HOW BEST TO 'GO ON'? PROSPECTS FOR A 'MODERN SYNTHESIS' IN THE SCIENCES OF MIND

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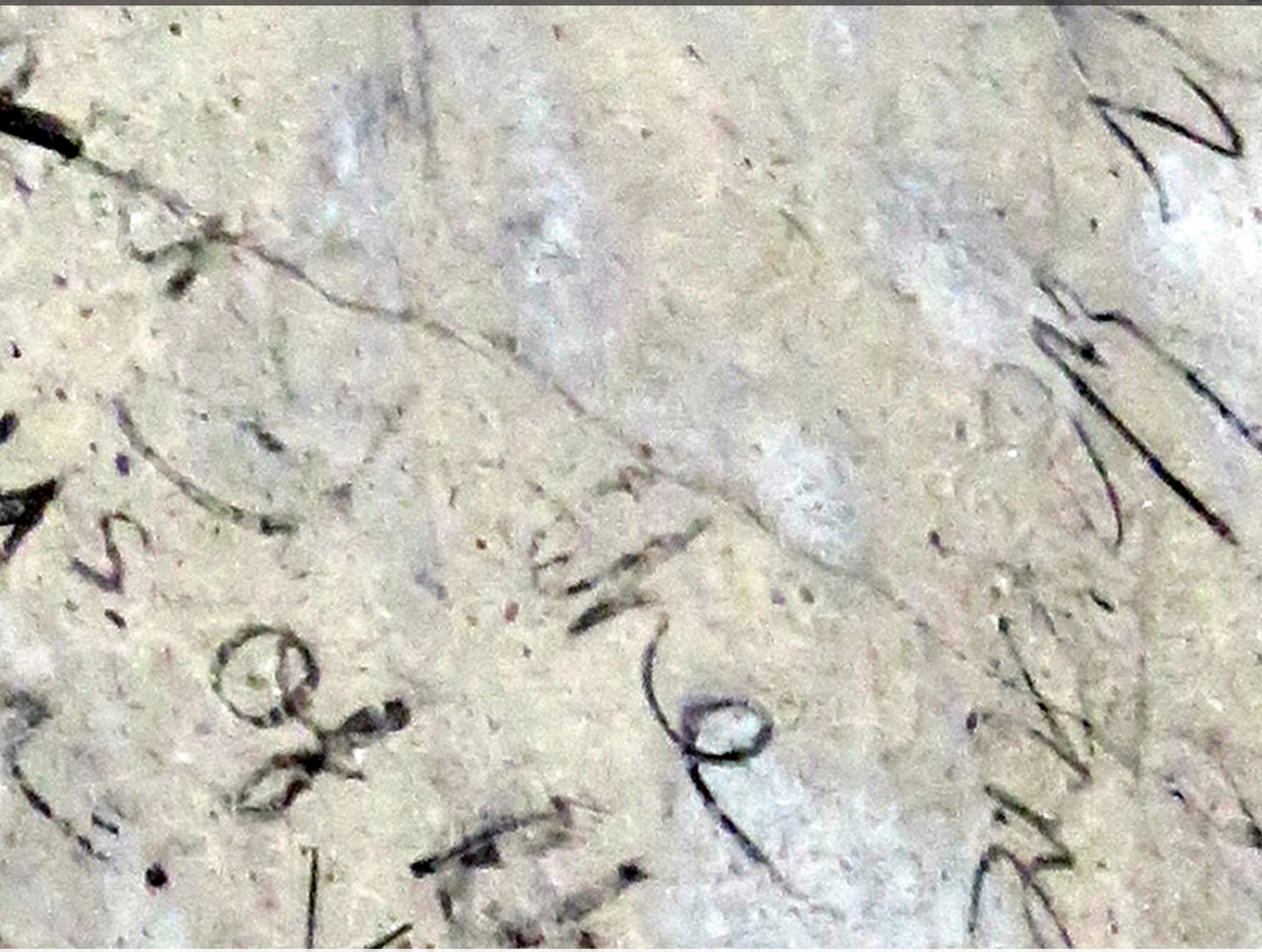

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HOW BEST TO 'GO ON'? PROSPECTS FOR A 'MODERN SYNTHESIS' IN THE SCIENCES OF MIND

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Photograph by John Cromby 'Engineers of the Imagination'

Psychology straddles areas from the biological to the social and cultural. Within that vast range, there have been recent explosions of interest in neuropsychology, genetics and epigenetics, and the evolutionary bases of mindedness. Correspondingly, there have been conceptual innovations and new empirical evidence in relation to the embodied, social and discursive processes supporting mind and personhood. Simultaneously, awareness of developmental processes and their dynamic interweaving of genetic, physiological, neurological, social and cultural elements has also increased.

Might such developments help 'connect the dots' between diverse aspects of mindedness and the contexts within which it arises? Whilst it seems clear that mind is co-constituted of both biological and socio-cultural processes, how might we bring these disparate realms of knowledge together? In a number of these areas, suggestive integrative possibilities have been explored (e.g., predictive processing, embodied and situated cognition, dynamic developmental systems theory) and insights such as a focus on action, 'knowledge as skills', embeddedness and connectivity have been pursued across a range of disciplines.

This edited collection of articles bring together such possibilities – and others - in the same forum in order to provide an opportunity to re-visit a recurring discussion within theoretical psychology: The claimed lack of - and potential for - theoretical synthesis and unity.

While the chapters range over a number of areas of research, this collection is focused on current prospects for conceptual synthesis within - or convergence of research between - aspects of mind

and mindedness. As is clear from the contributions, it highlights integrative conceptual proposals that emphasize action-orientation, process, embeddedness and connectivity – especially between explanatory 'levels'.

Beyond specific proposals for integration, several of the contributions explicitly or implicitly expose broader questions about the purpose of psychological research, the epistemological and ontological commitments required, and the relevant social, political and economic contexts within which such research is performed. This is perhaps inevitable since any aim for synthesis of various understandings of mind will - or should - lead to consideration of the general implications, beyond the 'science', that follow from an integrated account of mind and mindedness.

Whether or not the contributions in this volume provide insights into profitable paths towards greater theoretical synthesis in the sciences of mind or, alternatively, provide grist for the mill of renewed skepticism over the potential or even desirability of such synthesis is unpredictable. Whichever the outcome, we feel sure that they will help provoke future productive research in, and thinking about, the sciences of mind.

Kevin Moore and John Cromby
Associate Guest Editors

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EDITORIAL
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Editorial: How Best to "Go On"? Prospects for a "Modern Synthesis" in the Sciences of Mind

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Keywords: theoretical synthesis, multi-level systems, neurophenomenology, levels of explanation, enactivism, developmental systems theory, reciprocity, argumentation

The Editorial on the Research Topic

How Best to "Go On"? Prospects for a "Modern Synthesis" in the Sciences of Mind

For some time, conceptual unity in psychology has been seen as both a scientific "holy grail" and a feared hegemonic project—see, for example Observer (1982), Kantor (1984), and Dixon (1983). This may be because a focus on integration, perhaps paradoxically, may intensify various tensions within a psychology whose sub-disciplinary constitution actually reflects fault lines and dualisms in the organization of knowledge more generally.

In recent years, we have seen new areas of theory and methods, including enactivism, embodied cognition, discursive psychology, second-person neuroscience, developmental systems theories, and a stunning growth in the neurosciences, genetics, and epigenetics. Our contributors explore whether such advances have helped synthesize the diverse understandings of mind within psychology. In so doing they frequently emphasize the unifying prospects of dynamic, adaptive, action-orientated, "socialized," systems-based, and embodied approaches, and are correspondingly critical of reductionist, mechanistic approaches.

The articles are of two kinds. The first deals directly with the integration of the sciences of mind and cognition as a broad project (Marshall; Stam; Andringa et al.). The second focuses on prospects for synthesis within specific contexts of theory, method, and practice, including reciprocity (Berra) psychiatric theory, and diagnosis (Castiglioni and Laudisa; Di Francesco and Marraffa) methods for investigating consciousness (Olivares et al.); theories of vision (Laurent) and argumentation (Lillo-Unglaube et al.).

Marshall's proposal concerns relationships between "levels" in psychological understanding, arguing that combining an embodied approach with a developmental systems account, within a relational worldview, overcomes the conceptual "splitting off" of mind from brain and body. He highlights the vital role that "pattern explanation" (akin to Aristotle's formal cause) has in a relational developmental systems approach, because it allows increased conceptual clarity over the relations between a system's organization and its activity and thus avoids reductionism.

With a similar focus on the integration of levels of explanation, Di Francesco and Marraffa consider the relationship between consciousness (personal level) and the unconscious (sub-personal level). They argue that, contra an eliminativist perspective, some personal level concepts such as "motivation" and "attachment" can, in dialectical relationship with neuroscientific findings, provide a useful indication of how personal and sub-personal levels of explanation can operate together.

Relatedly, Castiglioni and Laudisa reject what they see as the reductionist, biological underpinnings of the DSM-5 approach to psychiatric diagnosis. Their article speaks to a context

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where consistent evidence for the biological deficits purportedly associated with the functional psychiatric diagnoses remains elusive, and where major funders such as NIMH no longer rely upon these diagnoses. Focusing on the DSM categorization of depressive disorders and the removal of the "bereavement exclusion clause"—and thus the continuing conflation of "endogenous" and "reactive" categories of depression—they show that reducing experiences of distress to quasi-medical symptoms actually undermines theoretical and clinical accuracy.

Digging further into neurological findings, Laurent proposes a new "Multiscale Enaction Model" of visual perception that challenges a hard-wired, modular account. He suggests that converging data indicate a need to acknowledge the multiple systems at various scales that interconnect to create visual experience.

With a similar focus on the relations between neurological findings and phenomenological experience, Olivares et al. examine the potential for "second-person methods" (through interviews) to fulfill the promise of a unified neurophenomenology. They argue that such methods provide more systematic data than do direct first-person methods (e.g., introspection in both its strong and weak forms) and can help bridge experiential and neurological descriptions of conscious experience.

Berra addresses the important phenomena of altruism and reciprocity in primate social groups. The aggregation of individuals into socially-bonded and cooperative groups, she argues, is best explained by emotional tracking of interactions—rather than the more cognitively "expensive" bookkeeping of expectations of rewards suggested in other theories. Her parsimonious approach facilitates consistent explanations of social reciprocity throughout primate groups that exhibit various levels of cognitive capacity. It also suggests a theoretical synthesis of emotional processes with the requirements of complex and dynamic adaptive social behavior.

For humans, cooperation also often involves debates and the making of arguments. As discursive psychology demonstrates, these psychological processes are simultaneously fundamental to political, legal, scientific, and educational discourse. The potential synthesis of normative ("classical") and cognitive approaches to understanding human argumentation is investigated by Lillo-Unglaube et al. They examine two argumentative fallacies (the "slippery slope" argument, and the *ad hominem* argument), and conclude that descriptive and experimental studies could potentially integrate normative and cognitive research traditions to produce an integrated body of theory on the psychology of argumentation.

In their ambitious contribution, Andringa et al. provocatively suggest that all cognition derives from two general modes that are based on common tendencies in all life forms: the coping mode, and the co-creation mode. The first is structured around the goal of meeting immediate needs while the second operates to construct environments within which pressing needs are less likely to arise.

The selection concludes with Stam's insightful argument over the very idea of conceptual synthesis in the sciences of mind. He proposes that psychology is in fact already relatively unified *methodologically*, through the adoption of an "indeterminate functionalism." He then argues that the neurosciences, while not acting to synthesize psychology, will nevertheless, influence our understanding of being human—perhaps by coming to see the brain as a technology that we use, but do not fully understand.

What, then, are the prospects for this "Modern Synthesis," and how should we best "go on?" Unsurprisingly, these papers provide no unequivocal answer to these questions. What does emerge, however, is that posing them raises many challenges—across theory, method, and practice, and at a range of scales. It is also clear that raising the issue of conceptual synthesis reveals significant bumps and hollows in our understanding of mind, and inspires innovative responses to those challenges.

AUTHOR CONTRIBUTIONS

KM wrote the first draft of the Editorial. JC revised that draft and the revisions were incorporated into the final manuscript. KM has now revised the manuscript in the light of the Editor's review comments.

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Beyond different levels: embodiment and the developmental system

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The value of studying a phenomenon at multiple levels of analysis is often emphasized in psychology, but a lack of clarity about the nature of levels and the relations among them remains an impediment to progress. The suggestion here is that an approach combining the tenets of embodiment with the construct of the developmental system provides a way forward. Embodiment opposes the splitting off and elevation of a level of mechanisms that has characterized much of cognitive science. In contrast, a constructivist embodied approach places a level of mechanisms in the context of a formal or systems level of analysis, with developmental process framing the interpenetrating relations between levels. Such an approach stems from a relational worldview that opposes conceptual splits and posits that levels of structure and process comprise an indissociable complementarity. The combination of embodiment and developmental systems within a relational worldview is discussed and elaborated through outlining the integrative approach of relational developmental systems, which has been proposed as a scientific paradigm within which formulations of the interrelations among brain, body, and mind can be advanced.

Keywords: levels of explanation, developmental systems, multilevel analysis, philosophy, developmental psychology

The value of explanations spanning multiple levels of analysis has become an important emphasis in psychological science, yet a coherent framework for explicating such levels and the relations among them remains elusive. Within the field of cognitive science, one influential attempt to conceptualize different levels of analysis was put forward by the vision scientist David Marr (1982). In line with the computational emphasis that characterized cognitive science at the time he was writing, Marr's account concerned three levels "at which any machine carrying out an information processing task must be understood" (Marr, 1982, p. 25). The first level, which Marr called the *computational* level, concerns the general nature of the problem or task at hand. At the second level of *representation and algorithm*, a sequence of operations and a representational format is specified that would solve the problem specified at the first level. At the third level of *implementation*, the question is how that particular solution could be realized on a machine (i.e., a description of the physical hardware needed). There are similarities between Marr's account and other levels-based proposals from the same era (e.g., Simon, 1969; Dennett, 1971; Wimsatt, 1976), but his model has remained particularly influential. However, on closer examination, two particular issues constrain the utility of this basic framework (see also Marshall, 2013, in press).

First, psychological science has often been characterized by a tendency to emphasize the explanatory priority of one level over another. For example, it could be argued that cognitive science has historically been too concerned with Marr's second level of representation and algorithm, or the level of problem-solving in terms of what symbols are needed for a solution, and the rules under which those symbols can be manipulated. This emphasis can be partly traced to the influence of the idea that cognition consists of formal computational reasoning processes acting on the syntactic, but not the semantic, aspects of symbolic representations (Fodor, 1975). This cognitivist approach was associated with an alignment of cognitive psychology with the emerging discipline of artificial intelligence, which further contributed to the dominance of an information processing view of the mind (Newell et al., 1958). From this perspective, cognitive operations could be seen as manipulations of sub-personal representations to which meaning had been pre-assigned (for a recent critique, see Allen and Bickhard, 2013). It has been argued in various places that the move toward cognitivism, with its associated emphasis on Marr's second level, was fundamentally a wrong turn in that it prevented the emergence of more integrative accounts of mental life (see Bruner, 1990; Thompson, 2007; Rowlands, 2010).

Second, psychology as a discipline has not arrived at a clear formulation of how to conceptualize the relations between levels. Indeed, it could be argued that the lack of a coherent explanatory framework for understanding the relations between different levels is one of the biggest obstacles to progress in the discipline. This problem can be partly traced to an emphasis within cognitive science on the relative autonomy of each of Marr's levels, which in turn stemmed from the proposal that a given task or problem could be solved in a myriad of ways, using different representational systems or forms of physical implementation (Fodor, 1975; Putnam, 1975; Pylyshyn, 1984). While this notion of *multiple realization* appears to avoid the problem of causal

reductionism (Miller, 2010), it sidesteps the crucial question of how to conceptualize the relations among levels.

Given the lack of coherence concerning the nature of levels and the relations among them, how are we to move forward? The suggestion here is that a framework that recognizes the interpenetrating nature of the relations between levels, and in which considerations of development play a key role, is a way forward. More specifically, it is argued that a *relational developmental systems* approach (Overton, 2013), in which the interconnections among levels can be articulated within the context of *embodiment*, provides a route toward a truly integrative account.

EMBODIMENT

Embodied approaches have become increasingly visible in psychology over the past three decades (e.g., Varela et al., 1991; Damasio, 1994; Glenberg, 1997; Clark, 1998; Anderson, 2003; Wheeler, 2005; Thompson, 2007; Barsalou, 2008; Beer, 2008; Overton, 2008; Semin and Smith, 2008; Menary, 2010). Although there are clearly different theoretical and empirical strands of embodied cognition (Wilson, 2002; Kiverstein, 2012), to a greater or lesser extent they all challenge the isolated computational mind of cognitivism, which lacks a brain, a body and a culture (Edelman, 1992).

By locating the brain in the body of an active, agentive organism, embodiment threatens the clear distinctions between perception (input), cognition (information processing) and action (the execution of instructions or output) that underpin the cognitivist account. One key tenet of embodied approaches is that cognition can no longer be packaged into an isolated level of information processing, or Marr's second level of representation and algorithm. As noted by Clark (2000), "our notions of what top-level task needs to be performed, and what kinds of algorithms are adequate to perform it, are deeply informed by reflection of details of bodily implementation, current needs, and action-taking potential" (p. 96). As such, embodiment puts pressure on a tidy separation of levels (or the isolation of any one level), and the need to understand the relational ties among levels moves to the fore.

Embodiment places the organism as an active agent that is tightly interconnected with its environment, with the actions of the individual constantly modifying these interconnections, a process that in turn influences subsequent actions. In one particular theoretical approach to embodiment, this feedback loop is the foundation of a dynamic system in which the boundaries between individual and environment cannot be clearly determined (Stewart et al., 2010). In turn, this proposal brings with it some far-reaching suggestions. Specifically, advocates of what Chemero (2009) terms *radical embodied cognitive science* suggest that the dynamic coupling of organism and environment has two related implications for framing the study of mental life (see also Hutto and Myin, 2012). First, that cognitive processes are distributed across the dynamic system that results from the non-linear coupling of individual and environment. Second, that the formulation of the wider cognitive system as a dynamic system challenges the need to invoke the concept of representation in accounts of mental life (Silberstein and Chemero, 2012). This challenge is partly founded in the work of Gibson (1979), who proposed that preexisting environmental structure largely negates the need for the concept of mental representation as it is usually understood.

In line with these points, empirical work from the radical embodied perspective often draws on dynamical systems theory as a basis for modeling the coupling of an agent's behavior over time with the changing state of the environment. However, it would be misleading and potentially damaging if an embodied approach was equated with one particular flavor of dynamic systems models. Among others, David Witherington has argued that a full understanding of living things entails seeing levels of organization and process as being complementary and indissociable (e.g., Witherington, 2011; Witherington and Heying, 2013). He makes the point that this stipulation pushes against the Gibsonian emphasis that is apparent in certain flavors of dynamic systems theory, for instance that of Thelen and Smith (1994). According to Witherington (in press), embodiment could be productively aligned with an approach more resembling Piagetian constructivism (see also Witherington and Margett, 2011), a sentiment that would be endorsed by those dynamical systems practitioners who see constructivism as being fundamentally consistent with systems approaches (e.g., van Geert, 2011).

RELATIONAL DEVELOPMENTAL SYSTEMS

Here I wish to highlight the suggestion that a particular constructivist approach to embodiment, informed by specific lines of systems thinking in developmental science and the philosophy of biology, has a great deal of potential for informing the understanding of different levels of analysis. This approach is termed *relational developmental systems* (RDS), as put forward by Willis Overton and Richard Lerner, who have suggested that it has key implications for understanding the nature of levels and the relations between them (Overton and Lerner, 2012; Overton, 2013). As the term suggests, RDS combines two broader metatheoretical streams: relationism and developmental systems. The worldview of relationism rejects any simple notion of separable causes, and can be contrasted with what Overton (2006) terms a Cartesian worldview that encourages dichotomies, elevates the explanatory value of proximate mechanisms, and precludes integration. Working under the umbrella of relationism allows these constraints to be jettisoned and enables a move toward a more integrative, developmentally oriented account of brain, body, and mind.

At a finer grain of theory, RDS is further informed by the developmental systems approach that emerged from a particular strand of psychobiological research in the 20th century (Lehrman, 1953; Schneirla, 1959; Gottlieb, 1970) and which brings together related viewpoints from developmental and evolutionary biology (Oyama, 1985; Griffiths and Gray, 1994). While this strand consists of various threads with different emphases (Johnston, 2010; Griffiths and Tabery, 2013), at its core are the notion of the developmental system, the necessity of multiple modes of explanation, and the stipulation that no single aspect of the system can be elevated in terms of its causal role (Shea, 2011). In turn, the developmental systems approach has its roots in principles derived by embryologists in the mid-20th century (e.g., Spemann, 1938; Kuo, 1939) who documented how organismic development

proceeds through a process of differentiation and integration. This foundational notion went on to influence developmentalists such as Werner (1948) and Piaget (1952) who laid the foundations for a biologically-informed developmental science of life and mind.

Drawing on the construct of the developmental system, RDS embraces several forms of explanation and brings them together in a relational framework. One key emphasis is on the importance of what can be called *pattern explanation*, or what Overton (1991) labeled *competence*. In turn, the notion of competence is similar to Aristotle's notion of the *formal cause*, which is interrelated with, but different from, other types of explanation such as efficient or material causes (Caston, 2006). It is important here to emphasize the necessarily abstract quality of pattern explanation, which transcends the framing of temporally related antecedents and consequences that is usually associated with the notion of causation. As such, pattern explanation refers to the structure or organization of the endogenously active system. This abstraction reflects the view that organization is not something that exists over and above the parts of a system, yet at the same time allowing organization more than a descriptive role. In this sense, the notion of organization as constraint (Thompson, 2007; Deacon, 2012) is helpful. As framed by Witherington (in press):

> "the explanatory causality of a system's organization rests in its top-down constraint. Constraint involves a lessening of variability, a narrowing of degrees of freedom, and as such plays a critical role in causal explanation by virtue of establishing limitations for what kinds of bottom-up processes... are available to a given system; thus, the nature of local interactions cannot be fully understood divorced from the organizational whole in which these interactions are embedded" (p. 90).

The necessity of relating multiple modes of explanation is central to the RDS approach, in which pattern explanation provides the meaning context for a different and complementary level of *processes*, or what Overton (1991) labeled *procedures*. In referring to distinct, observable factors having a casual action that precedes a specific effect, processes (or what in Aristotelian terms would be efficient causes) are quite close to everyday notions of causation. However, as discussed by Witherington (2011, in press), this can too easily lead to a diminished role for structure and a denial of the explanatory import of the formal patterns. According to accounts that discount a causal role for pattern explanation, the appearance of structure arises from the operation of complex positive and negative feedback processes, but does not causally influence the subsequent operation of those processes. However, this neglects the fact that complex processes must be organized in some way, and it is this issue that necessitates the formal level of explanation, which becomes the *system* of a systems approach. Simply put, it is a mistake to believe that pattern explanations are rendered unnecessary if enough processes are described. Adopting such a position would present a conundrum that stretches far back in the history of philosophical and scientific thought, which is that every efficient cause or mechanism cannot be caused by another efficient cause or mechanism. In contrast, from a relational viewpoint, form and process can be seen as inextricably linked through the notion of *circular causality* (Witherington, 2011). Any living system acts according to its particular organization, and that organization changes through its activity.

Perhaps the most problematic manifestation of the neglect of pattern explanation comes through a situation in which processes—as properties of parts of a system—are conflated with the properties of the whole system. In their critique of cognitive neuroscience, Bennett and Hacker (2003) termed this the *mereological fallacy*, such that an accumulation of neural mechanisms cannot stand in as a full explanation of the properties of the individual person. Related instances of conflating subpersonal processes with personal-level properties of the individual are a widespread problem in many areas of contemporary psychology, including developmental science (for discussion of one example, see Rakoczy, 2012). Avoiding these pitfalls requires the understanding that processes at the procedural level must be organized in some way, and that in and of themselves, processes or mechanisms have no context. It is this issue that brings the focus to competence or formal explanation as a different level of analysis, with the stipulation that this level provides a functional context for a different, complementary level of processes.

Given the above, we can move toward seeing the importance of a dynamic pattern that entails an indissociable relation between organization and activity. To use the terminology of Overton (1991), if the level of procedures is understood as the active processes through which competence comes into being, while simultaneously the competence level serves as a context for organizing the procedural level, we can begin to understand how the two levels operate in a complementary fashion. This allows arrival at a relational frame in which the interleaving of pattern explanation and the understanding of specific processes is appreciated as being fundamental to the scientific enterprise (Overton, in press).

A relational perspective on the different levels of structure and mechanism also brings considerations of change and transformation to the fore (Overton, 1991), because the reciprocal relations between the levels must be seen in the context of the developmental process itself. From the viewpoint of RDS, the dynamic tension between competence (pattern explanation or system) and procedures (specific processes) becomes the basis of an inherently developmental, constructivist perspective. As circular causation, the developmental process recognizes both the emergence of form through process along with the constraining (downward) influence of form on process (Witherington, 2011, 2014).

Through an awareness of circular causality, we can begin to understand how the relational and inherently developmental ties between levels provide an integrative foundation for the study of brain, body, and mind. This understanding then allows us to chart a course away from the fallow territory that psychology currently occupies. The integration of the concept of the developmental system with the relational worldview brings forth the importance of considering "co-acting, co-developing processes functioning according to the reciprocal causality entailed by complex positive and negative feedback loops" (Overton and Lerner, 2012, p. 375). As such, the framework of RDS has been offered as an integrative paradigm in which living organisms are understood as

dynamic, adaptive, non-linear, self-organizing and self-regulating systems (Lerner, 2006; Overton, 2013). From this perspective, the notion of a system provides a formal explanation, with the directional features of adaptation and self-organization constituting a final pattern explanation (Overton, 2010). RDS recognizes the dynamic complexity of developmental processes and further exposes the inadequacy of split approaches that emphasize simple interaction and the elevation of one level of analysis over another.

In terms of applications of the relational framework, it is important to recognize that RDS is a "mid-range" metatheory that provides a set of core concepts that can inform more specific theories and guide empirical investigation (Overton, 2013). Compatible approaches are those that reject split, mechanistic, or reductionist tendencies and instead put an emphasis on understanding the ontogeny of the individual in the context of the developmental system. One practical example of how this emphasis is realized comes from the family of empirical methods known as person-centered approaches, which in contrast to variable-centered analyses, focus on intraindividual variation rather than on group means (Nesselroade and Molenaar, 2010; von Eye et al., in press).

Finally, if we consider how developmental processes can illuminate the relational ties between different levels, various fundamental questions arise. How can novel structures arise that are different from the sum of their parts? How can activity at one level of explanation account for change at a qualitatively different level? How can the result of "doing more of the same" not simply be "more of the same"? From a much broader perspective, similar puzzles are at the center of the fundamental philosophical problems of intentionality, consciousness, free will, and agency. The underlying question running through these problems involves the problem of relating a level of system or meaning to a level of processes. The conventional approach of isolating or splitting off one of these levels leads directly to the brain-mind or mind-body problems, which are irresolvable when viewed through the traditional lens of analytic philosophy and an associated Cartesian-Split-Mechanistic framework. In moving toward a more embodied framework, the integration provided by relational developmental systems offers a transformation that is based on the fundamental premise that levels of meaning and processes should not be set against each other, but must be viewed as an indissociable complementarity (Overton, 2006, 2010, 2013, in press).

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A plea for a more dialectical relationship between personal and subpersonal levels of analysis

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Bermúdez (2005) termed "the interface problem" the question of clarifying how typical subpersonal explanations in cognitive sciences, whatever is their specific form, are related to folk psychology. In this opinion article we will approach the interface problem from a specific angle, i.e., the relationship between consciousness and the unconscious as it has taken shape within cognitive sciences.

