Embodiment, Interaction, and Experience: Toward a Comprehensive Model in Addiction Science

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Current theories of addiction try to explain what addiction is, who experiences it, why it occurs, and how it develops and persists. In this article, I explain why none of these theories can be accepted as a comprehensive model. I argue that current models fail to account for differences in embodiment, interaction processes, and the experience of addiction. To redress these limiting factors, I design a proposal for an enactive account of addiction that follows the enactive model of autism proposed by Hanne De Jaegher.

1. Introduction. Addiction—"a strong and habitual want that significantly reduces control and leads to significant harm" (Sinnott-Armstrong and Pickard 2013)—is a difficult-to-model form of psychopathology faced with several philosophical questions. Is addiction a disease (Leshner 1997; Heyman 2009)? Are individuals who experience addiction (henceforth termed IWEA) morally or legally responsible (Sinnott-Armstrong and Pickard 2013)? What does it mean to say that IWEA are 'powerless' (Matthews 2010)? Which purposes should a presiding model of addiction serve (Sinnott-Armstrong and Pickard 2013)? Which IWEA should be included in empirical studies? Which account of addiction is the most precise (Sinnott-Armstrong and Pickard 2013)? What does it mean to say, "I am addicted"? How should I think and feel about individuals who use and perhaps also abuse drugs?

Unfortunately, current theories of addiction are inherently unsatisfactory in resolving these issues. Specifically, the widely accepted medical model of addiction (NIDA 2014) is unable to account for differences in embodiment,

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interaction processes, and the experience of addiction. With the goal of one day resolving these issues, I offer a comprehensive model of addiction that follows the enactive account of autism proposed by Hanne De Jaegher. With the enactive approach, embodiment, interaction processes, and experience are fundamental to our understanding of psychopathology.

In explicating an enactive model, I show that addiction is best characterized as a difference in *embodiment*—that is, a difference in "both the body as a lived, experiential structure and the body as context or milieu of cognitive mechanisms" (Varela, Thompson, and Rosch 1991, xvi). Under an enactive approach, addiction "depends upon the kinds of experiences that come from having a body with distinct *sensorimotor capacities* [i.e., regularities in how sensory stimulation and motor action depends on an individual's active bodily engagement with the environment]," which "are themselves embedded in a more encompassing biological, psychological, and cultural context" (173).

I argue that, like autism (De Jaegher 2013) and other psychopathologies (Fuchs 2010; McGann, De Jaegher, and Di Paolo 2013), addiction can be described as a unique way of connecting to, making sense of, and navigating the world, determined by the IWEA and their particular embodiment as much as by their environment. As De Jaegher (2013) has shown with her enactive account of autism, I hope to establish that a comprehensive model of addiction is possible, and that such a model requires the integration of accounts of the embodiment, interaction processes, and experience of addiction.

2. Current Theories. Addiction is seen as arising "out of either pre-existing characteristics of individuals or the acquisition of characteristics that, together with a given set of environmental circumstances, result in powerful motivations to engage in harmful behavior patterns" (West 2013, 34). IWEA, as characterized by the Europe Monitoring Centre for Drugs and Drug Addiction, "are regarded as possessing particular dispositions and/or inhabiting particular environments that promote addiction, through either initial engagement in the addictive activity or susceptibility to the development of addiction once the individual has undertaken the activity and been exposed to its consequences" (34). The main types of explanatory theories include models at the level of the individual (e.g., automatic processing theories, reflective choice theories, goal-focused theories, biological theories, process-of-change theories, integrative theories) and models at the population-group level (e.g., social network theories, economic models, communication/marketing theories, organizational systems models).

3. Problems with Current Theories. More important than specific criticisms and limitations of each theory is that none of the theories serve as a comprehensive model—that is, none of the theories suffice on their own

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to explain addiction as a whole. According to West (2013, 88), "different contexts and different addictive behaviors require different blends of policies at different times in different cultures" and thus require different theories. As a result, each current theory is limited in scope and has gaps that have yet to be effectively addressed. Maintaining multiple theories of addiction thus raises epistemological, methodological, and practical concerns. This suggests that it may be beneficial to unify the different theories in an integrative framework to help better explain addiction. A comprehensive model of addiction would incorporate the pertinent aspects of each individual theory and combine them into a single, more robust model that could be utilized to improve treatment strategies (West 2013).

