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Spotlight Commentary

Can a microdynamic approach to sleep-onset imagery solve the overabundance problem of dreaming? Commentary on Tore Nielsen's "Microdream neurophenomenology"

Jennifer M. Windt*

Philosophy Department, Monash University, Level 6, Menzies Building, Clayton Campus, 20 Chancellor's Walk, Clayton, VIC 3800, Australia

*Correspondence address. Philosophy Department, Monash University, Level 6, Menzies Building, Clayton Campus, 20 Chancellor's Walk, Clayton, VIC 3800, Australia. Tel: +61-3-99-05-15-19; E-mail: jennifer.windt@monash.edu

Abstract

Nielsen proposes that a microdynamic approach to experiences occurring in the earliest stages of sleep onset, which he calls microdreams, can shed light on the process of dream imagery formation. I discuss microdreams in the context of simulation views, in which dreaming is defined as the immersive experience of a virtual world centered on a virtual self. I also evaluate his proposal to expand the dimensions included in the oneiragogic spectrum by kinesis. I conclude that while a subset of microdreams might not fulfill the conditions to count as even minimal dreams, their investigation can nonetheless help address key questions in dream research and may even constitute a distinctive pathway to the generation of full-fledged dreaming.

Key words: imagery; sleep and dreaming; binding and multisensory integration; sleep onset; hypnagogia

The Microdynamic Approach and the Overabundance Problem

In an exceptionally rich and thought-provoking article, Nielsen (2017) proposes a research methodology to address the "overabundance problem": progress in dream research has been hampered by the availability of too much information both on the phenomenology of dreaming and its neural basis. Nielsen proposes a subset of sleep-onset imagery—microdreams—as a research model: because of their brevity and comparatively simple phenomenological structure, microdreams isolate core features of dreaming while also reducing its complexity. Microdreams create ideal conditions for gathering detailed phenomenological descriptions, time-locking them to associated neurophysiological events, and identifying memory and concurrent external stimulus sources to probe the mechanisms underlying dream imagery formation. Nielsen's paper also offers a timely and much needed review of research findings on sleep-onset imagery, which has long been a dormant area of sleep and dream research, and introduces a new conceptual framework.

Here, I will focus on the relation between microdreams and full-fledged dreams. I argue that while the analysis of microdreams can extend and enrich dream research, a subset of microdreams may not fulfill the conditions to count as even minimal forms of dreaming. I also discuss Nielsen's claim that kinesis is central to dream formation and propose that there might be two distinct pathways to the generation of immersive dreaming.

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Are Microdreams Minimal Kinds of Dreams?

Designating a subset of sleep-onset experiences as microdreams suggests that these present the core characteristics of dreaming in a greatly simplified, isolated form and at a minimal time scale. Microdreams would then help demarcate the difference between dreaming and non-dreaming: they would help isolate and empirically ground the minimal set of necessary and jointly sufficient conditions for dreaming to occur.

It is useful to consider this proposal in the context of a broader taxonomy of dreaming. Dream research was long hampered by lack of agreement about its target, with different research groups using different definitions. This situation was further complicated by the notorious variability of dreaming itself. Only recently has there been increasing convergence on simulation views of dreaming (Revonsuo *et al.* 2015). Different versions of simulation views exist, but their key claim is that dreams simulate the experience of a world centered on a self. Dreams have an immersive structure: they involve a subjective sense of presence, with imagery arising mostly independently of an appropriate external stimulus source.

In the simplest version of simulation views, spatiotemporal self-location—"here-and-now" experience—is both necessary and sufficient for dreaming (Windt 2015a). A majority of dreams involve multimodal (especially visual and motor) imagery as well as strong emotions. Yet neither these nor a representation of self as an embodied or cognitive agent are necessary. Dream reports may even describe the experience of being a disembodied entity or an unextended point in space. This simplified version of the simulation view acknowledges that dreams often involve richer forms of reality and self simulation, including the phenomenology of bodily interaction with the dream world (Nielsen 2010; Windt 2018a, b). But it provides a precise cutoff line for identifying minimal forms of dreaming and classifies non-immersive sleep experiences as dreamless (Windt *et al.* 2016). Examples include conscious thoughts, but also isolated perceptual or even hallucinatory imagery and bodily sensations that lack integration into a larger hallucinatory context.

How simulation views define the relation between dreams and sleep stages is importantly different from Nielsen's microdreams. Simulation views define dreaming independently of sleep stages and instead offer immersion as a phenomenological criterion. By contrast, Nielsen's microdreams are defined by their brevity and occurrence in the earliest stages of sleep onset, before drowsiness has given way to sleep.

An important issue is whether a uniform phenomenological characterization of all microdreams is possible and specifically whether all or a subset of microdreams are immersive and count as minimal dreams. For now, I take this to be an open question. Convergence between temporal (or sleep stage) and phenomenological characteristics would be attractive, but is not guaranteed. After all, it has so far been impossible to identify the sleep-stage correlates of (immersive) dreaming and establish a one-one mapping between types of sleep experience and sleep stages (Windt *et al.* 2016).