Our starting point is the contrast between the cognitive unconscious and the Freudian one. If examined from an orthodox cognitivist point of view, psychoanalysis turns out to be a brilliant but failed attempt to build a genuine subpersonal psychology. Freud aims to go beyond the psychology of his times, which is a psychology of consciousness; his theory of the unconscious is, therefore, *programmatically* against a "consciousness-centric" mentalistic framework. The problem is that, *as a matter of fact*, Freud failed to extricate himself from that framework. Like many psychoanalytic ideas, the Freudian unconscious is just an enlargement, or extension, of a psychology—folk psychology—hinged on the idea of a person who is able to have conscious mental experiences.

According to a number of philosophers this extension of our ordinary psychological conception of mind is a strength of psychoanalytic theory. In this perspective, the grounds for psychoanalysis "lie in its offering a unified explanation for phenomena (dreaming, psychopathology, mental conflict, sexuality, and so on) that commonsense psychology is unable, or poorly equipped, to explain" (Gardner, 1999, p. 684). This approach has been taken as the basis of a defense of psychoanalysis against well-known epistemological objections: like folk-psychological explanations, psychoanalytic explanations should be exempt from the epistemological and methodological requirements of experimental science (Manson, 2003, p. 179). Donald Davidson is one the referents of this conception of psychoanalysis. On his view the personal level is autonomous and different from the subpersonal one, and is to be studied by means of different methods: you need *hermeneutics*, not the quest for natural laws. That is, the folk-psychological explaining is here viewed as an interpretive activity aimed to give sense to behavior—to "rationalize" it. Accordingly, when one runs across such a "pathology" of reason as self-deception, the personal psychology framework is not to be given up in favor of the subpersonal one, but rather it must be enlarged or extended so that one can find somewhere else the rationality set out by the principle of charity. In this vein, the psychoanalytic partitioning the mind is seen as a metaphoric device to coherently describe within the personal-level explanatory framework a phenomenon (self-deception) that otherwise would be uninterpretable (Davidson, 1982).

This attempt to abandon Freud's positivistic naturalism and reconstruct psychoanalysis on hermeneutic grounds has a very long story. In the 1970s an influent version of this project was initiated by a number of psychoanalysts of Rapaport's school; especially George Klein and, close to his ideas, Roy Schafer. According to these psychoanalysts the "biologistic" Freud is no longer defensible, and the whole Freudian metapsychology is to be declared waned owing to its association to the drive-discharge theory. By contrast, we have to reconsider the psychoanalytic clinical theory insofar as it rests on the intentionality of the interpretive process.

This "clinical theory versus metapsychology" argument, however, tries to regenerate psychoanalysis by renouncing to its main legacy. For Freud's hypothesis of a biological component that is constitutive of mental life is just what ensures for the psychoanalytic theory its typical content of systematic objection against the claim of self-legitimation made by rational consciousness: therefore, it is the ground of the very idea of a subpersonal-level unconscious. The Freudian hypothesis, to the extent that it views human subject as "tossed about" by its own biologicity, rules out that inner life can regain its own center in the free intentionality of consciousness. Vice versa, a psychoanalytic hermeneutics entirely aimed at insisting on the theme of meaning at the expense of the "blind" and "biological" theme of drive dynamics, runs the risk of surreptitiously reintroducing the pre-Freudian picture of the conscious subject as primary subject.

In this perspective, the hermeneutical approach to psychoanalysis is to be contrasted with the project of replacing Freud's positivistic naturalism with a neurocognitive naturalism (see, e.g.,

the writings of other two members of Rapaport's group: Holt, 1989; Rubinstein, 1997). Thus, a dynamic psychology that aims to develop psychoanalytic theories under the guidance of cognitive sciences fully confirms the *critical* content of Freud's theory of unconscious, i.e., its being a repertoire of tools to penetrate the self-defensive nature of self-conscious subjectivity. But here the Freudian personal-level unconscious is superseded by a level of analysis that aspires to be genuinely *subpersonal*: the information-processing level, wedged between the personal sphere of phenomenology and the subpersonal domain of neurobiological events.

However, the advantage of a dynamic psychology driven by cognitive sciences against the hermeneutical approach to psychoanalysis might turn out to be problematic. The reason lies in the convergence of two related issues: the interface problem and "the mark of the mental" problem. If we try to solve the former in a strong reductive way, the personal mind is to be defined in terms of the subpersonal mind. But then the question arises whether we can really explain when a subpersonal phenomenon deserves the title of mental without any reference to personal, folk-psychological concepts. In the case of a negative answer, the overall strategy of superseding personal with subpersonal psychology would be in danger.

Let us see in more details how the problem arises. Any bottom-up approach to cognition that rejects the primacy of the personal level should explain how the personal phenomena described by commonsense psychology in terms of conscious, deliberate, linear processes, which introduce "prescriptive or normative" concepts that "have no echo in physical theory" (Bermúdez, 2005, p. 44), are in fact a product of unconscious, automatic, parallel, sub-personal mechanisms. If that is so, the attempt of the radical naturalist to explain the genesis of personal-level psychology starting from sub-personal, unconscious mechanisms is quite demanding, since the gap between the two levels looks wide and deep.

Apparently, the radical naturalist has a simple way out: the concepts that "have no echo in physical theory" should be eliminated from scientific psychology just as it happened in the past, when scientific progress led to drop the protoscientific theories of phlogiston and caloric fluid. Commonsense psychological explanation should not be taken at its face value, but (at best) as a useful device for practical purposes. But now the mark of the cognitive problem strikes: the radical naturalist who rejects the intuitions about the mental embedded in our folk-psychological explanatory practices must offer a criterion to distinguish the sub-personal processes that are genuinely mental from those that are not. Without such a criterion, the emancipation of subpersonal from personal psychology is illusory. Yet, the task of making a principled distinction is not an easy one. For it is quite obvious that in the brain there are many unconscious, automatic, parallel mechanisms that, albeit not mental in nature, have a basic role in the existence of mentality. As Damasio (2010, p. 73) noticed, for example, certain brain regions such as the spinal cord and the cerebellum give contribution to essential brain functions, but are not essential to mind-making.

In other words, when we try to understand the relation between subpersonal and personal levels of psychological explanation, we face a dialectic between dependence and autonomy. If we consider the personal mind as completely autonomous, we fall in hermeneutics and in anti-naturalism, losing contact with the scientific development. If we adopt a strong vision of the thesis of dependency, we end up adopting eliminative or reductive approaches that are at risk of losing the mental as their own object of study, replacing it with objects that belong to different levels of analysis. That being so, the wisest strategy may be to pursue reflective equilibrium between dependence and autonomy, namely, working back and forth between the ordinary image of ourselves as self-conscious, intentional, rational agents, and the scientific conception of ourselves as biochemically-implemented computational machines, by revising these two images wherever necessary so as to pursue the regulative ideal of a coherent self-conception.

A good example of a research area in which a dialectical relationship between personal and subpersonal levels of analysis turned out to be extremely fruitful is provided by the way in which psychological constructs very close to the personal level such as motivation and attachment served as bridges between dynamic psychology and cognitive sciences.

The notions of motivation and attachment are at the core of contemporary psychodynamic theories that are fruitfully interacting with cognitive sciences (see, e.g., Fonagy et al., 2002; Lichtenberg et al., 2011). Now, the constructs of motivation and attachment can be definitely considered an advancement over the concepts that were formerly used to account for the same phenomena. But as we said, the concepts of motivation and attachment are very close to the personal level, and what is more they are not very precise. In other terms, their usefulness notwithstanding, they did not undergo that process of "fragmentation and reconfiguration" through which experimental psychology and cognitive neuroscience have put folk-psychological categories like attention or memory (Churchland, 1986, p. 365). What can be said in favor of motivation and attachment is that these concepts are more precise and work better than others.

Therefore, when the term "motivation" is defined as the whole spectrum of those factors that trigger, maintain, intensify, modulate or terminate physical activities or psychological events of any kind, we easily realize that it is a term that groups a heterogeneous bunch of factors, which are very difficult to classify (Jervis, 1993, pp. 288–289). At times such factors are to be examined one by one; but often it is useful to consider them all together under the label "motivations." The main point here is that in any case the use of such term was a conceptual progress—e.g., over the 19th Century concept of will.

The term "attachment" too does not refer to a homogeneous and well-identifiable phenomenon; it is a "bond," a term that is to be strictly and exclusively construed as a metaphor. There are attachment behaviors (due to different factors), and there are subjective experiences of attachment, which also can barely be grouped together and classified; but attachment in itself is an idea between the imaginative and the abstract, which originates from the extension of expressions such as "to keep attached" or "adhered."

The epistemological moral that can be drawn from this case of dialectic interaction between personal and subpersonal levels of investigation can be concisely expressed in the following way. According to the eliminativists, history of psychology consists in a linear process through which the systematic research supersedes and goes beyond commonsense psychology—and together with it philosophical psychology. But things are more complicated. The progress of psychology is not due *only* to the elimination of the concepts (and the models and metaphors) of commonsense psychology in favor of the constructs of scientific psychology. Sometimes progress occurs because non-strictly scientific and unclear concepts are superseded by new concepts that are as much insufficiently scientific and yet more appropriate and precise (Jervis, 2011, p. 167).

Thus, there can definitely be terms of the personal-level psychology that are "unsuited *per se* for scientific or theoretical purposes" (Wilkes, 1988, p. 196). The aforementioned concept of will is a case in point. However, in other cases—like those of "motivation" and "attachment"—the ontological vagueness of a concept may be compensated by pragmatic virtues such as, e.g., the potential to increase the explanatory resources in some area of scientific psychology. In short, the eliminativist primacy of metaphysical considerations over the epistemological ones cannot be generalized: it is necessary to evaluate on a case-by-case basis.

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Toward psychiatry as a 'human' science of mind. The case of depressive disorders in *DSM-5*

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The aim of this paper is to argue that a strictly reductionist approach to psychiatry represents a theoretical and clinical obstacle to a fruitful synthesis between neurobiological and sociocultural aspects of the sciences of mind. We examine the theoretical and practical motivations underlying this approach, by analyzing the case of depressive disorders, as defined in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*), and the related removal of the "bereavement exclusion clause." We first explore the claim that *DSM* is atheoretical, observing that, far from being atheoretical, *DSM* adopts an implicit, biologically inspired view of the mind; we show that such a view leads to a sort of circularity in the definition of depressive disorders, in which psychopharmacology seems to play a key role. We then turn to further problems deriving from this position, analyzing the issue of placebo effects in the treatment of depressive disorders and the philosophical question of normative preconditions for psychopathological diagnosis. Finally, we address the issue of subjectivity, which, together with the related aspect of the subject's relational context, appears to be crucial to any scientific theorizing about mental disorders, despite *DSM*'s attempt to exclude it. Our defense of a non-reductionist view of mental disorders, however, does not imply that we endorse any sort of metaphysical dualism, or anti-diagnostic or anti-psychiatric positions. On the contrary, we argue that the adoption of a reductionist position actually undermines the theoretical and clinical accuracy in explaining depressive disorders.

Keywords: depression, *DSM*, reductionism, normativity, diagnosis, bereavement, constructivism, naturalism

INTRODUCTION

Over the past two decades, the landscape of psychiatry[1] has changed dramatically: impressive developments within neuropsychology have fuelled an explosion of interest in the biological bases of mindedness (Andreasen, 1984, 2001; White et al., 2012; Walter, 2013), often leading the subjective, relational, and contextual factors influencing normal and abnormal behavior to be overlooked. Despite claims about the social and discursive dimensions of mind and personhood, particularly those informed by social constructionism (Harré, 1998; Borch-Jacobsen, 2009; Gergen, 2009), biologically inspired views seem to currently prevail, at least in relation to the explanation of mental disorders. In this paper, we examine the theoretical and practical motivations underlying this predominance, by analyzing the case of depressive disorders as depicted in the American Psychiatric Association's (APA) *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*). In particular, we take the definition of major depressive disorder (MDD) and the related omission of the "bereavement exclusion clause" as instances of a more general view informing the approach brought to bear in *DSM-5* (American Psychiatric Association [APA], 2013a). We claim that *DSM* system implicitly assumes in the case of MDD a reductionist stance and that such a position is likely to represent a serious clinical and theoretical obstacle to developing a "modern synthesis" within the sciences of mind.

As is well known in the philosophy of science, the term *reductionism* may have different meanings according to what exactly is held to be reduced: we may be reductionist in trying to reduce either the *language* of a theory T to the language of a reducing theory T′, or the *laws* of T to the laws of T′, or the basic *entities* described by T to those described by T′ (see the review in van Riel and van Gulick, 2014). Although there is no rigorous, universally accepted theory of reduction, in this paper, we will refer to a "reductionist approach" as an approach that tends in principle to reduce psychological and psychopathological phenomena to their neurobiological correlates.

We attempt to show that despite its allegedly descriptive and atheoretical standpoint, the *DSM*, as currently formulated, implicitly relies on a strongly individualistic view of depression and, more generally, of a range of mental disorders: it supports an unwarranted view of the "mind" and the "human being" as essentially reducible to their neurophysiological bases, at the expense of failing to take into account the relational, social, and cultural factors influencing mental suffering.

The paper is organized as follows. First, we examine the claim that *DSM* is atheoretical. In this regard, we emphasize that, far

[1] *DSM* has acquired over time an increasing relevance, up to the current status of "Bible of psychiatry" (Maj, 2014). Given this status, its relevance has had a significant impact also on the work of other figures in the field of mental health, such as for instance clinical psychologists and counselors, who both in their clinical and research activity refer to *DSM* and to its diagnostic categories, and even for judges and lawyers, due to the wide and long-established use of *DSM* in criminology and forensic psychiatry.

from being atheoretical, *DSM* adopts an implicit, biologically inspired view of the mind, and we suggest that such a view leads to a sort of circularity in the definition of depressive disorders, in which psychopharmacology seems to play a key role. We also address the problem of reliability vs. validity in the diagnostic process; this issue has been raised by the major critics of the current *DSM* edition as a systematic whole, strictly linked to the importance of taking into due account the subjective and contextual factors for diagnosing depressive disorders. We then turn to further problems deriving from an atheoretical position, discussing the issue of placebo effects in the treatment of depressive disorders and the philosophical question of normative preconditions for psychopathological diagnosis. Finally we return to the issue of subjectivity, which, together with the related issue of the subject's relational context, appears to be crucial to any scientific theorizing about mental disorders, despite *DSM*'s attempt to exclude it. As we hope to make clear, however, defending a non-reductionist view of mental disorders need not imply endorsement of any kind of metaphysical dualism, or of anti-diagnostic or anti-psychiatric positions. On the contrary, we argue that the adoption of a reductionist position actually undermines the very accuracy in explaining depressive disorders in theoretical and clinical terms.

It must be clearly emphasized that our critical remarks are focused on a specific disorder (MDD). This critical stance need not imply a dismissive attitude toward the whole diagnostic system proposed in the manual: MDD formulation by *DSM-5* is especially wanting from our point of view, but we acknowledge that in several other respects and with reference to other pathologies (i.e., neurocognitive disorders and personality disorders) *DSM-5* may be seen as a significant advancement (Migone, 2013; Maj, 2014).

DEPRESSIVE DISORDERS FROM THE ATHEORETICAL PERSPECTIVE OF *DSM*

The publication of *DSM*'s fifth edition in 2013 was preceded, and is still accompanied, by strong debate, both within the scientific community and in the media (Wakefield, 2010; Angell, 2011a,b; Spitzer, 2011; Frances, 2013; Insel, 2013). The issue at stake is that *DSM-5* may lead to the increasingly widespread "medicalization" of psychology. It is suggested that – also due to its impact via the social media – *DSM-5* is likely to turn into a true "social representation" (Moscovici et al., 2001) with the power to strongly influence clinical practice, pushing it in the direction of the large-scale prescription of drugs. Notably, among the most distinguished critical voices taking part in this debate, we find Robert Spitzer and Allen Frances, the editors of *DSM-III* (American Psychiatric Association [APA], 1980) and *DSM-IV* (American Psychiatric Association [APA], 1994), respectively.

One of the most significant and controversial changes in the new edition of *DSM* is its dropping of the "bereavement exclusion clause," that is to say, its omission of the last bulwark still present in *DSM-IV* that had allowed a distinction to be drawn between depression and normal sadness (Horwitz and Wakefield, 2007; Horwitz, 2011; Wakefield and First, 2012; Wakefield and Schmitz, 2012). This clause prevented people who had experienced the loss of a loved one in the two months prior to the onset of symptoms from being diagnosed with MDD. Frances (2013), head of the *DSM-IV* task force, regretfully observes that dropping the bereavement exclusion clause means confusing mourning with melancholia:

> "*DSM-5* has made it easier to diagnose MDD among the bereaved, even in the first weeks after their loss. This was a stubbornly misguided decision in the face of universal opposition from clinicians, professional associations and journals, the press and 100s of 1000s of grievers from all around the world" (Frances, 2013, p. 103).

In *DSM-5* bereavement comes to be considered "a severe psychosocial stressor," which only represents an "additional risk" (American Psychiatric Association [APA], 2013b) for the outset of depressive disorders in people already constitutionally inclined toward depression. The removal from *DSM-5* of the bereavement exclusion clause seems to be the logical outcome of a process initiated many years earlier with the publication of *DSM-III* (American Psychiatric Association [APA], 1980). In this section we try to illustrate some of the assumptions that have produced this outcome. It is not our intention to retrace here the complex history of depression in Western culture and the intricate taxonomic issues that have arisen over time and which are also reflected in the various editions of the *DSM* (for a detailed account see: Ehrenberg, 1998; Shorter, 2009, 2013). We shall only refer to a general and widely accepted distinction concerning the origin of depressive symptoms: the traditional dichotomy between "endogenous" depression (once called *melancholia*), that is to say, biologically based depression arising in the absence of any apparent external reason on the one hand, and reactive depression, that is, a depression triggered by negative external circumstances on the other (Pignarre, 2001). This distinction, which informed the history of psychopathology for centuries and still seems meaningful to the extent that it retains its status as a Western common sense belief, first lost support and ultimately was totally abandoned by contemporary psychiatry. The outcome has been the "triumph of major depression." "Continuing this tradition seemed relatively straightforward, but instead the tradition derailed and the two depressions became collapsed into one" (Shorter, 2009, p. 158). *DSM-III* appears to have represented a sort of point of no return in the direction of the demise of this traditional distinction.

> "[. . .] When *DSM-III* launched 'major depression' in 1980, psychiatrists found themselves quite without defense. Many sensed that there was a big problem in conflating endogenous depression and reactive unhappiness: we were told that breaking up with your boyfriend was on a par with lying curled into fetal, melancholic ball. Both could be major depression as long as the "Chinese menu" of criteria was satisfied" (Shorter, 2013, p. 195).

How did this come about? The main reason was that starting from its third edition, *DSM* has been presented as an *atheoretical* and solely descriptive tool, that is to say, as independent of any particular psychological or psychiatric theory. This decision was justified by Spitzer, who headed up the *DSM-III* task force, on the basis of the reasonable practical need to formulate a common language for the scientific community, which up to that time had been divided into different factions to such an extent that it was virtually impossible to obtain diagnostic agreement on given patients among clinicians from different theoretical schools.

Hence the decision to define and categorize the different mental disorders solely on the basis of descriptive symptoms, without attributing them to any (set of) causes, whether internal or external, because this would imply a specific theoretical system. This *DSM* symptom-based perspective has also allowed mental disorders to be defined as clinically significant symptoms reflecting dysfunction inside the individual (Wakefield, 1992), without taking into account the life events and social context in which the onset of symptoms takes place[2].

In the case of depressive disorders, this new approach meant that there were no longer any grounds for the distinction between neurotic and psychotic depression, a distinction that relied on a psychoanalytic framework (Shorter, 2009, 2013); even more importantly, it was no longer possible to draw the more general distinction between endogenous and reactive depression, and therefore a wide and heterogeneous range of disorders that manifested with similar symptoms were placed under the same diagnostic category of MDD. For a diagnosis of MDD, an individual must present – on a close to daily basis – five of the following nine symptoms for a period of at least 2 weeks: (1) depressed mood; (2) anhedonia, that is to say, diminished interest in usually pleasant activities; (3) weight gain or loss or change in appetite; (4) insomnia or hypersomnia (excessive sleep); (5) psychomotor agitation or retardation; (6) fatigue or loss of energy; (7) feelings of worthlessness or excessive or inappropriate guilt; (8) diminished ability to think or concentrate or indecisiveness; (9) recurrent thoughts of death or suicidal ideation or suicide attempt. A diagnosis of MDD also requires the five symptoms to include either depressed mood or diminished interest or pleasure (American Psychiatric Association [APA], 1980, 2013a). According to Horwitz and Wakefield (2007), the problem with this kind of definition is that the mere presence of a particular group of symptoms is *sufficient* to diagnose the presence of a depressive disorder.

In *DSM-IV*, the grief experienced after the death of a loved one was considered distinct from other cases, because the same group of symptoms was viewed as representing a physiological reaction to a highly stressful negative event.

> "Yet symptoms such as depressed mood, loss of interest in usual activities, insomnia, lessened appetite, inability to concentrate, and so on might naturally occur for a period of 2 weeks in the absence of any disorder after any of a wide range of negative events, such as betrayal by romantic partners, being passed over for an anticipated promotion, failing a major test that has serious implications for one's career, discovering a life-threatening illness in oneself or in a loved one, or enduring the humiliation that follows revelations of disgraceful behavior. Such reactions, even when quite intense due to the severity of the experience, are surely part of normal human nature. Just as it is obvious why the *DSM* excludes bereavement from diagnosis, by parity of reasoning it seems obvious that it should also exclude these other sort of reactions to negative circumstances. The diagnosis, however, does not exclude such non-grief responses. Because of the symptom-based nature of the criteria, any sadness response involving enough of the specified symptoms for at least 2 weeks will be misclassified as a disorder, along with genuine psychiatric disturbances" (Horwitz and Wakefield, 2007, p. 9).

Thus, given that taking a person's life events and social context into account in the diagnostic process may turn out to be too complex, modern *DSM*-informed psychiatry accepts the hypothesis that a diagnosis of major depression may be formulated on the basis of symptoms alone: in practice, the mere presence of five out of the nine depressive symptoms indicates that a particular individual, regardless of his/her life events and the meaning (s)he attributes to them, suffers from depression and as a consequence may be treated with antidepressant drugs. This approach is likely to result in the frequent mislabeling of normal sorrow (arising in response to negative events in a person's life) as depressive disorder and, indeed, the last 20 years have seen an explosion in the US of flawed diagnoses of depressive disorders requiring pharmacological treatment, a pandemic largely driven by marketing pressures orchestrated by Big Pharma (Angell, 2004; Horwitz and Wakefield, 2007; Herzberg, 2009; Hirshbein, 2009; Greenberg, 2010). Although remaining "cautious about the possibility of incorporating context into diagnostic criteria and about the unreliability and false negatives that might result." Spitzer (2007, pp. 8–9) himself has recognized this limitation of *DSM*: "... its criteria specified the symptoms that must be present to justify a given diagnosis but ignored any reference to the context in which they developed. In doing so, they allowed normal responses to stressors to be characterized as symptoms of disorder". All these issues – he concluded – should be seriously considered as part of the agenda for *DSM-5*.

Despite the caveats coming from Spitzer, Frances, and many other eminent authors (see for instance Goldberg et al., 2010), the paradoxical decision finally made by the *DSM-5* task force was – instead of broadening the range of negative triggering events – to also expunge bereavement as a criterion for discriminating between normal and pathological depressive symptoms, relegating to a footnote the criteria for distinguishing depression from bereavement. This footnote, proposed by a European psychiatrist (Maj, 2014), specifies a number of clinical indicators such as a feeling of emptiness and loss alongside a preserved normal level of self-esteem in physiological grief versus anhedonia and a sense of self-disgust in depression, as well as recommending that clinical assessment take the patient's overall personal history and cultural context into due account.

At this point, it is interesting to analyze the arguments used by the *DSM-5* task force to justify their omission of the bereavement exclusion clause (American Psychiatric Association [APA], 2013b).

The first argument concerns the fact that the period of 2 months following the loss of a loved one was arbitrary, given that "both physicians and grief counselors recognize that the duration is more commonly 1–2 years" (p. 5). The alleged "logical" consequence was that – in order to avoid any arbitrariness regarding duration – no time period should be indicated for normal grieving; thus, a person who has lost a loved one may potentially be diagnosed with clinical depression starting from the day of the funeral.

[2]It is interesting to recall that in the first edition of *DSM* (American Psychiatric Association [APA], 1952), mental disorders were defined in terms of *reactions* (schizophrenic, neurotic, depressive...), a definition which presupposed the existence of "external" factors causing mental suffering to the individuals (Greenberg, 2010).

The second argument recognizes bereavement "as a severe psychosocial stressor that can precipitate a major depressive episode in a *vulnerable* individual" (p. 5, italics added). The concept of "vulnerability" is introduced as the basis for distinguishing between normal "physiological" sorrow over the loss of a loved one and a case of major depression. But, how is it possible to differentiate between these two kinds of suffering on the basis of symptomatic-behavioral criteria alone? Similar behaviors are observed in both cases, as the *DSM-5* editors seem to have acknowledged by dropping the bereavement exclusion clause. Even more importantly, "vulnerability" – like the opposite quality of "resilience" (Walsh, 2006) – is not an observable "fact": it far more closely resembles a theoretical construct. But what kind of theory would underpin such a construct?

The third argument put forward helps to clarify this: "Bereavement-related major depression is most likely to occur in individuals with past personal and family histories of major depressive episodes. It is *genetically influenced*" (*ibidem*, italics added). The kind of vulnerability involved here seems to be "genetic," and identifiable on the basis of "family histories" of major depressive episodes. Even if we leave aside the problematic nature of assessing in the "here and now," on the strict basis of *DSM* symptomatic criteria, major depressive episodes in patient's family members that may have taken place in the distant past, the only familial factors referred to here appear to be genetic ones: family histories of MDDs are merely considered in terms of their genetic influence on depressed individuals. However, family therapy and constructivist traditions might offer a very different view of shared family histories, for instance in terms of members taking part in the same family relational games (Selvini Palazzoli et al., 1989), family narratives (White and Epston, 1991), or family semantic constructs (Procter, 1996; Linares, 2010; Ugazio, 2013).

The fourth and final argument is highly significant for the line of reasoning that we go on to develop in this paper: "The depressive symptoms associated with bereavement-related depression *respond to the same psychosocial and medication treatments* as non-bereavement-related depression" (*ibidem*, italics added). The atheoretical and symptom-based nature of *DSM-5* allows different kinds of depression to be put together in the same category, *because they may be effectively treated using the same remedies, particularly medication.*

We would stress that while the first argument seems to be a matter of which convention to apply in relation to the duration of grief, the last three are based on an implicit assumption that is reductionist in nature, namely the assumption that concepts such as "vulnerability," "familiarity" and the like may be reduced to their biological counterparts.

Thus, *DSM-V* reaches the conclusion that "*evidence* does not support the separation of loss of a loved one from other stressors in terms of its likelihood of precipitating a major depressive episode or the relative likelihood that the symptoms will remit spontaneously" (*ibidem*, italics added). What kind of "evidence" are we talking about here? In addressing this issue, let us sharpen our analysis of *DSM*'s atheoretical approach by focusing on two more general aspects.

The first aspect regards the difference between reliability and validity. *Reliability* refers to the degree to which a diagnostic system such as *DSM* allows two (or more) clinicians to independently agree on the diagnosis of a particular case, attributing it to the same category. *Validity* (or more appropriately *construct validity*) is the power of a given diagnostic category to actually represent and measure the phenomenon (i.e., the construct) it was designed for. Now, it is commonly held that *DSM has* addressed the need for reliability, which, as mentioned above, was a key unresolved issue prior to *DSM-III*, whose adoption meant that clinicians from different theoretical traditions could finally avail of a tool and a common "factual-symptomatic" language with which to compare and discuss their clinical assessments. On the contrary, however, *DSM* has been unable to offer robust construct validity for its own categorization of mental disorder. Such a flaw is not surprising if we consider the merely descriptive nature of the system, given that construct validity necessarily implies some kind of theory or model of the phenomenon to be studied that an atheoretical approach by definition cannot provide. Frances (2013) points out how difficult it is to find a balance between reliability and validity: the former imposes simplicity in order to make generalizations across all people suffering from a particular disorder; the latter tends to be subtle, complex, and inferential with a view to capturing clinical differences among individuals.

