality not *merely* sensible that dreams can be condemned. (1914: 69)

And later on:

> I have all the experiences that I seem to have; it is only things outside my mind that are not as I believe them to be while I am dreaming. (1948: 149–150)

The received view virtually went unchallenged for at least two thousand years, illustrating the effect of immediacy of dream experience in philosophical theorizing. This situation begins to change with Wittgenstein's renouncing remarks in *Philosophical Investigations* (1953).

> Now must I make some assumption about whether people are deceived by their memories or not; whether they really had these images while they slept, or whether it merely seems so to them on waking? And what meaning has this question? […] Does this mean that it is nonsense ever to raise the question whether dreams really take place during sleep, or are a memory phenomenon of the awakened? (pt. II, vii)

Picking up the cues left by Wittgenstein, Norman Malcolm launches a full-blown attack on the received view. In (1956), Malcolm launches a series of interconnected criticisms: (a) dreaming and sleeping are contradictory concepts, (b) dream reports are senseless and unfit to verification, and (c) no communication can be made in dreams. Malcolm's work is in the fashion of conceptual analysis, depth grammar and crude verificationism that are characteristic of the philosophical outlook of the period. Most importantly, Malcolm completely disregards any empirical study on the phenomena in question; he claims that if psychology were to discover some objective way of studying dreams, it would be dealing with a concept of dreaming different from its normal use in language. In a reply to Malcolm, Putnam states that this is a fallacious view of science and its relation to concepts. Putnam argues that science does not simply discard concepts and replace them with new ones; rather, science *updates* our concepts. When it comes to the correct definition of a concept, the matter will ultimately be settled by experts (1975*,* p. 219). In addition, Malcolm fails to make an important distinction: creature consciousness vs. state consciousness. We say a person is conscious if she responds to external stimuli: hence, creature consciousness. This usage of *consciousness* is different than saying a person is conscious of, say, some imagery or belief. The image or belief that one is conscious of can be autogenerated. Thus, response to external stimuli is not a requirement for state consciousness. In other words, state consciousness may be present with response to either external or internal stimuli (Rosenthal 1986). It seems, then,

Malcolm's attack is targeted on creature consciousness. If so, the attack fails; state consciousness may be present even in the absence of creature consciousness.

A decade later, Daniel Dennett revived the subject again, although, unlike Malcolm, Dennett did not initiate a direct assault. Instead, he offers an alternative model of dream formation to undermine the appeal to received view (1976). Under Dennett's model, contents of dreams are selected and arranged by unconscious brain processes and inserted into memory as a false episode. Thus, dream recall is the first time the content gets experienced. The theory has the following crucial implication: as Dennett puts, "It is not like anything to dream, but it is like something to have dreamed" (p. 161). Since there is nothing conclusive in dream reports to choose between the received view and his alternative theory, so Dennett claims, the question of which one is better will be answered by their ability to account for a variety of situations. Consider such dreams where the dreamer wakes up, only to find out that what she was dreaming about seems to be caused by some external stimulus. For example, the dreamer dreams about a goat. The goat starts to bark, yet when she wakes, she realizes the barking of the goat was in fact the buzzing of the alarm clock.[12] On the received view, such dreams would entail precognition –that somehow the dreamer anticipates the buzzing of the alarm clock and incorporates it to the dream narrative beforehand. Given its paranormal implications, this explanation is highly implausible. On Dennett's alternative however, since the dream recall is the first time the content gets experienced, no such conclusion is implied. A suitable narrative to incorporate the effect of the external stimuli can take place at the instant of waking and uploaded to consciousness accordingly.

Dreaming in general is characterized by passivity of the dreaming subject and a general lack of situational awareness. The phenomenon known as lucid dreaming seems to contradict these characterizations. In philosophy, the response to lucid dreaming was mostly negative. For instance, Malcolm does not even acknowledge the existence of the phenomenon. Unlike Malcolm's quick dismissal of it, however, Dennett attempts to give an account of lucidity in his model. The effect of having had a lucid dream can be achieved by "the literary conceit of a dream within a dream" (pp. 160-161). In other words, the recalled content might simply involve an impression of awareness that one was having a dream as a part of its narrative structure. Yet some philosophers found this explanation

[12] This example is based on an anecdote given by Dennett (1976).

implausible. Kathleen Emmett, for instance, argues that there is a big difference between realizing that I am dreaming and dreaming that I am dreaming. The latter is non-lucid in the sense that "I am ignorant of the fact that I am still dreaming" (1977, p. 448). If the distinction is valid, then the former case -awareness of dreaming while one dreams- is an instance of experience. Dennett disagrees, however, about whether this criticism leads anywhere. The distinction Emmett makes is only valid from an external point of view: that "I'm ignorant of the fact that I am still dreaming" is true in relation to an external point of judgment. The distinction between "is so" vs. "seems so" cannot be made on the basis of experience alone. Thus, the problem stands: if someone gives a report of having had a lucid dream, the report is in no way different than a report of having had an ordinary dream: it is subjective testimony. Dennett's effort is to show that the problem cannot be solved by conceptual work alone. As such, the question whether lucid dreams, or any type of dreams at all, are experiences will be settled by empirical research (1979, p. 317).

In (1990), a series of experiments carried out by Stephan LaBerge precisely does this. Previously, psychologists were skeptical about whether lucid dreams occur during REM sleep, as ordinary dreams do. Instead, they hypothesized that lucid dreams might be products of brief/micro awakenings. Given that reports of lucid dreaming are obtained only after the awakening, it remained impossible to prove that they didn't occur after the end of REM sleep. To overcome this obstacle, LaBerge and his colleagues sought a method to obtain reports of lucid dreaming within REM sleep. In one experiment, participants were instructed before going to sleep to perform a certain eye movement (i.e. *left-right-left-right*) when they realize that they are having a dream, thereby signaling that they are aware of dreaming. If these eye movements were to be obtained during unambiguous REM sleep patterns on EEG, it would show that lucid dreams do occur during REM sleep. Results were positive: participants did make the pre-arranged eye movements while EEG displayed paradigmatic REM patterns (pp. 109-126). Ramifications of this experiment are clear: it shows that awareness, and so consciousness, is present in sleep–at least in the case of lucid dreaming. Furthermore, the experiment shows that communication can take place while being asleep, in the form of pre-arranged eye movement signals, contra Malcolm.

But perhaps Dennett's alternative can survive these results. Perhaps what really happens in LaBerge's experiment is that the participants are conditioned by the act of agreeing to make eye movements, so while they fell asleep, unconscious brain processes

handle the task of making the agreed eye movements in accordance with the content of the dream sequence. Anticipating this objection, LaBerge carried out a second experiment. This time the task was to count 10 seconds between each sequence of eye movements. Again, the results were positive: participants did wait 10 seconds before initiating the second sequence of eye-movements. The accuracy of the time interval suggests that the task was being handled by some conscious thinking. But if so, this greatly undermines the Dennettian skepticism made in the previous case. Of course, one can still argue that lucid dreaming is a queer type of dreaming and does not really reflect core features of ordinary dreaming. In other words, one can simply argue that two types of dreaming are fundamentally different. Yet certain dream reports collected by LaBerge shows that there *could* be a transition from an ordinary dream to a lucid dream. In (1991), LaBerge and Rheingold mention such a transition:

> In a dangerous part of San Francisco, for some reason I start crawling on the sidewalk. I start to reflect: this is strange; why can't I walk? Can other people walk upright here? Is it just me who has to crawl? I see a man in a suit walking under the streetlight. Now my curiosity is replaced by fear. I think, crawling around like this may be interesting but it is not safe. Then I think, I never do this – I always walk around San Francisco upright! This only happens in dreams. Finally, it dawns on me: I must be dreaming! (p. 63)

What happens in this anecdote is not simply a shift from unconsciousness to consciousness. Rather, the change is gradual. It seems that the consciousness was there all along, and later on accompanied by reflective thinking. However, the anecdote still suffers from being only subjective testimony (see the next section for neurophysiological work on lucid dreaming). Indeed, it is hard to think of a behavioral method of verification for dreams, or a portion of dreams, that does not seem to contain reflective thinking. The experiments made by LaBerge et al. succeeded in proving the presence of consciousness by means of voluntary action since participants exhibited such behavioral cues during the instant of lucid dreaming. The non-lucid portions of dreams are still a black box, and this prevents an accurate understanding of both phenomena.

At any rate, it is safe to say that the project of refuting the received view has, for all practical purposes, failed. Psychology was always dismissive towards the attempt, but neither do contemporary philosophical theories challenge it. It is no coincidence that this period also saw the rise of neuroscience and advancement of brain imaging techniques. Indeed, it is especially difficult to maintain a skeptic attitude towards the received view

today due to numerous empirical studies targeting the domain with positive results. These are mostly due to pioneers like Allan J. Hobson (1988; 2000), David Foulkes (1990) and Mark Solms (2000). Hobson, whose physiological theory of dream generation has dominated the field for a few decades, describes dreaming as:

> Mental activity occurring in sleep characterized by vivid sensorimotor imagery that is experienced as waking reality despite such distinctive cognitive features as impossibility or improbability of time, place, person and actions; emotions, especially fear, elation, and anger predominate over sadness, shame and guilt and sometimes reach sufficient strength to cause awakening (Hobson et al. 2000, p. 795)

Contrast this with the minimalist account offered by Foulkes, who defines dreaming as "the awareness of being in an imagined world in which things happen" (1990, p. 9). Likewise, Mark Solms characterize it on par with "hallucination, delusion, disorientation, negative affect, attenuated volition, and confabulatory paramnesia" (Solms 2000, p. 848). In lieu of these characterizations, a growing number of philosophers and philosophically oriented scientists such as Thomas Metzinger (2003), Antti Revonsuo (1995; 2009), Jennifer Windt (2015) etc. are now taking dreaming as a genuine case of conscious experience and investigating what follows from there. Metzinger, for instance, takes dreaming to be showing that "how full-blown, complex reality-models can evolve from an exclusively internal stimulus source" (2003, p. 256). Likewise, for Revonsuo, dreaming is:

> Complex, organized, temporally progressing, multimodal contents of consciousness during sleep that amount to a simulation of the perceptual world. (2009, p. 61)

The received view regarding the m-component is supplemented by another *received view*, what I will refer as *received view*$_2$, regarding the p-component. The *received view*$_2$ is much younger than *received view*$_1$. It is the result of persistent attempts of science to bring the mind closer to the brain. Lavie and Hobson (1986) traces the occurrence of this trend to 18th century. They note:

> The next step in the progress toward the understanding of dreaming as an endogenous product of the brain cannot be credited to any one person, but rather to the slow, step-by-step progress in physiology, particularly that of the nervous system (p. 234).

Hobson traces the occurrence of this trend to 18th century, when positivism was gaining prominence in scholarly circles. For instance, according to Albrecht Haller's 1779 textbook, *First Lines of Physiology*, dreaming occurs:

> whenever a small portion of the brain, or common sensory is, by the resultant motion of the spirits, kept in a state of vigilance, while all the rest of the empire of senses and voluntary motion is silent and at rest (quoted in Lavie and Hobson 1986, p. 236).

The trend continued into the 19th century. For instance, Edward H. Clarke, who studied hallucinative phenomena from the physiological perspective, writes:

> The characteristics of sleep, favorable to dreams, are first, and most important, the predominance in the cerebral machinery of automatic over volitional control; second, the process of repair, by which all activity is produced and kept up; third, a tendency to exaggerate sensations, emotions, and ideas; and fourth, the inactivity of reason and judgement, (quoted in Lavie and Hobson 1986, p. 237)

Given this historical background, the last century of dream research has been dominated by the view that dream-formation occurs in the absence of a *significant* link between the brain and the body-*cum*-environment, such that the source of the content of dreams are to be found primarily in memory processes (Foulkes, Solms) and/or in physiological processes, e.g. PGO waves (Hobson)[13]. While laboratory findings suggest that this view is an idealization of the more complex relationship between dream phenomenology and sleep environment, no attempt has been made to systematize extra-cerebral sources of dream-content. Indeed, the dominance of Hobson's physiological model was in large part responsible for this neglect. Hobson's AIM (Activation-Input-Modulation) model is a three-dimensional vector state-space model where the transitions of variables represent the change of conscious states across the sleep-wake cycle (Hobson et al. 2000). The variables A, I and M, stand for activation level, input-output gating and modulation type, respectively. In waking, the brain shows high level of activation, the source of the activation is external input, and this input is modulated by aminergic neurons. In REM sleep -the stage the model assumes as where paradigmatic form of dreaming occurs- brain shows similar high activation levels. However, the input source is now internal, and it is modulated by dopaminergic neurons. Hobson and colleagues argue that the internal source of input in the dreaming state is the PGO bursts that originate at the brainstem level[14]. It is assumed that these that bursts are randomly

[13] Not everyone adheres to this view; most notable example is Wilhelm Wundt, and, more recently, Jennifer Windt (2015).

[14] It should be noted that experimental work on PGO waves has been done primarily on non-human animals, particularly cats and rodents, as well as some primates, and actual human studies are not

occurring, which in turn explains the various dream instabilities and bizarreness. These bursts are 'interpreted' by the higher forebrain regions to organize them into seemingly-meaningful narratives. Without doubt, the model is the most refined form of the received view$_2$ that has been in development since the 18th century. The culmination of the received view$_1$ and the received view$_2$ finds its most daring (and most *internalist,* for that matter) account in Antti Revonsuo's case for taking dreaming brain as a model system for consciousness. Now, it was Patricia Churchland (1988) who first proposed studying dreaming as a model system in studying consciousness; however, her premise was that it is because dream consciousness is so different from waking consciousness that studying dreaming would reveal that consciousness has no underlying unity or form. In contrast, for Revonsuo, it is because dream consciousness has the same structure with waking consciousness in the absence of interfering external parameters that dreaming is an ideal model for consciousness studies. In particular, Revonsuo offers three postulates regarding dream experience (2006, pp. 55-56):

(i) The dreaming brain generates (or supports) phenomenal consciousness.

(ii) Phenomenal consciousness generated by the dreaming brain includes the full range of phenomenal contents.

(iii) Phenomenal consciousness generated by the dreaming brain has similar overall form and organization as phenomenal consciousness during wakefulness.

Revonsuo's postulates, except for some debate over (iii), are in fact more prevalent among dream researchers today than Churchland's understanding of the phenomenon. It is thus a good representation, if not a bit strong, of the overall conviction among researchers on the matter.

2.1.2. Depth vs. Breadth of Dreaming

One can raise a legitimate concern regarding the generality of the above characterizations of dream experience. Is dreaming a uniform phenomenon? What amount of variation exists among the population? On the one extreme, any mentation during sleep can be taken as a dream; on the other extreme, only the sleep mentation that

possible due to the invasiveness of the procedure. See Gott et al. 2017 for the current status of the research.

includes a perceptual structure akin to waking perception counts as a dream. Essentially, this concern boils down to the contrast between what Solomonova & Wei (2016) calls the *depth vs. breadth of dreaming*:

> In general terms, we propose that "breadth of dreaming" refers to the study of what is typical for dream content in a given population, while "depth of dreaming" would probe what is possible in the dream state (p. 408).

In particular, we can consider three issues related to the contrast. The first issue is related to what is common vs. what is possible in dreams. The second issue is the existence of atypical dreams i.e. lucid dreaming, OBE experiences etc. These issues can prompt us to consider whether there are any necessary and sufficient conditions to identify a conscious episode during sleep as a dream. I tackle this question in turn.

Soon after Descartes advanced his methodological skepticism based on the kinship between dream experience and waking experience, his contemporaries attempted to find clear cases of contrast between the two. For instance, in *An Essay Concerning Human Understanding*, John Locke claims that the experience of pain in waking is quite different than the experience of pain in dreaming. He invites Descartes to consider:

> I believe he will allow a very manifest difference between dreaming of being in the Fire, and being actually in it (IV.ii.14).

The question of whether phenomenal pain exists in dreams occupied the modern researchers as well. Studies suggests that phenomenal pain is also present in dreams as well as in waking life. For instance, in a laboratory study Nielsen et al. (1993) observed that somatosensory stimulation (a pressure cuff applied around 5 minutes to legs) applied during REM sleep resulted in a significant number (31%) of dream reports involving references to pain sensations (in a rather direct manner) and often bringing about emotional themes such as anger.

Pain notwithstanding, there is quite a bit of generality in the sensory modalities experienced during dreaming. According to analysis of dream reports and questionnaires, visual sensations dominate the dream scene by far, followed by auditory and kinesthetics sensations, while olfactory, gustatory, tactile, visceral and nociceptive sensations are rarely mentioned (Hobson et al. 2000; Okada et al 2005).

Another issue of dream experience discussed by the critics was the coherence of dream narrative. For instance, in Leviathan, Thomas Hobbes contrasts dream experience with waking experience in terms the notion of absurdity: in dreams, we do not employ the same kind of reflective thinking that we do in waking, resulting in an indifference to bizarreness.

> […] waking I often observe the absurdity of Dreames, but never dream of the absurdities of my waking Thoughts; I am well satisfied, that being awake, I know I dreame not; though when I dreame, I think my selfe awake (pt. I, ch. 2).

A similar point has been raised by Gottfried Leibniz, and also, later, by Bertrand Russell. Both philosophers emphasized the absence of a coherent narrative in dreams, and concluded this absence is a sign of contrast between dreaming and waking (1949 pp. 718-719; 1922, p. 95). Research done by Frederick Snyder, however, suggests otherwise: approximately 75% of dreams contain little to no bizarre elements (1970).

Last but not least, two aspect of experience in dreams also seem to be quite common among the general population: sense of self and sense of agency. Data show that the dreamer is a participant in the dream scene in more than 90% of dreams; in more than 70% of the dreams the dreamer is an active agent (Strauch and Meier 1992). A recent study that maps the type of agency (cognitive, motor, motor-athletic) onto sleep stages (onset, NREM, REM) shows that dream reports obtained after REM awakenings contain significantly more descriptions of higher motor and athletic-motor agency compared to after NREM and onset awakenings (Speth et al. 2017).