One possibility is that the phenomenology of microdreaming is diverse. As wakefulness is interrupted by microsleeps and conscious mentation slowly slips toward dreaming, the immersive structure of both dreaming and waking experience may temporarily break down. Such imagery would still have spatiotemporal characteristics, but would lack integration into a unified and immersive scene. An example would be isolated visual imagery, such as a face or pattern appearing seemingly out of nowhere, independently of a broader spatiotemporal, multimodal, or narrative context. Such experiences would best be described as early precursors to immersive experience but would not themselves count as dreamful. By contrast, microdreams occurring in later substages of sleep onset, as sleep becomes more established, may have the overall coherence and immersive organization that characterizes both waking and dreaming. I think such variation would fit in well with the occurrence of microdreams on the border between sleep and wakefulness.

Another possibility is that all microdreams, including those in the early substages of sleep onset, are in fact immersive. Yet this would not necessarily qualify them all as dreams, as there could still be variation in the extent to which they lack an appropriate external stimulus source. Some might involve the sense of presence in a hallucinatory (and hence dreamlike) scene, whereas others might involve largely veridical (and hence perceptual) experiences of the actual sleeping environment. In yet other cases, veridical perception of the bedroom may merge with hallucinatory, illusory, or even more imaginative, daydream-like imagery (Windt 2015a, chap. 11.2). Here, my point is that even immersive microdreams would fail to count as dreams if they were predominantly perceptual.

So far, these are just theoretical possibilities. More systematic studies involving larger samples are needed and it seems likely that the phenomenology of microdreams will have to be assessed on a case-by-case basis. Based on the examples provided by Nielsen,[1] it would seem that microdreams typically have a dynamic or kinetic component as well as spatial imagery (e.g. Fig. 3), but may indeed lack a broader temporal context as well as integration into an immersive and largely stimulus-independent (visuo)spatial scene. Visual imagery, e.g. of non-self-characters or objects, often has an oddly fragmented character, appearing seemingly out of nowhere or even lacking a sense of location relative to the self (e.g. Table 3, examples 1, 4). Other cases involve bodily experiences occurring seemingly without a larger context (e.g. Table 3, example 6). I would argue that such microdreams are non-immersive and hence dreamless.

Other microdreams involve immersive (and seemingly hallucinatory) scene construction (e.g. Table 3, examples 11, 12), while yet others seem to be intermediate cases. The latter include incomplete self-other distinctions, such as overlapping experiences of self- and observed movement (Table 3, example 17), and incomplete scene construction, such as the experience of non-self-persons or objects appearing independently of a larger spatiotemporal scene, but nonetheless having a particular spatial location relative to the self (e.g. Table 3, example 18).

Non-immersive microdreams would still be useful for the microdynamic approach, but they would not be mini-versions of dreams, even in the reduced sense of minimal dreaming implicit in the simulation view. They would better be described as prequels to dreams, in which the core feature of self-centered world simulation was lacking or only incompletely expressed. Investigating these different cases might shed light on the gradual transition from non-immersive and hence dreamless to immersive, dreamful experience; more generally, it could provide important glimpses of the organization of conscious experience, including underlying complexities and nuances.

1 All tables and figures referred to in this commentary can be found in Nielsen (2017).

Should the Oneiragogic Spectrum Be Expanded?

Based on his analysis of microdreams, Nielsen proposes that the oneiragogic spectrum (Windt 2015a, chap. 11.2) be expanded to include spatiotemporal kinesis. The dimensions I originally proposed were (i) the gradual emergence of an integrated, largely hallucinatory visuospatial scene; (ii) changes in phenomenal–functional embodiment, or in the pattern of bodily experiences and their degree of causal coupling with the physical body; (iii) the emergence of a temporal reference frame, culminating in prolonged, narratively organized episodes; (iv) the integration of waking-memory sources; and (v) the integration with autobiographical memory and recallability.

I agree with Nielsen that kinesis is central for understanding both full-fledged dreaming and its precursors. While I did not include it as a separate dimension of oneiragogic experience, kinesis does play a role in my original classification. Kinesis is implicit in (ii) in the form of (illusory) self-movement; it is also often involved in (i) the emergence of visuospatial scenery and (iii) temporal and narrative organization, both of which are associated with an increase in dynamics.

Whether kinesis is best treated as a separate category as suggested by Nielsen or, as in my classification, carved up to distinguish between self- and observed environmental movement and subsumed under the existing dimensions is, I think, a largely empirical question. In favor of his proposal is that non-self-characters experienced at sleep onset, as in felt presence, are plausibly linked to illusory own-body perception (Nielsen 2007) and that experienced self- and other-movements can be incompletely differentiated (Table 3, example 17). In favor of mine is that movement sensations are linked to changes in experienced self-location, which in turn is crucial to immersive dreaming (Windt 2015a, chaps 7 and 12). That said I do not think that these two options need be mutually exclusive. My original aim was to introduce a taxonomy for distinguishing different types of changes that can guide further investigation of oneiragogic experience. This taxonomy was inspired, in part, by Nielsen's earlier research (Nielsen 1992, 1995). His new proposal now takes another step toward greater conceptual precision, and I welcome the addition of kinesis as being very much in the spirit of my original proposal.