> "If the criteria set includes items that are inferential or complicated, different clinicians will disagree on whether or not they are present. Worshipping at the temple of reliability, the *DSM* criteria sets are as simple as they can be – a catalog only of what is the most surface and common in mental disorders. This was a necessary choice, but it necessarily compromises validity-constraining ourselves to the simple blinds us to subtlety, nuance, and individual variability" (Frances, 2013, p. 23).

This is an inconsistency which is both theoretical and clinical: some of the main depressive symptoms are found not only in the case of bereavement or other negative events, but also in other forms of psychopathology (See Ugazio, 2013, p. 228).

> "Thus the recent focus in psychiatry on reliability of diagnosis based on symptoms has been pursued at some cost to validity – that is, whether the diagnosis represents a correct attribution of disorder. The *DSM*'s criteria for MDD are one instance in which increased reliability has had the inadvertent side effect of creating substantial new validity problems" (Horwitz and Wakefield, 2007, p. 8).

The second aspect is, in a sense, more radical because it is of a philosophical nature: is it really possible to be atheoretical? One of the major conclusions from the philosophical analysis of science after the demise of logical empiricism in the second half of the 20th century has been that there is no such thing as notions of "experience," "fact," "evidence" and the like which are *not* theoretically informed. In the wake of the tradition begun by philosophers and historians of science such as Hanson and Kuhn, a commonplace of contemporary philosophy of science is that any piece of scientifically relevant 'evidence' is in fact *theory-laden* (Hanson, 1958), that is to say it is meaningful only when viewed as part of a theoretical framework – which Kuhn calls a *paradigm* – implicitly assumed by the scientist in order to make sense of phenomena

(Kuhn, 1962/1970[2]). In the words of the philosopher of science Peter Godfrey-Smith,

> "[. . .] a paradigm is a whole way of doing science, in some particular field. It is a package of claims about the world, methods for gathering and analyzing data, and habits of scientific thought and action. In Kuhn's theory of science, the big changes in how scientists see the world – the 'revolutions' that science undergoes every now and then – occur when one paradigm replaces another. *Kuhn argued that observational data and logic alone cannot force scientists to move from one paradigm to another, because different paradigms often include within them different rules for treating data and assessing theories*" (Godfrey-Smith, 2003, p. 76).

Furthermore, mainly on the basis of Quine (1953) work in epistemology and the philosophy of language, contemporary philosophy of science questions the very possibility of drawing a sharp distinction in principle between purely "factual" statements, directly indicating "pure" experience, and "theoretical" statements (Quine, 1953: for a review of Quinean philosophy, see Hylton, 2014). In this sense, the "selectivity" of *DSM*'s atheoretical approach – which implicitly seems to draw a vague distinction between "abstract" and "factual" theories (whereby the latter resemble mere "facts" or "states of affairs") – also appears to be ill-founded from a solely epistemological point of view.

DSM's NEUROBIOLOGICAL VIEW AND THE ISSUE OF "CIRCULARITY" IN THE DEFINITION OF DEPRESSIVE DISORDERS

It is widely recognized that the history of modern psychiatry has been profoundly influenced by the discovery and diffusion of drugs, particularly antidepressants (Kirsch, 2009; Shorter, 2009, 2013; Greenberg, 2010). In addition to the economic relationships between academic psychiatry and pharmaceutical producers, which many scholars and opinion leaders have condemned as one of the main reasons behind the contemporary depression pandemic affecting Western societies[3] (Breggin and Breggin, 1994; Angell, 2004, 2011a,b; Cosgrove et al., 2006; Herzberg, 2009; Greenberg, 2010), the advent of psychopharmaceuticals has also played a crucial "epistemic" role in the theoretical definition of depression (Ehrenberg, 1998; Pignarre, 2001). The *criterion of efficacy* of the same medication in treating depressive symptoms regardless of context was one of the arguments on the basis of which the *DSM-5* editors decided to drop the bereavement exclusion clause. The effectiveness of a given type of drug (typically Selective Serotonin Reuptake Inhibitors, SSRI) on depressive symptoms is often taken as an established matter of fact, in terms of the observable effect of certain molecules on human behavior, and not as a theoretical hypothesis still awaiting full empirical support. The theory that a chemical imbalance in the brain causes depression seems to be widely accepted (Kirsch, 2009; Shorter, 2009, 2013). We will come back later to the weak points of such a theory, focusing for now on the *epistemic role* of the effectiveness of antidepressants, that is, the role played by drugs in defining the "validity" of the construct of "depression."

First of all, it is important to note that, despite enthusiastic claims about advancements in neurobiological psychiatry, unfortunately no reliable biological markers have been found so far for the majority of mental illnesses, including depression. Nonetheless, recent neuroscientific discoveries about brain functioning obtained through neuro-imaging techniques (Legrenzi and Umiltà, 2012) are often taken as evidence justifying an almost exclusively neurobiological approach to the explanation of the mental realm. In describing the excessive ambitions associated with *DSM-5*, Frances (2013) writes:

> "First was the unrealistic goal of transforming psychiatric diagnosis by somehow basing it on the exciting findings of neuroscience. This would be wonderful were it possible, but the effort failed for the obvious reason that it is still a bridge too far" (Frances, 2013, pp. 95–96).

Dowrick (2009), in reviewing the findings of the scientific literature on the biological basis of depression, adds:

> "It would greatly assist the cause of those who see depression as discrete category or a disease entity if it could be demonstrated that it does have a unique and specific biological basis. Although psychiatrists such as Andreasen (2001) write as if such a basis has already been demonstrated, in reality this is far from the case. The search for a clear genetic explanation of depression – the holy grail of biomedical sciences and the pharmaceutical industry – has been extensive, arduous, and well-funded, but the results of this quest have not justified the enormous effort or expenditure" (p. 70).

This lack of evidence, though typical not only of psychiatry but also of many other branches of medicine (Maj, 2014), seems to be particularly significant for psychiatry. Together with the assumption that drugs effectively treat depressive symptoms on the one hand, and the *DSM* symptom-based criteria for depression on the other, it gives rise to a sort of "circular definition": we label as *depression* the set of disorders whose symptoms are sensitive to the therapeutic action of antidepressants. In the absence of both a clear general definition of "mental disorders" (Wakefield, 1992; Frances, 2013; Maj, 2014) and of undisputed criteria for separating normal and abnormal depression, the drug efficacy criterion seems to have offered an easy way out. Pignarre (2001) describes such an approach as "small biology," as opposed to "great biology," which can provide solid proof of the causes of (organic) illness and has clear biologic markers at its disposal. Due to the fact that pharmaceuticals seem to act effectively on depressive symptoms although the causes of the disorder are still unknown, the drugs play a crucial role in the identification of the disorder itself. This definition is not represented by a set of necessary and sufficient conditions explaining the onset of depression, but by positive responses to drugs – in terms of symptomatic remission.

From such a perspective, the distinction between endogenous and reactive depression becomes useless: because antidepressants display similar efficacy in both cases, the traditional distinction may be abandoned, including in the case of bereavement. Psychopharmaceuticals, given their essentially symptomatic effects,

[3]It should be pointed out here that the US is one of the few countries in which advertising directly targeted at the consumer has been legalized and that "official" *DSM* diagnoses are required for insurance companies to refund the cost of treatment. Frances (2013), who was in charge of the *DSM-IV* task force, expresses a sort of *mea culpa* for failing to predict the pharmacological abuse that came about in this situation and for failing to formulate stricter criteria for the diagnosis of depression and other mental disorders (such as ADHD, social phobia, autism, and so on).

are "practical" in nature, that is to say they are "atheoretical," consistently with the *DSM* framework. In order to endow them with theoretical status, it is necessary to come down on the side of the "biological option" as fully explaining mental disorders:

> "The major psychiatric illnesses are diseases . . . caused principally by biological factors, and most of these factors reside in the brain . . . As a scientific discipline, psychiatry seeks to identify the biological factors that cause the mental illness. This model assumes that each different type of illness has a different specific cause" (Andreasen, 1984, pp. 29–30).

Although this view still seems somewhat of a gamble, it has determined the success of medication-based treatment at the expense of other kinds of psychotherapeutic treatments such as family therapy, which search for contextual causes and remedies for (at least some kinds of) reactive depression (Pignarre, 2001).

Furthermore, it should be noted that *DSM* diagnostic categories were designed not only for clinical practice, but also for research purposes. The groups of homogeneous subjects suffering from a certain mental disorder who are eligible to take part in controlled studies within psychiatry are constructed on the basis of *DSM* categories. These subjects are often tested in terms of their reaction to different kind of treatments, especially drugs. But if, as we have argued, sensitivity to drug effects is part of the definition of the diagnostic categories, research designs too are likely to be compromised by a circular and self-confirming perspective.

Let us now turn to the controversial issue of drug effectiveness, from which the theory of chemical imbalance in depression derived most of its empirical support. It cannot be excluded that the effectiveness of treatment with medication might be due not only to the drug's active principle, but also to other factors, such as spontaneous remission or a placebo effect. Kirsch (2009), whose initial research interest was the placebo mechanism, has seriously challenged what he calls the "myth" of the effectiveness of antidepressants. After conducting a meta-analysis of published studies conducted in this field, he also examined unpublished literature, requesting permission from the FDA (*Food and Drug Administration*) to access "secret" databases. Kirsch's (2009) conclusions were astonishing: antidepressants work mainly on the bases of placebo effect. In particular, he found no significant difference between SSRI effects and placebos for light and moderate depression, while in the case of more serious depression the drug effect size was small. Moreover, psychotherapy seems to perform slightly better than drugs in terms of recovery (also at follow-up tests), while patients who received no treatment showed a significantly lower level of improvement than those who received any type of treatment (drug, psychotherapy, and placebo, respectively). In addition, when active placebos (i.e., inert substances with side effects) were used, there was no difference at all in the effects of antidepressants and placebos, a finding suggesting that the patients in double-blind randomized studies were able to guess which group they had been assigned to (drug vs. placebo) on the basis of whether or not they experienced side effects. Kirsch also compared studies using different drugs and found contradictory outcomes: depressive symptoms seem to be influenced in a similar way by medications that, respectively, increase and decrease serotonin levels; while drugs that have no impact at all on serotonin also seem to be effective[4]. These findings seriously question the widely accepted theory that antidepressants are effective, as well as the related theory that depression is explained by chemical imbalance in the brain. Kirsch draws a drastic conclusion in this regard: the account of depression as a chemical imbalance in the brain is simply wrong. Even if we do not wish to be so drastic, we are bound to conclude that there are many open questions in relation to the efficacy of antidepressants.

Studies conducted on non-human primates (McGuire et al., 1983; Raleigh et al., 1984; Sapolsky, 2005) suggest that serotonin levels vary as a function of primates' social status. When dominant males were removed from their high-level hierarchical position in the group, they appeared to manifest "depressed" behaviors, refusing food, and engaging in a diminished level of activity; at the same time their serotonin levels rapidly decreased. On the contrary, those who replaced the dethroned males in superior positions displayed an enhanced level of activity, along with an increase in serotonin levels. Therefore, although depression in primates appears to be correlated to low levels of serotonin, the etiological theory of serotonin deficiency seems not to play the main role in explaining depression: "elevated blood serotonin concentration is a *state-dependent consequence* of active occupation of the dominant male social position, and we believe that a reinterpretation of the significance of hyperserotonemia in humans may be warranted" (Raleigh et al., 1984, p. 405).

THE NORMATIVE NATURE OF PSYCHIATRIC DIAGNOSIS

Our analysis so far seriously questions the validity of both the epistemic value of the (a)theoretical *DSM* symptom-based definition of depressive disorders and the empirical validation of drug efficacy for their treatment. But even if, for the sake of argument, we were to leave these issues aside, another problem arises, namely the *normative* nature of both diagnoses and treatments in psychiatry (Stier, 2013). In general terms the status of normativity is an especially thorny issue, particularly against the contemporary background of naturalism (see De Caro and MacArthur, 2004; Laudisa, 2014 for a recent assessment of naturalism), currently by and large the prevailing approach to scientific knowledge. Assuming that our lives depend to a large extent on normative entities and issues, as well as on a biological, chemical, and physical structure, how do normative entities relate to the natural order? And do they *really* exist, or are they reducible after all to natural entities or processes? (See De Caro and MacArthur, 2010 for a recent assessment of normativity in relation to naturalism).

One of several instances of how normativity is relevant to our discussion concerns the notion of *normality*. Significantly Frances (2013) gave his book on *DSM-5* the title *Saving Normal*, devoting the entire first chapter to discussing "what's normal and what's not." Now it is clear that this sort of analysis – far from being 'factual' – presupposes a reference to values and culturally negotiated standards, according to which a researcher formulates a true theory of "normal" and "(psycho)-pathological" phenomena that

[4]According to Kirsch (2009) such conclusions hold not only for serotonin, but also for the other neurotransmitters that are usually considered to be implicated in depression.

is highly normative in nature: in order to distinguish between normal and abnormal conditions, one cannot avoid assuming – at least tentatively – a notion of what "normality" means in a given social context, and no "fact" *per se* can provide such a notion.

> "It would not be very shocking to claim that, e.g., neuroscientists have to use normative concepts such as the 'correct functioning' of certain brain areas. Nearly everything in the world – including psychiatry – is normative in this sense. A much more provocative claim is that psychiatry is guided by social, moral, cultural, and other norms. If this is true, and if it is also true that these kinds of norms are relative to time and place, then psychiatry cannot claim to know what a mental disease is 'in itself', where normality ends and mental disorder begins" (Stier, 2013, p. 2–3).

Something similar holds for the notion of *efficacy*, of which we can hardly make sense on the basis of merely factual or descriptive criteria. To say that a drug is "effective" means that it makes the patients feel *better*. If we wish to preserve their "heuristic" usefulness, at both the theoretical and practical clinical levels, we are forced to recognize that both the "normal–abnormal" continuum and the notion of "feeling better" are normative constructs that are not reducible to merely biological data. As Stier (2013) argues:

> "whether something is a mental disease can only be determined on the mental level. This is so because we can only call behavior deviant by comparing it to non-deviant behavior, i.e., by using norms regarding *behavior*. Second, from this it follows that psychiatric disorders cannot be completely reduced to the physical level even if mental processes and states as such might be completely reducible to brain functions" (p. 1).

Moreover, with specific reference to depression for instance, what role is the concrete, lived experience of depression supposed to play in enriching the interpretive explanatory framework within which the pathology is located? It turns out to be plausible to claim that, in this regard, a crucial role is played by the patient's own assessment of the relationship between self and the world: in "depressive" situations (Jacobs, 2013) patients fail to locate themselves in the world around them.

> "Depressed persons often report that they feel disconnected from the world, that it appears as an empty place deprived of all meaning, that other people and activities formerly enjoyed are no longer of interest, that they get stuck in deliberative processes of rumination and indecisiveness, etc." (Jacobs, 2013, p. 2).

If what is at stake here is making a *meaningful* connection with the world, it is far from surprising that such a highly evaluative and normative operation as that of attributing meaning to the relationship between oneself and the world eludes any biologically inspired, non-normative approach to psychopathology. However, any attempt to reduce the normative level to the empirical/biological level risks causing a significant loss in the analytical power of diagnostic categories (and consequently in the choice of clinical treatments). At a more general level, it means impoverishing the understanding, description, and explanation of mindedness.

THE LOSS OF SUBJECTIVITY AND INTERPERSONAL CONTEXT

As stated above, *DSM* justifies its atheoretical perspective on the reasonable grounds that there is a need to pursue greater reliability of psychiatric diagnosis. In the case of depressive disorders this reliability has not proved to be so robust in either theoretical or clinical terms. Furthermore, validity issues seem to be unsolvable using an atheoretical approach. The problems in both of these areas appear to be connected to the cutting out of subjectivity and interpersonal context from the diagnostic process.

> "A great deal is lost in the translation between the rich diversity of different individual experiences of depression and the bland five-of-nine criteria set chosen to define it. In describing the characteristics shared by those who meet the criteria for a given mental disorder, the *DSM* definitions must obscure the way they are individual and different. *DSM* definitions do not include personal and contextual factors, such as whether the depressive symptoms are an understandable response to a loss, a terrible life situation, psychological conflict, or personality factors" (Frances, 2013, p. 23).

The problem of subjectivity is well known to be one of the most thorny issues in the entire field of the sciences of mind. Not surprisingly the *DSM* symptom-based approach, inspired by evidence-based medicine (Pignarre, 2001; Shorter, 2009), attempts to objectify psychiatric mental disorders: in this view, subjectivity is a disturbance factor to be eliminated in order to purify scientific analysis of mental disorders. In particular, two kinds of subjectivity must be eliminated from *DSM*: (a) the subjectivity of the clinician making the diagnosis and (b) the subjectivity of the patient being diagnosed.

The former kind of subjectivity must quite obviously be sacrificed on the altar of reliability, by placing the clinician's theoretical and etiologic beliefs on hold. In its extreme version, however, this approach is likely to reduce the diagnostic process to a mere checking off of symptoms against a list that is far removed from the person's life as a whole. As Greenberg (2010) reports on the basis of his own experience, a psychiatric interview for diagnosing MDD may last about 7 min on average. Up to its fourth edition, *DSM* was formulated as a multi-axial system, made up of five dimensions on which the patient's condition was to be assessed. In addition to the first axis assessing symptoms, which over time became the most important and often the only one actually used, it was possible to assess, via Axis IV, psychosocial stressors (e.g., death of a loved one, divorce, losing a job, etc.) that could affect the diagnosis, treatment, and prognosis of mental disorders; while Axis V was designed to evaluate the patient's level of global functioning. This multi-axial approach has been omitted from *DSM-5*, in order to harmonize *DSM* with *ICD 10*, that is, the tenth edition of *International Classification of Disease* (World Health Organisation [WHO], 2010), a system that uses no axes. Moreover the axial system was considered too complex for practitioners to manage, with the risk that the diagnosis might be excessively biased by clinicians' subjective judgment (Migone, 2013).

However, the most important omission from *DSM-5* concerns the subjectivity of the patient. The negative effects of excluding the relational context and life events of patients from the diagnostic process have been emphasized many times in this paper, taking bereavement as a paradigmatic example in relation to MDD. Likewise, our various citations of Frances (2013) and other authors illustrate how the validity problems of *DSM* are largely caused by

its exclusive focus on symptoms, a perspective that overlooks the peculiar aspects of patients' subjective experience. In addressing the question of normativity, we have argued that one of the major issues for depressive patients is having a meaningful relationship with the world (Jacobs, 2013). Now, we wish to stress here that the personal *meanings* individuals attribute to symptoms and their possible causes are as important as the symptoms themselves in diagnosing the kind of disorder patients are suffering from (Kelly, 1955; Neimeyer, 2009; Jacobs, 2013)[5]. Moreover, personal meanings are deeply embedded in the social, relational, familial context in which individual patients live: life narratives and discursive and cultural practices have a profound influence on many individual mental processes, both normal and abnormal (Bruner, 1990; White and Epston, 1991; Stolorow and Atwood, 1992; Neimeyer and Mahoney, 1995; Stern, 2005; Denborough, 2014). But exploring such meanings requires much more than a symptom-based checklist. It requires a *theory* enabling clinicians to establish "robust" connections between the different aspects of a patient's experience. We are suggesting here that explanations in psychiatry and clinical psychology are at least in part based on *generalizations* of a particular kind, regarding both individual and relational processes in patients' histories, the origin of psychopathology, and the onset of full-blown symptomatology (Guidano, 1987; Neimeyer and Mahoney, 1995; Neimeyer and Raskin, 2000; Arciero and Bondolfi, 2009; Neimeyer, 2009; Villegas, 2011; Ugazio, 2013). Such generalizations derive from a particular form of knowledge – acquired in clinical and psychotherapeutic settings – that concerns a relatively limited number of individual cases; although this kind of knowledge clearly bears less statistical weight than that obtainable in experimental settings, it has the advantage of being more in-depth and sophisticated in nature than the analysis of patients' surface symptoms alone (Ugazio, 2013). The construction of this kind of generalization requires the adoption of an explicit theoretical standpoint enabling the formulation of hypotheses regarding subjective and contextual factors influencing the onset of symptoms.

The position just outlined is driven by a "double dissatisfaction." Our first dissatisfaction is with psychological approaches based on generalizations defined in terms of overly "simple" operational constructs, which may only be evaluated via checklists of symptom or in controlled laboratory settings, that is, generalizations that do not take adequate account of the subjective and relational factors underlying the origin and manifestation of psychopathologies (Compas and Gotlib, 2002). But at the same time, we are also dissatisfied with positions denying the possibility that general statements may be formulated from clinical data, due to their idiosyncratic nature and the "complexity" of the subject matter (Anderson and Goolishian, 1992; von Glaserfeld, 1995): in the name of the uniqueness of each individual person and of the self-referential character of knowledge (particularly in relation to the human sciences), subjectivism and relativism risk confining clinicians within the narrow boundaries of the single case, preventing them from making, albeit tentatively, even the most necessary generalizations in terms of diagnosis and treatment (Ugazio, 2013).

CONCLUSION

In this paper, through our analysis of the paradigmatic case of MMD and of the omission of the bereavement exclusion clause from *DSM-5*, we have argued that a solely symptom-based approach is seriously flawed, being based on an unduly restrictive view of mental disorders. Not surprisingly, such a view has justified a dramatic "medicalization" of normal psychological phenomena (such as mourning), causing increasingly widespread and indiscriminate use of drug treatments, and provoking strong reactions from some of the initial *DSM* supporters. From this strongly reductionist and naturalistic stance, mental disorders – despite their apparent peculiarity – are seen as essentially biological diseases, just like cancer or diabetes, and must be medically treated accordingly: in the near future technical tools and knowledge will be established that will allow us to reduce psychiatric symptoms to functional and/or chemical alterations in the brain (Andreasen, 2001; White et al., 2012). At the opposite end of the spectrum, advocates of anti-psychiatry (Szasz, 2001) maintain that mental disorders do not really exist *per se*, but rather are the outcome of the overwhelming pressure of cultural power on the weakest members of a given social system, a power that everyone is called to resist.

In more philosophical terms, if we appeal to the customary distinction (see for instance Moser, 2002) between ontology (concerning what there is in the world) and epistemology (concerning how we come to know what there is in the world), each of the above approaches tends to suppress one of these two aspects in exclusive favor of the other[6]. According to the reductionist and naturalistic approach, psychological and psycho-pathological phenomena are to be reduced in principle to their neurobiological correlates, because what exists in a fundamental sense is just the biological realm, whereas, according to the anti-psychiatric approach, mental disorders are to be reduced to culturally constructed artifacts. Thus both approaches appear to be ideologically driven and reductionist, given that they are both likely to prevent, in a theoretical and empirical sense, the fruitful integration of the neurobiological and sociocultural approaches within psychiatry and clinical psychology.

Are there any viable alternatives? The first could be the *Bio-Psycho-Social Model* (BPS), proposed by Engel (1977, 1980), that has been quite widespread as an alternative in psychiatry and in psychosomatic medicine to the reductionist biological model. BPS is supposed to be a model that combines both a philosophy of clinical care and a concrete treatment guide, with particular regard to the importance of the 'patient-as-a-person' in clinical relationship

[5]According to many psycho(patho)logical theories, in particular those informed by the constructivist paradigm, the problem of making sense of the self and the world is *the* problem of mental life (Bruner, 1991; Hermans, 2003). "A distinctive feature of constructivist perspectives in psychotherapy is a specific interest in processes of meaning construction (Neimeyer and Mahoney, 1995; Raskin and Bridges, 2002; Neimeyer, 2009). Guidano (1991, p. 56–60) defined psychopathology as a 'science of meaning,' developing the notion that 'personal meaning organization' guides the meaning making process underpinning the development of self, promoting coherence, and stability in personal identity" (Castiglioni et al., 2014, p. 120).

[6]For a discussion of the distinction between ontology and epistemology within the constructivist paradigm to which we refer later, see Hacking (1999), Raskin (2001), and Castiglioni (2011).

(Smith, 2002; Borrell-Carrió et al., 2004; Adler, 2009). From a philosophical perspective the BPS attempts to understand disease and illnesses by considering the multi-leveled organization of patients ranging from society to the biological. As a matter of fact, however, there is a wide debate about the validity and the consistency of this model.

On one side, it is considered as an important antidote to the reductionist biological psychiatry in as much as it reaffirms the importance of the psychological and social factors in understanding and treating mental disorders. Not by chance, BPS arose as an answer to the increase in the use of psychopharmacology linked to *DSM-III* (Ghaemi, 2009); so its caveats are still very relevant today (Adler, 2009, Helmchen, 2013).

But on the other side, it has been noted that "unfortunately, neither Engel himself nor his successors have ever provided clear-cut criteria as to how to use BPS characteristics to change the biomedical research paradigm" (Schubert, 2010, p. 389). According to these criticism, BPS never represented a real form of integration of the three levels, due to the fact that the interconnections between them remain unclear: such a general approach risks viewing the three levels (biological, psychological, social) as separate, given that their actual interrelations still require much additional analysis, both theoretical and empirical.

Bio-Psycho-Social Model's more severe critics argue that it has just resulted in a form of vague eclecticism, not only due to the lack of concrete applications, but also due to the assumptions of the model itself (Ghaemi, 2009, p. 3). 'The-more-is-better' assumption of BPS does not necessarily provide a real advance, neither in the theoretical nor in the empirical realm: "An empirical defense of the 'the more is better' philosophy sometimes is made based on the eclectic biopsychosocial intuition that medications and psychotherapy are always, and inherently, more effective than either alone. Empirically, sometimes this is so, sometimes not. Using one method or treatment purely often produces better results or is more valid than using multiple approaches together" (Ghaemi, 2009, p. 4). From a philosophical perspective, BPS combines general system theory, psychoanalysis, semiotics, and constructivism (Adler, 2009; Schubert, 2010) in order to provide theoretical foundations to all of the three levels. Such a combination, according to the critics, does not prove to be fully consistent and robust. Stier (2014), in his commentary on Helmchen's (2013) defense of BPS as an advanced, integrative, evidence-based conception of mental illness, argues that "the biopsychosocial model of mental illness is valuable as a reminder that there is more to mental illness than brain functions. Seen as theory, it will either be based on biology and meet similar trouble as the so called biologism in psychiatry, or else it will indeed be vague and border on anarchy" (p. 2).

Another more sophisticated alternative is represented by the so called "third wave of biological psychiatry" (TW). This framework supports what its proponents see as a growing caution in specifying the complex, multi-faceted nature of mental disorders, and argues in favor of a "multilevel approach ranging from genes to psychosocial mechanisms" (Walter, 2013).

First of all, although sensitive to the relevance of neurobiological correlation patterns, TW appears to be explicit on the amount of normativity implicit in any assessment of mental disorders: "According to the third wave of biological psychiatry, mental disorders are relatively stable prototypical, dysfunctional neural systems at various levels. *As with any understanding of disease in general the notion of a 'dysfunction' inevitably involves normative judgments of what is regarded as normal, functional, healthy on the one hand, and as abnormal, dysfunctional, pathological on the other hand*" (Walter, 2013, p. 2). Moreover, TW supports an approach to mental disorder in which sub-structures ranging from the biological to the socio-cultural level are seen as mutually interacting and linked by truly causal relationships. In order to provide a satisfactory explanation of mental disorders, a multilevel and multidimensional structure is postulated. All these levels are held to form what are called 'mechanistic property clusters' (MPC), with a terminology derived from a proposal originally presented by Kendler et al. (2011) and inspired by the application of the MPC concept to describe biological species (Boyd, 1991, 1999). In the latter case, morphological, physiological, and behavioral features appear to co-operate in order to characterize a species, although not all members need overlap in some single set of traits; "rather, members are clustered near one another in a feature space because of developmental, evolutionary, and physiological causal mechanisms and constraints" (Kendler et al., 2011, p. 1146). Kendler et al. (2011) support the extension to psychiatry of a similar approach: in this vein, we might conjecture the existence of a similar, complex and intertwined structure accounting for mental disorders, in which mechanisms ranging across the levels, albeit in a truly causal sense, can be conceived (although with a robust degree of idealization). Such kind of conjecture is also consistent with the claim that "etiological models for psychiatric disorders need to be pluralistic" (Kendler, 2008, p. 695; see also Kendler, 2005).