Neural correlates of lucid dreaming do not seem to differ substantially from the neural correlates of ordinary dreaming. In a landmark study, Siclari et al. (2017) identified activity of frontal brain regions with thinking and activity of parieto-temporo-occipital regions with perceiving, as one would expect (p. 875). He thus hypothesized that metacognitive abilities that are present during lucid dreaming might correlate with additional activation in the fronto-parietal cortex (p. 876). This finding is in agreement with the previous claims regarding the role of prefrontal regions in lucid dreaming (Neider et al. 2011; Stumbrys et al. 2013; Filevich et al. 2015). If this line of research is sound, then the difference between ordinary dreaming and lucid dreaming is one degree, not of kind. Of course, the question remains: How common is lucid dreaming? A study by Schredl et al. 2011 shows that in a representative sample of German adults (N = 919), 51% of the

participants reported that they had experienced a lucid dream at least once in their lifetime. Moreover, this frequency was higher among the female population. Interestingly, lucid dream frequency is negatively correlated with age. Non-biological factors like socio-economic states, however, seem to have no relation to lucid dreaming frequency.

Given these varieties of dreaming, is it possible to speak of a necessary and sufficient conditions for dream experience? In other words, what individuates dream experience? So far, we have discussed the similarity of overall form of dream consciousness with waking consciousness and the rich variety of conscious contents it might involve, including strong emotional contents. Taking these factors into account, Jennifer Windt (2015) offers the *Immersive Spatiotemporal Hallucination* model as a common denominator to all dream experiences. The model is made up of two components: spatiotemporal situatedness and affective immersion. Regarding the former, she writes:

> Spatiotemporal situatedness is a promising candidate for identifying the phenomenal core of dreaming for a number of reasons. To begin with, it suggests a unified and state-independent account of conscious experience, both in dreaming and in wakefulness. Much has been made of the perspectival nature of consciousness: conscious experience always seems to be tied to a perspective; it is inherently subjective (see Metzinger, 2003, pp. 156–162). Spatiotemporal self-location is a highly invariant property of phenomenal experience: though the phenomenal here and now as such are constantly shifting, they consistently form the center of the phenomenal world. Spatiotemporal situatedness can also be described as a particular kind of representational content, representing the spatial and temporal relation between the phenomenal self and the experienced world. (p. 521)

Regarding the latter, she writes:

> A similar point can be made about the emotional character of dreaming. Again, the key idea is that spatiotemporal self-location is a relative property: it allows us to experience our location relative to other persons and objects around us. The present model thus predicts that spatiotemporal self-location will be closely connected to emotions, which are themselves, after all, a fast and immediate way of gauging, perhaps via the perception of bodily changes (cf. sec. 2.2.2), events in the environment and determining our reactions to them. If dreams are essentially immersive experiences, it thus seems unsurprising that they will also be highly emotional: assuming that the feeling of presence is connected to our emotional susceptibility to ongoing events, the current model would predict that dreams should be almost consistently characterized by strong emotions—and this is precisely what newer studies suggest. (pp. 522-523).

While this characterization of the core properties of dream experience is weaker than what is suggested by Revonsuo's three postulates, it nevertheless overlaps with them to a great extent. As such, Windt's ISTH model is a fairly paradigmatic representation of dream experience as conceived by researchers studying dreaming. In the next section, we will attempt to dissect the underlying theoretical commitments of this model and discuss them in more detail.

2.2. Theoretical Commitments of Dreaming

The combination of received view$_1$ and received view$_2$ paves the way for what I will call the *standard conception of dreaming*. This section dissects the standard conception: it identifies two theses about dreaming and a corollary about mental states in general. I consider each in turn.

2.2.1. Equivalency Thesis

The received view$_1$ is a culmination of folk psychological biases regarding the mental component (m-component) of the standard conception of dreaming. This view can be expressed as an equivalency thesis:

> *Equivalency Thesis.* There is no first-person/introspectable quality that would differ between a veridical perceptual experience and a dream experience.

The first point to discuss regarding the above formulation is the legitimacy of the resemblance between perception and dreaming. Veridical perception is understood as a matching relationship between the phenomenal object of perception and the physical object in the world. Since the content of dreams does not seem to match with the actual world outside[15], dream experience can be conceptualized in terms of the other two perception-like experiences: hallucinations and illusions[16]. Traditionally, the received view$_1$ is understood as depicting dreaming as a species of hallucinatory experiences. In

[15] Yet perhaps they match with a possible world; but see O'Shaughnessy (2002) for an argument against it.

[16] Disjunctivist about perception would deny that perception, hallucination and illusion are of common kind. Since this objection is motivated by external concerns and finds little acceptance in psychology, I will ignore it. Regardless though, disjunctivist accounts of perception do not challenge the phenomenal equivalency of perception and hallucination/illusion.

contrast to veridical perception, hallucinatory perception occurs when there is no mind-independent object in the world that matches the phenomenal object of perception. Similarly, illusory perception occurs when the properties of the mind-independent object in the world are represented inaccurately in the phenomenal object of the illusion. As such, those who accept the received-view$_2$ conceptualize dream experience as hallucinatory, whereas those who reject the received-view$_2$ conceptualize it as illusory.

Let us begin with the hallucination and consider illusion as a special case of it. The hallucination view is most strongly defended by Antti Revonsuo:

> there is nothing in the experience itself, in the actual qualitative character of the experience, that necessarily distinguishes the dream experience from a corresponding perceptual experience in the waking state (2006, p. 82)

Revonsuo's take on the hallucination view underlies his *virtual reality metaphor of dreaming.* According to this metaphor, consciousness during dreaming is a structural replica of the consciousness during waking, thus a virtual reality is constructed by employing the purely internal resources of the brain in the absence of anything externally corresponding to these *seemings*. This is not accepted by all, at least not in its entirety. Wilhelm Wundt, for instance, claimed that at least some subset of dream experiences arises from the distorted *perceptions* of the sleeping body (1896). The so-called *Leibreiztheorie* (somatic-stimulus theory), popular in the 19th century until eradicated by Freud and his followers, advances the thesis that there is a strong causal relationship between the sleeper's body and environment and the dreamer's experiences.

Notice, however, that both the hallucination and illusion views agree on the perception-like quality of dream experience, so in essence they are no different with respect to the Equivalency Thesis. Now, the other way to conceptualize dream experience is in terms of imagination—a fundamentally different mental activity. Jean-Paul Sartre is one of the earliest figures in philosophy to propose the imagination model of dreaming (1936/2012). More recently, Colin McGinn offers a book-length treatment of the subject of imagination which presents a comprehensive list of contrast cases between percepts and images[17]. McGinn's model considers dreams as consisting of sensory images. For

[17] A different strand of imagination view has been advanced by Ernerst Sosa (2005) and Jonathan Ichikawa (2006). However, since this strand is primarily motivated with epistemic concerns, it does

reasons of space, I will not attempt a proper discussion of these cases here, but only mention them. Some of the results of McGinn's phenomenological investigation are (2006, pp. 12-32):

(a) that images are subject to will but percepts are not;

(b) that images are indeterminate but percepts are not;

(c) that images are attention-dependent but percepts are not;

(d) that images are attention-competitive but percepts are not;

(e) that images are evident but percepts are not;

(f) that images are not informative but percepts are;

(g) that images are not occlusive but percepts are.

On the subject of dreams, McGinn first entertains the possibility that dreams might constitute a third category, involving some elements of imagination but also other elements of hallucination.[18] However, this possibility gets discarded, as he concludes that possibilities of imagination can accommodate properties of dreaming, and as such, there are logical constraints not to posit a new category (i.e. Occam's razor; pp. 75-76). This might not be a proper application of Occam's razor; as Jennifer Windt argues, it is hard to characterize dreaming in one way or another while doing justice to the variety of dream experience. This being said, McGinn argues that all the properties of imagination are present during dreaming, except for (a). This exception, we will see, is the reason why there might be genuine beliefs during dreaming. Indeed, Sartre was puzzled by the issue of dream belief, writing:

> We will certainly be asked: how does it happen that you can believe in reality of dream images since it is you yourself who construct the dream as images. Their intentional nature as images should exclude every possibility to believe them to be realities (1936/2012, p. 212).

not deal nor bear a consequence on the issue of sensory content of dream experiences, which is what the Equivalency Thesis is concerned with.

[18] Some, in fact, defend this view; see Symons (1993).

McGinn's proposal for the solution of the puzzle, based on Sartre's earlier work, is the *fictional immersion* theory:

> […] the dream is a story –a piece of fiction- told in sensory terms (images), in which the dreamer becomes unusually deeply immersed (2006, p. 103).

In dreams, fictional immersion comes in overwhelming magnitudes, leading to the familiar emotional density we experience in dreams –at least as an impression upon awakening. Daydreams -another product of imagination- that we consciously will during waking do not create such strong emotional states, for example, either because we are unable to conjure images with intense emotional import or because we usually stop once it gets uncomfortable. Why then, are dreams different? McGinn's answer (and partly Sartre's) is that because "dream images are the product of an unconscious will" (2006, p. 90). While dreaming, a Freudian psychic split occurs; the unconscious part of the mind imagines the dream content, while the conscious part receives it. It is this hidden causation of dream images that leads the consciousness to take what it takes to be real. In this respect, dreams are on the same terms as delusions.

The Imagination View is not without empirical support. In particular, cognitive theories of dreaming advanced by Foulkes and Domhoff, and lesion studies investigated by Mark Solms align nicely with the imagination model. Three related lines of research are as follows: first, Foulkes' extensive studies on children's dreams suggest that the capacity for dreaming develops with age and in parallel to visual imagination skills in waking (Foulkes 1999). Second, imaging studies on dreaming shows that activity in visual processing centers in the brain resembles visual imagination more than visual perception: While in visual perception, processing in areas V1 and V2 are essential, under dreaming the activity is limited to V3 and V4 – same areas recruited during visual imagining tasks (Domhoff et al. 2015). Finally, lesion studies reveal the dependence of dreaming on visuospatial skills and on a specific network involving the limbic, paralimbic and association areas of the forebrain, as patients with lesions in these areas undergo cessation of dreaming (Solms 1997, 2000).

Notice that the phenomenological differences between perception and imagination as underlined by Sartre, McGinn and others, are often ignored in psychology. From the perspective of the cognitive sciences, the difference between imagination and perception is primarily about the information sources of the ongoing experience—whether it proceeds

top-down or bottom-up. Thus, for instance, Foulkes says that 'the pictures are sufficiently percept-like generally to lead us to believe, until the moment of our awakening, that we actually are seeing real events' (1978, p. 5). Likewise, recent findings of Nir and Tononi (2010) on the relationship between dreams and memory suggest that dreaming "might turn out to be the purest form of imagination" (p. 97). As such, the debate between dreaming as perception vs. dreaming as imagination does not necessarily have consequences for the Equivalency Thesis.

It should be mentioned that, regardless of the nature of dream experience, there might be further differences even within the same experiential category. Noë and O'Regan (2001), for instance, claims that dream 'perception' and waking perception are quite different phenomenally; while waking perception is stable and uniform, dream perception is unstable and contains gaps. They emphasize this point in defending their sensorimotor theory of visual perception against arguments from dreaming.

> "A hallmark of dream-like experiences is the unstable and seemingly random character of dreamt detail. For example, the writing on the card is different every time you look at it in the dream. This suggests that without the world to serve as its own external model, the visual system lacks the resources to hold an experienced world steady." (2001, p. 947)

Note, however, that this objection rests on key assumption: that during dreaming we are isolated from the world outside. Later on, Noë writes: "when we dream there is no dynamic exchange with the environment (although this might turn out not to be true)" (2004, p. 213). As such, regardless of the validity of their objection (which is discussed in more depth in chapter 4), we will now move on to discuss this key assumption that is, in fact, part of the p-component of the standard conception.

2.2.2. Dormancy Thesis

There is a long tradition in philosophy of mind of employing *a priori* methods to launch a conceptual defense against the equivalency thesis. Such defenses are employed in arguments against various skeptical challenges posed by thought experiments such as the *brain-in-a-vat*, *Matrix*, *evil demon*, *argument from illusion* etc. For instance, the disjunctivist about perception denies that veridical perception and hallucination/illusion are of common kind. In contrast, there has been little to no attempt to challenge the physical component of the standard conception of dreaming, to a large extent because we have

been limited to conceptual resources. The physical component can be expressed in the form of a *Dormancy Thesis*; as the Equivalency Thesis is based on the culmination of views expressed in the received view$_1$, the Dormancy thesis is based on the culmination of views expressed in the received view$_2$. Unlike the Equivalency Thesis, however, the Dormancy Thesis is made up of two sub-claims: (*a) Isolation Claim, and (b) Inaction Claim*, along with a conjecture regarding the uniformity of neural correlates of behavioral states. I will talk about this *Uniformity Conjecture* in detail in the next section. For now, let us tackle the Isolation Claim.

Our awareness of external events severely diminishes during sleep. Moreover, responsiveness to bodily disturbances are likewise minimal. Since dreaming takes place during sleep, one can say that dreaming occurs 'off-line'. What physiological mechanism underlies this condition? Traditional explanation employed in responsivity studies is that during sleep (in particular REM sleep), sensory information is blocked at the level of the brainstem by a physiologically hard-wired mechanism. Hobson's AIM model, for instance, directly employs this explanation, and philosophers theorizing on the subject often follow this line. Metzinger, for instance, takes dreaming show "how full-blown, complex reality-models can evolve from an exclusively internal stimulus source" (2003, p. 256). Likewise, Revonsuo takes it to be "a fact that some system strictly confined to the brain can present experiences where perceptual objects are related to oneself exactly as in the same manner as conscious visual perception" (2006, p. 143). We can summarize these views as such:

> *Isolation Claim:* the dreaming brain is isolated from the external world, including the body, so that neither sensory information nor sensory systems play any role in the formation of perceptual experiences during dreaming.

The isolation claim is closely related, and indeed, partly responsible for, the Inaction Claim. However, it is somewhat harder to express it. The difficulty resides in the inherent ambiguity of the term 'action'. While within philosophy of action, action is a technical term, and differentiated from mere behavior; in the broader psychological literature, however, actions can be intentional or unintentional, physical or mental. As such, these uses must be distinguished from each other. To begin with, note that most dreams are dominated by imageries/experiences of 'doings', and while the dreamscape may contain a range of mental occurrences, the primary content of dreaming is the representation of the dream-self's and other dream characters' imaginary activities and

the sensory experiences that are associated with these. Thomas Metzinger, for instance, claims that the majority of dreams include: “a fully embodied, spatially extended self, moving around in a spatially extended environment.” (2009, p. 135). Likewise, Antti Revonsuo claims that “our dreams are full of vivid bodily movement (2006, p. 90). Despite this, however, sleeping subjects display no sign of overt behavior under normal conditions[19]. This condition is explained by muscle atonia: while *motor commands* are generated by the brain, the body is under the effect of temporary paralysis during REM sleep. Studies done in the 1970s on cats, rats and other mammalians showed that muscle atonia that is present in ordinary sleep can be surgically removed, by applying lesions on brainstem regions, such as on lateral pontine tegmentum (Blumberg 2010). The effect of these lesions is such that the sleeping creature starts to exhibit seemingly purposeful behaviour, which was often thought to be as the dreamer acting out her dream. In humans, patients who suffer from REM Sleep Behaviour Disorder report their dreams to be quite intense and full of seemingly bodily actions. Furthermore, polysomnographic evidence shows that during sleep, the peripheral excitation observed in body parts correlate to some degree with the contents of dream reports. (Cherpillod et al. 1965).

What about covert behavior, or *mental actions*? Mental activities we engage in during waking consciousness range over quite a diverse list: planning, deciding, remembering, judging, assuming, entertaining, visualizing, imagining and such. Some elements of this list, in some weaker form perhaps, also seem to be present in dreaming (Kahan and LaBerge 1996). Most ordinary dreams seem to contain episodes of realizing, pretending, assuming and other variations of the waking mental life. Crucially though, these activities occur under a diminished reflective capacity. Do mental occurrences during dreaming involve agency then? Consider the problem through the lens of morality. One figure in history who was concerned with this was St. Augustine. Here is a version of Augustine’s nocturnal worry: when my dreams involve imagery of myself, committing acts that I take to be immoral, am I thereby morally responsible for the immoral acts I commit in my dreams? In Confessions Book X, Chapter 30 (pp. 233-34), he wrote:

> You commanded me not to commit fornication... But when I dream [images of fornication] not only give me pleasure but are very much like acquiescence to the act.

[19] Sleep-walkers and other parasomniacs excluded.

Augustine thought that the answer should be “no”. It is not clear why he thought so though3. The explanation he gives seems to be as follows: since his conscience was clouded during sleep, he simply did not commit any action—the dream merely happened to him.

> Yet the difference between waking and sleeping is so great [that] I return to a clear conscience when I wake and realize that, because of this difference, I am not responsible for the act, although I am sorry that by some means or other it happened in me.

The hidden premise here is this: moral responsibility requires agency, which in turn requires the capacity for reflection. One cannot be held morally accountable if one is not able to think through the act. In more contemporary terms, this implies a reflective model of control for intentional action. On a reflective model, I intentionally act by a sort of voluntary choice-making through introspection (Eilan & Roessler 2003). This seems to be what Augustine is denying: that he made a conscious choice to act in an immoral way. Thus, he is denying having a certain belief at the moment about making a conscious choice. Empirical work in this area follows the same line of argument to a large extent. Imaging studies reveal deactivation of dorsolateral prefrontal and inferior parietal cortices, which are thought to be correlates of executive/deliberate processes. These deactivations seem to explain the cognitive deficits experienced during the dream, such as the loss of self-awareness, critical thinking and memory availability (Hobson et al. 2000). Moreover, some scholars have started to consider dreaming along the lines of mind-wandering, an event that occurs via a default-mode network, i.e. a network of areas that correlate with restful, task-independent mental activities (Domhoff 2011; Wamsley 2013; Fox et al. 2013)

In short, despite the presence of rich perceptual experiences associated with imaginary bodily movements (i.e. *bodily imaginings*) during dreams, both overt and covert agency is absent during dreaming. This can be summarized as an *Inaction Claim*.