Three limiting factors of current theories, however, restrict them from being combined into a comprehensive model. First, being disembodied and individualistic, they have difficulty characterizing how addiction reflects a difference in embodiment. Differences in embodiment among IWEA abound, for example, in attentional bias, decision making, immediate reward bias, impulsivity, learning, and memory (Crews and Boettiger 2009; Chanon, Sours, and Boettiger 2010; Yalachkov, Kaiser, and Naumer 2010). Unfortunately, a comprehensive framework to explain those differences is missing. As a result, proper diagnoses and treatment strategies remain insufficient.

Second, models of addiction do not consider the interaction process between (*a*) IWEA and their environment and (*b*) IWEA and other agents as central. Interaction processes influence, modify, and, in part, create the behavior patterns and intentions of IWEA. Without sufficient focus on the ways in which IWEA interact and "how that interaction transforms over time in a web of dynamics and constraints" (McGann et al. 2013, 207), a rigorous description of the relation between IWEA and their environment—an appropriate scientific description of addiction—cannot be developed.

Third, current models cannot adequately account for the experience of addiction. Experiences of addiction—for example, "the phenomenon of craving" (Jellinek 1960), "wanting versus liking" (Berridge and Robinson 1995), and "chronic loneliness"—play an integral role in deterring attempts at recovery (Fidler and West 2011). Additionally, such experiences are frequently drawn upon in support groups that help individuals acknowledge the presence of addiction, as well as identify with other members. Scientific concern for experiential variables is miniscule in comparison to scientific reports on common usage and reference to harm.

Without a model that can account for these three factors, we do not have a comprehensive model of addiction. These factors are key elements of the enactive account of addiction I propose here.

4. The Enactive Account of Addiction. The enactive account of addiction is a nonreductive, naturalistic model that views addictive processes (e.g.,

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craving, mental obsessions, abnormal reactions) as "dynamic and embedded interactions" (McGann et al. 2013, 203) between IWEA and their environment.[1] Addiction is not seen as residing in IWEA, but "as emerging, existing dynamically in the relationship between [IWEA] and their surroundings, including other agents" (203). Such a model of addiction "groups central concepts (such as action, sense, and agency) in the autonomous organization of [IWEA] and their value-laden, meaningful engagements with their environment" (203).

Two analogies, borrowed from McGann et al. (2013), may be useful. For example, a handshake does not exist except during its enaction. With the enactive approach, the same is true of addiction—it is "intrinsically relational and dynamic in nature" (McGann et al. 2013, 203). A dance endures "only while the dancers continue to act, and is defined by the coordination, the mutual sensitivity, and reciprocal influence between the dancers and the music" (203). With enaction, addiction "is a dynamically constituted process and, like a dance, or a handshake, should be studied and understood in dynamic, contextualized terms" (203).

The enactive account of addiction supports the following five related ideas. These five ideas, synthesized by Thompson (2007) to describe and unify the ideas of the enactive approach to cognitive science, are reworked to apply to addiction:

1. IWEA are autonomous agents that actively generate and maintain their identities and thereby enact or bring forth their own world.
2. The nervous system of IWEA is an autonomous system: it actively generates and maintains its own coherent and meaningful patterns of activity, according to its operation as an organizationally closed or circular and re-entrant sensorimotor network of interacting neurons.
3. Addiction is a difference in embodied action and sense-making; addictive structures and processes emerge from recurrent sensorimotor patterns of perception and action.
4. An IWEA's world is not a prespecified, external realm, represented internally by the brain, but a relational domain enacted or brought forth by that IWEA's autonomous agency and mode of coupling with the environment.
5. Experience is not an epiphenomenal side issue, but central to any understanding of addiction, and it needs to be investigated in a complementary and mutually informing way.