A final move of TW – a move that we prefer to remain neutral about – is to strengthen the link between psychiatry and philosophy of mind, on the basis of the claim according to which "if we better understand how mental states are related to brain states we might better understand how disordered mental states relate to disordered brain states" (Walter, 2013, p. 6). Our neutral stance on this option is motivated by what we see as a twofold risk. First, claims like the above seem to assume that mind–brain relation is a much easier issue than it really is: the 'hardness' of such an issue is often characterized as the circumstance that not only we do not know whether there is a solution to the mind–brain problem, but we are not even clear on what a 'solution' should look like. Second, even if we suppose that the mind–brain problem is not as hard as one might think, the sort of assumptions and style of reasoning typical of the philosophy of mind debates are likely to increase controversy that, far from positively contributing, might even make problems harder than they are.

Of course, like BPS, Walter's TW is not exempt from criticism. Pawelzik (2013), although he recognizes the value of Walter's proposal, points out some problems in the new wave of biological psychiatry. Firstly, being essentially "biological" and grounded in the methodology of neuroscience, it leads to a misguided vision of the mental realm, in which subjective consciousness is underestimated. Secondly, TW suffers from individualism: "mental functions –our ability to feel, to think, to act- are collectively

defined, socio-cultural artifacts rather than purely natural, individual dispositions." Therefore Pawelzik considers the "third wave as an individualistically limited enterprise" (p. 1). Thirdly, the brain plasticity, i.e., the possibility that experience – with particular regard to social experience deriving from *attachment relationships*- changes brain functioning is diminished: "If the mind that supervenes on brain states can actively change brain states, thereby redirecting the brain's development depending on various environmental contingencies—than this 'enactive mind' is obviously underspecified by the third wave concepts Walter offers." (. . .) "To sum up: Walter's description of third wave biological psychiatry is on the right track: we should embrace his purgation of a lot of biologistic thought. Still (...), Walter left the main conceptual pillars of biological psychiatry—'mindlessness' and 'medical model'—basically untouched (p. 2)."

If we turn back to *DSM,* it may well represent a useful tool among many others, and is therefore not to be considered (as is often the case) "the Bible of psychiatry" (Maj, 2014). It must be acknowledged that, in the section on "use of the manual," the editors of *DSM-5* themselves warn about the risks of taking its symptomatic categories as the only criteria on which a diagnosis can be based. Symptom-based criteria may complement but cannot substitute reconstruction of patient's clinical story and analysis of the social, psychological, and biological factors that may have influenced the onset of a disorder. In any case, checklists of symptom cannot convey the meaningfulness inherent in the clinical relationship with individual patients and the vivid knowledge to be obtained from "first-person" narratives of personal suffering (Frances, 2013; Jacobs, 2013). Furthermore, the provisional definition of mental disorders, formulated in the same section of *DSM-5*, specifies that pain caused by psychosocial stressors, especially the loss of a loved one, cannot be *per se* classified as a mental disorder: a claim that, as we have argued, can hardly be consistent with the omission of the bereavement exclusion clause and with the new definition of MDD[7].

Apart from these criticisms, we acknowledge the useful role of *DSM* system: it provides some criteria as to whether and how people should be diagnosed and treated when they are unwell. We already stressed the prominent role played by *DSM* system in reaching reliability in the psychiatric field, a huge problem that today – from a general perspective – can be considered as resolved. Moreover, if it is true that *DSM* might invite a pathologization of normal experience, as a counterpart it might also be seen as promoting a "normalization" of pathological experience, thereby fighting some forms of stigma associated with mental problems.

In any case, our criticism is directed toward a specific disorder (MDD) in *DSM-5* and not toward *DSM* as a whole. The problem is not replacing the *DSM* system completely, but rather integrating it with other perspectives and tools (where applicable) not only on the "concrete" level of clinical practice (where the above integration is often adopted, e.g., in the so called "integrated approaches" that rely both on pharmaceutical treatment and psychotherapy), but also on a more general and theoretical level. It must be admitted that the overall consistency of such an integration in the current state of knowledge might result far from completely settled.

Moreover, a revision of the reductionist approach should consider the thorny problem of its feasibility. Ideally, one solution might be to create a multidisciplinary "ecumenical scientific manual," in which all (or the major part of the) different perspectives and professional roles (i.e., psychiatrists, clinical psychologists, counselors, developmental/educational psychologists, family therapists, psychoanalysts, cognitive-behavioral therapists etc.) could be represented, discussed, and evaluated with regards to different mental disorders. Unfortunately, due to the presence of so many various points of view, there are limits to this kind of solution. The main ones are the risk of a reliability loss and the risk of high internal inconsistency: despite pointing at an integrated approach, such an attempt might result in a-systematic compilation of perspectives so distant that would be difficult to combine to create a worthwhile product[8].

To some extent, it is a controversy that probably will never be resolved. Due to the fact that (at least in our opinion) the real problem is not to forcedly integrate opposing perspectives, but to clearly understand the assumptions entailed by a determined perspective and its domain of application -in Kelly's (1955) words "the range of convenience" of a construct/theory-, perhaps it would be better if *DSM*, instead of declaring itself a-theoretical, could explicitly declare its theoretical position.

To sum up, we advocate what might be called a "moderate constructivist" meta-theoretical position. According to this position, it seems reasonable to view all diagnostic and clinical categories as provisional scientific constructs that can usefully guide both treatment and research, and to accept that the "normal–abnormal" continuum contains a structurally normative element (Pignarre, 2001; Frances, 2013; Stier, 2013). Thus, although it is possible to distinguish – in line with certain socially and culturally defined and theoretically informed scientific standards – the individuals that may be placed at each of the two extremes of the continuum, it turns out to be harder to position those falling in the middle.

As a concluding remark, we would like to stress that our argument here is meant to be founded not only on an enquiry into the empirical and theoretical structure of specific psychological and/or psychiatric theories, but above all also on a foundational and philosophical analysis reminiscent of a truly "humanistic approach" to the human sciences (Williams, 1991). It is our deep conviction that such an approach may contribute to paving the way for a more fruitful integration of neurobiological factors with cultural, social, familial, and personal meanings and values, toward achieving a richer and more valuable characterization of "human nature."

[7]For an alternative perspective on grief and bereavement, see Neimeyer et al. (2011).

[8]Another thorny issue should be considered. As we mentioned in paragraph 3, the "circularity" of definitions of clinical and research levels with relation to depressive disorders must be avoided. With regards to the double role that DSM plays in clinical and research fields, we see two possible solutions: (1) DSM could play both roles, *if the different general assumptions underlying the two roles are clearly specified*; (2) the two roles could be separated, while at the same time integrated in order to provide reciprocal feed-back between clinical practice and research. But the solution is to be found case by case. It is not surprising that DSM manual is usually supported by clinical casebooks that present real "prototypical" life histories to exemplify the various mental disorders (see for instance Spitzer et al., 2006; Barnhill, 2014).

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Multiscale Enaction Model (MEM): the case of complexity and "context-sensitivity" in vision

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I review the data on human visual perception that reveal the critical role played by *non-visual* contextual factors influencing visual activity. The global perspective that progressively emerges reveals that vision is sensitive to multiple couplings with other systems whose nature and levels of abstraction in science are highly variable. Contrary to some views where vision is immersed in modular hard-wired modules, rather independent from higher-level or other non-cognitive processes, converging data gathered in this article suggest that visual perception can be theorized in the larger *context* of biological, physical, and social systems with which it is coupled, and through which it is enacted. Therefore, any attempt to model complexity and multiscale couplings, or to develop a complex synthesis in the fields of mind, brain, and behavior, shall involve a systematic empirical study of both connectedness between systems or subsystems, and the embodied, multiscale and flexible teleology of subsystems. The conceptual model (Multiscale Enaction Model [MEM]) that is introduced in this paper finally relates empirical evidence gathered from psychology to biocomputational data concerning the human brain. Both psychological and biocomputational descriptions of MEM are proposed in order to help fill in the gap between scales of scientific analysis and to provide an account for both the autopoiesis-driven search for information, and emerging perception.

Keywords: autopoiesis, distributed cognition, dynamical systems, embodied cognition, embodiment, enactivism, motivated perception, situated cognition

> *"Es ist nicht zu leugnen, daß* auf die Dauer *über jeden Einzelnen dieser großen Zwecklehrer bisher das Lachen und die Vernunft und die Natur Herr geworden ist: die kurze Tragödie ging schließlich immer in die ewige Komödie des Daseins über und zurück, und die "Wellen unzähligen Gelächters" — mit Aeschylus zu reden — müssen zuletzt auch über den größten dieser Tragöden noch hinwegschlagen*[1]*."*
>
> *Friedrich Wilhelm Nietzsche, 1882.*
> Die fröhliche Wissenschaft.
> *Erstes Buch, 1, "Die Lehrer vom Zwecke des Daseins."*

INTRODUCTION

This paper deals with complexity in *vision*. Its purpose is to examine how conceiving complexity – in this specific case – implies to generate (largely generic) intellectual tools, which allow gathering and *synthesizing* data emerging from mind, brain and behavioral sciences.

From a behavioral point view, as well as from an anatomical-physiological point of view, vision can be studied in relation to non-visual processes (e.g., basic homeostatic loops, emotions, higher-level cognition, pathological events, social-economical factors). Here, I am presenting a perspective on *vision* that builds on previous work on enactive (Varela et al., 1991; Thompson, 2010; see also Stewart et al., 2010; Di Paolo and De Jaegher, 2012; McGann et al., 2013, for a view on the diversity of recent enactive research), embodied (Clark, 1999; Chemero, 2001, 2009; Thompson and Varela, 2001) *and* situated (Clark, 1997; Noë, 2009) cognition trends, empirical data in experimental psychology, works in theoretical integrative biology (von Bertalanffy, 1951; Weiss, 1963; Chauvet, 1993a,b,c, 2004; Kozma et al., 2005), and recent research in the neuroscience of brain connectivity. I focus the work on the various ecologies in which vision is embedded, *including the organism's subsystems demands*. The contexts in which biological vision emerge are multiple, and can be described at different scales. At this point of science development, these scales range at least from the cellular level to the social-economical level. Theoretical and empirical data suggest the need to consider *multi-layered context* as a predictor of behavioral and phenomenological activities of vision systems. In contrast with some previous views on enaction, I promote the principle of bottom-up teleological influences that weigh on visuomotor processes – in order to integrate the various couplings between biological processes.

The basic properties of the Multiscale Enaction Model (MEM) are conceived from the principles of emergence. As opposed to many approaches to psychology research, this model identifies multilayered contexts, which co-constitute mental processes. Similar general reasoning has been applied to theoretical biology. As reported by Weiss (1963, p. 389), the analytical process by which a cell is decomposed into its constituent atoms and ions does not provide much information about the difference between a live and a dead cell: "In trying to derive the more

[1] This quote is provided in English and discussed in the context of my theoretical proposal, later in the text.

complex systems from their elements, therefore, one must make up for this deprivation somehow by restoring the lost properties. The practice of doing this through symbols, such as 'organization' or 'integration,' is an old one, but seldom makes explicit as to whether these symbols are meant to be final logical postulates to compensate for the limitations of pure reductionism or merely provisional promissory notes that they will ultimately yield to analytical resolution." Because the problem's essence of cellular unity is tightly linked to "the indispensable *cooperative existence of all these features*" (i.e., genic replication, contractility, respiration, selective permeability . . .). In the same vein, the problem of organization in psychology has often been conceived at an abstract cognitive/psychic level, through the intervention of "executive functions" and different "memory," representational systems. The thesis underlying the conception of MEM is that the mainstream tendency consisting in evoking *dei-ex-machina* as the *loci* of control of behavior (see Bruner and Goodman, 1947, for early critics of this tendency) conducts to consider the functioning "laws" of cognitive "structures" or "functions" as the central task of cognitive psychology, whereas these "structures" have been inferred in specific contexts, yielding specific couplings within the individual and between the individual and the external environment. This process is associated to both a foundational tunnel vision and amnesia. The tunnel vision refers to the neglect of complexity and multiscale connectedness. Complexity generates cognitive and behavioral variability at the macroscale. Instead of seriously considering this complexity and coordinative processes at a more elementary level, the privileged process is to conceive centralized structures of control and to define variability as error (in relation to the "standard" behavior initially modeled). Then, the amnesia refers to the forgetting process of the foundational context, in which the "rules" or "laws" of cognitive structures were inferred. Progressively, "structures" and "functions" get increasingly autonomous from other elementary connections at a lower level.

The central feature of MEM is its sensitivity to multi-layered context. I define the "context" of any biological unit of interest as any other elementary (or groups of) living or non-living material or symbolic objects, which, through their connectedness with the first biological unit, may influence its activity. Hence, there is an acquaintance relation between MEM and previous embodied (i.e., accent put on the bodily context), enactive (i.e., special interest in the sensorimotor contingencies, and sometimes in the autopoietic process), and situated (i.e., inseparability between cognitive processes and their context of production, the latter being conceived at different scales as a function of the authors) approaches. These approaches all have different interests. However, the originality of MEM also lies in the *flexibility* that accompanies the scale level attached to the considered context. The multiscale character of the model lies in its ability to connect perceptual activity to a wide range of contextual influences, whose level of abstraction can considerably vary.

The procedure that is employed in this article consists in gathering empirical evidence for promoting MEM as a unifying paradigm within psychological science. A discussion of its detailed properties as well as its links with theoretical integrative biology models is proposed in the final part of the paper.

In the following lines, I successively review seminal and foundational approaches to dynamics and systemism in visual perception, gather recent empirical works that implicitly or explicitly give *evidence for multiscale couplings* between visual behaviors (or phenomenology) and various other systems, and report neuroscience findings that inform us about how brain networks support integrative cognitive processing. Finally, I summarize salient features of MEM: multiple connectedness, embodied, multiscale, flexible teleology, as well as emergent and dynamic operational couplings. Potential impacts of MEM on both a synthesis in the field of brain and mind sciences, and psychological intervention in complex and real settings are discussed.

THE CHALLENGING VIEWS OF EMBODIED AND CONTEXT-SENSITIVE VISUAL PERCEPTION

There has been a long history of exchanges between the fields of psychology, biology and computer science. These relationships have influenced the way cognitive psychologists themselves have considered perceptual and cognitive abilities. In the classical and radical computational-symbolic approach to human cognition, which heavily relies on mental representations, visual-perceptual information is ambiguous and requires further cognitive interpretation and enrichment from the observer. In this framework, the impenetrability of perception (Pylyshyn, 1999) is explicitly or implicitly established. On the explicit side, some authors defend hypotheses such as the informational encapsulation of early vision (Raftopoulos, 2001). The data that are discussed throughout the current paper, in contrast, highlight the need to build a theory in which visual processes are seen as coordinated and emerging phenomena. I want to present existing data on humans that show how vision is coordinated with other systems and to take the case of vision as an opportunity to develop a proposal for a 'modern synthesis' in the sciences of mind. Thanks to the coordinative property of mental and neural nets, vision systems behave as real intelligent systems by continuously adapting to the current goals of the agent.

A PATH TOWARD SYNTHESIS: FIRST SYSTEMIC APPROACHES IN PERCEPTUAL PSYCHOLOGY

Over the last few decades, many disciplines in science have been increasingly concerned with the consideration of complexity and dynamical non-linear phenomena (Capra, 1997; see Beer, 2000, for the case of cognitive science). This has also been the case of psychological approaches to vision. In cognitive psychology, one of the first trends concerned with the consideration of the dynamic nature of visual perception was the "New Look" stream, whose prominent figures were Jerome S. Bruner and Leo Postman (see Bruner and Postman, 1949, for an overview). The basic idea developed in the 1940s was that visual perception in humans was connected to other psychological systems that constitute the observer's global personality. Building on the statement that perception should not be studied independently from "the rest of the dynamical system that constitutes the person," Bruner and Goodman (1947, p. 33) claimed what the psychological study of perception should be: "the problem is, indeed, to understand how

the process of perception is affected by other concurrent mental functions and how these functions in their turn are affected by the operation of perceptual processes." This was clearly a strong proposal characterized by the systemic concern developed by the authors. At the time, many other approaches, actually considered the perceiver as if it was a rather passive recording instrument. "One might, in most experiments, describe him in much the same graphical terms as one uses to describe the latest piece of recording apparatus obtainable from Stoelting or the American Optical Company. Such psychology, practiced as it were *in vitro*, has fallen short of clarifying the nature of *perception* in everyday life much as did the old nerve-muscle psychophysiology fall short of explaining *behavior* in everyday life" (Bruner and Goodman, 1947, p. 33). What the authors criticized in their paper was also the discrepancy between the lab situation and the marketplace. In everyday life, many factors interact and change the perception that emerges. In order to understand those changes, we must give credit to variability and analyze its underlying mechanisms. One major obstacle to the development of the approach of the authors in the years following their publication was probably the relationship of a lot of researchers to variability, which was often considered as noise or as being associated to the effects of "attention." Bruner and Goodman (1947) also questioned the latter concept, which usually prevents researchers from getting further into the causes of variability, and especially into the description of the relationships between perception and other systems. That is, by invoking a *deus-ex-machina*, one does not make significant progress in the description of *what* system really dynamizes perceptual activity. By invoking attention as a cognitive structure, perceptual psychologists sometimes avoid considering perception as an open system, or to be more precise, avoid considering that perception *forms* systems with non-perceptual processes.

Bruner and Goodman (1947) investigate perceptual processes in the context of social-economical needs. In one of their tasks, they asked poor and rich children from Boston to evaluate the size of coins. Participants had to manipulate a knob, which controlled the diameter of a projected circle of light. When they judged that the diameter of the projected circle was equivalent to the one of the coin they had in the palm of the left hand – at the level of the light, and six inches to its left – then the trial was over. Results showed that all the participants overestimated the size of coins, but this overestimation was more important among the poorer than among the richer children. Interestingly, other children took part in the experiment in the "control condition" in which coins were replaced by medium-gray cardboard disks of identical size. In this condition, no overestimation was reported. The perception of similarity of sizes between two objects that are simultaneously available in the visual field is *influenced* by both the financial needs of participants and the value of stimulation. The variability of visual similarity perception across participants can be understood if we consider perception in the broader context of social-economical factors. That is, the emergence of visual perception is dependent upon *the initial conditions of the perceiver*. The sensitivity to initial conditions is a basic property of dynamical systems that will be discussed later on in this paper. In order to better understand the evolution of those initial conditions and their potential impact on the emergence of visual perception, I will go on with the review of systemic vision models. Understanding sensitivity to initial conditions implies to develop *a conception of the connectedness of perception to other systems*. In the next paragraphs, I build on the discussion of different systemic trends in order to provide a *synthetic conception* of the place of perception within the living organism.

THE GIBSONIAN ECOLOGICAL APPROACH TO VISUAL PERCEPTION: IDENTIFICATION AND CRITICS

One other major approach in the systemic views landscape is ecological psychology. Gibson (1950, 1966, 1979) proposed to study perception as an embodied process that couples with motor action. He assumed that we could not understand perceptual adaptation to the world if we isolate perceptual activity from motor abilities and actions. The systemic nature of the approach lies in the tight association between perception and action. Gibson's research seems to be founded on basic postulates: (1) the human subject and the environment should be modeled in their reciprocal information; (2) relevant information is made of "invariant" optical elements and gradients (of texture, speed . . .); (3) perception – a pick-up process of (environmental) optical invariants – informs us about our relation with the environment and is directly "meaningful" in terms of potential actions (i.e., affordances). The systemic nature of the approach is well illustrated in the description of action-dependent perceptual invariants. For instance, as a function of your heading direction, the nature of visual flow will qualitatively vary. More specifically, the focus of expansion (FOE) – which is the optical point from which a radial pattern of velocity vectors develops – evolves in the visual field as a function of heading direction. The FOE signals to the observer the current heading direction. If the observer's movement changes such that the heading direction also changes, then the place of the FOE changes accordingly. Action creates information. Here, we realize that perception must be understood in relationship to action. Gibson proposes *a synthesis* between perception and action in order to predict both perceptual and motor activity as a function of each other. "We must perceive in order to move, but we must also move in order to perceive" (Gibson, 1979, p. 223). The observer's ability to detect this kind of change (i.e., the position of the FOE) is allowed by the intrinsic nature of sensory systems, which are formatted to be sensitive to gradients of velocity.

One of the most advanced steps in recent ecological studies is the production of "laws of control" which mathematically bind perceptual information and motor parameters in order to give an account for the way humans control movement, on the basis on perceptual information. This has been accomplished by unifying the fields of ecological psychology and dynamic systems theories (Kugler and Turvey, 1987; Lee, 1998; Warren and Fajen, 2004). For instance, Warren et al. (1986) modeled human motor regulation of running over an irregular surface. The task constraints implied that participants adjust step length as a function of the demands of the irregular terrain. The authors showed that motor action could be regulated on the basis of the available visual data in the optical flow, which was created by the runner's motion. While

approaching the irregularities of the terrain, the observer experiences the optical expansion of those objects. The time-to-contact (tau or τ; Lee, 1980) can be extracted from this cue, since the time-to-contact is given by the inverse of the relative rate of visual object dilation. Furthermore, Warren et al. (1986) demonstrated in their study, that for adjusting step length as a function of irregularities, participants could adjust step duration as a function of vertical impulse (I) [given that mass (m) and gravity (g) are quasi-constant] by using optical information derived from τ, that is, Δτ, which is the difference in time-to-contact between two surfaces:

$$I = m.g.\Delta\tau \quad (1)$$

This kind of control-law illustrates well the very strong coupling between the current movement and available visual information, and that critical information for subsequent coordination of movements can be extracted from this dynamical change in visual stimulation. Information is available in the pattern of change of stimulation as a function of time, so that vision is non-dissociable from and – in our own terms applied to those data – *enacted by* the current motor context of the organism.

More recent empirical research using virtual reality in humans, such as the study by Warren et al. (2001), have also proposed some kinds of elaborate control-laws, for instance to explain how humans guide locomotion to a goal. In this type of law, flow information is combined to another *visual* information, which is the egocentric direction of the visual goal. The reported control-law is a linear combination of flow and of the perceived direction of the visual target, weighted by the magnitude of flow (Warren et al., 2001). Among recent developments, and beyond modeling of human behavior and applications in neural networks, ecological psychology has also found an allied in behavior-based robotics (Arkin, 1998), specifically in a Gibsonian trend (Duchon and Warren, 1994, 2002) sometimes so-called "ecological robotics" (Arkin et al., 1998; Duchon et al., 1998). For instance, Duchon and Warren (1994) noted that laws of control were applicable to any moving agent (see, for recent instantiations of the principle in the critical context of autonomous airborne navigation, Serres et al., 2006; Franceschini et al., 2007). In their paper, Duchon and Warren (1994) proposed two laws of control that they tested on an actual robot that evolved in an unmodified office environment. The laws concerned the obstacle-avoidance problem. Building on previous studies conducted by Gibson in humans on the one hand, and by Srinivasan and Gregory (1992) in insects on the other hand, the authors proposed to implement their two laws of control, which respectively corresponded to the Balance Strategy and to the Avoid-Closest Strategy. The first one acts to equate the rate of optic flow in the left and right halves of the visual field, whereas the second one, inspired from the previously presented *tau* variable, makes the agent turn from the place of the visual field with the lowest time-to-contact. They reported that, globally, their robot succeeded well in avoiding obstacles while moving in a real environment.

However, a major limitation of the Gibsonian ecological approach, especially in psychology where humans are modeled, lies in the reduction of the system in which vision is embedded, to a two-dimensional (perception-action) scheme. Though the central point of this paper concerns the systems in which vision is hypothesized to be contextualized, the direct character of perception in Gibson's approach should be shortly discussed here. Information, according to the ecological approach, is conceived as being unambiguous and specifying directly affordances, which are perceived opportunities of action in a given environment, and given the biological properties of the organism. Those biological properties are related to the ones that underlie opportunities of motor action (e.g., the height of the leg, which is reported to the height of a stair in order to determine whether the latter is 'climbable'; Warren, 1984). The environment is processed and measured in relative units, as a function of biomechanical and physiological properties of the perceiving organism. What I want to defend here is that this is just one single kind of embodied and context-sensitive vision. Nevertheless, vision is not only sensitive to the motor properties of the organism. Although the Gibsonian ecological approach is systemic, it has a "single-scale" focus of analysis. I would rather suggest adopting a "multiscale" approach to context-sensitivity. In order to develop this view, I will provide the reader with examples related to different *scale levels* in the analysis of contextual influences.

ZOOM OUT! COGNITIVE AND BEHAVIORAL FOUNDATIONS OF THE MULTISCALE ENACTION MODEL

This multidimensional view on the determinants of vision relies on the acknowledgment of the complex interplay between vision and *non-visual factors*. Therefore, I will review empirical studies in humans showing the influence of basic appetitive drives, biomechanical constraints and fatigue, mood and affective processes, higher-level cognition and cognitive expertise. These influences will be studied as a function of their type (i.e., an impact on phenomenological experience *per se*, or an early influence on the orientation of visual sensors). Each factor of influence will be considered as a contextual parameter that should not be neglected, when one wants to understand and/or influence human perception.

THE SEE-WHAT-YOU-NEED EFFECTS: BASIC DRIVES MODIFY SENSITIVITY TO VISUAL STIMULATION

Some relations between basic drives and perception have been studied in the field of neuroscience through the concept of alliesthesia (Cabanac, 1971, 2006), showing that hedonicity was a central component in behavioral regulation. At the sensory level, the same individual differently evaluates a given stimulation as a function of his internal equilibrium, and according to the principle that what is pleasant is what is useful. Therefore, while the state of the organism is evolving, the hedonic relation to a given stimulation simultaneously evolves. This phenomenon has been known as alliesthesia under the influence of Cabanac.

More specifically, in the field of vision, Changizi and Hall (2001) proposed to test the differential effects of salt and water ingestion before a judgment task where the transparency of different categories of stimuli had to be evaluated. Immediately before the judgment task, the 37 participants distributed in the thirsty group ate one lunch bag of salty chips (35 g, 190 kcal, 350 mg

sodium) whereas the 37 participants distributed in the non-thirsty group were supposed to drink water until not thirsty. Stimuli were then presented through a stereoscope. Three categories of stimuli were tested (i.e., stimulus with high probability that it is due to a scene with a transparent surface: "definitely transparent"; ambiguous stimulus for which probability that there is a transparent surface is neither very high nor very low: "ambiguously transparent"; stimulus with very low probability that it is caused by a scene with a transparent surface: "definitely not transparent." Participants used a computer mouse to press a "transparent" button if they perceived a transparent surface, and to press a "not transparent" button if they did not perceive a transparent surface. Results showed that the experimental ingestion had a significant effect for the "ambiguously transparent" stimuli. Participants belonging to the "thirsty group" exhibited a greater inclination to perceive transparency than the participants belonging to the "non-thirsty group." The authors' theoretical framework is both probabilistic and utilitarian. Probabilistic because the derived percept is hypothesized to be the best "bet" on the basis of available stimulation, and utilitarian because the best "bet" depends not only from what is most probable, but also from the costs and benefits of the stimulation for the organism. Changizi and Hall (2001) interpret their experimental data, stating that salt ingestion conducted to change the utilities attached to visual stimulation and that thirsty participants tended to be more sensitive to transparency because that is a typical visual property of water; and water is the element needed by thirsty participants. In our terms, visual processing would embody basic needs in order to satisfy the current goals of the organism. This shows the need to develop our understanding of motivational influences over vision and visual judgment (see also Balcetis and Dunning, 2006, 2010, for a complementary view of such influences).