> *Inaction Claim:* the dreaming subject is overtly and covertly inactive, so that neither bodily nor mental agency play any role in the formation of perceptual experiences during dreaming[20].

[20] There is an interesting analogy between this way of conceiving dreaming and Nozickian *experience machines* (1974) -machines that generate experiences of doings without actual doings. Dreaming as such is an actual experience machine, except it involves whole array of experiences, not just pleasurable ones.

Notice that this raises a prima facie difficulty for action-based perception theories i.e. theories that claim that action is not only causally/instrumentally necessary for perception, but also constitutively necessary for it. I discuss these further in Chapter 3. For now, let us discuss an assumption underlying most studies on sleep and dreaming—indeed, most studies on neural correlates of consciousness in general. I take up this next.

2.2.3. Uniformity Conjecture

Early researchers were aware that certain sleep behavior indicated dreaming, such as the rapid movement of eyes in humans and bodily twitches in animals during sleep, but they lacked a method for capturing more fine-grained markers. In 1950s, researchers successfully used electroencephalographic recording over a full night of sleep and discovered the cyclic patterns of electrical activity in the brain, now known as Non-REM and REM sleep stages (Dement & Kleitman, 1957). This led to a hasty attempt to equate dreaming with REM sleep, given the intuitive association between the rich phenomenological features of dreaming and the wake-like EEG activity of the REM stage. Since then, such neurophysiological accounts of dreaming have dominated the field, in particular the work of Allen Hobson with his Activation-Synthesis Model. This model was the orthodoxy until Mark Solms' then-radical discovery: while it is true that REM sleep awakenings (i.e. awakening the subject shortly after the detection of paradigmatic EEG patterns) result in more dream reports as well as richer sensory and affective dream content, nevertheless, dream reports are also obtainable from after NREM awakenings. Moreover, subjects with lesions to brain regions that result in total cessation of dreaming (or obtaining dream reports) nevertheless do continue to REM sleep. As such, it is now clear that there is a double dissociation between REM sleep and dreaming (Solms 2000).

Nevertheless, efforts to identify neural correlates of dreaming continued. It is instructive to know how sleep stages are structured in physiology. Currently, the sleep-wake cycle, or the *sleep architecture*, is divided into five stages: Wake, N1 (onset), N2, N3 (slow wave) and R (rem sleep). The division is primarily based on characteristic EEG patterns. N2 occupies the majority of sleep, followed by stages R and N3. Stage R is further divided into phasic and tonic phases. While EEG activity during Wake and N1 is not entirely distinguishable, N2, N3 and R have their own characteristic patterns. N2 is distinguishable by the presence of sleep spindles and K-complexes—atypical bursts of EEG patterns that are thought to be associated with preserving sleep and consolidating

memories. N3, on the other hand, is dominated by high amplitude, low frequency delta wave activity. Finally, R shows a pattern quite similar to Wake with the difference of less stable frequencies over time. Experimental awakenings from REM sleep reliably produce high rates of dream reports—thus the characterization of REM sleep as dream sleep or paradoxical sleep.

How reliable are these segmentations of sleep stages based on EEG activity? Given Mark Solms' unexpected finding, researchers sought explanations. On one view, mentation during REM and mentation during NREM result from different *generator* mechanisms; on another view, a single *generator* mechanism associated with REM produces different (degraded) results during NREM stage. To reconcile these views, the *Covert Rem Sleep Hypothesis* has been offered by Tore Nielsen (2000).

> One possible reconciliation is that sleep mentation is, in fact, tightly coupled to REM sleep processes, but that some of these processes under certain circumstances may dissociate from REM sleep and stimulate mentation in NREM sleep in a covert fashion. This alternative conceptualization maintains a 1-gen assumption but couples it with an assumption of psychophysiological isomorphism. The same (REM sleep-related) processes are thought to be responsible for sleep mentation regardless of stage, even though in NREM sleep these processes may be activated in a piece-meal fashion and against an atypical neurophysiological background. Some REM sleep processes would thus combine in as yet unspecified ways with NREM sleep processes to produce unique profiles of NREM sleep physiology and intermittent occurrences of REM-like sleep mentation. The origin of these mechanisms in REM sleep events may explain observed similarities in REM and NREM mentation reports, while their dissociated nature may explain apparent qualitative differences. This model is in some respects similar to the 1-gen model in that it assumes commonality of processes for all mentation reports, but it differs in that it extends this commonality to physiological processes. The model is also similar in some respects to the 2-gen model in that it assumes psychophysiological isomorphism between sleep mentation and some features of sleep neurophysiology and in that it explains qualitative differences in REM and NREM mentation as a function of the dissociated quality of covert activation (e.g., piecemeal activation, atypical neurophysiological background). (p. 861)

Motivation for Nielsen's hypothesis is largely based on practical shortcomings of polysomnographic technology in discerning fine-grained transition intervals. Thus, it is quite plausible that further development in recording technology will alter the traditional understanding of sleep architecture in significant ways. (In chapter 5, I introduce recent findings in that area). In any case though, notice that the underlying assumption is that

brain activity in a given sleep stage is uniform over the cortex with respect to a given measurement criterion. This assumption is in fact not limited to sleep science. All neural correlates of consciousness studies are committed to the same assumption; in fact, this is a major component of how global levels of consciousness are defined. There are three basic behavioral states in consciousness studies (insofar as behavior is the indicator of consciousness): these are waking, deep sleep and rem sleep. These states are by definition mutually exclusive. As such, neural correlates of these behavioral states are taken to be distinct and distinguishable from each other on the basis of neurophysiological readings (e.g. EEG). The importance of this working assumption is to allow for the possibility to *individuate* these global states of consciousness by way of identifying their neural correlates. Thus, the conjecture can be expressed as follows:

> *Uniformity Conjecture:* neural correlates of dreaming are uniform in the sense that it is possible to individuate dreaming as a state of consciousness distinct from and mutually exclusive with other states of consciousness.

Indeed, gross EEG recordings show that they each exhibit a uniform and synchronous activity over the cortical regions. However, there is a caveat; with the introduction of high-density EEG, researchers are now coming to realize that co-existence of paradigmatic EEG correlates of behavioral states are in fact possible. I discuss these in chapter 5. Regardless, the uniformity assumption is a part of the p-component of the standard conception of dreaming.

Chapter 3.

Argument(s) from Dreaming

Given the standard conception of dreaming, one can raise an argument in favor of internalism against various externalist views of perception and perceptual experience. Let's begin by emphasizing the difference between *the dream argument* and *an argument from dreaming*. The former, most famously articulated by Descartes, argues for an epistemic conclusion: sense perception cannot provide knowledge of the external world. It is an argument based on the m-component of the standard conception, resulting from the *received view*$_1$ and can be expressed as the *Equivalency Thesis*. The latter, on the other hand, is an argument schema, or a collection of arguments, that is concerned with the vehicles of the very same phenomenon (i.e. the mechanism that generates the phenomenon), to argue for internalist conclusions in philosophy of mind and cognitive science. The argument schema below is one way to express it:

(1) If [ET] is true, then for all token mental phenomena M of the ordinary sort, M satisfies [C]

(2) There exist an M* such that M* does not satisfy [C]

———————

(3) [ET] is not true

In (1), the schema is substantiated by substituting an externalist theory of mental phenomena in place of [ET] and the associated externalist condition in place of [C]. Since the literature on externalism diverges with respect to its theoretical and empirical groundings, this would prove useful to express the views in question more faithfully. Next, (2) is the result of a commitment to the p-component of the standard conception of dreaming i.e. whatever [C] is, there exists a token dream phenomenon that does not satisfy it. In the following sections, I illustrate this by discussing three of such externalist

views: embodied, enacted and embedded mind theses. While these views are often mentioned as an all-in-one pack (along with extended cognition, i.e. 4E cognition), they are susceptible to an argument from dreaming in relation to the different parts of the p-component of the standard conception (though not necessarily independent of each other).

3.1. Against the Embodied Mind Thesis

To begin, I will use a more restricted understanding of Embodied Mind Thesis (henceforth EMT) than what is prevalent in the literature. *Embodied Mind* is an umbrella term that extends to capture various discussions of mental phenomena as strongly related to the subject's body. This relation can be in terms of a causal relationship or, more radically, a constitutive relationship. Since internalists do not deny the causal role of the body and environment in contributing to mental features of dream phenomena, my formulation of the embodiment thesis will be along in terms of a constitutive relationship, albeit I rely on the notion of mechanistic constitution I introduced in chapter 1.

Let us begin first with what it means to say that a mental phenomenon is *embodied*. This can be expressed as a condition:

> *Embodiment Condition (EmC):* A token perceptual phenomenon P is said to be embodied if there exists a mechanism M such that its constituent objects (set O) and activities (set A) contain at least one term referring to - what is typically taken to be- a bodily object and/or bodily activity, and M explains P.

Consider, for instance, the relationship between bodily senses (including visceral senses) and the perception of the immediate space around the organism i.e. the *peripersonal space*. Much has been done to discover the role of bodily processes in modulating the perception of this space, which in turn is essential for perception of the world at large[21]. While the precise relationship is yet to be discovered, what has been found so far can be taken to suggest that bodily processes are indispensable for external perception. In general, then, EMT claims that:

[21] See, in particular, Brozzoli et al. 2011, Seth 2013 and Couto et al. 2015.

> Mental phenomena (of ordinary sort) are only explained by mechanisms whose constituents involve parts and processes referring to -what is typically taken to be- a bodily part or a bodily process.

Now remember what the Isolation Claim says: dreaming occurs while the brain is isolated from sensorimotor processes. If so, however, then for a token dream phenomenon D, there exist a mechanism M (where O and A are subsets) such that M explains D, yet no bodily objects are members of O and/or no bodily processes are members of A. As such, an argument from dreaming against embodied cognition can be constructed in the following way:

(1) If [EMT] is true, then for all token mental phenomena M of the ordinary sort, M satisfies [EmC]

(2) There exist token mental phenomenon D such that D does not satisfy [EmC]

———————

(3) [EMT] is not true

Premise (1) follows from the EMT and EC. Premise (2) follows from the Isolation Claim of the Dormancy Thesis: since dream phenomena are constituted by neural objects and activities alone under the standard conception, the embodiment condition is not fulfilled.

3.2. Against the Enacted Mind Thesis

The ways in which an organism interacts with its environment using its body is taken to be essential for cognition and perception by the proponents of enactivism. Again, the relationship between the organism's actions and its cognitive system is understood as constitutive rather than causal (though this modest variant also exists. See for instance, Shapiro 2011). Traditional cognitive science treats cognition as 'sandwiched' between perception and action, where the latter two are taken to be peripheral functions of the mind -as Susan Hurley writes:

> On this traditional view, the mind passively receives sensory input from its environment, structures that input in cognition, and then marries the products of cognition to action in a peculiar sort of shotgun wedding. Action is a by-product of genuinely mental activity. (1998, p. 8)

Hurley identifies two assumptions that the traditional account is committed to:

> The first is that the relevant causal flows are primarily one-way or linear: in from the world through sensory systems to perception to cognition to motor systems to action and finally out to the world again. The second is that the relations between perception and action can be adequately understood as instrumental: perception is a means to action and action is a means to perception; they are merely mutually expedient. (1998, p. 10)

In contrast, enactivism rejects both of these assumptions. Now the first assumption i.e. one-way communication between perceptual and motor systems, is already challenged by various recent theories of motor cognition (see for instance, Jeannerod 1999 and Jeannerod 2003). More interestingly, and related to the current discussion, is the second assumption i.e. instrumental relationship between perception and action. Enactivism sees the relationship not as merely instrumental (causal), but also constitutive. Indeed, this point has already been made by Francisco Varela in the *Embodied Mind* (1991).

> […] if you talk about a machine with a feedback loop through the environment, so that the effects of the machine's output affect its input, you're actually talking about a larger machine that includes the environment and the feedback loop in its defining organization. Distributed processes can leak through boundaries: significant structure may be distributed not just within internal states but also across internal and external states. (quoted in Hurley 1998, p. 3)

In a similar manner, Evan Thompson emphasizes the role of agency for perception of the world as follows: "a cognitive being's world is not a pre-specified, external realm […], but a relational domain enacted or brought forth by that being's autonomous agency and mode of coupling with the environment" (2005, p. 407). Cognition (and perception), then, is enacted as it depends, constitutively, on the organism's interactive or exploratory activities. Again, let us start with clarifying what it means for a mental phenomenon to be enacted in mechanistic terms.

> *Enactment Condition (EnC):* A token perceptual phenomenon P is said to be *enacted* if there exists a mechanism M such that its constituent activities (set A) contain at least one term referring to -what is typically taken to be- an interactive or exploratory activity and M explains P.

Thus, we can state the Enacted Mind Theses (ENT) as follows:

> Mental phenomena (of ordinary sort) are only explained by mechanisms whose constituents involve activities referring to -what is typically taken to be- an interactive or exploratory activity.

Now, under the standard conception of dreaming, perceptual experiences while dreaming happens while the body lies dormant in sleep. Not only the overt behavior absent is, but many prominent theories of dream formation treat dreaming as an occurrent mental state involving some sort of mental apathy. There are two senses of inaction involved here. The first one is obvious: overt inactivity i.e. during sleep, in particular the REM stage, the body is paralyzed and muscle atonia takes place. The other is less obvious: covert/mental inactivity i.e. dream formation is independent of mental agency. For instance, under Hobson's Activation-Synthesis model, dream formation is the result of random PGO signal bursts originating from brainstem and propagating across the sensory cortex. Hobson later on modifies this account with his newer AIM model: higher brain regions attempt to 'interpret' these PGO bursts and hence, dream formation is the result of this interpretive activity (Hobson et al. 2000). Still though, interpretation here is not a mental activity but an automatic brain process. Thus, under the standard conception, during dreaming the subject is both physically and mentally inert i.e. the Inaction Claim. This claim serves to launch the following argument against ENT:

(1) If [ENT] is true, then for all token mental phenomena M of the ordinary sort, M satisfies [EnC]

(2) There exist token mental phenomenon D such that D does not satisfy [EnC]

———————

(3) [ENT] is not true

One aspect of enactivism must be clarified though. A prominent version of enactivism —*sensorimotor enactivism*— claims that perceptual experience "is something we do, rather than something that happens to us". This claim is qualified with a further

one, namely that “vision is a mode of exploration of the world that is mediated by knowledge of what we call sensorimotor contingencies” (Noe & O’Regan 2001), thereby emphasizing the role of sensorimotor knowledge arising from dynamic interactions with the environment, but the meaning of this claim is ambiguous. As Shapiro (2011) notes, this claim can be understood in two different ways:

> *Weak Sensorimotor Enactivism:* in order to have visual experience, the organism must have exercised the relevant interactions *in the past* to obtain the knowledge of sensorimotor contingencies involved.
>
> vs.
>
> *Strong Sensorimotor Enactivism:* in order to have visual experience, the organism must exercise the relevant interactions *in the moment* to obtain the knowledge of sensorimotor contingencies involved.

The strong variant is quickly disconfirmed by the existence of paralyzed subjects: people just don’t stop having visual experiences when they are no longer able to feel and move their bodies (not to mention that they don’t stop having dreams either!). The weak variant, on the other hand, while resilient to such counter-examples, is nevertheless susceptible to a *causal-constitutive error* i.e. the error of mistaking a causal relationship for a constitutive relationship. That is, under the weak variant, the actual interaction with the environment becomes a causal (etiological) story of how the relevant knowledge of sensorimotor contingencies are acquired in first place; yet if the knowledge of sensorimotor contingencies is to be constitutive parts of visual experience it should be instantiated *in the moment*. Now, if the possible range of perceptual experiences during dreaming is a subset of actual perceptual experiences one *had* during waking, then the existence of such experiences does not posit a difficulty for the weak variant of sensorimotor enactivism. If, however, one can have novel perceptual experiences during dreaming, then even the weak variant of sensorimotor enactivism has an issue: since these experiences occur in the absence of interaction with any sort of environment under the standard conception of dreaming.

A causal version of sensorimotor enactivism, while methodologically interesting, does not have the theoretical punch that its stronger sibling has. One strategy to save sensorimotor enactivism is to drop the emphasis on knowledge of sensorimotor contingencies and modify it to speak about the *facts* of sensorimotor contingencies. As Daniel Hutto writes in (2005): “it is not knowledge –not embodied know-how per se– that

gives perceptual experiences their character but facts about the nature of our embodiment in relation to particular active engagements. These are facts that we do not know and do not need to know in order to have experiences" (p. 401). According to Hutto then, it is because perceptual experience varies with the contingencies of the environment in a law-like manner that it has the characteristics it has[22]. However, it is not clear what distinctive aspect of Noe & O'Regan's account remains after this move, as the importance of interaction with environment is common to a variety of action-oriented (pragmatic) theories of cognition (notice the similarity between Hutto's revision and Gibson's account of perception). As such, my understanding of enactment thesis here does not necessarily depend on Noe & O'Regan's particular variant.