1. McGann et al. (2013) describe the enactive approach to cognitive science. This quotation and several others that follow made no reference to addiction. In order to connect their work on the enactive approach to addiction, I have used their words with slight modifications to demonstrate their applicability.

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4.1. Sense-Making. These five related ideas help us understand one of the core tenets of the enactive account of addiction—that situations are meaningful (McGann et al. 2013) to IWEA. Under this notion, addiction is experienced as an IWEA copes with or makes sense of her situations. Addiction, understood as a difference in embodiment and sense-making, is the process of "coordinating the needs of [IWEA] (biological, affective/cognitive, social) with environmental factors (either facilitating or hindering)" (McGann et al. 2013, 204).

Sense-making is related to IWEA's "autonomy at various levels, such as that of living processes of material self-construction" (McGann et al. 2013, 204). "The needs and demands for the continuation of a precarious form of life explain why [IWEA] have a meaningful perspective on their interactions with the environment, why things matter to them" (204). Thus, the enactive account of addiction "offers an approach of naturalizing notions such as meaning, value, significance, and normativity" associated with addiction "in ways that can still be examined using dynamical systems tools" (205). Furthermore, it allows for a comprehensive model by characterizing addiction in terms of differences in embodiment in the way IWEA coordinate their needs with environmental factors.

4.2. Participatory Sense-Making. Interaction between IWEA and their environment involves *engagement* among IWEA, other autonomous agents, and their environment. Engagement encompasses the qualitative features of interactions once they start to "take on" a life of their own (De Jaegher 2013). The experience of engagement is "the fluctuating feelings of connectedness with an other, including that of being in the flow of an interaction and tensions" (De Jaegher 2013, 6).

Interaction is defined "on the basis of the autonomy of the interaction process and that of the individuals involved" (De Jaegher 2013, 6). A *social interaction* is "a co-regulated coupling between at least two autonomous agents" (6). The idea of coupling is the mutual influence between IWEA and their environment from which meaningful behavior emerges (McGann et al. 2013). Each coupled IWEA "contributes to its co-regulation, but the interaction process [being autonomous] also self-organizes and self maintains" (De Jaegher 2013, 6).[2] This implies that the interaction itself sometimes endures in a way that none of its participants intended. Through *coordination*, interactions between IWEA self-organize and self-maintain.

2. De Jaegher (2013) describes components of the enactive approach in relation to the enactive account of autism. This quotation and several others that follow made no reference to addiction. In order to connect her work on the enactive account of autism to addiction, I have used her words with slight modifications to demonstrate their applicability.

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Coordination is "the non-accidental correlation between the behaviors of two or more systems that are in sustained coupling, or have been coupled in the past, or have been coupled to another, common, system" (De Jaegher and Di Paolo 2007, 490).

Consequently, when an IWEA with certain capabilities, intentions, and motivations interacts with other agents and the environment, not only do the participants and/or the environment influence the sense-making, but also the interaction processes as such modulate the sense-making that takes place (De Jaegher 2013). It is this notion that is the key concept of *participatory sense-making* (De Jaegher and Di Paolo 2007). That is, "we literally participate in each other's sense-making. We generate and transform meaning together in and through interacting" (De Jaegher 2013, 7). This means that, in application to addiction, capabilities, intentions, and motivations of IWEA can be explained as being created and altered via interactions. Interaction among IWEA, other agents, and their environment "opens up new domains of sense-making" that such IWEA "would not have had on [their] own" (De Jaegher 2013, 7). In short, the concept of participatory sense-making provides a framework to understand interactive processes associated with addiction.

4.3. The World of IWEA. Similar to individuals who experience autism, the ways in which IWEA act are typically viewed as disordered, a result of a brain disease, to be diagnosed and treated away. Two questions considered by De Jaegher (2013) (with slight modifications so as to apply to addiction) are as follows: (1) Why do IWEA move and perceive in the way that they do? (2) What does this have to do with how IWEA engage with and understand the world, others, and themselves?