Visual judgment, when considered at the psychological level, is highly dependent on what occurs at the physiological level. If psychological performances on the one hand, and physiological loops involved in hydration regulation on the other hand, are not considered as coordinated parameters, and if they are not conceived synthetically, the meaning of cognitive judgment does not emerge. In the latter case, there is an epistemological gap between cognitive processes, which are described as a sequence of decontextualized operations, and the rest of the body to which they actually refer.

CARRYING HEAVY LOADS AS WELL AS FATIGUE MAKE YOU OVERESTIMATE HILL INCLINATION

Other authors have also proposed a framework providing insights into how visual information processing in humans can be influenced by internal dynamical factors. Proffitt (2006) and his Group, from the University of Virginia, developed a theoretical framework, as well as an experimental program on the impact of observer's physical potential on visual judgment. According to Proffitt (2006, p. 110), "[v]isual perception is not solely a visual process. What one sees in the world is influenced not only by optical and ocular-motor information, but also by one's purposes, physiological state, and emotions. Perceptions are embodied; they relate body and goals to the opportunities and costs of acting in the environment." According to the researchers, perception and judgment would express the opportunities of acting in the environment. Instead of "coldly" and stably judging physical values of environmental dimensions, we would do it as if we were intending to physically act in the environment. In one of their classical experimental situation, participants are asked to judge the inclination of small hills. Proffitt et al. (1995) investigated the ability of humans to estimate the inclination of those hills as a function of three response modalities. Individuals were either required to answer verbally, or they would give their response by visually aligning a disk such that the inclination of a part of the disk was equivalent to the inclination of the hill, or they would manipulate a haptic device (i.e., a palmboard) without controlling the device visually. The authors found that the participants generally overestimated hill inclination in both verbal and visual modalities but not in the haptic one. Estimations affected by overestimation concern measures of "explicit awareness," according to the authors. Explicit overestimation of slant would be useful because it would promote "a heightened sensitivity to differences in the small inclines that people can actually traverse" (see Proffitt, 2006, p. 113). The position is evolutionary in nature. The eye probably integrated evolutionary pressures concerning not only optics but also other factors that would express the economy of action and the subjective value associated to acting in a particular environment. In this vein, Proffitt et al. (1995) similarly demonstrated that physical exhaustion changed the amplitude of slant overestimation. In one experiment, they recruited regular runners and asked them to evaluate different hills' inclination before and after difficult run training. In both visual and verbal modalities, the angle judged after running was significantly higher than before running. This pattern of results suggests that participants visually and verbally evaluate inclination as if they were projecting to physically move toward the summit. Here, the physiological context of the organism leads to biased visual judgment as a function of motor availability of participants. This has been confirmed since by other studies showing that wearing a heavy backpack lead to the same types of overestimations (Bhalla and Proffitt, 1999).

What this kind of data suggests is that visual judgment is fundamentally context-sensitive, and this context can be, among others, the biomechanical constraints as well as the current physiological state of fitness of living organisms.

ARE YOU HAPPY? THEN YOU ARE READY TO CLIMB THE HILL AND TO SEE THE GLOBAL PICTURE!

In a more recent study, Riener et al. (2011) manipulated participants' mood and placed them subsequently in the previously presented protocol of slant evaluation. Further evidence for an embodied perception of spatial environment was provided. Participants in a sad mood reported hills to be steeper. Riener et al. (2011) interpret those data in terms of energetic potential, which leads to anticipate more or less subjective cost associated to climbing the hill.

Other protocols investigate the impact of mood on the variation of similarity judgments of hierarchical (compound) stimuli. Building on a psychophysical-like task proposed by Kimchi and Palmer (1982, global-local focus test), Gasper and Clore (2002), in their second experiment, investigated the relationships between mood induction and the weighting of global and local factors

of visual similarity. After inducing respectively happy, neutral, and sad moods in three different experimental groups (using a writing procedure of autobiographical events), they asked participants to perform the similarity judgment task. In this task, three compound stimuli were simultaneously presented: one at the center above the two others, which were located respectively on the left and on the right of the display. Participants were supposed to decide which, among the two figures presented below, was the more similar to the above presented shape (i.e., reference shape). One of the two options was globally similar (e.g., globally a triangle) to the reference shape, and the other one was locally similar (e.g., made of small squares) to the reference shape. Results showed that participants in negative mood were less likely than individuals in a positive or neutral mood to use the global form as a basis for matching the objects. The experiment therefore indicates that visual similarity judgment is influenced by mood state.

According to Clore and Huntsinger (2007) mood moderate natural or spontaneous tendency. Positive mood would correspond to a "GO" signal and negative mood to a "STOP" signal. In the case of the present task, the natural tendency would correspond to the global processing (see Huntsinger et al., 2010, for a complementary discussion). Mood, as a dynamic affective state, acts as a coordinative contextual factor for visual perception in humans that eventually determines how visual detectors are oriented, and what is actually seen.

THE EXPERT EYE MOVEMENT AND COGNITION-PERCEPTION COUPLING

The orientation of the eyes is one of the earliest stages of vision organization, on which contextual non-visual parameters can intervene. In the trend of expertise research, several studies have shown that (i) experts deploy their eye movements differently from more novice individuals, in their domain of expertise, and (ii) the nature of cognitive expertise is coupled with the type of visual search that is employed. Reingold et al. (2001) conducted research on chess expertise and eye movement. They demonstrated in a check-detection task that experts have a greater visual span for structured configurations of games. Chess experts extracted information from both foveal and parafoveal regions and were able to process interpiece relations. They produced a fewer number of fixations per trial than other participants. The other interesting and synergic point is that experts had a higher proportion of eye fixations that fell between individual pieces rather than on the pieces. Those data on the larger visual span in experts were congruent with others collected in a change detection task, combining the flicker and the gaze-contingent window paradigms. Expertise decreased change blindness, but only when patterns where structured and corresponded to real, possible game situations. Taken together, these results clearly indicate that visual search strategies in experts are different from those found in novices or in intermediates. The expertise of an individual heavily constrains what he looks at and how wide his visual span can be.

In the same vein, Laurent et al. (2006) reported data on visual search strategies in expert and novice basketball players. Participants performed a same-different judgment task of schematic basketball scenes pairs. Participants were asked to decide whether the two scenes – that were sequentially presented – were identical or different. Differences were local distortions of the position of zero, one, two, or three player(s) on the playground. Results showed that experts made fewer errors than novices and that visual search in expert basketball players was poorly sensitive to local distortions in contrast to what was found in novices, where the number of eye fixations on the second configuration was linearly and negatively correlated to the number of local elements that were displaced. Therefore, it seems that experts have a consistent and rather relation-oriented visual search, whereas novices have an attribute-oriented visual search.

All these data are important to the present development on context-sensitive vision, since eye-tracking research in the field of expertise is congruent with former studies on expertise focusing on higher-level mnemonic processes. The latter already showed that experts had a superior ability in recalling or recognizing structured patterns of game. The coordinative nature between cognitive and lower-level perceptual processes has already been developed elsewhere (Laurent and Ripoll, 2009). Through some processes such as categorical perception, perception becomes attuned to critical visual features that are diagnostic of higher-level successful categorizations (Goldstone, 1994; Schyns et al., 1998). Therefore, cognition and perception become coordinated, not only because cognition exploits perceptual information, but also, because vision becomes coordinated with the needs of cognitive activity. The coordination suggests that cognition is also, as it is the case of other processes developed in the preceding paragraphs, a dimension of the ecology of vision.

Data belonging to this (non-comprehensive) review on the influences of non-visual processes over vision serve to illustrate the recent empirical endeavors that should be taken into account in order to discuss the classical view of cognition as a set of process restricted to a "sandwiched" layer *between* sensory inputs and motor outputs, (see also, for such a critical discussion of the classical view; Varela et al., 1991; Stewart et al., 2010). Note that in this classical view, sensory and motor processes are rarely regarded as "cognitive." In opposition to those postulates, perception and action, in this article, are regarded as *basically coupled with the organism goals* or, to avoid confusions about any hypothesized abstraction level of "goals" in organisms, in other words, the teleological dimensions of the organism subsystems. All the dimensions of the human being that represent some pressure in order to achieve the equilibrium of the organism and to change its internal state or the state of its coordination with the environment (e.g., thirst, emotions, higher-level motivations) embody the teleology.

So far, I have addressed arguments that should help us refine our understanding of the nature of vision. Vision, though often regarded as "hard-wired," essentially bottom-up, is, as other "later" cognitive processes, embedded. Visual perception and behaviors emerge from complex interplays between different biological, psychological, and social dimensions. Modeling variance of behaviors and phenomenal processes implies to put these processes into their context. One major obstacle in this perspective lies in the increasing analytical decomposition of research objects, as well as probably in the institutionalization of disciplines and scientific

careers involving specific objects and methods that might be too narrowly defined. Therefore, psychological concepts usually tend to get proximal explanations in the primary field of expertise of researchers. However, as demonstrated just above, many dimensions influence a given psychological process; and the lack of conceptual integration decreases the potentials for a synthesis. This synthesis is needed in order to get a unified approach to human psychology, and to prepare future psychologists to the diversity of dimensions they could usefully model and modify in the complex real world.

In order to get further into the formalization of the multiple couplings involving different scale levels, I will discuss recent biocomputational developments. These developments may have non-marginal influences over our quantitative representations of networks, connectedness, and their transformation with time, and could help us refine our representation of the coordination between processes and scales of analysis.

ZOOM IN! BIOCOMPUTATIONAL FOUNDATIONS OF MEM APPLIED TO VISION

STRUCTURAL AND FUNCTIONAL CONNECTIVITY: BASIC PROPERTIES FOR CONTEXTUAL INFLUENCES IN THE BRAIN

The dynamic processes that have been described so far at the psychological level are specific cases of complex interactions. Properties of complex networks have been studied in biological and computational neuroscience (Scannell and Young, 1993; Scannell et al., 1995, 1999; Sporns, 2011). The complexity of networks, defined as interconnected nodes, lies in their size, and in the interaction between network's architecture and dynamics (Sporns et al., 2004). Both the behavior of individual nodes and the architecture of their interconnections give rise to a global equilibrium and to behaviors. A major conclusion of these analyses is that the brain is a highly integrative system (Tononi et al., 1998; Tononi, 2004). Full delineation of brain structural and functional connections is currently an object of effort for a group of scientists who work on the definition of "human connectome" (Sporns, 2011, 2013; Smith et al., 2013; Van Essen, 2013; Van Essen et al., 2013).

At the structural level, data coming from biological and computational neurosciences, neurology and neuropsychology not only revealed specific roles attached to brain areas in the process of vision (Zeki et al., 1991; Tootell et al., 1998; Rolls and Deco, 2002), but have also recently shed light on the "anatomical hubs" present in some brain regions (He et al., 2007; van den Heuvel and Sporns, 2011, 2013), among which we find parts of the visual cortex. He et al. (2007) founded their works on the analysis of covariation in cortical thickness, because they assumed that covariation could be due to "mutually trophic" influences. These covariations were previously found to associate visual cortex, lateral geniculate nucleus, and optic tract (Andrews et al., 1997), a network critical to the emergence of visual representations. Based on this methodology, He et al. (2007) revealed that brain networks are made of "small worlds," short- and long-range connections usually found when human diffusion imaging is used. The structural architecture of neural networks seems to be highly related to functional activity and information exchange through neural nets. Some diseases such as some forms of Alzheimer disease (AD) provoke a disruption in neural pathways, including visual system's networks. This can occur from the primary visual cortex level to visual associative areas (Morrison et al., 1991). In those cases, impairment at the structural anatomical level has direct consequences upon functional connectivity: elementary integration of visual information is weakened.

At the functional level, studies have been developed in order to account for complex biophysical coordinations between brain areas (Varela et al., 2001), or even between different brains (Dumas et al., 2012). Rodriguez et al. (1999) studied how the synchronization of oscillating neuronal spikes occurs in the brain in the frequency range 30–80 Hz (i.e., gamma oscillations). In their experiment, participants viewed ambiguous stimuli, which could be perceived either as faces or as meaningless stimulation. Participants were asked to indicate whether they perceived a face or a meaningless stimulation by pressing one of two answer keys. Results showed that visual perception of faces but not meaningless stimulation corresponded to periods of "long-distance pattern of synchronization" in the gamma band between the left parieto-occipital areas and frontotemporal regions. In this case, the coupling between occipital (massively involved in the visual processing of retinal information), parietal (spatial cognition and episodic memory), and fronto-temporal (recognition and perceptual learning) regions was conceived as the neural bases for perception. The principle of *co-increasing* in activation (measured for instance by the regional cerebral blood flow) in infero-temporal and occipital areas has been confirmed later in brain imaging protocols, as being a basic neural process underlying visual categorical perception of face familiarity (Rossion et al., 2001) and other emotional influences on perception (Adolphs, 2004; Vuilleumier and Huang, 2009). Rodriguez et al. (1999) pioneering electrophysiological study identified electrophysiolocal markers of brain coordination during visual perception process. After the perception phase but before the motor one, that is during the transition between perception and action, a desynchronization was reported. Finally, when the participants were launching the motor response, a new phase of synchronization (involving slightly similar couplings between right temporal and central regions in both meaningfulness conditions) was reported. This research has shown how each phenomenological (through the analysis of the perceptual phase), or behavioral (through the analysis of the motor phase) activity, in this task, was embodied in specific couplings and decoupling between neural nets. Based on a similar electrophysiological analysis, Varela et al. (2001) have proposed a framework for conceiving the unity of some "cognitive moments" and the distributed architecture of neuroanatomy. Coherent behavior and cognition would emerge from large-scale integration. The underlying mechanisms would consist in the synchronization of electrical activities "over multiple frequency bands." Varela et al. (2001) stressed the reciprocal nature of connections in the process of integration, in opposition to the more strictly bottom-up view of integration, in which the process is conceived as the computations carried out between sensory and motor areas (i.e., in "associative" areas).

More recently, Vuilleumier and Driver (2007) described the evolution in the use of fMRI for characterizing brain contribution to a given function. If early use of fMRI consisted in

attributing functions to particular brain regions or networks, advanced research in the domain is currently investigating how distant regions in the brain interact with each other and change their own activity as a function of their current connectedness to other active regions. This trend is known as "functional integration." Advances in the understanding of human brain provide evidence for complex coordination between brain regions. "*Functional connectivity arises from context-sensitive dynamics that unfold rapidly but are shaped by a backbone of structural connectivity that can change only slowly*" (Kleinschmidt and Vuilleumier, 2013, p. 333). Even if bottom-up models of vision have had a considerable influence over the way psychologists and neuroscientists have represented computation in visual systems (Marr, 1982), recent neuroimagery studies provide evidence for visual cortex activity modulation as a function of the connections between functionally related territories.

Nir et al. (2006) found a correlation between spontaneous fluctuations in blood-oxygen-level–dependent (BOLD) signals related to cortical regions – all involved in visual processing – in participants placed in the darkness (i.e., no light illuminating the scanning room). When participants were visually stimulated those correlational patterns suddenly changed. Cortical regions (e.g., left parahippocampal place area, posterior fusiform gyrus, superior temporal sulcus, post-central sulcus, central sulcus, lateral sulcus) exhibited large-scale synchronized slow (<1 Hz) fluctuations at rest. Coordinative patterns are changed as a function of contextual influences. For any region, the latter are represented by the activity of other connected cortical networks. When no retinal information is received, some brain regions involved in visual processing tend to synchronize their activity. In other words, not only does the activation pattern depend on external stimulation, but this pattern is also, at each point of the neural network, dependent on its structural and functional relationships to other parts of the network.

Vuilleumier and his colleagues have carried out a series of studies showing that emotions and other higher cortical controls involved in "attentional modulation" interact with vision at the cerebral level (Vuilleumier et al., 2001, 2004; Mazzola et al., 2013; see also Vuilleumier, 2005; Vuilleumier and Driver, 2007; Vuilleumier and Huang, 2009). They have been interested in long-range couplings between the "visual" cortices and distant regions that have traditionally been investigated separately (i.e., amygdala, fronto-parietal cortex). The visual effects of emotion, through the contribution of amygdala, and the visual effects of what the authors call "attention," through the contribution of fronto-parietal circuits, have similar boosting effects on the activity of the visual cortex. They both contribute to enhance the processing of visual stimulus.

Similarly to what has been described as contextual effects at the behavioral level earlier in this paper, "*contextual*" *influences* occur almost everywhere in the brain. The highly converging nets create the biological basis for multiple couplings at different scales from the microscale of synaptic connections to the macroscale of area coordinations. The analysis of the coupling between brain areas, employed in the works reported in this section, offers exciting perspectives and should be one key element of a complex approach to vision in the future.

In order to improve the synthesis between brain, behavioral, and mind sciences, it would be very helpful to connect those studies involving vision with two important lines of research. The first line is constituted by the synergetic trend (Haken et al., 1985; Kelso, 1995, 2012; Kelso and Engstrøm, 2006; Kelso et al., 2013; Tomasi et al., 2014), which is rarely applied to the field of vision *per se*. This trend successfully gathers different components and analyzes their collective behavior through the tracking of order parameters, which characterize their mutual relations (e.g., phase relations of oscillators). This framework provides models of brain activity and behavior, by integrating the coordination of system components. The second line has involved research carried out by Menon (2011) and colleagues on the dynamic changes observed in the coupling between brain components. The research has sought to characterize psychiatric and neurological disorders. Menon conceives three major types of functional networks and relates diseases to specific alterations of these networks. Mechanisms underlying the pathological alteration of information processing are contextualized at different spatial scales, from abnormal small-world architecture, to large-scale functional disconnection. His approach does not involve the visual function, but gives interesting lends for conceiving different types of network evolutions and different consequences on the emergence of behaviors.

Despite the obvious intellectual contribution of the research mentioned up to this point, two questions are still pending. The first is related to how *different scale levels* of organization of the visual system are coordinated; the second concerns the characterization of the *meaning of subsystem behavioral changes*: in other words, why does a given component exert some specific constraints at some times, and others later?

TOWARD BRIDGES BETWEEN SCALES OF ANALYSIS FOR A SYNTHESIS IN "VISUAL" BRAIN CONNECTIVITY SCIENCE

As previously put forward by the 1998 Nobel Prize winner in physics Laughlin (2005) "*reliable cause-and-effect relationships in the natural world have something to tell us about ourselves, in that they owe their reliability to principles of organization rather than microscopic rules.*" However, if organization is central to our issue, this takes place at different scales in the brain. Any synthesis (which involves connecting things, ideas. . .) endeavor in the field of mind, brain, and behavior must account for this multi-layered organization, within brain, and from brain to behavior.

Evidence for the emergence of neural and behavioral activities from multiple couplings at different scale levels can be found in studies of diseases affecting the central nervous system. Not only do the couplings occur at multiple scales in the brain, but also couplings occurring at different scales influence each other. For instance, multiple sclerosis has recently been considered as a disconnecting syndrome (He et al., 2009; Kleinschmidt and Vuilleumier, 2013), in which increased functional connectivity can be recorded. Though the impairment level of neural structures in various diseases is often negatively linked to the functional connectivity level assessed by fMRI (Yu et al., 2008; Zhou et al., 2013), the impairment of small-word neural nets in multiple sclerosis can lead to increasing the activity level of *larger nets* involving more distant regions

within the brain (Kleinschmidt and Vuilleumier, 2013). At this point, we realize that the increase in functional activity at a scale level can be interpreted only if we analyze and understand what happens at *another scale level* in the brain. *The synthesis, the access to the global meaning of the system behavior emerges from the understanding of structures and events at different scales and from the conceptual relationship that is established between them.*

Vision heavily relies on network functionality *and* dynamics. Functionality is not over when partial impairments of local networks are found, because dynamics is possible. Different couplings at similar or other levels can compensate for the damage of local networks. This kind of neural plasticity involving compensatory processes that encompass different interactive scale levels (partially) supports the continuity of behavioral performance and phenomenological production. Further evidence for changes in the scale level of neural ensembles involved in vision has been reported in deaf cats (Lomber et al., 2010). In these animals, which exhibit supranormal visual performance (e.g., improved peripheral target localization; lower thresholds of movement detection) the "auditory cortex" is recruited during visual perception. Reversible deactivations of posterior auditory cortex and dorsal auditory cortex respectively suppressed any superiority in localization and in movement detection. Therefore, scale-dependent reorganizations involving the addition of neural territories occur in the brain to support heightened functional performance at the visual behavioral level.

The subject of interactions between scale levels has been recently addressed by Kim et al. (2013), in the context of the connectome project. They categorized recent works in the domain into three classes: macro-scale (inter-regional connectivity), mesoscale (neuron level and its projections), and microscale (including all synaptic contacts). The authors presented details of most advanced methodologies for characterizing each scale. The subsequent problem lies in the integration of information across scales, which implies to get partial common frames of references from one scale to another. This obviously technical issue lets basic questions concerning the nature of causal links between scales unanswered. At different levels of scientific analysis, progress in the description of networks is made in spite of material challenges. However, a model of couplings between neural activities belonging to the three scales is still lacking.

Our review makes it salient that data have been accumulated, which show that information (defined electrically or symbolically) and behavior are fundamentally dependent on the context. The latter emerges in the brain through structural and functional connections that constitute the background for potential coordinative patterns. Synthesizing involves gathering sparse arguments and unconnected conceptual tools. We must consider conceptual connections between what occurs at brain, phenomenological, and behavioral levels. A major issue for the integration of knowledge, the connection of unconnected fields in science, is the understanding of the ends of the variations. In order to shift from an operative view on couplings and complexity to a more global perspective where meaning can be associated with complex "computation," an approach combining the emergence conditions of mutual influences and the meaning of these influences should be privileged.

MEM AND ITS DYNAMICAL ZOOM: TOWARD THE THEORETICAL INTEGRATION OF CONNECTEDNESS AND EMERGENT TELEOLOGY

A synthesis in the field of mind sciences not only requires to gather information at different scales of analysis but also to shed light on *why* different systems are coupled and *why* their coupling evolves with time. We need to think and model the "motivational" forces that draw different scales of the central nervous system as well as phenomenological states and behavior toward a given and momentary equilibrium. However, the teleological dimensions of cognition and brain dynamics are more rarely modeled. The emerging goals that are pursued by the individual can also (as connectedness) be described at different levels of abstraction (Laurent, 2003). From low-levels of cognitive control over goals to the abstract management of personal motivation, individual forces that drive cognition must be integrated, as connectedness, in a conceptual model of mind. If much work has been done over the two last decades in the field of complex neural networks, connectedness and complex cognition, the integration of teleology and motivation in those works is far to be achieved. In the following paragraphs, I am presenting two descriptions of MEM that account for the various effects reported earlier in this paper. The first one is developed with psychological concepts, whereas the second one is developed with biocomputational concepts. The goal of the procedure is to provide supplementary opportunities for exchanges between disciplines. In both descriptions, the role of scale interaction is being discussed.

DESCRIPTION OF MEM AT THE PSYCHOLOGICAL LEVEL

Once the theoretical framework – for (i) conceiving the coupling between a cognitive component and a larger whole, (ii) identifying the teleological dimensions emerging from the multiple components – has been developed, methodological tools should be coined in order to describe the macroscopic behavior of the system. For instance, for vision, the collective behavior may be tracked by the use of eye movement recording. This technique informs us about the parts of the environment with which a human subject interacts. This interaction is the macroscopic behavior emerging from a complex coupling between the visuomotor subsystem and any other subsystem that is connected to the visual system. According to MEM, the amount of visual modulation by other subsystems depends on both the structural and the functional connectivity. Structural connectivity is generated both innately and as a result of individual goals and prolonged experiences with environmental structures. This can be altered also by aging and disease. Functional connectivity is influenced by dynamic teleological pressure coming from the rest of the organism. This pressure can be transmitted through the structural connection within electrical and chemical systems. Knowing the structure of the visual system is useful but not sufficient in order to predict its behavior. We must *re-build the ecology* (both within the body and outside the body) in order to conceive visual-motor

dynamics. What the individual searches for in the environment is dependent on his emergent "motivation." Here, "motivation" is wholly embodied and distributed in all the living system, each component (as shown previously in the empirical part) exerting a pressure on what visual search and experience finally are. The variance in eye movements, unexplained by a single factor, can be further investigated in the framework of multiscale couplings.

Figure 1 presents a summary of MEM organization at the *psychological level*. This lets us draw perspectives for further empirical research within a complex approach to perception. The influence of teleological factors is embodied in perceptual and motor activities, which are not "encapsulated," but rather penetrated by non-perceptual or non-motor factors with which they form systems at different scales, that is, from the neurological to the social-cultural scale. The conceptual synthesis in this model lies in giving an account for evolving (and interacting) ends at different levels of abstraction as well as predicting their effects on cognitive systems. In other words, this consists in considering cognitive systems as essentially *goal-driven*, in recognizing that what is processed fundamentally depends on the current characteristics of all nets that are connected to them. The *synthesis* between disciplines is only possible if researchers are able to recognize not only that their research object is influenced by various factors pertaining to multiple and flexible scales of abstraction, but also if they systematically engage in the description of the motivations or teleology attached to these factors. In this framework, *context-sensitivity* is a basis for the conception of open systems and the intellectual synthesis between classically separated research fields. *The focus of MEM is both on multiscale connectedness (or functional coupling) and embodied teleology (or distributed and local autopoiesis)*. Connectedness is often cited as a critical factor of system dynamics, but the scale at which this is considered is rarely flexible. Teleology is very rarely evoked. Nonetheless, as reported in the precedent sections of this paper, the change in a subsystem "needs" dramatically modifies the strength of the influence this subsystem will exert on visual search for information and attunement to features that are critical at any given time. Taking into account these needs and their connections with visual and mental processes allows us modeling multiscale environments of psychological processes, and then contributing to rebuild the *ecology of mind*.

The perception-action cycles are under the influence of multiple embodied motivational forces (i.e., the emerging teleological force field). The notion of "emerging teleological force field" refers to the sum of electrical and chemical information emerging from local neural nets and single neurons, which translate local constraints and needs into constraints for search of information, through patterns of functional neural connections. The multiscale enaction lies in the following principles: (i) any part of the body plays a role in the definition of the search needs for information and operational closure of the organism (ii) the strength of local influences over perception-action cycles is influenced by factors whose expression duration ranges from macrogenetic (i.e., evolutionary) to microgenetic (e.g., glycemic regulation needs) scales (iii) perception-action cycles are interfaced with different needs, which can be associated with various levels of abstraction (iv) the autonomous activity produced at any cellular unit or ensemble of cell is an expression of the autopoietic characteristic (i.e., affirmation of self-identity) of living units, so that cooperation and competition are basic properties of relations between cells or groups of cells.