3.3. Against the Embedded Mind Thesis

If an organism's interaction with an environment is constitutive of its perception as these interactions form a coupled system of organism-environment so that the separation of two becomes impossible, then the next step is to consider the aspects of environment (i.e. environmental processes and properties) in which these interactions take place and are constrained by. This is the motivation of embedded approaches to mental phenomena. Rupert, in (2004), expresses the hypothesis of embedded cognition as such:

> Cognitive processes depend very heavily, in hitherto unexpected ways, on organismically external props and devices and on the structure of the external environment in which cognition takes place (p. 393).

Here the external props and devices can range from physical environmental props and devices to social and cultural artefacts and processes. In the mechanistic framework, embeddedness can be expressed as a condition regarding the mechanisms of perceptual phenomena:

> *Embeddedness Condition (EdC):* A token perceptual phenomenon P is said to be *embedded* if there exists a mechanism M such that either its constituent objects (set O) or activities (set A) contain at least one term referring to -what is typically taken to be- an environmental object or activity and M explains P.

[22] Hutto & Myin (2013) notes that covariance between perceptual experience and alteration of physical environment through action cannot be explained purely in internalist terms (i.e. brain-states) as one cannot derive content from mere covariance (what they call the *Hard Problem of Content*).

Given this formulation of embeddedness condition, one can construct an *Embedded Mind Thesis* (EDT) regarding mental phenomena:

> Mental phenomena (of ordinary sort) are only explained by mechanisms whose constituents involve either objects or activities referring to -what is typically taken to be- an environmental object or activity.

Now, the standard conception does not necessarily involve a claim to the effect that challenges the EDT directly. To the extent that the content and form of dreams are drawn from waking life, physical and socio-cultural aspects of the environment are building blocks of one's dreams (consider, for instance, the phenomenon of black&white dreams during the era of black&white television -see Schwitzgebel 2002). However, given the Isolation and Inaction claims together with the Equivalency Thesis, it can be taken to suggest that dreams are autonomous from one's waking life, sometimes expressed in the conventional wisdom that "anything is possible in a dream". In other words, the standard conception suggests that content and form of dreams are ultimately autonomous, and any influence through waking life is accidental (causal) rather than essential. This is because it treats the dreaming brain as a virtual reality machine; capable, in principle, of instantiating novel phenomenal experiences. This, in turn, allows us to launch an argument against EDT in the following way:

(1) If [EDT] is true, then for all token mental phenomena M of the ordinary sort, M satisfies [EdC]

(2) There exist token mental phenomenon D such that D does not satisfy [EdC]

———————

(3) [EDT] is not true

Now, unlike the arguments from dreaming against embodied and enacted mind, the argument here against embedded mind is arguably vaguer than the former two. This is partly so as embedded mind is a less discussed variety (of vehicle externalism) in the literature and well-defined theses are hard to come by (unlike embodied, enacted and

extended mind views which all have strong proponents and opponents). Regardless, if content and form of dreaming is autonomous in some sense from one's waking life, then the argument claims that these are not constitutive parts of one's mental life.

3.4. Offline Mental Simulations and Argument(s) from Dreaming Reconsidered

In chapter 1 I've mentioned that some authors claim that because vehicles of perceptual processing are externally constituted, character of perceptual experience is likewise externally constituted since the latter depends on the former. We should, however, consider the possibility that this is not so. In the context of dreaming, this implies that dreams might be phenomenally embodied even if they are not functionally embodied -what Jennifer Windt refers as the *Independence Hypothesis* (2015). If Independence Hypothesis is true, then these two do not depend on each other. The issue here, in other words, is whether embodied experience is something that can be simulated.

In dealing with this question, consider a parallel case. Varieties of externalist theses discussed above all assert that mental phenomena are intimately linked -in some sense of intimacy- with the body, action and environment. This assertion by itself leaves the nature of the link rather ambiguous, however. In particular, the link can be considered in at least two ways, as Andy Clark does in (2006):

> a) *Larger Mechanism Story (LMS):* "[…] aspects of body and world can, at times, be proper parts of larger mechanisms whose states and overall operating profile determines (or minimally, helps determine) our mental states and properties" (Clark, 2006, p. 39).
>
> b) *Special Contribution Story (SCS):* "[...] the specific details of human embodiment make a special and [...] ineliminable contribution to our mental states and properties" (Clark, 2006, p. 39).

Both stories acknowledge body as the locus of mind, yet they do so for different reasons. LMS depicts brain, body and environment as functionally defined elements of a mechanism that realizes cognitive processes (which result in mental states). It thus inherits the central thesis of functionalism in philosophy of mind: mental states are individuated on the basis of what they do, wherein what they do is independent of how they do it. Here the body, action and environment are crucial for the sort of computational profile they offer, but this computational profile does not necessarily require the actual

body, action and environment -the computational role played by these elements can be simulated. LMS thus is a sort of extended functionalism; instead of the vanilla one, it distributes the mental over the environment, but still treats it as multiply realizable in various kinds of media (its physical implementation).

There are a number of computational models that provide a sort of *existence proof* for simulation of processes that are seen as essential (for mental phenomena) by the proponents of embodied cognition. One such proof is offered by Rick Grush in (2003). Grush claims that construction of inner dynamical models can enhance the performance of tasks related to action and perception, and the computational resources of the brain are indeed capable of implementing these inner models. The models he talks of involve feed-forward control loops that can generate predictions of the perceptual and sensory consequences of actions performed by organisms, which helps to adjust online control of motor movements by comparing the actual feedback with the predicted one. Obviously, there's no reason why we are unable to use same model offline, and this is exactly what he claims to happen in motor imagery. Grush criticizes body-centric approaches to cognition as being limited to closed-control loops that are *too coupled* with the body and environment so as to prevent complex action-planning requirements of higher-level organisms. He further claims that studies of motor cognition show that such requirements do exist for humans[23].

[23] This latter, empirical, claim is true, but does not necessitate Grush's model. A motor imagery is a cognitive process that rehearses an action representation without executing its actual bodily movements. As such, it is argued that motor imagery (MI) and motor execution (ME) share similar representations and employ similar mechanisms in the motor networks of the brain. In particular, MI can be used to anticipate the actual consequences of carrying out the action in question. Furthermore, observing others' actions activates similar representations in motor network of the observer. Thus a simulation mechanism is posited, where action representations, of which contains a semantic -to represent goal states-, a kinematic -to assign the optimal movement variables-, and a kinaesthetic -to anticipate the outcome- component, are processed in relevant motor networks to anticipate its results. (Jeannerod 2006). As such, the conclusion is that action representations can operate off-line. In Jeannerod's standard motor simulation theory (2006), simulations activate the motor system in the brain (the same motor networks as in ME) during the processing of internal motor representations. Simulation in this sense confined to prediction of possible consequences. More sophisticated alternatives include the activation of memory and association centres that stores the sensory consequences of past actions. In particular, Barsalou's grounded simulation (2010) provides a mechanism where the rehearsal of action representations triggers multisensory associations that have been established along the course of past engagements with the world. Finally, there are models that also posit the simulation of sensory feedback, of which Grush (2004) is an example. Grush's (2004) emulation theory involves the activation of both motor and sensory systems during the processing of action representations, and thus offering a complete equivalency between MI and ME. While empirical studies support the simulation theory in general nevertheless,

More recently, a growing number of researchers are employing statistical methods to understand perceptual processing and experience. According to this approach, perception involves Bayesian inferences, often in the form of unconscious inferences that are similar in spirit to what was theorized by early psychologists like Helmholtz (1867). The main motivation for this view is that perception is underdetermined by the environmental stimuli available to the senses. Yet, our perception of the world is uniform and stable over time. Such characteristics of perception, Helmholtzians argue, can only be maintained by an inference-like procedure that involves prior hypothesis about how to world ought to be in order to fill the gaps left by suboptimal sensory data.

The motivation behind Helmholtz's claim is no stranger to philosophers of perception. Our access to the external world is often thought to be indirect i.e. mediated by our sensory system. Call this *indirect approach* or simply *indirect perception*. A common problem of perception, in the case of vision, can be expressed in terms of the relationship between the proximal stimulus—energy that impinges on our sensory receptors-—and the distal stimulus—the cause of that energy i.e. what is out there. Light reflected from objects creates a pattern of stimulation on the surface of the retina, which, ultimately is a 2d array of information. The perceptual system, in turn, must 'infer' a 3d scene out of these data. However, the available information is compatible with a wide range of alternative 'images', and somehow the brain must 'favor' a particular one out of this range. How does this process occur? Helmholtz thought that what happens is something equivalent to an unconscious inference, as he wrote:

> The psychic activities that lead us to infer that there in front of us at a certain place there is a certain object of a certain character, are generally not conscious activities, but unconscious ones. In their result they are *equivalent* to a conclusion, to the extent that the observed action on our senses enables us to form an idea as to the possible cause of this action (1867, p. 430; italics added)

To recap: what our brain is 'aware' is the effect on our sensory receptors. Given the effect, we must infer its likely cause. This can be considered as a mapping problem, though not all mappings are problematic. Assuming that the world is deterministic, we can relatively easily map certain causes to certain effects i.e. come up with a generative model $f : \mathrm{C} \rightarrow E$. However, in perception the process is inverted: we must come up with an

they do not necessarily determine the nature of the simulation process. See O'Shea and Moran 2017 for a comprehensive review.

inverse model that maps from effects to causes, f^{-1}: $\mathrm{E} \rightarrow C$. Since for any given effect there are a wide range of possible causes, this process is not trivial. In optics, it's called as the *inverse problem*. Bayesian equation provides a method to deal with the inverse problem.

$$P(object|\ sense\ data) \propto P(sense\ data\ |\ object)\ \times\ P(object)$$

Here, the task of the observer is to figure out the actual state of the world or an object in the world. However, the observer has no access to the actual state of the world other than its effect on her sensory system. In order to infer beliefs about states of the world (posterior), the observer can multiply the probability of her sensations given the state of the world (likelihood) with a belief about the plausibility of that state of the world (prior).

While Bayesian methods provide practical tools for empirical researchers, more theoretically motivated researchers saw an opportunity to hypothesize a certain model of the mind given its apparent implications. The apparent implication in this case is this: Bayesian inference works on the basis of some prior knowledge about the world. Since this knowledge is the precondition of posterior knowledge, it cannot be formed merely out of incoming data, or so the indirect approach assumes. Note that this assumption radically reverses to role of sensory data in making up perception: rather than driving consciousness, sensory signals are utilized to correct and update perceptual hypotheses about the world. In other words, perception is driven by top-down influences rather than bottom-up signals. The reversal of perceptual processes from bottom-up to top-down brings about a profound impact on the epistemology of perception. Some have taken this reversal as a support for a Kantian framework, which asserts that perception is constructed from the conceptual capacity of the mind:

> Predictive Coding Theory presents us with a view of perception as a Kantian in spirit, "spontaneous" interpretive activity, and not a process of passively building up percepts from inputs. In fact, the bottom-up signal that is propagated up the processing hierarchy does not encode environmental stimuli, but only signifies the size of the discrepancy between the predicted and actual input. On such a view, although the world itself surely affects perception—after all, the size of the bottom-up error signal is partly dependent on sensory stimulation—its influence is merely corrective and consists in indirectly "motivating" the system, if needed, to revise its perceptual hypotheses. (Gladzeijewski 2016, p. 16)

Predictive coding theory offers a representational framework to think about how the mind forms hypotheses (statistical estimates) that fits to the world outside. The locus of the theory is the *principle of prediction error minimization*, which Bayesian inference offers one method to do so. In the case of dreaming, predictive coding implies that one might be under an offline simulation such that embodiment is *simulated* rather than physically realized. With this in mind, Clark argues that:

> Systems that know how to perceive an object as a cat are thus systems that, ipso facto, are able to use a top-down cascade to bring about the kinds of activity pattern that would be characteristic of the presence of a cat. […] Perceivers like us, if this is correct, are inevitably potential dreamers and imaginers too. Moreover, they are beings who, in dreaming and imagining, are deploying many of the very same strategies and resources used in ordinary perception. (Clark 2013, p. 764)

More generally, Hobson et al. (2014) argues that "the waking brain engages with the world to predict the causes of sensations, while in sleep the brain's generative model is actively refined so that it generates more efficient predictions during waking" (p. 1). This claim rests on a number of questionable empirical assumptions: (i) that dreaming is a REM sleep phenomenon, (ii) that during REM sleep the brain is free of the task of interpreting exogenous sensory signals and (iii) dreams are primarily tasked with learning through threat-simulations[24]. Regardless, the task of refining the generative model amounts to -on the phenomenal side- a virtual reality of waking (embodied) consciousness. Another author motivated by this view is William Domhoff in (2017), where he characterizes dreams as *embodied simulations*. Domhoff's understanding of embodiment in this context seem to be limited to re-enactment of sensations related to embodied experience. Unlike the predictive coding variant, however, here the re-enactment draws its sensory material from memory and learned associations (which makes it similar to Barsalou's take on motor imagery).

Now if LMS is true and simulation is nomically possible, then the impact of arguments from dreaming against externalism is significantly hampered, for it suggests that EmC, EnC and EdC can be instantiated through simulation. There are good reasons,

[24] See also Revonsuo 2000.

however, to see LMS as, first, not a proper explication of embodied cognition and, second, not a nomically possible way of realizing mental states[25].

Let us return to the first issue. Consider L. Shapiro's concern with LMS:

> If embodied cognition is to earn its reputation as a new and fruitful approach to psychology, should it not be doing more than reminding us that psychological processes can be implemented in a variety of ways and that the investigation of cognition can proceed independent of attention to implementational details? (2019, p. 9)

Shapiro sees LMS as committed to what he calls *body neutrality* -an extreme form of disembodied cognition. Clark's view implies that embodied cognition is primarily about implementation of mental processes rather than the processes itself. For Shapiro, on the other hand, embodied cognition should make it "possible to predict bodily properties on the basis of an examination of mental properties and vice versa" (2019, p. 5). This, in other words, rejects the Seperability Thesis I've mentioned earlier: psychology and physiology can, under an embodied approach, be studied together. Shapiro reviews a variety of experimental studies, which I will not go through here. Important to note here is that Shapiro's position comes with a price that might be too much to pay: he claims that "Special Contribution Story works best when attributing to the body a simple causal influence on cognition" (2019, p. 12). He further clarifies:

> The body shapes cognition, but mainly in the sense that its properties dictate the manner in which interactions with the world must take place, which in turn creates associations that determine the qualities of preferences. Simply put, human experience with the world comes about through the body's actions on the world, and the history of success and failure of these actions, which will depend on our capacity to manipulate our particular bodies as need be, has the potential to create all manner of associations.

Shapiro sees the distinction between causal vs. constitutive as arbitrary, and so for him, framing the role of body in causal terms does not threaten the theoretical punch of embodied cognition in a significant way. This is not shared by most in the externalist camp, however. A proper analysis of causal vs. constitutive relationships is beyond the

[25] This latter issue is motivated by more or less the same concerns that turned many philosophers away from functionalism and I will not rehearse them here.

scope of this work; in the present context, I will assume the distinction is genuine and reason accordingly.

Are there no other alternatives than LMS vs. SCS? One might suspect that Clark is positing a false dichotomy and that Shapiro is following suit. On the one hand, proponents of LMS rightly demand to know what is so special about biological entities -since they themselves seem to be made of microscopic mechanisms. On the other hand, proponents of SCS rightly point out to the fact that biological entities are able to do something that no other kind of entity seem to be capable of doing as far as we know -so we have no reason to suppose the LMS, other than fancy thought experiments whose presuppositions are highly dubious.

There might be a -sort of- middle ground, however. To see this, consider Thomson & Cosmelli's interpretation of the *brain-in-a-vat* thought experiment (2011)[26]. In the thought experiment, we are to imagine a human brain surgically removed from the host body while keeping the nerve endings where input and output connections are made intact. The brain is then preserved in a vat and input/output ports are hooked to a computer. The computer provides sensory stimulation for the brain through input nerves and alter the world simulation it runs by taking the motor commands from the output nerves. Thus, while the brain has lost its host body, it now has a virtual body in the form of a computer simulation, since all there is to a body is to act as a sensorimotor interface. Since the thought experiment is *conceivable*, it shows the validity of Minimal Substrate Thesis: brain states alone are sufficient for conscious experience.

Taking their inspiration from Dennett's remark that impossibility in practice is sometimes more interesting than possibility in principle (Dennett 1991), Thomson & Cosmelli (2011) elaborate on what kind of an engineering task the envatment process would be. First, consider that the brain needs to be kept alive: this means that an adequate circulatory system must be hooked to it. Second, the brain is not a reflex-machine: this means that its intrinsic activity must be able to modulate the working of its circulatory system. These two requirements already suggest that the brain's activity will be tightly

[26] To be clear, the debate between Clark and Shapiro above is over cognition, while Thomson & Cosmelli's work here is about consciousness. Still, the issue of perception -which is in focus here- overlaps both with issues about cognition and issues about consciousness, so as to justify the shift here.

coupled with its life-support system. The remaining task is to run an adequately responsive world simulation: that means the simulation needs to be able to update itself with respect to motor efference signals it receives from the brain and feedback the matching sensory reafference signals. Furthermore, it needs to be able to do it in way that the brain normally receives sensory signals: stimulation on the nerve endings should mimic the stimulation it normally receives from the peripheral nervous system. Finally, the stimulation device should run in harmony with the brain's life support system; it must be constructed and connected in a fail-proof manner or else there's always a risk for fatal system crashes. When these and possibly more of such concerns are taken into account, it becomes apparent that "any adequately functional 'vat' will be a surrogate body" (Thomson & Cosmelli 2011, p. 172).