If embodiment and sense-making are fundamentally interconnected, these questions are essential (De Jaegher 2013). When IWEA move, perceive, or cope with emotions differently (e.g., obsessively engage in, or feel compelled to engage in, an addictive behavior in response to being situated within close proximity of reward-predicting stimuli or a stressful environment), this inseparably relates to how they understand the world. The world is not prespecified but is brought forth through the process of sense-making, defined by differences in embodiment (Thompson 2007). Just as how the color bluish-green is not in light or perception but in the interaction between light and perception, the activity of the nervous system is not determined by the external world but by the nervous system itself—and thus, the world is not internally represented but is instead brought forth (Maturana 1980). This fact, however, is underrecognized in current theories.

The enactive account of addiction emphasizes the link between the sensorimotor-affective (i.e., embodied) characteristics of IWEA and the ways in which IWEA make sense of their world. As with autism (De Jaegher 2013), the notion of sense-making is ideally situated to integrate evidence

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of the sensorimotor-affective aspects of IWEA that are involved in different stages and mechanisms of addiction (Yalachkov et al. 2010) that have historically been examined in isolation. The concept of sense-making may ultimately help to connect the key embodied aspects of addiction in a comprehensive model.

5. Evidence for a Difference in Embodiment and Sense-Making in Addiction

5.1. Perception in Addiction. I now review evidence of the particular ways in which the sensorimotor-affective aspects of IWEA differ from those who do not experience addiction. IWEA exhibit *attentional bias*—"a non-conscious tendency to focus attention on particular types of objects or features"—toward reward-predicting stimuli (i.e., stimuli for which individuals are willing to work and which are approached), primarily drug- or addictive-behavior-related cues (West 2013, 89). IWEA additionally show *cognitive bias*, or a propensity to "preferentially process information or form mental representations of particular types of objects or features of objects in the environment" (90), toward stimuli or situations associated with their addiction (McCusker 2001). IWEA may also acquire *object recognition* and *classification expertise* with regard to real stimuli or images associated with their addiction (Yalachkov et al. 2010).

Individuals in various stages of addiction exhibit markedly different *evaluations*, that is, "beliefs about the degree to which something is good or bad in some way, e.g. harmful vs. beneficial, morally right or wrong," toward particular actions relevant to obtaining a positive reward and/or their addictive behavior (West 2013, 90). For example, an IWEA may perceive stealing from a family member in order to purchase alcohol or using drugs in the presence of their children as morally permissible—even "the right thing to do." Individuals' *incentive salience*—a motivational 'wanting' attributed to a reward-predicting stimuli—is significantly higher compared to that of individuals who do not experience addiction (Berridge and Robinson 1995). MacKillop et al. provided evidence of greater *delayed reward discounting* (DRD) in IWEA, specifically "in individuals exhibiting addictive behavior in general and particularly in individuals who meet criteria for an addictive disorder" (2011, 2). A prime example of DRD includes *temporal discounting*, or the tendency to prefer immediate but modest rewards to future but sizable rewards (MacKillop et al. 2011). In other words, IWEA prefer everything "now."

Perceived control—"the extent to which people believe they can enact a given behavior" (West 2013, 92)—continuously becomes distorted in IWEA, almost always in relation to control over their addictive behavior. For example, IWEA in recovery report intruding perceptual thoughts, such

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as "I don't have addiction," "I am normal," and "I can control my addictive behavior." Alcoholics Anonymous speaks toward this perceptual difference, suggesting that "the idea that somehow, someday he will control his drinking is the great obsession of every abnormal drinker. The persistence of this illusion is astonishing" (Alcoholics Anonymous 2001, 30). Such distortions of perception undeniably play into the high relapse rates seen in addiction.