A (visual) system able to take into account the initial conditions of the agent is a real intelligent system, since this one has an immediate adaptation to the *dynamic* or *evolving goals* of the agent in which it is embedded. Therefore, understanding how

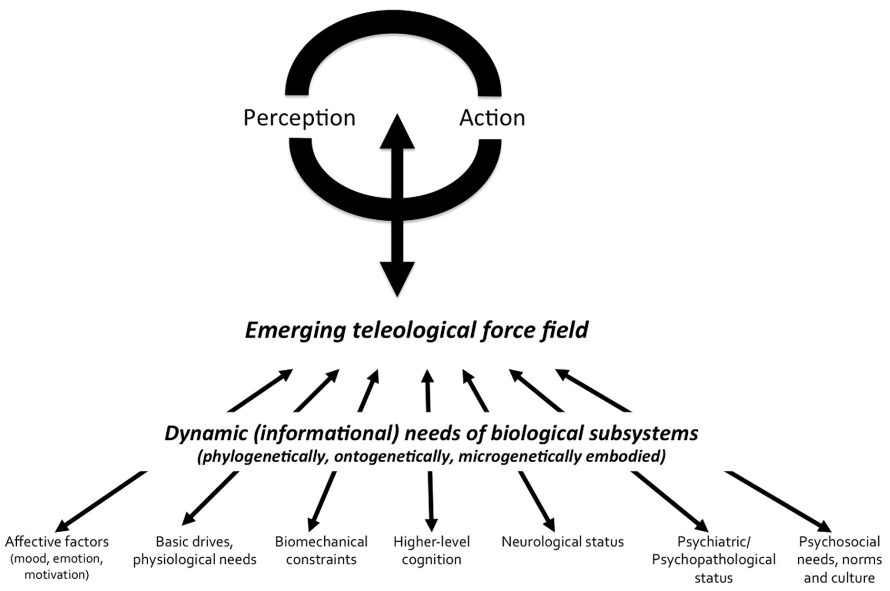

FIGURE 1 | Schematic description of MEM at the psychological level.

different cognitive or neural systems interact becomes central to theorizing the variance of visual perception. Furthermore, each identified interaction between visual and non-visual processes becomes a new opportunity of understanding and influencing world representations and behavior. The proposed conceptual model is empirically testable. Each of the connections represented in the **Figure 1** has already been exemplified and experimentally tested, and supporting data have been reported in our review. However, its heuristic value is also related to the acknowledgment that visual and motor systems are influenced by other components that provide them with teleological perspectives. *The connection between biological-cognitive processes on the one hand, and their meanings in a wide range of coupling contexts on the other hand*, is fundamental to the integrative science of complex living systems. MEM is, for those reasons, in part in rupture with Maturana and Varela (1980) assumptions according to which autopoietic systems are strictly non-teleological. These pioneering authors had probably to distinguish between classical functionalism and teleology, on one side, and their autopoietic systems theory, on the other side. This was aimed at eliminating any reference to an abstract "purpose" that would, from the external world, guide the regulation of behavior. In this sense, I agree with Maturana and Varela's (1980) project to naturalize our theories of human cognition. There is no need to evoke any external law to the human subject in order to found our understanding of individual regulation. This is not that external constraints do not influence individual behavior, but rather that any meaning arises in the context of self-referenced evaluative processes and values. However, with MEM, I propose to stress the *flexibility* of what context is and what the autopoietic levels should be in *both* our theoretical *and* empirical research. In MEM, there are multilayered recursive loops and identity-affirming processes. The whole body is not the only autopoietic unity; at another end of the continuum, the single cell has also its own organization. Signals processed by the cells generate recursive loops. Neural ensembles behave through excitatory or inhibitory activity, and influence perceptual-motor systems. In this perspective, perceptual-motor activity in frontal, parietal, temporal, and occipital areas embodies goals, needs, emerging in distal regions. In this sense, the ends of perceptual-motor systems are strictly emerging, by summing local action potentials. Once again, the teleology mentioned here is in no way similar to an external principle that would indicate, from outside the organism, the ends of a living being, specie, or an individual. Well before biologists, psychologists or cyberneticists, Nietzsche already warned his readers against "teleological" discourses.

> "*There is no denying that* in the long run *each of these great teachers of a purpose was vanquished by laughter, reason and nature: the brief tragedy always changed and returned into the eternal comedy of existence, and the 'waves of uncountable laughter' – to cite Aeschylus – must in the end also come crashing down on the greatest of these tragedians.*"
>
> *Friedrich Wilhelm Nietzsche, 1882.* The Gay Science. *Book One, 1, "The teachers of the purpose of existence."*

Instead of explaining the regulation of behaviors or existence in relation to *external* causes, or in relation to elementary "cognitive functions" that are usually thought of as if the specific context of their evaluation did not count, I suggest to consider humans as being made of contexts (subsystems), many of which signal the critical environmental parts to deal with as a function of the autopoietic necessities of the moment. The ability of these subsystems to orient perceptual-motor cycles can be referred to as emerging teleological constraints. These teleological constraints need not be symbolically represented. They are embodied through metabolic and electrical activity, which take their meaning in relation to local basic autopoietic units that are the cells.

DESCRIPTION OF MEM AT THE BIOCOMPUTATIONAL LEVEL

As proposed by Capra and Luisi (2014, p. 155), "[e]mergent properties are the novel properties that arise when a higher level of complexity is reached by putting together components of lower complexity. The properties are novel in the sense that they are not present in the parts: they *emerge* from the specific relationships and interactions among the parts in the organized ensemble." *MEM applies this principle to teleology*. In other words, the global goals that are pursued by the individual emerge from the coordination between multiple more elementary teleological forces at the subsystem level. In the present paper, I reviewed the role of basic needs, mood regulation goals, social-economical determinants. All these "local" parameters are forces that are progressively and hierarchically coupled to cognitive and perceptual processes.

The modalities of local needs combination and integration should receive computational solutions. Systematic research has to be carried out in order to reveal how vision emerges as a consequence of information integration. For instance, careful control over needs or goals should be observed in order to measure the effects of the strongest needs and goals of the wider agent system at any given time, in comparison with less demanding ones. A simple win-loose principle can be envisaged in order to perfectly satisfy the most valued goal, but complex motivations could also lead to a multipurpose visual search connecting different goals with vision. At a more elementary scale, MEM is characterized by connectedness and informational exchanges between the organism subsystems. The roles and positions in space of these subsystems are various. In order to account for the perceptual-motor dynamics occurring under the influence of multiscale information integration, a hierarchical process taking into account interactions between different parts of the system will be proposed. Contemporary advances of theoretical biology can be considered as foundations for some of these computations carried out by MEM. Chauvet (1993a,b,c, 2004) proposed mathematical tools accounting for the hierarchical information integration. In this framework, information integration is under the constraints of several organizational factors associated to biological systems. According to Chauvet (2004, p. 211), "the functional organization of a biological system can be represented by a mathematical graph in which the summits correspond to the sources and sinks of the system and the arcs correspond to functional interactions between them." Chauvet takes space and time into account. He introduces the concept of *structural discontinuity* in order to account for the propagation of functional interaction through different milieux. If there is a discontinuity between the source and the sink, the interaction Ψ will need to go through the inferior level ϕ. Chauvet proposes the *S*-propagator (*Structure*-propagator) notion, which is an operator describing

the move of activation through structural hierarchy. The *S*-propagator corresponds to the following mathematical function:

$$P_{i0} = P_0 \phi P_i \quad (2)$$

where the propagation between two discontinuous spaces, the source situated at r_i and the sink situated at r_0, involves the interaction ϕ from which it results. According to Chauvet (2004, p. 227), three steps are required in order to propagate the functional interaction Ψ between different structures:

(1) The propagation of the functional interaction within the source, involving the operator P_i.
(2) The modification of the interaction by the structural discontinuity generating another interaction at a lower level ϕ.
(3) The propagation of the Ψ interaction at the higher level in the sink at r_0.

Between distant interacting structures, other lower-level dynamics moderate information transmission. **Figure 2** illustrates how MEM integrates those principles of theoretical biology and relates elementary autopoietic activity to structural organization and emergence of eye movement control and visual search of information. Each structural space is associated with a dynamics that contributes to shaping upcoming and downcoming information, such that the communication between two structures depends on both (lower-lever) elementary autopoietic dynamics and (higher-level) integrative dynamics.

In this example, the functional interaction between the anterior cingulate cortex (ACC) and the frontal eye field (FEF) is noted Ψ and is allowed by the propagation of the interaction in the source P_i toward the inferior dimensional level *S* (in the cingulate eye field [CEF]). The propagation of the interaction ϕ at the *S* level is shaped by the dynamics of the CEF, such that the functional interaction at the Ψ level is dependent on the upcoming P_0 interaction. Beyond those solutions inspired by theoretical biology (Chauvet, 2004), MEM relies on a principle of multiscale and emerging autopoiesis from the cellular level to the most integrative structure that is the organism. Instances of potential activation patterns are presented. The presence [arrow]/absence [no arrow] of cell excitatory [blue]/inhibitory [red] signals, is a function of both *local cell needs* and *structural activity*. Dashed arrows represent top-down connections and potential modulation of upcoming information by higher-level neural nets. The integrative autopoietic subsystem acts as a filter of the interaction propagation between the ACC and the FEF, and contributes to influence eye movement and search for information.

Emerging motivational information space can be conceived as a fundamental integrative autopoietic field, beside the more elementary manifestation of autopoiesis at any cellular level of the organism. Structural discontinuity between perception-memory and action can be filled in by propagating functional interaction through the motivational subsystem.

Multiscale Enaction Model conceives enaction as the result of multiscale integration, self-affirming of identity, and meaning emergence, *at different structural levels*. In other words, if MEM contributes to gather processes classically associated with different scientific disciplines, it also recognizes the multiplicity of the human being and, at the psychological level, the role of *emerging* teleologies in the constitution of the perceptual-motor *Umwelt*, and then, of the subjective world. As pointed out in the elegant and huge work by Thompson (2010, p. 14): "[o]ne key point is that the enactive approach explicates selfhood and subjectivity from the ground up by accounting for the autonomy proper to living and cognitive beings." It is required, at this time of our scientific developments to better

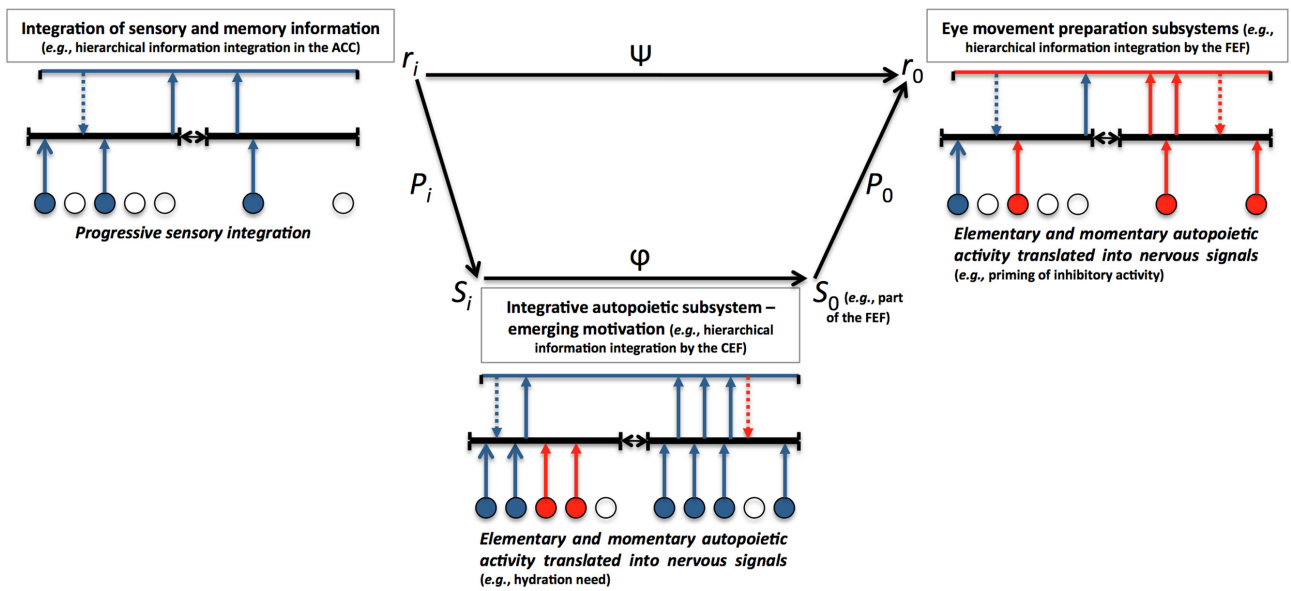

FIGURE 2 | Biocomputational solutions to multiscale enaction in MEM.

understand, and further research – both theoretically and empirically – the process by which, a kind of operational closure occurs through perceptual and motor processes. However, in contrast with some "enactive approaches" that reduce the causes of emergence to sensorimotor activity, MEM includes multiple scales of determinants, ranging from cellular autopoiesis to complex embodied social behaviors. The embodiment process of motivation lies in the *progressive hierarchical integration* of local "needs." MEM connects embodied motivation to visual search behaviors, perception, and the subsequently emerging subjective world.

CONCLUSION

In this article, I have proposed a model (MEM), which integrates complex and dynamical approaches to vision, on the basis of experimental results. This approach highlights the need to consider both the connective characteristics of visual hardware, and the dynamic nature of the coupling between various bottom-up and top-down processes. The enactive multiscale view that has been proposed, in the continuation of earlier enactive proposals (Varela et al., 1991; Thompson, 2010), is based on empirical data showing that human visual-perceptual activity is strongly dependent on non-visual and non-motor activity. This implies to contextualize vision in the more global framework of functional hierarchical systems (Proffitt, 1993) that are dynamically shaped by the current *embodied* needs of the system. This differentiates the current proposal from previous enactive works more strictly based on sensorimotor loops and contingencies. As dynamical systems, humans are made of evolving needs (e.g., satisfying thirst, collecting specific information, reaching a place in the physical environment), and then what they search for in the environment changes with time as a function of internal initial conditions. Those initial conditions conduct the human organism to *enact* a given world.

The study of coordination between visual and non-visual factors makes it urgent to develop "an embodied motivational psychology of perception" (i.e., not confined to abstract views on elaborated or symbolically driven motivations, but based on any teleological perspective embodied in the organism). The enactive approach proposed here tries to capture sources of variability in perception. In order to achieve our goals of understanding finalized vision, we must understand the very nature of the respective activities of the systems that are found to be coordinated with vision, as well as the modes of coordination that are variously employed by the organism as a function of time.

Conceiving artificial agents whose properties would be inspired from those fundamental principles may also contribute to reduce the gap between what is known about "connected cognition" in humans and cold or "disconnected cognition" in some machines (see Vunka Jungum and Laurent, 2009, for a discussion of this problem in the context of emotions; and Arkin, 2005, for some lends concerning the inclusion of emotion-related processes in robots). Given processing time- and power-limitation of human cognition (i.e., bounded rationality; Simon, 1956, 1957; Gigerenzer and Selten, 2002; Kahneman, 2003; Hertwig et al., 2013), the modeling of couplings between vision and needs/current priorities may well be a strong foundation for the understanding of true intelligent behaviors.

Finally, each revealed influence of non-perceptual factors on perception also offers the opportunity of psychological intervention in order to change psychological equilibrium. Empathy, in the framework of psychological science, is not only a process of goodwill and compassionate listening, but also implies to understand the context in which the individual is embedded. The kind of approach to perception developed here should facilitate the meeting between real-world complexity and the theorization of human mind and behavior. Any synthesis in the field of mind, brain, and behavior, implies to conceive complexity, which is the quality of a system made of multiple entities that are related to each other by multiple connections. Conceiving complexity at different levels of abstraction also requires the openness of research objects and systems in order to coordinate scientific concepts. This kind of synthesis should not only be beneficial to scientists, but also to professional intervention in the field of psychology. Psychologists and human-centered professionals have not psychic, biological, cognitive, or social beings to deal with. They face whole complex systems whose behaviors emerge from the multiple couplings between various determinants. Constituting interactions in perception as a privileged object of psychological science should also allow reducing the frustration of students and professional when they shift from theory to complex and real settings on the field and they establish that the whole is greater than the sum of the parts. Perception is an early process. Getting tools in order to manipulate this primitive cognition should be an asset to change the *Umwelt* of humans, that is, the perception of what the world is and what the possible actions in the world are.

To summarize, following the presentation of MEM applied to complexity in vision, the best way to contribute to a modern synthesis in the field of mind sciences is to develop and employ a framework based on the recognition of multiscale couplings. The latter result in the emergence of multiple embodied teleological forces (i.e., dynamic patterns of electrical and metabolic activity), which induces – at each moment – a specific operational closure with the environment. In other words, we get perceptually- and motor-tuned to our local and global emerging needs. Not only does this model contribute to reuniting body, mind, and behavior, but it also achieves thematic and subdisciplinary connections within psychology, by connecting objects that are usually researched independently as "functions" and that have progressively acquired both modularity and functionality statuses, because of the lack of theoretical, methodological, and empirical integration (or contextual relativism).

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Neurophenomenology revisited: second-person methods for the study of human consciousness

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In the study of consciousness, neurophenomenology was originally established as a novel research program attempting to reconcile two apparently irreconcilable methodologies in psychology: qualitative and quantitative methods. Its potential relies on Francisco Varela's idea of reciprocal constraints, in which first-person accounts and neurophysiological data mutually inform each other. However, since its first conceptualization, neurophenomenology has encountered methodological problems. These problems have emerged mainly because of the difficulty of obtaining and analyzing subjective reports in a systematic manner. However, more recently, several interview techniques for describing subjective accounts have been developed, collectively known as "second-person methods." Second-person methods refer to interview techniques that solicit both verbal and non-verbal information from participants in order to obtain systematic and detailed subjective reports. Here, we examine the potential for employing second-person methodologies in the neurophenomenological study of consciousness and we propose three practical ideas for developing a second-person neurophenomenological method. Thus, we first describe second-person methodologies available in the literature for analyzing subjective reports, identifying specific constraints on the status of the first-, second- and third- person methods. Second, we analyze two experimental studies that explicitly incorporate second-person methods for traversing the "gap" between phenomenology and neuroscience. Third, we analyze the challenges that second-person accounts face in establishing an objective methodology for comparing results across different participants and interviewers: this is the "validation" problem. Finally, we synthesize the common aspects of the interview methods described above. In conclusion, our arguments emphasize that second-person methods represent a powerful approach for closing the gap between the experiential and the neurobiological levels of description in the study of human consciousness.

Keywords: neurophenomenolgy, second-person methods, elicitation interview, descriptive experience sampling, double-blind interview, mutual circulation

The Neurophenomenological Program

Francisco Varela in his article "*Neurophenomenology: a methodological remedy for the hard problem*" (Varela, 1996) proposed a novel research program for the study of human consciousness or lived experience by combining experimental methods of neuroscience with phenomenological methods of Western philosophy. "Phenomenology" has at least two different meanings in this context. First, it represents a research program for the study of human consciousness that includes phenomenology, introspection and meditation as its main methodologies (i.e., phenomenology as a *general* concept; Varela, 1996, p. 333). These are based, respectively, on the "reduction" and "suspension of the natural attitude" derived from the phenomenological tradition; on the attentional capacities derived from scientific psychology; and on meditation practices derived from Buddhist and Vedic traditions (Varela and Shear, 1999, p. 7). Second, phenomenology can be understood as a specific disciplined method for describing lived experience, first introduced by Husserl, and further developed by Merleau-Ponty and others (i.e., phenomenology as a *restricted* concept coming from the philosophical tradition). In the context of the neurophenomenological program, the notion of "Phenomenology" refers to the first sense (i.e., the general concept of phenomenology) which includes the Husserlian phenomenological tradition as one of its specific methodologies.

Given the importance of this topic for the rest of the article, it is worth drawing a strict distinction between the concepts of introspection and phenomenology (in its *restricted* conceptualization). Although both methods have existed for over a century, there are still contemporary studies that confuse the introspective and the phenomenological approaches, as has been alerted in several publications (Varela, 1996; Gallagher and Sørensen, 2006; Gallagher and Zahavi, 2008). This misinterpretation is even committed by very well known professionals of Cognitive Sciences, such as Dennett (1991), who confused the phenomenological method with introspectionism in his book "Consciousness explained" (Varela, 1996; Gallagher, 2000).

Nowadays two different procedures denominated "introspection" can be distinguished in the experimental research applied in Cognitive Sciences: introspection in a weak sense and in a strong sense (Gallagher and Sørensen, 2006). The weak concept of introspection is applied in those experimental designs where a person is required to report his or her own experience (in a verbal or behavioral response) when a specific stimulus is provided, e.g., a word, an image, a sound (Jack and Roepstorff, 2002; Price and Aydede, 2005). While the concept of weak introspection has been used for over a century in research focusing on the subjective experience of consciousness (Locke, 2009), introspection in the strong sense has been frequently confused with the phenomenological method. The reason for this misinterpretation is that the concept of introspection in the strong sense applies a method that makes the participant exclude any subjective interpretation from his or her experience and focus on their "pure" perception (Gallagher and Sørensen, 2006). Another characteristic of the strong concept of introspection is that the person, prior to the testing phase, is trained in this specific type of experiences that must be achieved. Initially, the researcher provides the participant with a number of the qualifying categories already operationalized by the investigator. Once the experiences in these categories are collected in verbal reports, the researcher transforms them into quantitative data, which could be compared with other third-person data (Gallagher and Sørensen, 2006).

On the other hand, there are a number of different variations of the phenomenological method. In the context of Varela´s work, the method incorporates three steps (Gallagher and Sørensen, 2006; Gallagher and Zahavi, 2008). In the first step, denominated as "suspending beliefs or theories about experience," the interviewer raises open questions about the interviewee's experiences. These questions lack any categorization or information that could bias the experience of the person. Through the method of open questions the interviewer aims for the individual to focus their attention on their own experience, reducing the number of possible interpretations (*epoché*). Through accomplishing the epoché, the person does not alter the veridity of the lived experience, but the interpretation on the phenomenon. This first step is similar to the concept of introspection in the strong sense. In the second step, called "gaining intimacy with the domain of investigation," the interviewer gives the individual an insight into the study's targeted experience. For that, the interviewer assists the person in exploring his or her experience in multiple ways (elaborated in the "Second-person method" section below). The task of the researcher is to enrich the conscious experience by guiding the session, which will allow the interviewee to more easily evoke the pre-reflective experiences. Thanks to this enrichment, the interviewee will have access to a new comprehension of his or her experience, i.e., to an intuition of his or her lived experience. While in the first and second steps the method is focused on the subjective experience, in the last step this changes. The third step in the neurophenomenological interview, termed "offering descriptions and using intersubjective validations," is focused on externalizing the experience and sharing it with a community. This final step is of a great importance with respect to the scientific study of phenomenology. Depending on the scientific validity of this methodology, the results found in the interview might be replicated and accepted in the scientific community, or rejected based on the method's inadequacy (this epistemological problem discussed below). In a nutshell, the descriptions that the interviewer collects are permanent properties that stay invariant during different analyses. They constitute a stable structure in the experience. Through this permanent feature, the same study could be repeated with other participants, and consequently confirmed or rejected in intersubjective validation. One important characteristic of this kind of validation is that the reports collected are not transformed into quantitative variables, which allows for keeping the data in its first-person experience state. This is an essential feature of phenomenological method. In the general context of the research, the phenomenological data (first-person), which was collected in a second-person interview, can be correlated with third-person data (behavioral response, neuroimaging, electroencephalography, EEG). Varela named this triple level of study as "mutual circulation" (Varela, 1996).

To summarize, introspection and phenomenology are different methods of studying the lived experience in first-person. Nevertheless, they are both part of the neurophenomenological

program. The two methods are complementary in the first-person analysis. Varela expressed this notion in the following terms: "Phenomenology does share with introspectionism an interest in the reflective doubling as a key move of its approach to phenomena" (Varela, 1996, p. 338). From a procedural point of view, introspection is the first step in Varela's phenomenology, showing the content of the lived experience. However, the introspective method is insufficient to explain the whole lived experience of a person. To complete this description, it is also necessary to integrate the phenomenological and the meditation methods. Just with the application of these three neurophenomenological methods the subjective experience can be comprehensively explained.

One of the goals of the neurophenomenology is to unify two different traditions, the neuroscientific experimental approach and the phenomenological approach (as a general concept) by integrating the lived, experiential data with neuroscientific data (Froese and Fuchs, 2012). Thus, neurophenomenology has to combine two distinct methodological procedures. On the one hand, the neuroscientific procedures furnish third-person "objective" data (e.g., fMRI, EEG) and, on the other, the phenomenological procedure provides first-person data, meaning reports of the observer's lived experience. Just as there are many methods for obtaining third-person data, there are several means to acquiring data about a lived experience. These include -as described above- the phenomenological, introspective and meditative methods (Varela and Shear, 1999). To counteract the methodological differences between its constituents, the success of the neurophenomenological program requires a "necessary circulation" or communication between the first- and third-person accounts. In other words, neurophenomenology requires an integration of the third-person methods with all of the described first-person approaches (Varela and Shear, 1999).

Since its original conception, one of the main challenges for the neurophenomenological program is the creation of formal models for integrating both phenomenological and neurobiological accounts. The difficulty lies in establishing the correlation between local and global patterns of neural activity and their relationship with the phenomenal structure of the subjective experience (Lutz et al., 2002). Regarding the difficulty of generating models that link empirical and experiential data, Froese and Gallagher (2010) have suggested an intermediate step. They propose using agent-based modeling and mathematical simulation for developing formal models capable of integrating objective and subjective data. Another challenge in front of neurophenomenology has been the integration of extended and embodied aspects of human cognition. This issue has been addressed by investigating the relationship between cooperative patterns of neural activity and ecological (Colombetti, 2014; Desmidt et al., 2014), environmental (Beaton, 2013), and embodied/social aspects of the phenomenal experience (Lutz and Thompson, 2003; Froese and Fuchs, 2012). Thus, the problem of constructing a "bridge" between phenomenology, neurobiology and the environment finds its place as one of the main challenges of the neurophenomenological program.

During the last decade, several researchers have explicitly incorporated first-person phenomenological data in their third-person experimental protocols, exemplifying neurophenomenological practice (Lutz et al., 2002; Garrison et al., 2013; Petitmengin et al., 2013). In one of the first and most influential examples, Lutz et al. (2002) correlated phenomenological reports, reaction times and dynamical analysis of brain activity EEG. Thus, EEG activity was recorded during the presentation of a point pattern with depth information called an auto-stereogram. Each participant had to press a button when they achieved to clearly observe the three-dimensional figure and make a report of their experience. According to their first-person accounts, different phenomenological categories (or clusters) were identified regarding the level of participant's preparation at the time the three-dimensional figure was perceived. According to these phenomenological clusters, EEG recordings were classified and patterns of brain functional connectivity (i.e., gamma-band phase synchrony) were computed. Their interest on first-person data was based on the hypotheses that the variability of the brain response after the perception of the three-dimensional figure could be generated by mental fluctuations attributable to the attentional state of the subject, or spontaneous thinking processes, or cognitive strategies on the task, among other possibilities (Gallagher, 2010, p. 24). Their "descriptive strategy"—a set of phenomenological techniques used for improving first-person accuracy of reportability of internal experiences (Bayne, 2004, p. 352)—can be described in two steps:

First, experimental subjects were trained. Training consisted of a set of practices for increasing the attentional sensitivity over actions and internal states that are related to the present experience (Thompson et al., 2005). Specifically, training was based on the practice of the *epoche* (Gallagher, 2010) which consists of the suspension of all previous judgments about the external world in order to attend to the experience itself; it is a description not of the content of *what* subject knows, but rather of *how* the experience happens. For Lutz et al. (2002), training consisted of improving subjects' performance in the perceptual discrimination task as well as in the accuracy of their experiential reports. Participants were asked open questions between trials, which directed their attention toward their own mental processes. It was hypothesized that their responses could account for the between-subject variability in objective task performance by revealing differences in strategies employed, distractions, attentional states, and the like. Unlike traditional paradigms that deploy averaging techniques in order to attenuate the high variability of neural activity when interpreted as "noise," Lutz et al. (2002) studied these "noisy" signals as representative of subjective parameters by taking into account the descriptions given by the participants after every trial.

Second, participants' experiential reports were given after each trial and were organized into "phenomenological clusters." "Phenomenological clusters" represented categories of trials, established based on first-person reports, that captured subjective variability during the task. Each cluster then permitted dynamical analysis of brain activity (Gallagher, 2010). For each phenomenological cluster, subcategories based on the state of preparation felt by the participants prior to stimuli presentation were identified. For instance, in the "steady readiness" cluster subjects reported that they were "well prepared" when the imaged appeared on the

screen. Thus, phenomenological clusters gave richer and multi-dimensional information about the structure of conscious experience by accounting not just for the behavioral data (reaction times) but also for the neural correlates associated with conscious experience. In particular, prior to the presentation of the visual stimulus, they observed a large-scale pattern of phase synchrony in the frontal brain region in prepared subjects but not in unprepared subjects. Second, the degree of phase scattering recorded in the back electrodes was also modulated by the degree of preparation, i.e., the lower the degree of preparation the greater dispersion phase. Third, an earlier large-scale pattern of phase synchrony in prepared subjects (300 ms) than in the no-prepared subjects (600 ms) for the motor response.