How is this a middle ground between LMS and SCS? First, it acknowledges the key LMS concern that there is nothing mysterious about biological matter. Second, it acknowledges the key SCS concern that having a body is the only, *ipso facto*, way of having consciousness. The authors remark that "we don't mean a body like ours in its material composition, but one sufficiently like ours in its functional organization" (2011, p. 172). The vocabulary of mechanistic constitution we relied on so far allows us to explain this more clearly. When extended cognition claims that mental states are extended into the world, it relies on an understanding of material constitution i.e. mental states are materially constituted by entities beyond the extent of the brain. However, proponents of SCS can acknowledge the role of body and environment by employing an understanding of mechanistic constitution i.e. mechanisms that explain mental phenomena are constituted by entities beyond the extent of the brain, while still being committed that mental phenomena is materially organism-bounded. What does this say about the issue of simulating embodied experiences without actual embodiment? A similar line of thinking can be applied here. While the material substrate required for simulation might be brain-bound, an explanation of simulatory mechanisms might not be possible in brain-bound terms alone. At the end of the day, a proper defense of SCS against LMS is, likewise, beyond the scope of this work, and I assume that the externalists theories I consider here have commitments similar in spirit to SCS spirit, albeit in a (mechanistically) constitutive manner.

Chapter 4.

Dreaming and Sleep

In the previous chapter, we have raised a number of arguments against vehicle externalism through standard conception of dreaming. Assuming these and potentially other such arguments are valid, what options are there for externalists to resist their conclusion? This question will be dealt in this chapter. I begin by discussing the obvious alternative: rejecting the perceptual equivalency between waking and dreaming i.e. the *Equivalency Thesis*. I've already mentioned some of the previous attempts at this in Chapter 2, and stated that I do not see them as viable. Here I will also explain why this is so. After that, I will move on to discuss the other option: rejecting the Dormancy Thesis. In order to do this, however, first we must clarify a potential confusion regarding the phenomena to be explained by externalism, and second, we must identify the correct dependency relationship between dreaming and sleep. After doing these, I finish the chapter by offering an argumentative strategy to deal with the aforementioned internalist conclusions.

4.1. Against the Equivalence Thesis

Challenges toward the perceptual equivalency of waking and dreaming may come from two directions, one conceptual, the other phenomenal, though they are interrelated. That is, a challenge can start with a phenomenal investigation and end up with a conceptual verdict, and vice versa, it can start with a conceptual analysis and end up with a phenomenal verdict. Ultimately, however, we will see that while conceptual challenges end up being irrelevant, phenomenal challenges end up being inconclusive.

a) One such conceptual challenge is to put forward a conceptual distinction between imagination and hallucination and claim that dreaming is more akin to imagination. This is because while imagination is *constructive*, hallucination (and perception in general) is *receptive* and the standard conception of dreaming says that dreams result from endogenous brain processes.

b) Another potential conceptual challenge is to deny that veridical perception and illusion/hallucination are of *common kind*. Disjunctivists about perception interpret

statements like ‘I’m seeing a cat’ as ‘either I’m seeing a cat, or I am hallucinating a cat -hence the name, *disjunctivism*. Again, this does not imply a phenomenal difference between seeing a cat and hallucinating a cat, but it does imply, for the disjunctivist, that these are different kinds of mental states.

c) Regarding the phenomenal challenges, one such challenge is to deny that dream experiences are hallucinative (a species of perceptual experience) and claim that they are imaginative. This sort of challenge starts from investigating dream phenomenology, but ultimately ends up with a conceptual judgment. As I mentioned in chapter 2.4, some philosophers, including Sartre, McGinn and Thompson, claim that phenomenal properties of dreaming reveal that it is more akin to imagination than hallucination; for instance, images are evident and non-informative, but percepts are the opposite.

d) Another such challenge is to claim that dreaming and waking, while belonging to the same experiential category, are nevertheless still so highly different from each other such as to warrant judgments of equivalency with waking perception. As mentioned in chapter 2.4, authors like Alva Noe point out to the differences in visual experience between waking and dreaming i.e. while waking vision is stable and coherent, visual experience in dreams is taken to be unstable and fragmented.

Now, with respect to (a) the distinction does not necessitate a phenomenological difference and, in general, judgments on phenomenology on the basis of this distinction are not regarded well in psychology and cognitive sciences. From the perspective of these sciences, the difference between imagination and perception is about the causal origin of information that goes into the perceptual experience i.e. whether it is top-down (endogenous) or bottom-up (exogenous). Furthermore, as discussed, recent work in predictive coding and cognitive penetration of perception blurs the line between constructive and receptive aspects of perceptual experience.

With respect to (b), the question for disjunctivists is to explain why veridical perception and illusion/hallucination are phenomenally identical. For the critics of disjunctivism, this is easy: they seem the same because their vehicles are the same, or highly similar at least. As such, if veridical perception and illusion/hallucination are different

kinds of mental states, it is not because of their vehicles, but some other justificatory consideration that does not have any consequence for vehicles of the phenomena.

That leaves us with phenomenal challenges, (c) and (d), and I do not see a strong prospect with such challenges targeting the Equivalency Thesis. And here the reason is methodological. Note that any analysis of dream phenomenology is going to be on the basis of dream reports i.e. what is reported by the subject upon awakening. As such, there is an issue of reliability -how reliable are these reports in establishing claims about dream phenomenology? Indeed, those who claim that dreams are not conscious experiences that happen during sleep, like Malcolm (1956), based their rejection precisely on this. However, this is not what I am claiming i.e. I do accept that dream reports are good sources to show that dreams are conscious experiences, but I reject that they are good sources for assessing phenomenal equivalency between dreaming and waking.

Let us recall the original criticism toward dream reports. Malcolm claims that it is only on the basis of dream reports we can talk about how dreaming is, and as such, there is a conceptual link between dreaming and dream reports. Since dream reports are unverifiable, so is the assumption that dreams are conscious experiences that happen during sleep. Malcolm dismisses the scientific research on dreaming as irrelevant to the conceptual problem. On the opposite end, there is Dennett (1976) who claims that dream reports are irrelevant and builds up an alternative model—the so-called cassette theory—that can explain the impression that one has dreamed without making it necessary that dreams are conscious experiences. According to this theory, the content of a dream is composed unconsciously by the brain during sleep and loaded into memory only at the moment of waking. The upshot of this is that there is no conscious experiencing of the dream, or in Dennett's words, "it is not like anything to dream, although it is like something to have dreamed" (p. 161). The cassette theory is in fact a sort of parody, illustrating that without scientific results to settle the issue, conceptual work can take any route. Malcolm and Dennett, thus, represent two extremes over the issue: for the former the issue is entirely conceptual, for the latter it is entirely empirical.

In (2015) Jennifer Windt attempts to reconcile these two alternatives. Windt believes that Malcolm is right for emphasizing the conceptual link between dreaming and dream reports, and Dennett is right that scientific dream study is paramount in settling the issue—but not without a theoretical foundation. She offers a theoretical foundation by

establishing a positive link between the phenomenon of dreaming itself and the subsequent dream reports. At the heart of Windt's antiskepticism lie three working assumptions. First, dreams could be phenomenally indistinguishable from waking (*experiential assumption*). Windt supplements this with the *transparency assumption*: dream reports are epistemically transparent—they are trustworthy indicators of the occurrence of the dream experience. Combining these with the *reportability assumption* which states that dreams are truthfully reportable experiences after waking, Windt wants to advance a methodological framework in which dreams are conscious episodes during sleep as evidenced by transparent dream reports. Note that these are called assumptions—not conceptual truths or empirical hypotheses. Windt claims that no independent evidence for these are forthcoming from dream research (2015, p. 155). Rather, she argues that they lay the foundation for the possibility of empirical dream research in the first place. For instance, finding the neural correlates of dream experience requires contrasting dreaming and non-dreaming, and this requires, in turn, accepting dream reports as trustworthy. As she puts it, "the scope of scientific dream research is determined by the combination of transparency and reportability assumptions under *ideal reporting conditions*" (2015, p. 166, emphasis added). However, the ideal reporting conditions that Windt speaks of are not quite clear. Certain elements, such as reporting right after waking according to an experimental protocol, are there. But as Windt acknowledges, the definition of ideal reporting conditions is quite vague and open to empirical refinement. Now, the ideal reporting conditions determine the validity of the reportability assumption—that is, the reports of dreaming can be taken at face value only under these ideal reporting conditions. If so, however, given that these conditions are to be empirically discovered, we are faced with a possible circularity in Windt's account.

Regardless, Windt urges us to view these assumptions in a different light as well: inference to the best explanation (IBE). The fact that people report having a dream upon waking is best explained by taking dreams to be experiences (2015, p. 145). Windt's defense can perhaps be anticipated. She begins by pointing to the elephant in the room—why we report that we have undergone various sensory impressions after waking—and from there builds up a comprehensive IBE account of dream research—something that philosophy failed to provide. On the other hand, Windt's antiskepticism is also empowered by another sort of consideration: that denying the transparency of dream reports would entail denying the first-person reports of conscious experience in general. One may not

find this convincing, however. For instance, a lot has been done to improve the first-person reporting conditions in the neurophenomenological tradition, and these are based on reporting the experience as it happens, in real time. It is not obvious that these techniques can be straightforwardly applied to dream reports, since simultaneous reporting is not possible. Nevertheless, this may not be a major problem, since Windt's antiskepticism only tries to establish the modest claim that dreams are conscious experiences. And if she is right about this, then still, from the fact that dreams are conscious experiences, it does not follow that they are *such and such* conscious experiences. That is, dream reports are still unfit to establish claims about detailed phenomenal properties of dream experiences, at least given that there is, at the moment, no consensus on *ideal reporting conditions*. Thus, my point stands: challenges toward the Equivalency Thesis are not methodologically viable at the moment, and this should motivate us to find an alternative strategy to deal with internalist conclusions arising from dreaming. That alternative strategy is to challenge the Dormancy Thesis, either in its entirety or some part of it. I discuss this next.

4.2. Setting the Stage for Alternatives

How does one show that the Dormancy Thesis is unsupported —and possibly refuted— by the available body of research? Note that the Dormancy Thesis is a thesis about the vehicles of dream phenomena. First, however, we need to get clear about the phenomena to be explained. Consider the different grammatical constructs with which we describe someone having thoughts, feelings, images and such during sleep. Someone, who's from her sleep behaviour (say, through observing her sleep-talk) we infer that she is having a conscious episode we say, 'she is dreaming'. Upon waking, we might ask her about her dream and receive the answer that 'I was dreaming of my cat'. Thus, we have two grammatical constructs regarding how to describe dream phenomena: *dreaming* and *dreaming that X*. These two different grammatical constructs capture a difference between two types of mental states one undergoes during sleep. How to characterize these states? And what is the relationship, if any, between them?

In general, talk of mental states (and, as such, phenomenally conscious states) seem to admit of at least two aspects: a local aspect, in which the mental state in question is individuated by its content e.g. perceiving that the coffee mug is blue, and a global aspect, in which the mental state in question is individuated by the enabling conditions it presents for the local aspect to take place e.g. being awake so that one can perceive that

the coffee mug is blue. Thus, a different way of characterizing local mental states is that they are *content-involving*; a different way of characterizing global mental states is that they are *content-enabling*. Some examples of local mental states are perceiving that X, believing that X and etc.; some examples of global mental states are being awake, being comatose and etc. While local mental states are individuated by their content, global mental states are individuated with respect to a variety of properties that made up the aforementioned enabling conditions. Bayne et al. (2016) identify two kinds of dimensions that might differentiate one global state from another. With respect to content-related dimensions, global mental states differ from each other by way of how they gate mental content. For instance, comatose patients produce no fMRI response to spoken speech while patients emerging from minimal conscious states do so, but not to its semantic content; likewise, mildly sedated patients are able to identify low-level properties of perceptual objects while not being able to categorize these objects and etc. With respect to function-related dimensions, global mental states differ from each other by way of how they regulate mental functions. For instance, patients undergoing absence seizures can exhibit perceptually driven motor responses while being unable to exhibit higher-order mental functions like reasoning, planning and etc.

An important question is about how local mental states are related to global mental states. In other words, how should the dependency relationship between these two aspects of mental states be formulated? For this purpose, consider how a local mental state is realized. In the study of consciousness, a distinction is made between the core realization and total realization of a given (conscious) local mental state. The general idea is that, “core realization of a property or a capacity suffices for that property or capacity only when placed in the context of a larger system that constitutes the total realization” (Wilson 2001). Those who claim that there are neural correlates of consciousness typically identify the core realizing system with the minimal supervenience base for a (conscious) local mental state -the system that varies as the content varies (Block, 2005). In other words, fixing the core system fixes the content of mental state. The system, of course, is the brain, sometimes qualified further as the cortex. The cortex, however, cannot realize a local mental state unless appropriate enabling conditions hold (it needs intact thalamus and brainstem functioning, for instance). These enabling-conditions are properties of the global mental state a subject is in. The system that realizes a global mental state, then, is the total realizing system. In the parallel terminology of state vs. creature consciousness

(Rosenthal, 1986), it is the system that is made up by the neural substrates of creature consciousness. As noted by Thompson and Cosmelli (2011), this is still incomplete as a mechanism responsible for mental phenomena, since neural substrates of creature consciousness are sustained by appropriate functioning and influence of non-neural body parts and environment. These can be referred as *background-conditions*. The debate between internalism and externalism, then, is a debate about what is the minimal supervenience base for mental phenomena, such as perceptual experience. For the internalist, this is the core realizing system; for the externalist, this is the core realizing system plus whatever aspect of body and environment they see constitutive for perceptual experience i.e. enabling-conditions and background-conditions.

Now I do not offer a precise analysis and formulation of the relationship between local and global mental states here. Indeed, I don't have it. Instead, I will offer some broad observations. The first relationship we can observe between local and global mental states is (ontic) *dependence*. Put simply, there are no free floating local mental states, and whenever a local mental state is instantiated, a global mental state is also instantiated. To perceive the coffee mug, one must be in a particular global state that instantiates appropriate enabling-conditions, say, one must be awake. The second relationship we can observe between the two is *covariance*. That is, properties of one's local mental state covaries with the properties of one's global mental state. For instance, if one is undergoing absence seizures, one cannot have higher-order perceptual thoughts and vice versa, if one is having higher-order perceptual thoughts, one is not undergoing absence seizures.

These observations, when taken together, can pave the way for supervenience claims. However, as mentioned in the first chapter, supervenience does not directly translate into (mechanistic) constitution. To make a constitution claim, the condition of *lower-order description* must be satisfied as well i.e. the entity that does the constituting should be described at a lower level than the entity that is constituted by it. And as such, while local states depend and supervene on global states, they are not (mechanistically) constituted by them, because the global mental state is not described in a lower level than the former - both can be described at the behavioural level, for instance.

With these remarks, let us return to the subject matter. As the preceding discussion suggests, two aspects of dreaming, expressed by the *dreaming* and *dreaming that X*, can be understood as dreaming as a global mental state and dreaming that X as a local mental

state. Call these *dreaming*$_{global}$ and *dreaming*$_{local}$, respectively. I have discussed local vs. global mental states and the relation between the two for the following reason: the explanatory target regarding dream phenomena is not dreaming$_{local}$, but dreaming$_{global}$. That is, the issue is not how it is possible to have this or that conscious content during sleep, but how it is possible to have this or that conscious episode. This is because vehicle externalism does not deal with contents of mental states -at least not directly; rather, it deals with the mental capacities or functions of the organism i.e. in virtue of what sort of relationships does the organism achieve or exhibit these capacities. As such, vehicle externalism is primarily in the business of explaining global mental states, and insofar it is required to explain dream phenomena, it is required to explain dreaming$_{global}$. Now, to give an explanation for dreaming$_{global}$, we need to characterize its relationship with sleep. But first, let us start with the relationship between *dreaming*$_{global}$ and *dreaming*$_{local.}$ Given the relationships we identify between local and global mental states, there is indeed a dependency relationship between dreaming$_{global}$ and dreaming$_{local}$ -the latter depends on the former. However, we cannot say that this dependence relationship is one of constitution, since dreaming$_{global}$ is not a phenomenon described at a lower level than dreaming$_{local}$, and hence it doesn't explain it. But consider how dreaming$_{global}$ is individuated. Notice that, if the Equivalency Claim is true, this cannot be on the basis of how it gates or structures conscious content, since these characteristics will be shared with other global mental states (e.g. being awake and perceiving). The distinctive characteristic of dreaming$_{global}$ is derived from its relation to its realizer system: sleep neurophysiology. If so, however, this would give us a constitutive supervenience relationship between psychological properties of dreaming$_{global}$ and neurophysiological properties of sleep.

> (properties of) dreaming$_{global}$ constitutively supervenes on the (properties of) sleep neurophysiology

If so however, by way of transitivity, we can say that:

> (properties of) dreaming$_{local}$ constitutively supervenes on the (properties of) sleep neurophysiology

This relationship is crucial for a rejection of the Dormancy Thesis (or some of its parts). If the realizer system of global-dreaming is not entirely constituted by the brain, that is, if the explanation of the realizer system of global-dreaming is not entirely based on properties of the brain (i.e. brain states, brain structures, brain processes etc.), then by

way of dependence the realized phenomena cannot be taken as constituted by properties of the brain alone. This, in turn, justifies a sleep-centric approach to deal with internalist concerns arising from dream phenomena.

4.3. Against the Dormancy Thesis

Recall the claims that made up the Dormancy Thesis i.e. the *Isolation Claim*, the *Inaction Claim* and the *Uniformity Conjecture* that supplement these. In order to challenge the Dormancy Thesis, then, one might attack one or more of these claims. For instance, in order to challenge the view that dreams occur in a state of functional disembodiment, Jennifer Windt calls the Isolation Claim into question (2015). That is, while dreamers are not anatomically disembodied, nevertheless, if dreams occur as a result of purely brain processes in the absence of any sensory information from the environment, then they can be seen as functionally disembodied. Windt then goes on to survey studies of awareness of external stimuli during sleep and sensory sources of dream content. Such studies do show, without doubt, that the sleeping brain is not entirely isolated from the real body and environmental inputs (I review some of these in the next chapter). As such, she puts forward a *Weakly-Functional Embodiment Hypothesis:*

> Dreams are weakly functionally embodied states in that the processing of real-body inputs and the production of motor out- puts are attenuated, but not completely absent, in the dream state, and in that a majority of bodily experiences occurring in dreams are best understood not as arising independently of the physical body but as illusory perceptions of the sleeping body (p.383).