Yet Nielsen's proposal also raises a more substantial challenge. Implicit in my original categorization seems to be the claim that dynamicism sets in with the emergence of an immersive spatiotemporal scene, but is lacking in fleeting images or microdreams. In light of Nielsen's analysis, this is empirically false. At the very least, it seems I underestimated the kinetic quality inherent in even fleeting imagery.

I also proposed that minimal dreaming can arise independently, at least in principle, of modality-specific imagery and bodily experience including movement sensations (Windt 2015a, chaps 8 and 11). By contrast, Nielsen proposes that kinesis may be integral to both the simplest (immersive) dreams and their non-immersive precursors. The idea that, e.g. vestibular sensations may be a central factor for dream imagery formation generally sits well with my own proposal (Windt 2015a, chap. 12). It is also in keeping with existing models of out-of-body experiences, in which out-of-body autoscopy, or seeing one's body from the outside, is preceded by feelings of moving outside one's body (Cheyne and Girard 2009). Also in favor of his position is that even in reports of minimal dreams, the sense of presence is often associated with vestibular imagery such as floating (LaBerge and DeGracia 2000).

Could there still be instances of immersive spatiotemporal hallucinations that lack kinesis entirely, both in the form of self- or observed environmental movement? Conceptually, this seems possible. Empirically, it is worth noting that in full-body-illusions, where multisensory conflict induces changes in experienced self-location and self-identification, both the participant and the avatar with which they identify stand still throughout the experiment (Lenggenhager *et al.* 2007). There are also reports of static dreams from stages 2 and 3 non-rapid-eye-movement (NREM) sleep that appear to involve a sense of self-location including visuospatial scenery (Noreika *et al.* 2009). Future research could investigate whether in these dreams, the sense of subjective duration is independent not just of events or narrative progression but also of any kind of experienced self- or observed environmental movement.

If it turns out that at least a subset of immersive and hence dreamful experiences does not involve kinesis, we might say that there are two distinct pathways leading into immersive dreaming. One would be dreamless sleep experiences arising in NREM sleep, where the transition from non-immersive imagery, sleep thinking, or even purely temporal experience (Windt 2015b) to immersive dreams occurs, at least initially, independently of kinesis. Static dreams would be an example. The other would be non-immersive microdreams at the lower end of the oneiragogic spectrum, where kinesis might be consistently associated with the emergence of an immersive (visuo)spatial scene. Kinesis, under the conditions of sleep onset, would then be a causally enabling, but not a necessary or sufficient condition for dreaming to occur. The pathways leading into dreaming might, in other words, be state-dependent, reflecting the differences in conscious state, responsiveness to external stimuli, level of brain activity, etc. that hold between e.g. drowsiness preceding sleep onset and the deeper stages of NREM sleep.

Can Insights from Microdreams Be Generalized to Full-Fledged Dreaming?

I think the answer to this questions is clearly yes. I also think this is true even if microdreams (or a subset thereof) do not fulfill the conditions to count as even minimally immersive dreams. The analysis of microdreams can help identify and experimentally isolate the state-dependent, causally enabling conditions for dreaming to occur. Microdreams are oneiragogic in the sense of being experiences leading into dreams (Windt 2015a); they are informative, in part, because they provide a glimpse of the borderline state between waking and dreaming. This is true even if some remain in this borderland without crossing the threshold into full-fledged dreaming.

The multisensory integration approach, in which experimental stimulation during sleep onset can be used to probe the inherently kinetic character of microdream imagery formation, is a particularly good example. Incorporation rates for external stimuli are likely higher in drowsiness than in NREM or REM sleep; modality-specific differences (e.g. for tactile or vestibular vs. visual stimulation) between sleep stages might also exist. The microdynamic approach to sleep-onset experience can also help investigate characteristics that are necessary but not yet sufficient for immersive dreaming. Non-immersive spatiotemporal imagery, which is prominent even at the lower end of the oneiragogic spectrum, is an example.

Another advantage of looking to microdreams is methodological, having to do with the comparative ease with which microdreams "can be mined for evidence of features that define

dreaming's phenomenal core" (p. 6), as exemplified by Nielsen's upright napping procedure. To ensure that first-person reports of microdreaming have the required level of detail and specificity to capture the relevant features of experience—such as "here-and-now experience"—it might be useful to use detailed questionnaires or interviews. Verbal reports can be complemented by other reporting methods, such as drawings; training can help ensure participants have an adequate grasp of technical terms such as immersion. Exploring these different options may lead to more fine grained phenomenological distinctions. Descriptions of sleep-onset experience can then be refined in concert with sleep-stage scoring. I think one of the strongpoints of Nielsen's contribution is that it takes concrete steps in this direction. In sum, microdreams can help tackle the overabundance problem even though—or even because—a subset may not count as immersive and hence dreamful.

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