As this example shows, successful neurophenomenology requires collecting large amounts of first-person data. This may appear to be a straightforward task if it would be enough to just ask the participant what they were experiencing during the trials. However, this is not the case at all; a *disciplined* observation of the experience is required. For instance, it would be a mistake to assume that being aware of a particular experience is sufficient for providing adequate verbal description (Bockelman et al., 2013). Furthermore, it is required that participants are able to attend the experience (introspection) while still being able to suspend their beliefs or previous judgments (phenomenological reduction), to avoid (as far as possible) bias or contamination of first-person reports. A powerful way to address these problems is to structure first-person data collection using *interviews* that are mediated by a trained person able to help the participants with describing their experiences accurately, that is, an interviewer or mediator with the "attitude" for reporting first-person data. This approach is known as the *second-person perspective* (Varela and Shear, 1999). Furthermore, the mediator does not take a neutral position but rather examines the participant from an empathic stand for investigating an experience *in common*. Just like an ethnographer is not simply interested in compiling data from a community as a neutral observer but in apprehending a way of living, a mediator may employ a specific strategy for apprehending first-person lived experiences. Varela and Shear (1999) claim that "a mediator is eccentric to the lived experience (...) but nevertheless takes position of one who has been there to some degree, and thus provides hints and further training" (p. 8).

In this paper, we conclude that second-person methodologies represent a promising set of tools for studying human consciousness in the context of the neurophenomenological program. We first describe second-person methodologies available in the literature for analyzing subjective reports, identifying specific constraints on the status of the first-, second- and third- person methods. Second, in the discussion we analyze two experimental studies that explicitly incorporate second-person methods for traversing the "gap" between phenomenology and neuroscience. On the other hand, we evaluate the challenges that second-person accounts face in establishing an objective methodology for comparing results across different participants and interviewers: this is the "validation" problem. Finally, we conclude by showing the common aspects of the interview methods described above, in order to provide an overview of the general properties of this important methodological approach.

Second-person Methods

In this section we describe three second-person interview methods. Although these methods were not initially considered as part of the neurophenomenological program, we think they could be incorporated in the program if they meet to a possible extend the following three features. First, second-person methods require to be evaluated in the "mutual circulation" between the first, second and third person (Varela and Shear, 1999). For instance, the interviewer's and interviewee's description of the lived experience could be correlated with objective third-person data (Froese, 2013). Second, the acquisition of second-person data requires the mediation of a qualified interviewer. By a qualified interviewer we mean an emphatic mediator who could guide the interviewee in the process of becoming aware of their lived experience. Finally, the data collected by the interviewer should be used for computing correlational analyses with the neurobiological data, These three features are tightly related to neurophenomenology's "mutual circulation" between the phenomenological and the neurobiological data. Importantly, these three characteristics we propose here represent an aspiration for the neurophenomenological program. They could be partially or completely met depending on the limitations imposed by the complexities of specific experimental designs. These three features that we propose here for the second-person neurophenomenological method are similar to the three steps in the Varela's work. The first two features, to which the *epoché* of the phenomenological method should be added, attempt at developing the report of the lived experience. The third characteristic allows for the neurophenomenological analysis.

Descriptive Experience Sampling

Descriptive experience sampling is an introspective method developed by Russ Hurlburt during the 1990s for observing and describing inner experiences—such as thoughts, feelings and visualizations—and their perceptual components (Hurlburt, 2011). "Experience" refers to the attention-, stimulus-, and context-dependent contents of consciousness at a particular time (Hurlburt and Schwitzgebel, 2011). For instance, now I am attending to the letters I am reading (what is "outside" the subject), then to my thoughts about what I am reading (what is "inside" the subject), then I become aware of those thoughts when suddenly a memory irrupts or I start attending to a sound of the environment. Thus, inner experience, or simply "experience," refers to everything that is "directly present," what appears "directly before the footlights of consciousness" (Hurlburt, 2009, p. 157; for a discussion of the concepts see Hurlburt and Schwitzgebel, 2007, p. 15). In this setting, the term "pristine experience" describes what is already happening *before* attending to the reflection or observation, as when we get lost in our thoughts until something appears "out there" and grabs our attention without making us lose the flux of experience at any moment (Hurlburt and Akhter, 2006). Therefore, the aim of DES is to achieve faithful and informative apprehension of the interviewee with their experience, and of the interviewer with a description of the interviewee's experience. Altogether, this approach provides a phenomenologically valid and experimentally useful description of a particular experience at a particular moment.

The methodological procedure of DES consists of equipping the participant with an electronic device (a "beeper") which emits a sound that participant can hear through headphones while occupied by his usual activities (Hurlburt and Heavey, 2004). Previous training has ensured that participants are adept in attending to their ongoing awareness (the pristine experience) at the moment of the "beep" (Hurlburt and Heavey, 2004, p. 13). The beeper sounds 5 or 6 times per day and its function is to facilitate the phenomenological report in minimizing retrospection, and to reduce the perturbation of the ongoing experience. Importantly, the function of the beep is to select an experience *randomly*, thereby avoiding bias associated with intentionally selecting moments. Thus, each random "beep" commands the subject to attend to his inner experience at that particular moment, and to register (by written or verbal recording) the features of that particular experience. Finally, 24 h after collecting experimental samples, an iterative process of interviews takes place (Hurlburt, 2009). According to Hurlburt, the role of the iterative process of interviews is to allow for increasing the salience of pristine experience:

> The direct contribution of pristine experience is likely to decrease within each interview because the influence of reconstructions during the interview is likely to outpace the bracketing of presuppositions, even if genuine progress is made in bracketing presuppositions (i.e., the removal of parts of the interview contaminated by presuppositions or assumptions) and clarifying communication. However, if genuine progress is made in bracketing presuppositions and clarifying communication, the direct contribution of pristine experience is likely to increase across interviews because of the refreshment by the new pristine experience at each step (Hurlburt, 2009, p. 165).

All in all, the DES iterative process represents a useful method for obtaining first-person reports by facilitating "pristine" accounts of experience. An important feature of DES is its second-person character, arising from the essential role of the interviewer in mediating participants' ability to describe their phenomenological experience and in thus validating their reports.

Elicitation Interview

The elicitation interview (EI) is a technique developed by Pierre Vermersch at the end of the 1970s (Vermersch, 1994, 1999, 2009) designed to guide the interviewee to redirect her attention to specific aspects of her experience and to precisely describe them (Petitmengin and Lachaux, 2013; Valenzuela-Moguillansky, 2013).

Originally, Vermersch developed this technique in the context of his study of the cognitive processes involved in learning, particularly in problem resolution. Vermersch was interested in the procedural aspect of problem resolution, meaning the trajectory and the strategies that the person used while performing a certain task and not only in reaction times or success rates, which were the measures primarily used at that time. Thus, he designed a questioning technique that focuses on the physical or mental actions involved in performing a given task. In this sense, the EI focuses on the "how" of the experience rather than on the "why" or "what" (Petitmengin, 2006). For example, when I read, normally my attention is turned toward the content of *what* I read and not toward the processes involved in *how* I make sense of what I read. The latter normally stays implicit. The EI is oriented to access to this type of knowledge, hence its name, to make explicit what was hitherto implicit.

According to Petitmengin et al. (2007), the need of a technique to access the procedural aspects of our experience resides in the fact that, despite the intuitive belief that being aware of our own experiences is a fast and straightforward process, for us it is normally difficult to attend to the procedural aspects of our own lived experiences. Thus, one of the roles of the interviewer in this technique is to help the interviewee to sustain and stabilize his or her attention to such aspects.

Since its creation, the use of the EI spread to other contexts, particularly to the one of cognitive science and neuroscience (e.g., Petitmengin et al., 2007; Braboszcz, 2012; Valenzuela-Moguillansky et al., 2013; Gould et al., 2014; and see interview examples Maurel, 2009). Just like brain activity is recorded to obtain neuro-electric data in search for regularities of specific neuro-dynamic structures, Petitmengin (1999, 2006) and Vermersch (1994) have proposed collecting detailed interview data in search for regularities of specific "pheno-dynamic" structures.

The procedure of the EI could be described in terms of the following steps: (a) selecting a particular experience; (b) evoking the experience; (c) inquire into the temporal unfolding of the experience, or *diachronic* dimension; (d) inquire the experiential aspects that characterize each moment of the experience or *synchronic* dimension (Petitmengin, 1999, 2006; Petitmengin et al., 2013).

Step (a) relies on accurately selecting an experience in a particular moment. It would depend on the specific protocol whether the cognitive process associated with the experience under investigation is easily reproducible or not. If so, the researcher could devise a protocol enabling the interviewee to carry out the process here and now, and later through questioning to describe how he went about performing the process (Petitmengin, 2006).

Step (b) refers to evoking a past experience, which is to "*recalling a given experience as if re-enacting it*" (Valenzuela-Moguillansky, 2013, p. 340) in order to emphasize the retrospective contact. The experience may either have recently occurred (i.e., a cognitive task the participant has just performed) or it could have happened several years before, in which case the aim is for the past experience to be manifested in the present to the extent possible. Thus, the interviewer has to guide the interviewee toward an "embodied position" (Valenzuela-Moguillansky, 2013), in which they stand on the spatio-temporal context of his experience (the when, where and with whom). This embodied position facilitates the association of sensations and emotions by means of recalling episodic or autobiographical memory (Petitmengin et al., 2013).

In order to determine the effectiveness of evoking the past experience, Petitmengin (2006) used certain verbal, paraverbal and non-verbal "hints" which were indicative of the "strength" of a particular past experience. Thus, some ocular movements were indicative of the sensory register employed by the evocate state. For example participant's fixating sight on the horizon often represents attending to their inner voice. In other cases, information about the "strength" of the past experience was

derived from speech rhythm or vocal intonation. These were gestures the interviewer attended to because they went beyond the contents of speech. Instead, they represented a switch to pre-reflective consciousness of the experience to which the interviewee was attending.

In Step (c) the interviewer redirects the attention of the interviewee toward the procedural aspects of the experience (Valenzuela-Moguillansky, 2013). Once the interviewee is in a state of evocation, the interviewer helps the interviewee to describe the development of the experience using as axes of questioning her mental or physical actions. The interviewer guides the interviewee through the continuous flux of moments that characterize the unfolding of the experience or its diachronic dimension. The participant's attention is directed to *how* a particular experience happened in time instead of what that experience was about or *why* did it happen. The set of questions asked by the interviewer are called "empty content" questions (Petitmengin and Bitbol, 2009) since they are aimed at the structure of the experience rather than the content of the experience.

The interviewee is encouraged to take time exploring their experience and to try and avoid judgments or preconceptions about their experience or about the interview process, in order to maximize their attention on the procedural aspects of the experience itself. The participant is often asked to clarify certain non-verbal gestures or vague words (Petitmengin, 2006).

Step (d) refers to the identification of the characteristics of each moment of the given experience. According to Valenzuela-Moguillansky (2013), once a sequence of actions has been established, the interviewer can guide the interviewee's attention toward more subtle levels of the experience, such as bodily sensations, mode of attention, the characteristics of different sensorial modalities, etc. If we make an analogy of a participant's experience as a movie, a continuum of the frames of a cinematographic film, the diachronic dimension would be the sequence, frame by frame, of that continuum (Petitmengin, 1999). In contrast, a synchronic dimension cannot be described by successive temporal relations but rather by the emotional tone, the mobilized attention, and the sensory registers employed in the evocation. In this synchronic or spatial configuration of the interviewee's experience, their attention is directed to the structural aspect of the experience. For instance, describing the spatial features of what they "become aware" of, "the shape of the mental image," "the position of the image [which] appears at a given distance, in a given direction, with a given size, etc. (Petitmengin, 2006, p. 251)."

Once a set of interviews is completed, comes the analysis of the interviews. In a nutshell, the analysis of the interviews is a process of abstraction that aims to identify the generic structure of an experience. The first step is the identification of the sequence of actions and points of articulation between different stages or "phases" of the experience, which has been called the *diachronic structure* of the experience. The second step is the identification of the experiential categories that characterize each phase of the diachronic structure of the experience, which has been identified as the *synchronous structure* of the experience.

Then, through a process of comparison, comes the identification of the invariants of the diachronic and synchronic structures of the experiences of a group of persons. From these invariants *the generic structure* of a given type of experience is built (Petitmengin, 1999, 2006; Vermersch, 2009).

To sum up, the EI permits accessing specific aspects of a particular experience. It employs a technique of questioning aimed at stabilizing interviewee's attention and redirecting it toward the procedural aspects of the experience. In this way theoretical (i.e., the experimenter conceptualizing what the experience was) or representational (i.e., the participant only describing instead of reliving the experience) accounts of the experience is avoided. The analysis of the interviews allows building a generic structure of the experience identifying its "pheno-dynamic," which can be used to incorporate the experiential aspects of a cognitive phenomenon to its neuroscientific study.

Neuro-linguistic Programming

Neuro-linguistic programming was developed in the 1970s by Bandler and Grinder (1975) as a method for effective communication and personal development. It has been applied in personal coaching (Linder-Pelz and Hall, 2007), clinical therapy (Heap, 1988), among others (Sturt et al., 2012; Pishghadam and Shayesteh, 2014; and for a review of NLP studies see Witkowski, 2010). NLP studies how we experience the world through our senses and how we process consciously or non-consciously our percepts. NLP is further interested in the neural correlates of these processes (i.e., the *neuro* aspect). In addition, the programming aspect of NLP is concerned with how language is used for signifying the world (i.e., the *linguistic* aspect), and how people represent their experience by generating regular linguistic "patterns" (i.e., the *programming* aspect; Linder-Pelz and Hall, 2007).

The major contributions to the development of the NLP come from the work of Vermersch (1994) and Petitmengin (2006) who reconsidered several theoretical aspects of psychophenomenology for the study of experiences (Tosey and Mathison, 2010). For this reason, the NLP should not be considered as a method independent of the EI but rather as a complementary tool for the study of consciousness in its "pre-reflective" aspect (Mathison and Tosey, 2009, p. 193).

The NLP offers the opportunity to incorporate in the interview the experiential dimension of language in its verbal and non-verbal forms. Thus, Tosey and Mathison (2010) proposed a three step interview considering the following aspects: enabling evocation; identifying a "meta-model"; and eliciting sensory details. "Enabling evocation" refers to the introspective exercise of guiding the interviewee toward a state of evocation in which they re-create a past experience as if it is happening in the present (similarly as in the EI). The next step consists of investigating language patterns, that is, how the participant configures a taxonomy of syntactic structures, namely, the "meta-model" (Bandler and Grinder, 1975). The meta-model is indicative of the patterns that configure the interviewee "map of the world." In other words, creating the "meta-model" involves investigating the configuration of the interviewee's syntactic statements in order to reveal the underlying structure of the manner in which they signify their world.

The meta-model has been used for constructing questions in order to investigate "modal operators," which according to Tosey and Mathison (2010) are "*words that define the mode in which an*

action is to be carried out, such as 'will', 'can', 'may', 'might', 'won't' and so on" (p.37). Thus, in a prototypical study, the questions and instructions could guide the participant to attend to the patterns of their language and to the changes in their internal representations by the usage of one word or the other. For instance, Tosey and Mathison (2010) describe a study that was looking to elucidate the distinctive subjective experience of the operators *could* and *will*. Participants had to think of an activity they were intending to do without specifying the activity. Then, they were asked to think about the activity in such a way that they would be aware of and able to re-present the event to themselves. They were instructed to report the changes of those internal representations using the modal operators *could* and *will*. Particularly, the interviewer asked a participant: "(...) *and if I say 'You could do it?*'; [the participant replied:] *That's much gentler. The kinaesthetic is more relaxed, it's em. . .. The external auditory effect is one of support, so it's my choice. . . the internal, the picture is soft, still clear, but soft.*" (p. 20).

The last step corresponds to the elicitation of sensory details, conceptualized as internal sensory representations and their submodalities, as explained by Tosey and Mathison (2010): "*re-creations of experience as internal representations, a pre-verbal level of cognition where the senses were engaged in the subjective re-presentation of experience, lived or imagined*" (p. 23). Examples of representational systems are the visual, auditory, kinesthetic, olfactory and gustatory dimensions, among others investigated during the interview. On the other hand, the submodalities are sensory registers that contain properties belonging to each modality; for instance, a register of the auditory modality is the volume of the participant's voice (and its changes), its rhythm, intensity, etc.

NLP, as a second-person method, is based on the necessary contribution of the interviewer for directing participant's attention toward the "inner search" of their own experience; for inviting the participant in a sort of "exchange between situated individuals" (Depraz et al., 2003, p. 81); and for creating questions that allows for the investigation of a particular experience. We have to stress that, to our knowledge, the application of NLP has not been considered experimentally in the context of the neurophenomenological program. The closest instance of using NLP in the study of phenomenological experience is the research conducted by Andreas and Andreas (2009) regarding the experiential distinction between perceptual positions; as well as the theoretical work of Barsalou (2008) about grounded cognition.

Discussion

In the following section, we take a more analytical stance regarding the role of the second-person methods in the study of conscious experience. First, we put forth some qualifications regarding the status of the first-, second- and third-person methods that we believe are important to bear in mind. Second, we analyze two experimental studies that explicitly incorporate second-person methods for gaining access the "gap" between phenomenology and neuroscience. Third, we analyze the challenge that second-person accounts face in establishing an objective methodology for comparing results across different participants and interviewers, i.e., the validation problem. Finally, we conclude by synthesizing the common aspects of the interview methods described above.

The First-, Second-, and Third-person: Some Qualifications

We would like to briefly clarify that the distinction of persons that neurophenomenology makes can be done not only by the mode of accessing lived experience, but also by distinguishing how many persons are involved in an investigation about consciousness. Thus, we have to notice that when we study consciousness, there is always someone who investigates and someone who is being investigated. In a first-person investigation there is, obviously, only one person. In this case, the researcher and the person being investigated are the same person. Thus, here the *subject* and the *object* of the knowledge are one only. In other words, if the researcher wants to investigate some aspect of consciousness, they should undergo the experience by themselves. In a second-person investigation, on the other hand, there are two persons, one that investigates (the interviewer) and another one that is being investigated (the interviewee). Finally, in the third-person research, there are at least three persons, one that is under investigation, and one or more (a community) that investigates.

If we fail to take into account the last point, we could mistakenly conclude that the first-person method is the only faithful method for accessing lived experience since no mediation is needed. This is an idea that comes from the ancient philosophers such as Aristotle for whom knowledge occurs in God, defined as the intellection that "intellects itself" (Aristotle, 1958). The idea is further developed, for instance, in Descartes (2008), for whom the most evident knowledge is the thinking or awareness of himself. However, we have to bear in mind that first-person accounts require *discipline* in the context of neurophenomenology. As we have seen, it is not enough for the participant to describe his lived experience. They could be imprecise due to lack of attention or training, or to being biased by previous beliefs. This is why the mediation of the third and, in particular, the second person is highly relevant for studying the first-person accounts.

Some authors, such as Dennett (2011), propose that the status of first-person data should be considered as a kind of belief of the participant until they can be objectively tested by a third-person study (e.g., in a neuroscientific context). This implies that the only method that reaches the truth of the phenomenon is the third-person. Nevertheless, the neurophenomenological approach assumes "the lived experience" as data which are reported in first-person (Thompson, 2011). But it must be taken into account that the phenomenological report is influenced by the level of the person's training in attending to their thoughts, feelings and body or their ability to report the experience. This is the reason why it is necessary to add the studies in second- and third-person. The scientific explanations in each of the three persons have their own validity in the research, and neither poses a better level of explanation than the other. In fact, if applied in an explanatory circularity procedure, they allow for strengthening and improving the knowledge of the object of study. Although the debate between heterophenomenology and neurophenomenology is far away from the scope of this review, we advocate a neurophenomenological approach for the study of the lived experience where the phenomenological data are not considered as mere beliefs.

There are some meaningful ways to summarize the distinction between DES, EI and NLP. As Hurlburt (2011) puts it, "DES aims to make the visible memorable, EI aims to make the invisible visible" (p.70); in other words, DES try to make the visible visible, not assuming there are pre-reflective aspect of the experience and capture the directly experienced with fidelity enough; theoretically opposite to EI declare to find the source of the visible or that is not directly experienced. And the core methodological difference as Petitmengin and Bitbol (2011) put it, "EI is interested in what the subject *does* to apprehend his experience in the course of an interview [while] DES focuses exclusively on what happens "*before* the beep"—"pristine experience"—and not on what the subject does after the beep to describe his experience"(p.96).

Although the NLP has contributed methodologically to the development of the EI (Mathison and Tosey, 2009) because it shares some features with the introspectionist tradition, the theoretical structure of the NLP incorporates representational notions that are in conflict with the "embodiment" nature of the phenomenological program, e.g., with the "radical embodiment" stance (Thompson and Varela, 2001). However, in this manuscript we have considered the methodological aspect of the NLP as a second-person interview method rather than its explanatory account as a representational theory.

Testing the "Mutual Generative Constraints"

As we mentioned in the introduction section, the interplay between neuroscientific knowledge and phenomenological accounts is at the core of the neurophenomenological program. Despite the advances in the interview protocols, the incorporation of second-person methods in the neuroscientific study of consciousness is still scarce (Froese et al., 2011). However, here we show two potential examples of how second-person methods "could" casts a new light on the "gap" between these two (neuroscientific and phenomenological) levels of description of consciousness.

The DES in the Study of Mind Wandering

An example of the application of the DES is given by the work of Christoff et al. (2009) who investigated the *default network* during mind wandering. The study was concerned with whether brain regions associated with the default network were activated in the same time window as when the mind was wandering and moving away from the task. Participants were asked to sample their experience at random intervals in order to determine whether they were mind wandering and whether they were aware or unaware of their mind wandering. They showed an activation in the medial prefrontal cortex in association with both subjective reports and behavioral measures. Also, when participants were unaware of their own mind wandering, both default and attentional networks were strongly activated. This study provided direct evidence for the neural recruitment associated with mind wandering by combining experience sampling with the tools of cognitive neuroscience. One limitation of this study is that the level of introspection required was minimal as the design lacked a theoretical and methodological appreciation of principled first- and second-person methods (Froese et al., 2011). Despite this limitation, the finding of default network recruitment in association with subjective experience sampling helps validate the use of reports in the study of consciousness.

The EI in the Study of Epileptic Seizures

A paradigmatic case of the interplay between EI and neuroscience is the study of Petitmengin et al. (2007) who investigated the prodromic symptoms in the subjective experiences occurring before a seizure, which corresponds to the preictal that precedes epileptic seizures. Since the preictal neuro-electrical changes are correlated with changes in the subjective experience of epileptic patients, the authors showed how preictal/epileptic anticipation represents an example of the mutual dependence between the neuro-dynamic and pheno-dynamic analyses (Petitmengin, 2010).

In Petitmengin et al.'s (2007) study, EI application consisted of a progression of the steps of the interview process. First, they asked patients to remember and retain a seizure experience that had generated vivid sensations, images or sounds. Then, they guided the patient toward a concrete evocation of that particular preictal experience, by helping them rediscover the experience until they feel as if "reliving" it. During the reliving moment, the interviewer had to attend to a group of precise verbal, paraverbal and non-verbal clues, which indicated the patient was really going back to a past experience. Once the evocation was stable, they asked appropriate questions that helped the patient turn their attention toward the various registers of his pre-reflective experience (e.g., emotional tone, visual, auditory registers) in order to describe accurately the experience that they were "reliving" (Petitmengin, 2010).

The significant contribution of this study did not consist only of the detection and comparison of neurological and phenomenological data, but also of establishing the "*mutual generative constraints*" (Varela, 1999) between the two. The concept of mutual constraints is in the core of the idea of enriching both phenomenological and neurological data by generating mutual restrictions between them. This idea is consistent with the finding of a neurodynamic structure preceding seizures, namely, the "preictal neuro-electric desynchronization" and, reciprocally, of a corresponding phenodynamic structure of the preictal experience.

In conclusion, both the DES and the EI contributed for the detection of certain specific neuronal configurations that were not predefined but rather emerged when both levels of explanation—the neurological and phenomenological—are considered in the analyses. Despite the theoretical and methodological limitations described above, these studies showed the fertility of the second-person methods when phenomenological accounts are permitted to guide the neurodynamic analysis.

Second-person Methods and the Problem of Validation

It is however, of great importance to seriously consider to what extent the verbal descriptions of conscious experience resulting from second-person techniques valid for the scientific community. In particular, the challenge is to establish an objective method for comparing results across different participants and

interviewers. This is challenging because the interview methods are prone to bias in several respects (see Froese et al., 2011). However, this is not an exclusive problem of the second-person methodologies since the first- and third-person methods are equally prone to be biased (Froese, 2013). For example, first-person accounts require training since the description of the experience can be obscured by the judgments or belief of the person who lives it. The interviewer, on the other hand, could influence the interviewee answers. Finally, the third-person (the scientific community) could introduce a bias by invalidating first-person accounts (Varela et al., 1992, p. 12).

Nevertheless, and with the aim of reducing the bias in the methodologies in second-person, the three steps in Varela's approach have the purpose of increasing scientific validity through a procedure based on objectivity. As Gallagher and Zahavi (2008) point out, the aim of the phenomenological method is to achieve an objective procedure for the research of the subjective experience, which is a basic requirement in the scientific methodology. However, it is necessary to clarify that the model of objectivity proposed by Varela's second-person method is different to those just based on third-person methods. This difference lies in the lack of equalling objectivity with a reductionist model of quantitative measurement and in advocating a method of intersubjective validation. Through the intersubjective model some invariant structures are identified in the interview of different individuals. This persistent report among subjects does not suffer from subjective interpretation of their experiences or subjectivity of the investigator. Therefore, the neurophenomenological method can guarantee the replication of other studies that investigate the same kind of phenomenon.

In Addition, Varela proposed to solve the problem of validation of the subjective experience by mutual circulation, that is, an explanation in first-, second-, and third-person. The lived experience (first-person) and (second-person) should be reciprocally validated against the collective experience of the scientific community (third-person). In line with this idea, the double blind interview (DBI) is, to our knowledge, the only method that explicitly proposes a solution for the validation problem.

The Double Blind Interview

Froese et al. (2011) proposed the DBI as the first step toward an objective measure of the fidelity of introspective accounts. In the context of the validation problem, a response to the challenge would be to determine whether participants are able to improve their introspective performance by employing second-person methods in the context of classical experimental paradigms. Thus, the DBI is conceived as a method for calibrating and validating other interview methods. The authors exemplify their proposal by using an experimental paradigm of crowded visual displays. In the words of Froese (2013):

> Subjects are briefly presented with an array of visual stimuli and then asked to report what they have seen. It has been found that, although subjects report that they consciously experienced the whole crowded visual display (and they can indeed report any one of the items if appropriately primed), if left to their own devices they can subsequently report only a small subset of about four items. The methodological question is to what extent this retrospective blindness can be overcome with the guiding help of a suitably trained interviewer. Ideally the interviewer should not have seen the crowded display that was presented to the subject. This helps to avoid introducing implicit biases into the interview process, which is why we proposed to call this particular kind of second-person method the "Double Blind Interview" (p. 673).

Also, the DBI attempts to measure and standardize both the interviewer's (second-person) and interviewee's (first-person) introspective skills by incorporating an objective measure (i.e., a score) for establishing the authenticity of the reports published in the context of the scientific community (third-person). In Froese et al. (2011) words:

> A score for facilitated recall (calculated on the basis of an interviewer's ability to facilitate recall for a number of different participants, or on the basis of an interviewee's recall ability to be facilitated by a number of different interviewers, or some combination of the two) could be introduced as an explicit requirement for publishing verbal reports of lived experience. In this way readers would be enabled to objectively assess the level of introspective skill which played a part in the generation of the reports, and hence their reliability and authenticity (p. 59).