One can employ a similar approach with respect to the remaining components of the Dormancy Thesis. For instance, in a similar manner, by bringing forth the studies on sleep twitches, rem-sleep behavior disorder and mental agency during sleep, one can challenge the Inaction Claim and put forward a *Weakly Functional Enactment Hypothesis*. Does this mean, then, that by relying on such studies of 'existence', we can thereby prove that dreaming is embodied or enacted, albeit perhaps weakly?

Here lies the importance of getting the terms of the debate right; the direction of causal influence does not, by itself, show that dreaming is embodied or disembodied (functionally, weakly, strongly etc.), because the issue for the externalists is not about the causal origin of this or that perceptual experience. Causal influence of body and

environment is not a matter of debate between the two camps. Externalists are tasked with the constitutive question. The constitutive question is about why dream phenomena exhibit those characteristics i.e. are these essential characteristics of the dreaming state (in some, non-technical sense of 'essential') or simply its accidental features? This requires articulating a mechanism whose behaviour correlates with the observed characteristics of the phenomenon. Articulating such a mechanism, in turn, would require engaging with the underlying neurophysiology of sleep, beyond the studies of awareness of external stimuli during sleep and sensory sources of dream content. That is, if dreaming is embodied (or not), it is because the underlying neurophysiology of sleep is constituted by mechanism(s) that involve bodily and environmental processes (or not).

Now, of course these studies are paramount in dealing with internalist conclusions arising from argument(s) from dreaming, but their role and usage should go beyond providing mere 'existence proofs'. That is, they can help challenge the standard conception and foster an alternative, perhaps an externalist conception of dreaming, but doing so requires delving further into sleep neurophysiology and its underlying mechanisms. And notice that:

> Sleep is a global state, the control mechanisms of which are manifested at every level of biological organization, from genes and intracellular mechanisms to networks of cell populations, and to all central neuronal systems at the organismic level, including those that control movement, arousal, autonomic functions, behaviour and cognition. (Pace-Schott et al. 2002, p. 591)

Not only that, but if the Uniformity Conjecture is false (and we shall see that it is) then sleep is also a highly heterogenous behavioral state, which makes the task of identifying its relation to dreaming even less straightforward. Thus, any attempt at providing an alternative conception of dreaming must start with individuating *dream-sleep* i.e. the stage of sleep where dreaming happens. This task in itself is a major research program, highly contingent on the development of spatiotemporal resolution of imaging and other recording techniques, and there is currently no consensus on it in sleep science. Nevertheless, in the next chapter, I discuss some of the recent findings in sleep science that pertains to individuating dream-sleep, with the aim of showing that the standard conception of dreaming is mistaken and in turn, what an alternative conception of dreaming might look like.

Chapter 5.

Science of Sleep and Alternative Conceptions of Dreaming

Before moving on with this last chapter, let's take stock. In chapter 1, we have discussed the debate between (vehicle) internalists and (vehicle) externalists. We have said that the debate is cashed out in constitution claims. We have said that externalists claim, while internalists deny, that body and environment are constitutive elements of (vehicles of) perceptual processing and (character of) perceptual experience. We then remarked that these two camps, or some representatives of them (e.g. Hurley vs. Block), understand constitution claims quite differently: we said that externalists are usually pragmatists about ontology while internalists are usually realist. We then employed a notion of mechanistic constitution in order to be more faithful to externalists' predicament.

In chapter 2, we drawn a such and such picture of how dreaming is understood commonly: we named it as the standard conception, and we identified the components (mental and physical), theses (Equivalency and Dormancy) and claims (Isolation, Inaction and Uniformity) that make it up. In chapter 3, we said that with this conception of dreaming, there are a number of arguments that can be raised against (vehicle) externalism (against embodied, enacted and embedded views in particular), even against pragmatist externalists (as we formulated these arguments in terms of mechanistic explanation that they are potentially sympathetic).

In chapter 4, we stepped back and considered what externalists can do to repel these challenges: we said that its either this component of the standard conception or either that component, viz., Equivalency and Dormancy. We claimed that the Equivalency Thesis is a futile target due to methodological reasons. That left us with the Dormancy Thesis. We said that in order to attack the Dormancy Thesis, first we need to clarify what is the explanatory target. We claimed that what needs to be explained is not dreaming$_{local}$ but dreaming$_{global}$, as the former depends on the latter. We noted that in order to explain global dreaming, we need to explain the sleep mechanisms that *realize* it. Explaining is, in part or in whole, depends on offering/describing a mechanism; elements of that mechanism are constitutive for *that* phenomenon. We finished by stating an argumentative

strategy, and we criticized some earlier attempts (e.g. Jennifer Windt's) in characterizing dreaming as embodied or disembodied by relying on studies of awareness of external stimuli during sleep and sensory incorporation into dream content (responsivity studies for short) since such studies, by themselves, would only reveal causal relationships, not constitutive relationships.

We are now ready to discuss how the science of sleep relates to claims of constitution regarding dream phenomena. In the first part of this chapter, I begin by introducing two sleep mechanisms, or mechanisms that operate during sleep, that pertains to dreaming$_{global}$. I then discuss some of the difficulties with individuating dream-sleep i.e. the stage of sleep where dreaming happens, by relying on brain processes alone. In the second part of this chapter, I offer an extensive review of responsivity studies. These studies indicate that (1) there is a complex relationship between sleep mechanisms and dream phenomenology and (2) the standard conception of dreaming is most likely mistaken. I then offer an alternative conception of dreaming, more friendly to externalists, and note that its truth is contingent on there being a sleep mechanism that would predict its claims.

5.1. Sleep Mechanisms and Individuating Dream-Sleep

There are, at least, two things about sleep that pertains to dreaming$_{global}$. One, an organism, when sleeping, goes into behavioral unresponsiveness, at least to some degree. Two, the degree of behavioral unresponsiveness, along with a host of other properties, change over the course of sleep. As such, there must be mechanisms that govern these. Let's begin with the former.

Behavioral responsiveness, or the lack thereof, is related to gating mechanisms of sensory information (i.e. information-gating). It is understood as being the result of external information being suppressed by the brain. There have been two proposals regarding how this happens: (a) thalamic-gating, and (b) cortical-gating. Thalamic-gating so far has been the influential one. It suggests that incoming sensory signals are blocked at the level of thalamus (hence the name), and as such never reaches the cortex in the first place. This suppression is achieved physiologically and does not involve a cognitive factor. Cortical-gating in contrast proposes that stimuli do reach the cortex, however for various reasons, do not propagate between different regions, which is taken to be crucial for consciousness.

Cortical-gating thus allows the possibility of cognitive processing of the stimuli, even if it doesn't rise to consciousness. Note that these two alternatives suggest different conceptions of sleep: on the thalamic model, the organism is literally isolated from outside; on the cortical model, it might be more apt to say that the organism is *indifferent* to the outside.

Now, regardless of which model corresponds to reality, gating of information changes with the sleep stage, judging by the variation of behavioral unresponsiveness over the course of sleep. As we shall see during the review of responsivity studies, different stages correlate with quite different responsivity characteristics. In turn, sleep stage is modulated by a number of other mechanisms, at least one of them being the arousal-threshold mechanism. The notion of arousal-threshold corresponds to the minimum strength required for the stimuli to arouse the brain (the stimuli can be endogenous as well as exogenous). It thus has a role that modulates the sleep-wake cycle, though this role is not easy to define, since the mere presence of normal or high arousal level does not necessarily bring about conscious awareness (more on this shortly).

In short, we have these two mechanisms that operate during sleep and pertain to $\text{dreaming}_{\text{global}}$ -the explanatory target for vehicle externalism. These mechanisms either determine, or get determined by, or just simply relate to, sleep stages. In turn, sleep stage is crucial for assessing internalists claims regarding dream phenomena. That is, assuming that the Dormancy Thesis is true, there should be a stage, a part, an interval of sleep that the brain is isolated and the subject is inactive (in some sense of isolation and inactive), but rich perceptual experiences are undergone, and so 'rich' perceptual processing takes place[27]. That is the dream-sleep, and there are difficulties with individuating it, because there are difficulties with staging/segmenting sleep i.e. distinguishing between global mental states in terms of brain processes alone. These difficulties are either due to technological limitations (imaging/recording equipment), or some other methodological limitation (including using the wrong mathematical framework e.g. computation vs. dynamical systems). Thus, what matters for externalists with a pragmatist bent is that

[27] Or should takes place, unless simulation is possible.

global state that cannot be individuated by neural processes alone, or in other words, what is described, the mechanism, involves or refers to non-neural processes[28].

Let me illustrate the difficulty. The obvious choice for the internalist is to single out REM sleep as the stage of sleep where dreaming happens. Indeed, this has been the orthodoxy for a long time. REM sleep is characterized by desynchronized fast frequency EEG activity -essentially identical to waking- with near-complete loss of muscle tone and heightened arousal threshold. At the same time, experimental awakenings after REM sleep results consistently in more frequent and detailed dream reports. It seems like then, when internalists claim that perceptual experiences akin to wakefulness occur during sleep while the body lays dormant, they should have in mind REM-sleep. Hence, $\text{dreaming}_{\text{global}}$ should be explained by the neurobiology of REM sleep as a global behavioral state. However, as mentioned in 2.2.3, REM sleep is doubly-dissociated from dreaming since (1) dream reports are also obtainable after NREM awakenings, (2) subjects with lesions to brain regions that result in total cessation of dreaming (or obtaining dream reports) nevertheless do continue to have REM sleep (Solms 2000). It seems the internalists need to look elsewhere.

On the other hand, the double dissociation between REM sleep and dreaming should be reconciled with the fact that experimental awakenings after REM sleep reliably produces high rates of vivid dream reports. Sleep in general is constituted by two general behavioral states: REM sleep and NREM sleep. These states are defined primarily by their EEG signatures and in opposition to each other. EEG technology in the past demonstrated that activity patterns characteristic of these states are uniform over the cortex and synchronous between different regions. In other words, it has been thought that certain EEG patterns are exclusive to certain stages of sleep; slow wave activity for NREM and fast wave activity for REM. In the last few years however, with the introduction of high-density EEG with superior spatial resolution, researchers have come to realize that patterns of brain activity characteristic of different behavioral states can co-exist asynchronously in different regions of the brain (Funk et al. 2016). Tore Nielsen's Covert REM[29] model hypothesized that a single generator mechanism for dreaming,

[28] We cannot, of course, eliminate the possibility that our understanding of brain or neuronal processes will not change substantially so as to accommodate dreaming.

[29] ''Any episode of NREM sleep for which some REM sleep processes are present, but for which REM sleep cannot be scored with standard criteria'' (Nielsen 2000, p. 861).

characteristic of REM sleep, can be activated in a piece-meal fashion during NREM sleep, thereby resulting in dream-like mentation associated with REM sleep. Now given the evidence from high-density EEG studies, it seems REM-like high frequency activity can occur regionally, thus providing support to Nielsen's hypothesis. A highly acclaimed recent study done by Francesca Siclari and colleagues (2017) using high density EEG recording identifies a parieto-occipital 'hot zone' a core (neural) correlate of dreaming.[30] It has been found that local decrease in slow wave EEG activity (SWA) in posterior cortical regions predicts both REM and NREM dreaming (p. 872).

Here we see that researchers associate reduction in slow wave activity with consciousness, and vice versa, an increase in slow wave activity with unconsciousness. Thus, EEG activation is taken to be a core correlate of conscious experiences during sleep. *A core correlate*, however, does not mean *the core correlate*, for if perceptual experiences during waking and dreaming both share the reduced SWA as their EEG signature, what correlates with the differences in responsivity to external stimuli and presence of muscle atonia? Before discussing this, notice that up until now we treated REM sleep as a global state in itself, which has a single characteristic EEG signature, arousal threshold and muscle atonia. However, evidence indicates that REM sleep itself is constituted by two phases, tonic and phasic, with different arousal thresholds and muscle atonia intensities.

> […] published reports on behavioural arousal thresholds (ATs) in REM sleep are inconclusive. Only few studies actually find lowered responsivity in REM sleep (Bonnet et al., 1978; Townsend et al., 1976; Williams et al., 1964). Most reports show equal (Keefe et al., 1971; Okuma et al., 1966; Pisano et al., 1966; Watson and Rechtschaffen, 1969; Williams et al., 1966) or even lower ATs in REM compared with sleep stage 2 [non-REM (NREM) stage 2; Arkin et al., 1966; Cobb et al., 1965; Langford et al., 1974], suggesting that, in spite of atonia and poikilothermia, the organism is relatively easy to arouse from REM sleep. (Ermis et al. 2010)

Phasic and tonic phases are most easily distinguished by the presence of gross[31] oculomotor activity and muscle twitches. During the tonic phase, these phenomena are absent, and EEG shows predominance of theta rhythms, especially in hippocampal

[30] It should be noted that EEG recordings were averaged, so this does not necessarily exclude additional brain regions that might be involved in unconscious production of dream content (Siclari et al. 2017, p. 876).

[31] Most studies are not sensitive to micro-saccadic phenomena and more advanced technology is required to claim that micro saccadic activity is absent in tonic stage.

regions. Moreover, phasic REM activation occurs in short bursts compared to more stable and prolonged tonic REM activation. Increased oculomotor activity during the phasic phase is associated with the preceding occurrence of PGO waves, which are, in Hobson's model, associated with dream phenomena. However, experimental awakenings from phasic REM do not result in more vivid dream experiences than awakenings from tonic REM. Nevertheless, behavioral studies show that phasic REM sleep presents higher arousal thresholds than tonic REM. Crucially though, this difference in arousal thresholds cannot be characterized on the basis of EEG profile alone, as frequency spectra of the two phases are essentially alike (Usami et al. 2017). Because of this, for instance, Hobson and his followers claim that PGO waves should be the characteristic stage of sleep where dreaming occurs. However, we have mentioned that lesion studies show that PGO waves and other unique REM phenomena are not necessary for dreaming (Neilsen 2000; Solms 1997, 2000). What else is there to single out the dreaming phase of sleep?

Difficulties with accounting for the variability of behavioral, physiological and phenomenal differences across sleep stages in terms of brain processes alone -insofar as we are able to capture these processes through EEG and brain imaging-, should prompt us to consider a more fundamental control system that governs these i.e. the arousal system. Now, the concept of arousal is immensely hard to define, yet it is so central to sleep research -and consciousness research in general- that its use seems indispensable. On a first approximation, arousal is the physiological and psychological state of being awake i.e. perceiving and capable of responding to prompts. However, things are not so simple, since vegetative state patients have normal arousal levels, yet do not respond to stimuli.

> Arousal is a relative concept. It is not possible to understand arousal without the related vigilance state. Aroused state and sleep are two different sides of vigilance; we cannot define them without each other. To speak about arousal in sleep may sound controversial. There is however strong evidence that one of the essential features of sleep is the arousability and presence of abundant arousals. (Halasz et al. 2004, p. 3)

In sleep science, arousals are defined as brief intrusions of wakefulness or elevated vigilance during sleep. According to the American Sleep Disorders Association (ASDA) criteria, arousals are defined as abrupt EEG frequency shifts occurring after at least 10s of stable sleep and lasting 3–15 s (ASDA, 1992). These criteria are rather vague and does not deal with particular EEG signatures that might be obtained when overt

arousal behavior is observed. Indeed, arousal patterns seem to be contingent on various factors, some endogenous, some exogenous, and the resulting EEG signatures may vary greatly. At the cortical level, different patterns of arousal have been recorded on scalp EEG, and these patterns may occur globally or locally in various brain regions. These patterns seem to be sensitive to sleep stages, cortical regions, the strength and modality of the triggering stimulus and broad homeostatic factors (Halasz et al. 2004; see also Peter-Derex et. al 2015 for an experimental study confirming these points). As such, they resist a straightforward association with a single type of factor.

The inability to associate arousal patterns with cortical regions lead us to delve further into sub-cortical mechanisms modulating arousal. In vertebrates, arousal is modulated by a number of sub-systems: the autonomous nervous system, endocrine system, and, most importantly, ascending activating system (AAS). AAS starts with the reticular formation in the upper-brainstem: an extremely complex anatomical region made up of up to hundred different nuclei that have ascending (but also some descending) projections to many important brain structures: from thalamus to forebrain to cerebellum... AAS releases a number of critical neurotransmitters that module arousal and wakefulness: dopamine, noradrenalin, serotonin, choline, glutamine and etc, and extend to other neuronal populations regulating sleep and wakefulness in the thalamus, hypothalamus, basal forebrain and of course, the cortex.

Functional localization of these neuronal populations is quite difficult as well, but two populations seem to stand out: cholinergic and monoaminergic neurons. Cholinergic neurons fire most rapidly during wakefulness and REM sleep, and least rapidly during NREM sleep while monoaminergic neurons fire most rapidly during wakefulness, decrease activity during NREM sleep and fall silent during REM sleep. Thus, they are sometimes referred to as sleep-promoting and wake-promoting neurons, respectively. These neurons are taken to be a key factor in regulating sleep-wake cycle, and the midbrain structures that hosts them are taken to be the anatomical locus of the arousal system. Indeed, lesion and transection studies demonstrate the role of these midbrain structures in regulation arousal. After midbrain transection, for instance, the forebrain starts to show SWA on EEG. Lesions to mid-pontine result in predominance of wake-like EEG activity. However, these studies also demonstrate that the forebrain structures can also regulate arousal as well. This is because while these studies can generate acute arousal disruption, they don’t seem to be able to generate chronic arousal disruption. In

other words, subjects eventually return to normal sleep-wake patterns after some time. Thus, while cholinergic and monoaminergic neuronal populations in the midbrain are absolutely relevant to the arousal system, they are not essential.