5.2. Movement in Addiction. Research primarily has focused on *executive dysfunction*, whereby IWEA have an impaired ability for reflective control over behavior and risk taking. In less studied yet notable movement differences, IWEA have a distinct and shared willingness to fixate on a particular solution, typically in an effort to achieve rewarding stimuli, beyond that of individuals who do not experience addiction. With addictive behavior, for example, an IWEA may be willing to bike 20+ miles in 110-degree heat if it is the only means to acquire the drugs they perceive to "want" or "need." Another difference is the tendency for individuals to create and adhere to comforting ritualistic behaviors, typically around reward-predicting stimuli. Individuals will develop soothing routines around addictive behavior whereby the routines themselves can become desired as much as the reward-predicting stimuli. Lastly, IWEA are known to consistently prioritize the needs of the self above others. IWEA tend to go out of their way to secure reward-predicting stimuli for themselves first and foremost. In other words, when the oxygen masks on the metaphorical airplanes deploy, IWEA are quite proficient at securing their own masks first.

5.3. Affect and Experience in Addiction. Feelings of anxiety and depression are highly predictive of addictive behavior and relapse in IWEA. With IWEA, addictive learned behaviors serve as a primary coping strategy. In addition, IWEA report a heightened sensitivity to emotions. They tend to "dislike" feeling feelings and have a difficult time identifying, communicating, and knowing what to do about feelings. Some theorists take differences in affect in IWEA so far as to characterize addiction itself as a "feelings disease," or highlight specific feelings (e.g., shame) as being at the core of addiction (O'Connor et al. 1994).

Aside from reported difficulty with affect, IWEA report such phenomenal experiences as "not being given the script to life," "always being on low-grade alert," and "always feeling like something is missing." Such affective experiences may exist in individuals who do not experience addiction. Such life experiences no doubt are inherent in the human experience. Yet such experiences tend to be pronounced in IWEA. Relieving or removing these experiences of uncomfortable affect are often cited as the "reason" or "purpose" IWEA engage in addictive behavior in the first place.

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5.4. From Embodiment to Sense-Making. Similar to autism, differences in embodiment imply that there is different sense-making in addiction. As these differences in embodiment and sense-making in addiction are essentially linked, cognitive processes of IWEA are affected by embodied states—and those embodied states determine how IWEA relate to the world (De Jaegher 2013). To say that IWEA relate to the world is to say that they "construct and pick up as relevant that which is meaningful to [them], but not necessarily to someone else" (De Jaegher 2013, 9). Perceptual and sensory differences, particular patterns of moving, and distinct ways in which IWEA relate to emotions (i.e., differences in embodiment) can be viewed as alternative ways in which IWEA perceive the world and also as strategies to cope with it (De Jaegher 2013). For example, IWEA exhibit addictive behavior in order to relieve the experience of "always feeling like something is missing."

If embodiment differences in IWEA are intrinsically linked with sense-making in addiction, I suggest, as De Jaegher (2013) has with autism, that many IWEA will find joy or significance in behaviors and embodied styles of sense-making that are considered "addictive." A less studied factor in perceptual differences is the aesthetic element of reward-predicting stimuli. There may be significance to some addictive sense-making that simply is that of enjoying, thinking about, or "taking in" reward-predicting stimuli indirectly. This can involve discussing, telling stories, listening to songs, smelling, and appreciating such stimuli as they are. IWEA tend to value, care about, place priority on, and even enjoy reward-predicting stimuli above and beyond individuals who do not experience addiction.

The enactive account of addiction thus considers the way IWEA relate to the world as intrinsically meaningful to them. In this, IWEA are no different from anyone else. Following De Jaegher (2013), a simple way to test this approach is to see whether IWEA do in fact enjoy or suffer from that which they do.

The notion that IWEA gain a sense of ease and comfort from their particular activities, preferences, and thinking styles comes from positive reward theories. Evidence points toward IWEA reporting "stronger euphoriant effects from many addictive drugs and activities" (West 2013, 53; see also Wise and Bozarth 1987) than individuals who do not experience addiction. For example, verbal reports of IWEA's "first time" fully experiencing an addictive behavior of choice describe it as equivalent to a profound religious experience, whereby the "world opened up," "I felt like I could finally breathe," or "I finally felt comfortable in my own skin." Such addictive behaviors also provide functional benefits, for example, "maintaining a desired body shape" (Cawley, Markowitz, and Tauras 2004) and managing psychological distress (Pickard 2012). At least initially, IWEA tend to enjoy their addictive behaviors.