Recall the internalist claim: $\text{dreaming}_{\text{global}}$ is constituted by brain-processes alone; fixing these processes individuates dream-sleep. Yet we have seen that dreaming does not necessarily correlate with a particular sleep-stage or even a particular brain activity pattern. The mechanisms that pertain to dreaming, in particular information-gating and arousal-threshold mechanisms, are strongly related to the sleep stage, which in turn is modulated by the arousal system. However, the heterogeneity of arousal patterns, and their dependence to brain regions, stimulus modality, and broad homeostatic factors, along with the redundancy of neural circuits governing these prevents us from establishing a straightforward relationship between arousal and global mental states, which in turn prevents us from individuating dream-sleep in terms of brain processes alone. Indeed, once we are in the domain of the arousal system, we cannot really avoid the role of bodily and environmental factors. Of course, this might simply be a difficulty with respect to our present state of knowledge, and things may change in future. Be that as it may, the difficulty can still justify looking for an alternative conception of dreaming. Before doing that, however, I will first offer a review of experimental studies on responsivity to stimuli during sleep, as these studies nicely illustrate the variability of arousal and awareness during sleep.

5.2. Awareness of External Stimuli During Sleep and Sensory Incorporation into Dream Content

The Isolation Claim denies any contribution from senses to dream phenomenology. Internalists with respect to dream phenomena like Revonsuo and Metzinger cherish this feature of dreaming brain as revealing the phenomenal level of organization in its purest form. In other words, then, the form and content of perceptual experiences during dreaming are not due to operations of the senses, but the endogenous product of the sleeping brain's activity. Historical underpinnings of this claim have been mentioned in chapter 2. Nevertheless, the history of studies on sensory incorporation into dream content suggests that Isolation Claim is more ideologically rooted than actually confirmed by evidence. We will begin by reviewing these studies.

Awareness of external stimuli denotes any discernible response that the sleeper produces with respect to the external stimuli, and these can range from non-conscious EEG responses to sensory incorporation into dream content. Sensory incorporation occurs when an external stimulus is incorporated into dream content, albeit rarely in a direct manner (i.e. properties of the stimulus do not match to the properties of the conscious content). An initial challenge to identifying extra-cerebral sources of dream content stems from the more traditional challenge of identifying neural correlates of dreaming with brain activity during sleep. While a variety of neural and physiological markers of responsivity to experimentally controlled external stimuli are obtainable, the mere presence of these markers does not warrant claims about dream phenomenology. Studies where electro-encephalographic (EEG) response to stimuli have been observed sometimes fail to identify any reference in the subsequent dream reports and vice-versa, while some studies do not involve collecting dream reports in the first place. Furthermore, EEG activity is not always a good predictor of behavioral responsivity; phasic and tonic stages of REM sleep seem to differ with respect to arousal thresholds, yet this difference does not always correlate with discernible markers on EEG (Ermis, Krakow, & Voss, 2010).

Table 1. Some EEG Markers of Cognitive Activity During Sleep

EEG component	Interpretation and significance
K-complex	Suppressing cortical arousal in response to non-threatening stimuli
Sleep spindle	Cognitive processing of the significance of sensory stimuli
Mismatch negativity	Reflecting response to deviant/out-of-order stimuli
P200	Higher order perceptual processing modulated by attendance
P300	Reflecting memory activation in response to sensory stimuli
N400	Reflecting response to semantic stimuli (words, images etc.)
N550	Reflecting broad modality independent neuronal silencing

In general, there are two approaches employed in responsivity studies: one physiological, the other phenomenological. The first approach relies on detecting event related potentials. A stimulus is presented to the subject during various stages of sleep (mostly REM, as it is generally assumed to be the main dreaming phase of sleep), and then polysomnographic markers are analyzed to infer whether a cognitive processing has taken place with respect to the stimulus. The second approach relies on obtaining and analyzing dream reports. After the presentation of the stimulus, the sleeper is awakened and asked whether she was thinking of anything just before the awakening. Then the

subsequent report is analyzed to find indications of dream-contents in reference to the stimulus just presented. While the first approach suffers from the fact that physiological response does not automatically indicate perceptual response, the second suffers from the fact that there are no clear guidelines for what narrative elements count as incorporation.

Table 2. Some Examples of Sensory Incorporation into Dream Content

Stimulation type/Sleep stage and reference	Dream content	Incorporation quality
Electric stimulation to the wrist. /REM sleep. (D. Koulack, 1969)	"The thought was I felt a pinch in my hand. Electrical impulse."	Direct incorporation of the sensation
Somatosensory stimulation. Inflated blood pressure cuff on ankle. /Stage 1 NREM sleep. (Solomonova, 2017)	"I felt the pressure from the cuff, and all of a sudden I thought about my cat jumping, because my cat sleeps all the time on my legs."	A direct incorporation + an associative image of the cat
Somatosensory stimulation. Inflated blood pressure cuff on ankle. /REM sleep. (Solomonova, 2017)	"Liza was there to wake me up. She turned on the lights and asked me about my dreams. I was answering her. I could feel the pressure pump on my leg. She asked me what does it feel like, I said it feels like a hug. She said: "Doesn't it feel like someone pulling on your leg?"	A direct incorporation of the pressure cuff + a false awakening and incorporation of laboratory personnel and of a dream interview
Somatosensory stimulation. Inflated blood pressure cuff on ankle. /REM sleep. (Solomonova, 2017)	"At first I was flying… there were mountain tops everywhere, there was snow (…) then I found myself on a boat, it was stormy. I was holding on to a prow when the boat was tilting, I could touch the water (…). Suddenly, a dolphin took me and I was swimming on its back."	An indirect incorporation: intensified movement (boat, tilting, being carried away)
Somatosensory stimulation. Inflated blood pressure cuff on a leg. / REM sleep. (T. Nielsen, D. L. McGregor, A. Zadra, D. Ilnicki, & L. Ouellet, 1993)	"…the farmer (…) is trying to put a saddle on the horse. (…) At one point the horse was rolling right across his body. I heard this 'unnffl' sound as if it hurt him when it rolled across his legs. (…) He got up and turned his back on the horse. The horse stood up too. He put the horse's right hind foot in this suitcase-like thing with a metal box so he wouldn't stray. (…) I looked … and saw it was not hurting the horse, just trapping his foot. The horse tried to pull his foot out and follow the farmer, but he couldn't…"	Projection of the feeling of pressure on the leg onto two other dream characters: the farmer and the horse
Somatosensory stimulation. Tensors on foot. / sleep stage unknown. (A. Cubberley, 1923)	"People are dancing on a verandah, which also resembles a lighted stage. I am watching from B little way off, as if I were a spectator in a theatre."	Feeling of something on the foot transformed into dancing imagery

Auditory stimulation. Name "Richard". /REM sleep. (R. J. Berger, 1963)	"Had been to a sale in at a big shop at the center of Edinburgh."	"Richard" – the name of the shop in Edinburgh
Dozing while sitting on a couch near an IKEA cash register, which abruptly sounds with a loud clatter. Auditory. /Stage 1 NREM sleep. (T. Nielsen, 2017)	"A bright, multi-colored clown/jester suddenly somersaults with a snapping, elastic motion. His black suit had patches of red, yellow, green, blue, and other colors."	A sound triggers a sudden awakening/ movement in the dream character
Olfactory stimulation. /REM sleep. (M. Schredl et al., 2009)	"Cleaning a toilet that was full of yellow liquid."	Strong smell – imagery that likely has a strong olfactory component

Adapted from Solomonova 2017

The review that follows employ to a fairly common taxonomy of sensory modalities in organizing the studies discussed.

a. Vision

Since humans sleep with their eyes closed, studying responsivity to visual stimuli is difficult to carry out. When we close our eyelids, our eyes roll upward, a condition known as the *Bell's phenomenon*. With sleep onset, the eyes roll backward, and pupils get constricted to further cut off the information flow. Still, researchers studied the awareness of light stimuli during sleep. Earliest laboratory-based study is carried out by William Dement & Wolpert (1958). They presented 100-Watt light flashes to their subjects during eye-movement stage of sleep (phasic REM). Out of 30 trials with 12 subjects, they found a 23% incorporation rate, judged by the textual references in the subsequent dream reports. It was hypothesized by earlier researchers (Ladd, 1892) that dream imagery was the result of retinal patterns generated by light-rays penetrating the closed eyelids, and though Dement and colleagues research show that illumination affects dream content, it was not enough to establish the stronger claim. As such, Rechtschaffen & Foulkes (1965) went further to test this hypothesis. To do so, they came up with a setting to enable their subjects to fall asleep while their eyelids were open, and their pupils unconstricted. Then they presented various objects to their subjects, illuminated with a small light, during both NREM and REM stages. Out of 20 trials there was only one that slightly hinted a reference in her dream report to one of the objects presented. They concluded that, while illumination

per se can modify dream content, object perception does not seem to take place. Conduit, Bruck, & Coleman (1997) studied inducing dreaming using light flashes (together with acoustic tones) in NREM (stage 2) and REM sleep. While the NREM condition showed a significant increase in the subsequent imagery reports, no such increase has been found for REM condition. Furthermore, there was only a small (11%) direct or indirect relation between the stimulus modality and the contents of dream imagery. Similar results has been obtained by Fedyszyn & Conduit (2007) and Stuart & Conduit (2009).

a. Audition

By far the most common type of sensory modality used in responsivity studies is audition, given the practical ease of manipulating auditory stimuli without awakening the subjects. Such stimuli can be divided into two types: verbal (i.e. semantic) and non-verbal (i.e. acoustic). It is well known in the psychoanalytic tradition that stimuli such as the sound of heavy rainfall may induce an urge to urinate during sleep, which sometimes appear in the dream as genitally and/or sexually related themes (Renik, 1981). Not all sounds have such an effect, however. For instance, Schredl (2008) didn't find a correlation between snoring and nightmare frequency (but this might have to do with the fact that snores are self-produced -more on this later, but see Windt, Harkness, & Lenggenhager (2014). One of the earliest non-verbal laboratory study was carried out by William Dement & Wolpert (1958), using a 1000-cycle pure tone sounded for 5 seconds, slightly below the pre-determined awakening threshold for phasic REM sleep. About 15% of trials resulted in awakening, while subsequent collection of dream reports from the rest indicated a 9% incorporation rate. Incorporations were often in a direct manner (e.g. a loud, startling sound in dream) and usually triggered a threatening imagery (e.g. an earthquake). Bradley & Meddis (1974) studied the effect of a white noise stimulation presented during REM sleep, with increasing dB up until the point where subjects woke up. Analysis of subsequent dream reports indicated a 40% incorporation of the stimuli into dream-content when stimulus intensity was over 60 dB. Burton, Harsh, & Badia (1988) employed a similar procedure, but also included a NREM sleep (stage 2) condition. Likewise, they found a 35-to-40% incorporation rate, indicated by references in dream reports obtained from awakenings from both stages.

Sleep stage is an important factor for the capacity of a stimulus to generate arousal. Williams, Tepas, & Morlock (1962) studied the effect of a click stimulus (85db),

repeated every 2 seconds throughout the night. They observed a low amplitude of evoked responses on EEG, compared to the NREM stage. Assuming that REM stage corresponds to dreaming phase of sleep, this contrast is explained by the increased arousal thresholds during REM sleep, most likely because attentional resources are allocated to the ongoing mental imagery (in accordance with the so-called *Competition Hypothesis*). Later studies confirmed the difference in arousal thresholds between sleep stages. Using an oddball ERP paradigm, Bastuji, Garcia-Larrea, Franc, & Mauguière (1995) showed that REM sleep should not be characterized as occurring in sensory isolation; rather, the delayed evoked responses to stimuli seems to be the result of a cognitive process, to assess whether stimuli should be taken into account or not (monotonic stimuli generated less ERP than deviant stimuli). Sallinen, Kaartinen, & Lyytinen (1996) used ERP method to assess the receptivity of phasic vs. tonic REM sleep subjects to auditory stimulus. They found that the brain is more open to external events during the tonic stage of REM sleep. Similar results have been obtained in Atienza, Cantero, & Escera (2001).

A more common type of studies involves the use of verbal stimuli. Berger (1963) presented spoken personal names to their subjects during REM sleep; for both personally significant and insignificant names, a relatively high rate of incorporation has been observed. As might be expected, these incorporations were rarely in a direct manner - rather, they triggered associations, sometimes autobiographic, sometimes merely semantic. Importantly, incorporation was not correlated with any distinct EEG activity or galvanic skin response, though this might be due to the technologically inferior equipment of the time. Hoelscher, Klinger, & Barta (1981) improved this approach and extended it to include the NREM sleep (stage 2) as well. Likewise, analysis of subsequent dream reports indicated a higher rate of incorporation for concern-related stimuli (23%) than for concern-unrelated stimuli (6%). This led them to assert that subjects during sleep are able to make fine cognitive discriminations.

Voss & Harsh (1998) studied the effect of personality types on the disposition to be open to environmental stimuli during light sleep. Using two groups of subjects, *Monitors* -who are categorized as information-seeking type-, and *Blunters* -who are categorized as information-avoiding type-, they presented personally relevant and irrelevant names during the transition from wakefulness to sleep. As predicted, subjects' own names produced the greatest number of K-complexes and arousals. In addition, P300 component -which is believed to be a marker of cognitive processing- was higher for Monitors, while

N350 component -which is believed to be a marker of suppressing cognitive processing- was higher for Blunters. Given this, they concluded that higher level information processing still continues during light sleep.

Perrin, Bastuji, & García-Larrea (2002) studied the electrophysiological effect of linguistic detection -the N400 component- during sleep. They presented verbally meaningful and non-meaningful stimuli to subjects during waking, NREM (stage 2) and REM sleep. While signs of detection disappeared in stage 2 sleep, it reappeared in REM sleep, but in a different fashion than waking. In waking, brain is sensitive to pseudo-congruent words, while in REM sleep ERP response to pseudo-congruent words disappears. This difference of responsivity perhaps can be explained by referring to the hyper-associative manner of cognition during this stage of sleep.

While the ability to make such cognitive discriminations is significant, the sleeping brain can actually *do* more. Kouider, Andrillon, Barbosa, Goupil, & Bekinschtein (2014) studied the possibility of generating task-dependent responses (semantic categorization) in early stages of sleep. They trained their participants to make right-hand clenches for animal names and left-hand clenches for object names during waking. During light sleep, they expected to see LRP patterns on EEG in the same way, and this is indeed what they found. Andrillon, Poulsen, Hansen, Léger, & Kouider (2016) extended this study to all stages of sleep. They found that NREM2 sleep is responsive as much as wake state -but responses are delayed. Yet no significant deviation in the LRP was observed during deep NREM3 or REM sleep. In REM sleep, only words previously heard in wakefulness are classified. Authors argued that this implies a cortical rather than thalamic gating of external stimuli, at least in the early stages of sleep. In other words, suppression of external stimuli is the result of a higher-level cognitive processing rather than a hard-wired physiological blockage (contra Hobson's AIM model, for instance).

b. Olfaction

Olfaction has a somewhat special status in responsivity studies. The reason is multifaceted: for one, the olfactory system has a different neural wiring than other sensory systems -olfactory information does not travel through brainstem and thalamus, but instead wires directly to olfactory cortex through the olfactory nerve bulb. Furthermore, it has an immediate anatomical relation to the amygdala and hippocampus, making it

strongly associated with affective and mnemonic experiences. On the other hand, humans have weak odor identification, and so the relation between olfaction and semantic memory is weak -instead, olfactory memories are associative. Volitional olfactory imagery is not as vivid as other imagery modalities. Our immediate content of consciousness and memory is made up of mostly visual and auditory elements, as locating objects in the environment is such a big part of our lives White, Ashton, & Brown (2011). This shows itself in the prevalence of olfactory imagery in our dreams. As Zadra, Nielsen, & Donderi (1998) study shows, only 1% of home-dream diaries contain references to olfactory and gustatory sensations. See also Stevenson & Case (2005).

One of the earliest laboratory study done in this context is due to Trotter, Dallas, & Verdone (1988). In their pilot study, they presented their participants with pleasant and unpleasant odours during REM sleep. Out of 79 successful trials, 19% of dream reports indicated references to smell sensations. The study, however, contained a number of methodological flaws - the most important of which was that the stimuli used in the study not only targeted olfactory nerve but also the trigeminal nerve -which includes mechanical and thermal components. Schredl et al. (2009) addressed these concerns in their study. In particular, they used a sophisticated technology to present their participants with pure odor stimuli. Unlike Trotter and colleagues, they did not find indications of direct incorporation in the subsequent dream reports. Rather, the references were mostly associative: pleasant odours yielded more positive emotional themes (15.4%), while unpleasant odours yielded more negative emotional themes (13.3%). Given that specific odor memories are quite rare in the general population and given the methodological superiority of Schredl and collogues' study, these results can be taken as representative. A recent pilot study by Nováková et al. (2017) using two pure odor stimulants -vanillin and thioglycolic acid- produced similar results. Interestingly, participants increased ratings of the pleasantness of their dreams was irrespective of the pleasantness of stimuli.

a. Somatosensation

While audition is the most widely studied modality in responsivity studies, somatosensation is the most widely incorporated into dreaming. Here, somatosensation refers to a multitude of different sensory sub-systems, including mechanoception (sense of touch), thermoception (sense of heat) nociception (sense of pain), proprioception (sense of the movement) and equilibrioception (sense of balance). These sensory

systems are sometimes called bodily senses. In contrast to vision or audition, somatosensation is rarely mono-sensory, meaning that at any given time we are aware of our bodies in more than one modality. Studies seem to be indicating that the more multisensory the stimulus, the lower the arousal threshold e.g. it is easier to wake someone up by touching and calling her name than by simply touching or calling her name.

A. J. Cubberley (1925/2011) sought to undermine Freud's psychoanalytic approach to dreaming by showing how simple tension stimulations on the body -which would happen quite naturally during sleep in ordinary environments- can have profound effects on the content of normal dreams -a defense of Wundt's earlier somatic dream theory, in essence. While he offered a large survey, this study was methodologically preliminary -for one there were no physiological measures of dreaming at the time. A more proper laboratory study has been carried out by Dement & Wolpert (1958): there, the authors sprayed cold water on their subjects during REM sleep, which resulted in a 42% of incorporation -higher than the incorporation rate for sound or light stimuli. In addition, these trials resulted in more awakenings than the other stimulus conditions. See also Baldridge (1966) and Koulack (1969)

One fruitful avenue of investigation is to see how vestibular sensitivity affects dream-content. The idea that dream movement might be due to sensations of balance that arise out of movements that take place during sleep has been articulated frequently since the early days of somatic dreaming theories. More recent studies in neurophysiology show a connection between the vestibular nuclei in cochlea and the occurrence of REM bursts (Pompeiano, 1974; Woodward et al. 1990). A study by Gackenbach, Snyder, Rokes, & Sachau (1986) sought to find out whether frequent lucid dreamers, people who become aware of dreaming in the dream and who often become able to control their dreams -by moving, flying, steering in the dream world- have a higher vestibular sensitivity. Using a technique called caloric stimulation (cold water irrigation on inner ear), they experimentally induced vertigo effect on subjects and measured this by subjective reports and ENG activity. They then contrasted these data with previous self-reports of lucid dreaming frequency. The results indeed showed a correlation between lucid dreaming and vestibular physiology. To confirm the results of this study, Leslie & Ogilvie (1996) employed a more direct approach, by using an experimental setup that rocks subjects during REM sleep. As expected, as much as a 25% direct incorporation rate has been obtained by the analysis of subsequent dream reports. In a similar vein, Sauvageau,

Nielsen, & Montplaisir (1998) sought to find out if gymnasts are more resistant to the disruptive effects of the vestibular stimulation during sleep. While initially gymnasts are less susceptible to incorporation of vestibular stimulation into dreams, this effect has been observed to vanish with prolonged exposure -as would be expected with long term adaptation.

Apart from the sense of balance, Nielsen (1993) sought to find out the effect of direct pressure stimulation. Alternating randomly between the left and the right leg, a pressure cuff was used (around 5 minutes) during REM sleep. Incorporations were in a straightforward manner mostly: compared to controls, stimulation trials resulted in more leg sensations in subsequent dream reports (67% for right leg, 50% left leg). In addition, certain problem-solving sequences involving legs (such as getting free of an object that hinders movement) were observed, as well as occasional bizarre bodily/kinesthetic perceptions. More recently, Solomonova (2017) employed a similar procedure to investigate sensitivity differences between Vipassana meditators and controls.

Yu (2012) carried out a large-scale survey to see whether sleeping in the prone position increases the probability of having certain dream-themes in normal sleepers, as opposed to sleeping in the supine position. In particular, some correlation has been found between the contingencies of sleeping in prone position on dream-themes involving olfactory, gustatory and sexual imageries as well as persecutory themes like suffocating, though the effect of personality on the probability of the occurrence of these themes cannot be completely eliminated.

An essential modality in somatosensation studies is nociception -the sense of pain. Whether one can experience pain in their dreams has been a long-lasting debate in dreaming since the earlier philosophical discussions of the phenomenon (See Chapter 2.3). Nevertheless, it seems pain can be experienced in dreams. Nielsen, McGregor, Zadra, Ilnicki, & Ouellet (1993) observed that somatosensory stimulation (a pressure cuff applied around 5 minutes to legs) applied during REM sleep resulted in a significant number (31%) of dream reports involving references to pain sensations (in a rather direct manner) and often bringing about emotional themes such as anger. One problem with studying pain in dreams is that pain stimuli often triggers awakening or at least seem to reduce the depth of sleep. Raymond, Ancoli-Israel, & Choinière (2004) for instance, observed that patients with burn injuries suffers from high degree of sleep disturbances

(e.g. fragmented and light sleep), though here the duration of the pain stimuli is more important than the intensity of it. A behavioral laboratory study has been carried out by Bastuji, Perchet, Legrain, Montes, & Garcia-Larrea (2008). Using a device that delivers thermal laser pulses to the outer part of subjects' hands during an all-night sleep, they observed the evoked EEG activity. Laser stimuli slightly over the perception threshold frequently triggered awakening, and even when it doesn't, it resulted in motor (reflex) responses and disrupted sleep depth. Regardless, cortical responses have been observed in successful -non-awakening- trials. These responses were specific to the stage of sleep the subject was in. In NREM2, responses were weak compared to waking and shortly followed by K-complex patterns -which are believed to be suppressing awakening. In REM sleep, responses in frontal regions were attenuated, in alignment with the known frontal deactivation characteristic of this stage. In all stages, responses were delayed, followed by a P3 wave, which is thought to be a component related to cognitive processing of the stimulus. The authors also collected dream reports, however no signs of incorporation have been found. This might, of course, be due to the short duration (series of 5ms) of the stimuli applied. A more thorough review of the relation between nociceptive stimuli in sleep, reflex behaviours and arousal threshold has been offered by Mazza, Magnin, & Bastuji (2012). A recent electrophysiological study using, both surface and intracranial recording methods, carried out by Claude et al. (2015) found that nociceptive stimuli are processed in a different manner in sleep. That is, while inhibition of sensory processing during sleep is thought to be related to the occurrence of sleep spindles, it has been observed that spindles do not modulate the processing of nociceptive stimuli. From here one may perhaps speculate that the evolutionary (survival) significance of pain stimuli requires a different monitoring mechanism during sleep.

b. Interoception

Like somatosensation, interoception is made up of several sensory systems, often overlapping with somatosensory systems. Broadly, interoceptive systems enable the perception of the 'inside' of the body i.e. its physiological condition in relation to homeostatic and allostatic processes. Some of its subsystems are cardiovascular, gastrointestinal, urogenital, endocrinal and respiratory interoceptive systems. Compared to other modalities, experimentally manipulating interoceptive stimuli is not easy, and accordingly the number of studies are quite limited. Finley (1921) reports the case of a woman who, following an attack of influenza, suffered a severe case of lethargy. The

symptoms persisted even though she recovered from influenza. The actual pathology, a disruption related to the endocrine system, revealed itself in the peculiar contents of her dreams. These kinds of dreams, where the unknown illness manifests itself in dream-content, has been well-known since the time of antiquity -the so-called *prodromal dreams*.

Another avenue of investigation for interoceptive awareness is urogenital stimulation. Yazmajian (1967) presents a series of cases where testicular stimulation seems to influence dream-content of male subjects. Throughout the REM sleep males undergo a cycle of full or partial erections as resulting from autonomic physiological processes, which then seem to translate into various sexual dream-themes and more indirect emotional-themes like anxiety.

Last but not least, there are the dreams responsive to respiratory disruptions during sleep. Since the early days of sleep science, it was hypothesized that nightmares are caused, in part, by a lack of oxygen intake during sleep. In a laboratory study, Schredl (2008) investigated the effect of breathing pauses and nightmare occurrence. While a small correlation has been found in the case of healthy patients, in people with sleep apnea there was no such association. The author suggests this might be due to an adaptation/habituation process -the stimuli must be novel enough to get incorporated into the dream.

5.3. Varieties of Incorporation

As it is obvious by now, sensory incorporation rarely happens in a straightforward manner, and more often than not stimuli are incorporated indirectly rather than directly. By *direct incorporation* we mean that (1) the modality of the stimulus is preserved (e.g. sound to sound) and (2) location of stimulation more or less corresponds to the location of the sensation in the dream (e.g. electric shock to real-hand → pain sensation in dream-hand). *Indirect incorporation*, on the other hand, is highly varied. An initial distinction can be made between *stimulus-to-content* vs. *stimulus-to-context* incorporation. The former denotes the kind of incorporation where the stimulus, although it changes form and possibly modality, is still identifiable with a particular element/object in the dream (e.g. sound of a word triggers the imagery of a person known with a similar name). The latter is implicit -lacking an identifiable single element- and elusive (e.g. a urogenital stimulation triggering sexual themes or a rotten smell causing a bad dream). Within the former category (stimulus-to-

content) one can make further distinctions: *simile* and *symbol* -here the former denotes an association between the stimulus and content based on their perceptual similarity or closeness, as in the sounds 'Monkey' and 'Donkey', or a low intensity pain being similar to an itch; the latter denotes a more cognitive type of association: for instance, one is more likely to dream of a doctor after *seeing* a hospital than dream of a clown.

Table 3. Varieties of Incorporation

Direct Incorporation	Indirect Incorporation		
	Stimulus-to-context	Stimulus-to-content	
		Simile	*Symbol*

Not without relation to the variety of incorporation types, the literature so far reveals that the factors of response to external stimuli during sleep and sensory incorporation into dream content are highly nuanced and multifaceted, resisting a straightforward characterization of a governing principle on these processes. This should have been expected perhaps, given that sleep physiology itself is highly varied and lacks uniformity (Nielsen (2000); Siclari & Tononi (2017); Funk, Honjoh, Rodriguez, Cirelli, & Tononi (2016)). Nevertheless, some preliminary elucidations can be made. The initial distinction to make is between factors specific to the stimulus and factors independent of stimulus (or *stimulus-specific* factors and *stimulus-independent* factors). The latter corresponds to neuro-physiological conditions of sleep, most prominently sleep stages and information gating mechanisms.

Within the stimulus-specific factors we can make a further distinction between monotonic factors and non-monotonic factors. Some monotonic factors are straightforward to discern: both the *intensity* and the *duration* of the stimulus are positively correlated with the incorporation/response rate as well as the arousal strength, up until the point where habituation/adaptation renders the stimulus 'insignificant' for the sleeper. Another monotonic factor is the multisensory richness of the stimuli. It seems that the more sensory channels the stimuli invoke, the stronger the responsivity as well as quicker the arousal. This might be related to the fact that highest responsivity rates are obtained in somatosensation studies, as somatosensory stimuli are rarely in just one modality (water spray, for instance, stimulate both mechanoreceptors and thermoreceptors).

More interesting kinds of stimulus-specific factors are non-monotonic. Here the first candidates are the modality, novelty and subjective-significance of the stimulus. We have seen that there is quite a bit of variation with respect to modality, and here again it is difficult to straightforwardly identify a root cause. Some are due to the condition of the relevant receptors: for instance, object vision is diminished as eyes roll back and pupils dilate during sleep. Others are due to significance of the modality with respect to the evolutionary needs.

Novelty seems to have a nuanced effect. On the one hand, novel stimuli like loud sounds seem to generate stronger arousal. On the other hand, targeted memory activation studies during sleep show that only the previously memorized stimuli generate EEG response during REM sleep, while novel stimuli are mostly ignored. Last but not least, the subjective-significance of stimulus seem to have a positive effect on both response and arousal. At the end of the day, the sleeping brain seems to be far from *isolated,* and although the studies vary significantly and are not replicated enough, nevertheless, a clear pattern has emerged.

Table 4. Summary of Responsivity and Arousal Potentials with Respect to Modality

Modality	Arousal potential	Incorporation potential
Vision	Low	Low
Audition	Selective	Selective
Olfaction	Low	High
Somatosensation	High	High
Interoception	High	High

The question we are left with, then, is this: why all this variability? What explains or justifies their occurrence? If the standard conception of dreaming is true, then we have no grounds to account for these observations, other than saying that perhaps Isolation and Inaction are not complete. However, even though this would account for the existence of awareness of external stimuli, it would not account for their particular pattern -but perhaps an alternative conception can. I discuss this next.

5.4. An Alternative: The Vigilance Hypothesis

Humans cannot afford to be *dead to the world* during sleep, unless they actually are dead to the world. From an evolutionary perspective, organisms must continuously

monitor their environment to some degree, in order to cope with changes in their surroundings that might potentially prove fatal to their survival. Understood as such, it is plausible to expect that some degree of behavioral responsiveness is preserved at all times. The review so far shows that humans exhibit three kind of responses to external stimuli during sleep: (a) the stimulus is registered and leads to awakening, (b) the stimulus is registered but ignored, and (c) the stimulus is registered and incorporated into the dream. We further have seen that these responses correlate with mechanisms that are sensitive to properties of the stimulus and the stage of the sleep. With respect to the former, might there be a principled explanation of the variation between responses to different stimulus modalities? In particular, what explains the dominance of visual and kinesthetic experiences during dreaming?

One theory, *the vigilance hypothesis* put forward by Donald Symons asserts that "natural selection thus has disfavored the occurrence during sleep of hallucinations that compromise external vigilance" (Symons 1993, p. 181). Given that humans sleep with their eyes closed and their bodies stationary, vision and kinesthesis do not compromise external vigilance; hence, vigilance hypothesis predicts that they will occur relatively more frequently in dreams. On the other hand, audition, olfaction, mechanoception and nociception can be utilized to monitor the environment, thus their relatively smaller frequency of occurrence in dreams is also predicted by the hypothesis.

Now the Vigilance Hypothesis is quite modest in its scope. It just says that lack of conscious content with such modalities in dreams are predicted by the contingencies of how humans sleep. Yet it is remarkable in the sense that it establishes a strong connection between dream phenomenology, sleep physiology and evolutionary history. And indeed, it seems to be supported by analysis of dream reports and questionnaires (Hobson et al. 2000; Okada et al. 2005). That is, the conscious content of dreams predominantly involves distal sensations (vision being the most dominant), while proximal sensations rarely occur in dream content. Moreover, we have seen that proximal sensations have a higher rate of incorporation into dream-content, allowing the possibility to claim that most proximal sensations in dreams are illusory rather than hallucinatory (in agreement with the *Leibreiztheorie* defended by Wundt and his followers, most recently Jennifer Windt (2015)). Based on this observation, one can offer an Extended Vigilance Hyopthesis (EVH), an attempt to ground the variation of the sensory sources of perceptual experiences during dreaming in sleep processes governing information-gating and

arousal-threshold mechanisms. With respect to the embodied mind thesis, one can potentially use EVH to argue that, the particular phenomenology of dreaming results from the task of integrating illusory proximal sensations with hallucinatory distal sensations, in the service of broad homeostatic and allostatic functions (for instance, a potential link between the task of integrating interoceptive vs. exteroceptive sensations and embodied self is discussed in Seth 2013). Taken together, EVH would claim that this particular condition constitutes dreaming.

Notice how these two conceptions of dreaming differ from each other. On the standard conception, dreaming is, ultimately, for dreaming. Sure, it might have some functional role, like providing threat-simulations (Revonsuo 2000) or refining predictive processes (Hobson et al. 2014), but other than that, there is no strong relationship between its characteristics and those of sleep. On the alternative conception illustrated above, however, characteristics of dreaming are precisely contingent on characteristics of how we sleep, and what evolutionary and environmental constraints the need for sleep put us under. On the alternative conception, we dream the way we do due to homeostatic, allostatic and survival-related factors. Ultimately, both the standard conception and the alternative conception needs to be grounded in sleep neurophysiology and the individuation of dream-sleep from non-dream sleep. As discussed, both conceptions fail on this account at the moment. Thus, internalist claims regarding dream phenomena are, at the moment, unjustified, while externalists regarding dream phenomena, in future, may gain support.

Conclusion

Dream phenomena intuitively challenge vehicle externalism. I have attempted here to get clear about the ways in which they do so. These ways turned out to be fairly nuanced, as externalists turned out to be fairly different than their opponents with respect to how they understand matters of ontology. Externalists understand matters of ontology in more pragmatic terms, and for some the *pragma* is scientific practice. Scientific practice in life sciences, of which cognitive science is a part, proceed by way of offering mechanistic descriptions. These *descriptions* are what count as explanation in the life sciences, and externalists suggest that we base our ontology in them.

The way in which dreaming is conceived by researchers in both philosophy and science amounts to a *standard conception of dreaming*. The standard conception of dreaming challenges vehicle externalism because it implies that there is a mechanism (or a collection of mechanisms) that constitutes the phenomena of which has a behaviour that is characterized by Equivalency and Dormancy theses, and the conjunction of these theses falsify externalist claims, as in the case of embodied mind thesis. Proponents of externalism have a number of alternatives for defending themselves:

(a) they can reject the burden of proof by asserting that dream phenomena do not fall under the phenomena that externalists are supposed to explain, or

(b) they can attack the m-component/Equivalency Thesis by asserting that dream phenomenology does not resemble waking perceptual phenomenology, or

(c) they can attack the p-component/Dormancy Thesis.

I have claimed that Dormancy Thesis is the more promising target, and tried to illustrate how it can be used to launch an argument against externalism. I have then made some remarks on how the argument should be handled, and pointed in the direction of relevant avenues of empirical research. That is, dreaming is either put in a proper dependence relationship with sleep neurophysiology, so by way of individuating its mechanism(s) (which is a type, not token) we individuate dreaming (and perhaps only then

discuss whether the Equivalency Thesis is true or not), or remain as a nominal kind that we cannot properly generalize our talk about it.

Yet another way of speaking about dreaming, however, is perhaps to conceive of it as highly contingent on the ways in which we sleep and what our bodies go through while we do that. This way of conceiving of dreaming is more promising with respect to accounting for the findings of sleep science. It is also more promising to with respect to situate dreaming in our evolutionary history.

Future discussions, of course, should be sensitive to the terms of the debate. In particular, future discussions should be sensitive to the distinction between local vs. global mental states to identify the correct dependence relationship between dream psychology and sleep physiology, and to information-gating and arousal-threshold mechanisms to correctly individuate *dream-sleep*.

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