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The creation and adherence to ritualistic behaviors in addiction, like in autism, are additionally associated with great positive reward. Such behaviors appear to be highly motivating for IWEA. When IWEA engage in or anticipate engaging in such behaviors, there is often an observed increase in positive affect, something like a "bounce to their step" that was not there before. Ritualistic behaviors are considered by Lovaas, Newsom, and Hickman (1987) and De Jaegher (2013) to be "intrinsically motivating for the perceptual reinforcement and self-stimulation that they provide, even connecting this to the sensory joys of gourmet food, art, recreational drugs, and smoking" (De Jaegher 2013, 10).

While they might be meaningful and enjoyable, ritualistic behaviors and other particularities in IWEA often interfere with daily living. As a result, such behaviors can be challenging, for both the IWEA and their environment. However, this does not necessitate that such differences could not in themselves be important for IWEA. These embodied states, similar to autism, might only be considered troublesome "as a consequence of their manifesting in a context that can or will not accommodate them" (De Jaegher 2013, 10). This is not, however, to condone such addictive behaviors. Instead, I argue that dealing with differences in embodiment in IWEA should start from the meaning that they have for the IWEA, not from questions of whether they are appropriate and how to eliminate them. Focusing on the meaning can help researchers to find suitable ways for IWEA to cope with differences in embodiment. Coinciding with this idea, it has been hypothesized that the key to understanding why some individuals "mature out" of addiction and some do not "lies in the *purpose* served" by addictive behaviors (Pickard 2012, 2).

6. Conclusion. The enactive account of addiction contrasts sharply with current models that conceive of addiction as "neural hijacking" or as a "brain disease." In their place, the enactive account of addiction grounds central concepts (such as embodiment, sense-making, and interaction processes) in the autonomous organization of IWEA and in their value-laden, meaningful engagements with their environment. Distinct from approaches that begin with basic mechanisms and study dysfunctions in those mechanisms as a way to understand shared symptoms, the enactive account of addiction aims for a comprehensive explanation of addiction that espouses a complex, nonlinear relationship among its component parts. Most importantly, the enactive account of addiction provides researchers with a framework for understanding addiction that rests not on pathological processes but rather on identifying the humanity in the set of behaviors associated with people identified with this label.

The promise of an enactive approach comes from its ability to emphasize both the bodily aspects and experiential qualities of addiction in a com-

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prehensive model. An enactive approach may "be explicitly adopted to explore whether and how experience and neurophysiological processes correlate" and emphasize "the complexity of the mutual relations of brain, body, and world . . . , [which can] provide reasons within psychopathology as to why [addiction] should not be reduced to neurochemical impairments," and "why alternative forms of treatment such as bodily practices [e.g., yoga, mindfulness meditation] should be considered equivalent to drug-based therapy" (Colombetti 2013, 24).

In conclusion, it is essential to undertake an embodied analysis of addiction. Such an analysis may be realized through an enactive account of addiction. An enactive approach entails (1) the study of recurrent sensorimotor-affective patterns of IWEA (i.e., differences in embodiment and sense-making), (2) measurement of the interaction dynamics between IWEA and their environment and/or other agents using dynamical systems tools and their relation to neural activity, and (3) the "naturalization" of the experience of addiction. Such an approach may lead to the development of improved strategies for the assessment, prevention, and treatment of addictive behaviors.

As with any new approach, this "does not replace the continued search for more effective interventions (e.g. better pharmacotherapies, better behavioral support and treatment programs, more effective pricing policies)," but it highlights "the need to consider how [such interventions] work together to achieve the desired goals" (West 2013, 132). The enactive approach put forth here is one that prioritizes in a principled and coherent way the perspective of individuals who experience addiction.

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