In its first conceptualization, the DBI was proposed as a method of comparing two interview methods available at that time, i.e., the EI and the DES. However, it was not exempt of criticism by the authors of these methods. For instance, on the side of the EI, Petitmengin and Bitbol (2009) expressed reservations regarding the proposition of using external performance criteria to evaluate the reliability of interview-based measures of lived experience. In the DES camp, Hurlburt (2011), despite supporting the efforts for developing methods that validate phenomenological accounts, claims that validating the DES using DBI methods results impossible (p. 76). Hurlburt (2011) claims that DES cannot be validated under objective measurements since it represents a practice-based approach. In his view, DES can only be validated by assessing the internal coherence of the experience under investigation (i.e., the different internal aspects of the lived experience) rather than by objective measures.

It is important to notice that the DBI proposal has not been tested experimentally so far. However, according to Froese (2013) and despite the authors who previously doubted DBI's validity, a similar method has been tested by Petitmengin et al. (2013) by incorporating the EI into the "choice blindness" paradigm (Nisbett and Wilson, 1977; Johansson et al., 2006). In this paradigm, participants are presented with a pair of portraits of women and are asked to choose which one they prefer. This procedure is repeated for 15 trials. After six of the trials subjects are handed their chosen photo and asked to explain their choice; but in three of these trials they have actually been secretly handed a non-chosen photo. Interestingly, the results showed that with

the help of the EI participants detected that their choice had been manipulated in 80% of the trials, compared to only 33% when the choices were not followed by an EI. This result indicates that even if our awareness seems to be poor, it is still possible to consciously access our decision-making processes when our attention is directed toward its constitutive dimensions (Petitmengin et al., 2013).

In conclusion, the DBI emerges as the first explicit attempt for solving the validation problem in the context of the neurophenomenological program. Although it has not been tested experimentally so far, other similar methods have shown evidence for the direct efficacy of a second-person approach to the measure of conscious experience.

Conclusions: The Role of the Second-Person in the Interview Methods

Finally, we would like to conclude by summarizing the common roles of the second-person (i.e., the interviewer) in the methods described above. Despite the theoretical and methodological differences between the interview methods, several interdependent aspects between second-person methods can also be found.

Increasing the Ability of the Interviewee for Describing Lived Experience

In the DES, this can be noticed during the "expositional interview" performed by a skilled interviewer for helping to "bracket the natural attitude" (in Husserl's terms) or, in other words, for suspending participant's judgments about the nature of their experiences. By systematically repeating this procedure for a number of days, the EI aims to train the interviewee in becoming aware of their lived experience in such a way that they report it more accurately. Similarly, the contribution of the interviewer in both the EI and DBI is to facilitate the detailed reliving of a specific past experience by re-evoking it, and by directing the attention of the participant toward previously unattended or forgotten aspects of the experience. Finally, in the NLP framework, the interviewer investigates the cognitive and affective maps of the experience, trying to identify the different dimensions of the conceptual structure of the experience and to make the interviewee aware of these during the interview process.

Validating the Mutual Circulation between the First- and Third-person Accounts

Regarding the well-known difficulty of the interviewee at the moment of specifying, recognizing and categorizing their own internal states, the role of the interviewer as a guider and "catalyst" of the process of becoming aware is crucial for all of the methods described above. On the other hand, the first-person requires a disciplined training in order to describe their experience since reporting own experiences is not very common in daily life. Also, for an untrained participant, their primary experiential accounts can be indistinguishable from their secondary cognition (i.e., judgments, beliefs justifications). Thus, second-person methods possess an eliciting potential for faithfully describing first-person accounts as a measure of the ability to describe lived experience.

Attending the Accounts in Different Levels of Description

A crucial feature of the interview methods is that they allow the interviewer to examine the interviewee experience on different levels. In particular, first-person accounts can be described in both their verbal and non-verbal aspects (Petitmengin, 2006). Thus, visual and kinesthetic non-verbal indicators are especially relevant during the interview. For instance, the interpretation of gestures, the location of eyes in the space, or the movements that follow the verbal accounts, could bring non-explicit information about specific aspects of the interviewee's experience. In addition, the interviewer could calibrate the non-verbal indicators performed by the interviewee by interpreting them, and thus improve both the introspective skills of the participant as well as their own interview skills (Bockelman et al., 2013).

In conclusion, the present article has emphasized that second-person methods represent a powerful but still underappreciated approach for closing the gap between the experiential and the neurobiological levels of description in the study of human consciousness.

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An evolutionary Ockham's razor to reciprocity

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INTRODUCTION

Reciprocal altruism implies delayed payoffs by definition. It might therefore seem logical to assume that limited memory, calculation, and planning capacities have constrained the evolution of reciprocity in non-human animals. Here I will argue that this is not the case. First, I will show that the emotional track of past interactions is enough to motivate and maintain reciprocity over longer timespans. Second, I will propose a developmental pathway of this system of emotional bookkeeping. In particular, the neuropeptide modulation underlying mother-infant and pair bonding may have been coopted for emotionally mediated reciprocity. Finally, I suggest that similar rewarding mechanisms may motivate indirect reciprocity and cooperation in larger social networks. Therefore, reciprocity can be ultimately conserved in primate lineages, without the need for individuals to keep a detailed account of benefits exchanged.

DEBUNKING THE ASSUMPTION OF COGNITIVE CONSTRAINTS

Observations, experimental studies, and meta-analyses speak for a robust occurring of reciprocity in the social life of primates. An equally robust proximate mechanism, that is emotional bookkeeping can account for that occurrence. In this way, unnecessary assumptions related to delayed payoffs are cut out.

THE TIME WINDOW OF RECIPROCATION

Defining a time frame for immediate reciprocity, within minutes or hours, allows the effects of contingency to be controlled with great precision. However, observational studies have found that reciprocity does not occur during short time frames in primate species. For example, although both kin and non-kin Japanese macaques (*Macaca fuscata*) preferentially groom and support those individuals that overall supported and groomed them most, grooming and support are weakly correlated in the short-term. In fact, during a whole year, kin were never observed to support each other immediately after grooming (Schino et al., 2007). Similarly, prolonged observations on capuchin monkeys (*Cebus apella*), mandrills (*Mandrillus sphinx*), and olive baboons (*Papio anubis*) have revealed that short-lived imbalances are tolerated in favor of stable partner preferences (Frank and Silk, 2009; Schino and Pellegrini, 2009; Schino et al., 2009). Equitable, supportive, and constant bonds have been observed for 16 years in female chacma baboons (*Papio hamadryas ursinus*) (Silk et al., 2010). Accordingly, chimpanzees in the wild balance favors over periods of time much longer than single encounters, thus forming enduring relationships (Mitani, 2009; Gomes and Boesch, 2011). This seems not to occur just in primates; a study on captive ravens (*Corvus corax*) found evidence for long-term but not short-term reciprocity of support in favor of higher-ranking individuals, kin, and preening partners involved in an ongoing conflict (Fraser and Bugnyar, 2012).

When individuals are observed over months, instead of minutes or hours, it turns out that they maximize reciprocal benefits over time on the basis of shared positive experiences. This may be one of the reasons why experiments focused on contingency have failed to show reciprocity in both chimpanzees and cotton-top tamarins (Brosnan et al., 2009; Cronin et al., 2010; Yamamoto and Tanaka, 2010); perhaps they were rather testing for tit-for-tat strategies, which require mental scorekeeping for actor and recipient to alternate their roles. Suchak and de Waal (2012) have run a test giving pairs of capuchin monkeys the opportunity to alternate their prosocial choices (i.e., choices rewarding both the partner and the chooser). In this alternating condition, the sensitivity to payoff distribution was likely to be emotional more than calculated, as no temporal contingency could be found between an individual's choice and the partner's choice in the previous round (Suchak and de Waal, 2012).

Evidence for prolonged rather than immediate exchanges may indicate that reciprocity evolved despite differential cognitive capacities between species. Phylogenetic meta-analyses support this point. A meta-analysis on non-human female primates across 48 social groups, in 22 species and 12 different genera found a significant correlation between grooming given and received, even when controlling for kinship (Schino and Aureli, 2008). Consistent with this conclusion, a meta-analysis on food sharing in humans as well as other primates did not find significant differences in effect size of reciprocity between monkeys, apes, and humans (Jaeggi and Gurven, 2013). Species and populational differences are probably due to relative fitness benefits of coalitions in each primate society.

RECIPROCITY'S COGNITIVE REQUIREMENTS

Lloyd Morgan's canon states that "in no case is an animal activity to be interpreted

in terms of higher psychological processes if it can be fairly interpreted in terms of processes which stand lower in the scale of psychological evolution and development" (Morgan, 1903, p. 59). Following an analogous parsimony principle, Schino and Aureli (2009) proposed that the emotional track of favors received can sufficiently motivate actor and recipient to exchange their roles repeatedly. This cognitively inexpensive mechanism is fully compatible with traditional explanations of altruism based on inclusive fitness consequences, that is to say the increase or decrease in chances of certain alleles to propagate in the population (Hamilton, 1964; Trivers, 1971). Cost/benefit ratio will be taken into account by standard natural selection and the quasi-homeostatic emotional mechanisms that worked will be ultimately maintained.

As a consequence, there is no reason to assume that reciprocity requires the expectation of future rewards, calculation, and strategic capacities, contrary to what many authors have argued (e.g., Stevens and Hauser, 2004; Stevens et al., 2005; Ramseyer et al., 2006). A variety of emotional mechanisms, from trust and gratitude, to empathic understanding and contagion, have been proposed to mediate fairness and friendship in non-human primates (Brosnan and de Waal, 2002; Massen, 2010). Furthermore, the social psychology literature suggests that a timely, accurate bookkeeping of favors given and received may even be detrimental for human friendships (Silk, 2003). Much of the effective reciprocity occurring in everyday human life may be based on non-contingent, emotionally mediated equilibrium as well.

DEVELOPMENTAL PATHWAYS TO RECIPROCITY

Proximate explanations of behavior require the description of both physiological/psychological mechanisms, such as emotional bookkeeping, and developmental processes that lead to those mechanisms during an individual's lifetime (Tinbergen, 1968). Conserved neuropeptides have been coopted for a wide array of affiliative and reproductive behaviors in vertebrate species (Insel and Young, 2000; Sneddon et al., 2003; Curley and Keverne, 2005; Reaume and Sokolowski, 2011). In the next two sections, I outline a proposal suggesting that the development of reciprocity requires caregiving to occur early in life, and that the activity of endorphins, oxytocin, and dopamine systems explain the attitude of individuals to reciprocate.

THE EPIGENETICS OF ATTACHMENT

The neuroendocrine modulation underlying nurturance and attachment is a plausible candidate process coopted for emotional bookkeeping. Genetic mutations in oxytocin receptors are found more frequently than structural variations in neuropeptides themselves (Hoyle, 1999). In humans, common polymorphisms in the oxytocin receptor gene have been associated to differential social memory, as well as empathic, and maternal behavior (Rodrigues et al., 2009; Skuse et al., 2014). However, the developing oxytocin system is sensitive to early experience; the caregiving environment can affect the offspring's phenotype via stable changes in gene expression regulation, as shown by rodent models (Weaver et al., 2004). As an instance, receiving lower amounts of maternal licking and grooming inhibits the development of the oxytocin system through methylation of the estrogen receptor (ER)-α1b gene promoter (Champagne et al., 2006). In humans, the caregivers' oxytocin produces cross-generational effects on both infants' oxytocin and parental behavior (Feldman et al., 2013). Moreover, early exposure to abuse, neglect, or loss can result in reduced cerebrospinal oxytocin levels in adulthood (Heim et al., 2009). These findings suggest that early caregiving is necessary to parent-offspring bond formation, which in turn makes the oxytocin system sensitive to emotionally rewarding experiences and therefore may promote the subsequent capacity to reciprocate. Studies administering oxytocin by inhalation seem to support its effects on cooperation and trust in economic games (Zak et al., 2004; Kosfeld et al., 2005), and oxytocin specifically increases cooperative choices for participants with an insecure attachment profile (de Dreu, 2012). Hence, the oxytocin sensitivity may temporarily restore cooperation but its maintenance may need support from other neuropeptides.

BUILDING AND MAINTAINING RECIPROCAL BONDS

The cascade of interactions between different kinds of neuropeptides gives a rich picture of the processes underlying reciprocity. Oxytocin's sensitivity to the quality of relationship suggests that it is involved in keeping track of past affiliative interactions. In chimpanzees, for instance, recent grooming increased oxytocin levels only when partners were kin or non-relatives previously bound (Crockford et al., 2013). On the other hand, endogenous opioids, such as endorphins, provide feedbacks about the pleasantness of social interactions in both mothers and infants (Panksepp et al., 1994). Curley and Keverne (2005) suggested that after primates branched out from basal mammals, β-endorphin acquired the specific function of rewarding social encounters. The central release of endorphins can be triggered by the physical stimulation of social grooming and huddling (Keverne et al., 1989). It is likely that endorphins, rather than oxytocin, create the psychopharmacological milieu motivating individuals to reciprocate (Dunbar, 2010). Regardless of which neuropeptide plays a major role, the immediate pleasant sensation and mild analgesic effect of being groomed translates into paying back the favor at a later time. Indeed, although grooming can decrease short-term stress levels in both the groomed and the grooming individual (Aureli and Yates, 2010), only giving correlates with lower stress levels in the long-term (Shutt et al., 2007). Additionally, trust formation and trust maintenance engage brain areas—the ventral tegmental area and the septal area, respectively—differently related to oxytocin (Krueger et al., 2007; Shahrokh et al., 2010). Therefore, oxytocin may be embedded in different causal sequences depending on the stage of trust in the relationship. Future efforts should be placed in disentangling the roles played by oxytocin, endorphins, and dopamine in the reward system of the brain.

AN EMOTIONAL ROOT FOR SOCIAL INTELLIGENCE?

The extension of prosocial attitudes from dyadic relationships to individuals who helped others appears cognitively demanding. It has been theorized, for

example, that indirect reciprocity requires gossip to update the others' reputation (Alexander, 1979; Dunbar, 1996), and that human intelligence has undergone natural selection for these social demands (Nowak and Sigmund, 2005). Nevertheless, emotional mediation may be the glue that facilitates higher-order cognitive processing and binds individuals in larger social networks. Increasing the ecological plausibility of experiments on reciprocity, Sabbatini et al. (2012) introduced multiple partners to allow partner choice in capuchins; the time window of food transfers was longer in triadic than in dyadic interactions. Then, they observed the entire social network, and found out that the time interval had expanded even further (Sabbatini et al., 2012). As already shown, such prolonged exchanges are unlikely to result from deep reasoning. Consistent with this conclusion, a rudimentary, give-what-you-get mechanism accounts for the capacity of capuchin monkeys and 4-year-old children to pay forward positive, as well as negative behaviors (Leimgruber et al., 2014). Moreover, a naturalistic observation in a Japanese nursery school found that 5- to 6-year-old children help preferentially peers that they have previously seen helping others (Kato-Shimizu et al., 2013). They engaged in social indirect reciprocity without being able to formulate any explicit moral reasoning, suggesting that the cognitive component is not enough to explain this behavior. Basic affective processes may therefore keep track of exchanges between third parties, perhaps through gossip; after all, human vocalizations can provoke the release of both endorphins (Dunbar et al., 2012) and oxytocin (Seltzer et al., 2012). These findings suggest that enduring emotional/rewarding mechanisms may underlie the formation and maintainance of social preferences, reputation, and cooperation in numerous groups.

CONCLUDING REMARKS

This opinion piece offers a parsimonious solution to both the cognitive and evolutionary issues related to reciprocal altruism. The emotional track of past interactions motivates individuals to reciprocate without cognitively demanding expectations of future rewards from others. This cognitively inexpensive mechanism accounts for the long-term exchanges of favors among non-human primates. I have provided some evidence in support of the hypothesis that neuroendocrine systems have been recruited for reciprocity. In addition, I have proposed that over an individual lifespan, reciprocity arises as a consequence of positive, iterated interactions and their immediate benefits. Emotionally mediated reciprocity may also favor the formation of close-knit social networks. As long as bonding is mutually rewarding, its proximate mechanisms facilitate higher-order cognitive processing presumably required by living in larger groups.

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Toward an experimental account of argumentation: the case of the slippery slope and the ad hominem arguments

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Argumentation is a crucial component of our lives. Although in the absence of rational debate our legal, political, and scientific systems would not be possible, there is still no integrated area of research on the psychology of argumentation. Furthermore, classical theories of argumentation are normative (i.e., the acceptability of an argument is determined by a set of norms or logical rules), which sometimes creates a dissociation between the theories and people's behavior. We think the current challenge for psychology is to bring together the cognitive and normative accounts of argumentation. In this article, we exemplify this point by analyzing two cases of argumentative structures experimentally studied in the context of cognitive psychology. Specifically, we focus on the slippery slope argument and the *ad hominem* argument under the frameworks of Bayesian and pragma-dialectics approaches, respectively. We think employing more descriptive and experimental accounts of argumentation would help Psychology to bring closer the cognitive and normative accounts of argumentation with the final goal of establishing an integrated area of research on the psychology of argumentation.

Keywords: argumentation theory, Bayesian models, similarity judgment, slippery slope argument, ad hominem argument

TOWARD AN EXPERIMENTAL ACCOUNT OF ARGUMENTATION

Argumentation is a crucial component of our lives since in the absence of rational debate our legal, political, educational, and even scientific systems would not be possible (Mercier and Sperber, 2011). Although psychology has studied several aspects of argumentation, such as its role in social engagement (Means and Voss, 1996), in learning and education (Asterhan and Schwarz, 2007, 2009; Mercer, 2009; Howe, 2010), and in the construction of knowledge (Mason and Santi, 1994; Leitão, 2000, 2008; Schwarz, 2009), there is still no integrated area of research on the "psychology of argumentation" (Hornikx and Hahn, 2012). Recently, Hornikx and Hahn (2012) have employed this concept for encapsulating both theoretical and experimental accounts that mutually inform separate research communities studying human reasoning and argumentation.

Furthermore, although classical theories of argumentation have been devoted to understanding argumentative processes both in academic and daily-life contexts, there is no common theoretical ground between these theories. For instance, rhetoric considers argumentation to be a tool for persuading the audience, whereas dialectics consider argumentation to be the quintessence of a critical discussion aiming to determine the acceptability of a particular stance or point of view (Wenzel, 1990). Despite these theoretical discrepancies, for both rhetoric and dialectics the acceptability of an argument is determined by a set of norms or logical rules which allow classifying an argument as veridical or fallacious, i.e., the so-called *normative* approaches for argumentation.

We think the current challenge in front of psychology is to bring together the cognitive and normative accounts of argumentation. In order to achieve this, we claim that the psychological mechanisms of argumentative processes should be investigated by employing more descriptive and experimental accounts. In line with this idea, recent work has started to examine empirically the descriptive, psychological aspect of classical argumentative fallacies. In particular, modern approaches for studying argumentation such as Bayesian theory (Hahn and Oaksford, 2007; Corner and Hahn, 2009; Corner et al., 2011), the pragma-dialectical account (van Eemeren and Grootendorst, 2004; van Eemeren et al., 2009, 2012), epistemic vigilance (Sperber et al., 2010), and evolutionary psychology (Sperber and Mercier, 2012), have proposed plausible explanations for the mechanisms and cognitive aspects of argumentation in more ecologically valid

contextual accounts. In this article, we show how these descriptive approaches shed light onto the psychological mechanisms of argumentation.

Here we analyze experimental evidence of two classical argumentative structures. Specifically, we focus on the Bayesian analysis of the slippery slope argument and the pragma-dialectical analysis of the *ad hominem* argument. We think that further experimental research in the area is needed to increase the dialog between argumentation theory and cognitive psychology and thus provide a step toward an experimental account of argumentation.

CASE 1: THE SLIPPERY SLOPE ARGUMENT

The slippery slope argument is an argument from consequences traditionally conceptualized as an informal fallacy (Walton, 1992). The argument starts by considering an execution of a seemingly harmless action. The argument exhibits how the implementation of the action would inevitably lead to an undesired or detrimental consequence. Then, a conclusion is reached that aims to avoid the undesired consequence. Here is an example of a slippery slope argument:

> *"The government should not negotiate with terrorists (1). Once the government starts considering terrorists as valid interlocutors (3), we will start having dozens of new terrorist attacks (2)."*

We can see from this example that the structure of a slippery slope argument can be defined by three core aspects: (1) an initial decision intuitively acceptable; (2) a "case" or "situation" evaluated as unacceptable or dangerous; and (3) a process or mechanism by which violating the initial decision would facilitate the occurrence of that "case" or "situation" (Rizzo and Whitman, 2003).

In argumentation, the structure of the slippery slope argument has raised the question of its highly successful implementation in contexts in which a subject or a group of subjects attempts to persuade the audience in favor of an argument even when the argument or its usage are incorrect. In particular, cognitive psychology has initiated the investigation of the mechanisms underlying persuasiveness of the slippery slope argument by employing the cognitive concept of similarity and statistical tools from Bayesian theory (Corner et al., 2011).

SIMILARITY AND THE SLIPPERY SLOPE ARGUMENT: A BAYESIAN APPROACH

Similarity is the cognitive process of perceiving objects as a global unity when they share similar physical characteristics and as different objects when they do not (Tversky, 1977). Thus, similarity represents one of the main "grouping" principles in psychology. The classical approach in cognitive psychology assumes that concepts can be represented in a common problem space in which they are depicted as points in that space. Then, similarity is operationally defined as the distance between concepts (i.e., points) in that space. Objects that are psychologically more similar would be closer than ones that are dissimilar (Tversky, 1977).

Recent experimental evidence from the study of informal fallacies and decision making have shed light on the psychological mechanisms of the slippery slope argument by employing the notion of similarity (Hahn and Oaksford, 2007; Corner and Hahn, 2009; Corner et al., 2011). Specifically, this line of research has tested the hypothesis that the more similar the antecedents in an argumentative chain are, the more persuasive (or slippery) the slope will be. In other words, the mechanism underlying the acceptance of a slippery slope argument would be related to the degree of similarity between the antecedents of the argumentative structure.

In the last years, this hypothesis has been tested under the Bayesian account of argumentation (Corner et al., 2011). This approach considers fallacies as inductive conditional arguments in which the strength of the argument depends on the probability of the precedent actually preceding the consequent. These probabilities are determined by previous experience. In the case of the example described above, the argument is convincing when the conditional probability of the government negotiating with terrorists (i.e., antecedent A) is high due to the increase in terrorist attacks (i.e., consequent C). Then the calculation of the probability is $P(C|A)$. Thus, the conclusion consists of negating the antecedent since the antecedent has a negative utility. The underlying mechanism fixing the relevant probabilities for the model, i.e., $P(C|A)$, follows the continuous change of boundaries—as in distance in similarity between the categories. Then, accepting the antecedent in a slippery slope argument makes us prone to accept the consequence. In other words, accepting one element (i.e., antecedent—talking to terrorists) as part of a category (i.e., the consequence—terrorist attacks) would lead us to accept another element (i.e., negotiating) as part of the same category.

Corner et al. (2011) proposed a psychological mechanism of the slippery slope argument consisting of the re-appraisal of category boundaries based on the similarity or closeness between items in conceptual space. The rationale is that classifying an item *a* under a category *F* increases the probability that a further item *b* will be classified under the same category *F*. The authors employed a type of argument that allows to calculate similarity in the context of a decision making task. Thus, the experiment comprised of deciding whether action A should be carried out or not. In one example, participants had to decide whether an area is eligible or not for the status of "Outstanding Natural Beauty" by considering its inhabiting species. For instance:

Scarathon is home to 224 species of large animals.

Sellenfeld is home to 179 species of large animals.

Decision: Eligible for Area of Outstanding Natural Beauty status.

In these experiments, participants were asked to make a categorization decision of their own (i.e., whether Sellenfeld was eligible for the Outstanding Natural Beauty status), based on the information they had just read. The experiments were designed to demonstrate that the evaluation of a slippery slope argument is directly related to the re-appraisal of categorical boundaries. Specifically, the information was presented either as a categorization task, or as decision-making task. Experimenters showed that when *a* and *b* are similar, identical items *a* lead different groups of participants—regardless of whether they performed a categorization or a decision-making task—to evaluate slippery slope arguments as strong and to categorize new items, *b*, as *F*, when *a* had been categorized as *F*. However, this did not happen

when *a* and *b* were dissimilar. When *a* had been categorized as *F* and *a* and *b* were dissimilar, the same participants, who initially rejected categorizing *b* as *F*, re-appraised this decision on being told about an intermediate item *c* that was similar to *b*, and that was also categorized as *F*.

These results show that when both the beginning and end of the argumentative chain of a slippery slope argument are similar, the probability that both were perceived as belonging to the same category is higher and hence the persuasive strength of the argument is stronger. These results suggest that the persuasiveness of the slippery slope argument is due to the concatenation of antecedents/evidence and consequences/reasons that are perceived as similar.

In conclusion, the above study shows how the concept of similarity and probabilistic tools of cognitive psychology can be used for shedding light on an old philosophical problem in argumentation, i.e., the problem of the persuasiveness of the slippery slope argument. This line of research suggests that an evidence-based, descriptive approach can be useful to move forward the traditionally more normatively oriented discussions of the Argumentation field.

CASE 2: THE AD HOMINEM ARGUMENT

A second classical argumentative fallacy that has initiated some empirical investigation is the *ad hominem* argument. In an "*Ad hominem*" argument, it is the person who makes a statement rather than the veridicality of the statement that is attacked by the opponent. In other words, the proponent of a statement is targeted instead of the statement itself (Walton, 1998). According to van Eemeren et al. (2012), there are three variants of this fallacy: "(a) an abusive variant of *ad hominem*, in which the other party's person is attacked directly by depicting them as stupid, bad, or unreliable, (b) a circumstantial variant, in which the other party is attacked indirectly by casting suspicion on their motives, and (c) a *tu quoque* variant, in which the other party is attacked by pointing out a contradiction in their words or between their words and their deeds" (p. 347). Recent experimental research (van Eemeren et al., 2009) has shown that participants' judgments of how reasonable an *ad hominem* fallacy is are a function of the strength of the argument that targets the proponent. Thus, the abusive variant of the *ad hominem* argument is judged as the most unreasonable and the *tu quoque* as less so.

The fact that experimental subjects judge the abusive *ad hominem* as an unreasonable discussion move raises the question of why is it that this fallacy occurs as often in argumentative discourse (i.e., oral and written) without it being recognized as a fallacy by the audience. In other words, the unreasonableness of this fallacy is easily recognized in experiments but in real life situations this fallacy remains undetected more often than not. Recently, this question has been tested from a pragma-dialectical perspective using the concept of "strategic maneuvering" (van Eemeren et al., 2012).

PRAGMA-DIALECTICS AND "STRATEGIC MANEUVERING"

Recent work in argumentation theory has started to empirically test the psychological concerns about the extent to which people are prone to employing procedural norms in rational argument rather than focusing solely on normative issues as traditional argumentation research does (van Eemeren et al., 2009). These studies have been conducted under the so-called pragma-dialectical account of argumentation (van Eemeren and Grootendorst, 2004). While strictly logical approaches are focused on the study of arguments as ready-made products, pragma-dialectics is developed to study the different kinds of procedural rules that define reasonable argumentation. Following this approach, the *ad hominem* argument is viewed as fallacious specifically because it violates fundamental procedural norms of rational arguments and not solely because it violates a particular norm or logical rule (as in normative theories).

Recently, pragma-dialectics has incorporated elements from rhetoric into experimental analysis of *ad hominem* argument (van Eemeren et al., 2012). In particular, the authors have raised questions regarding the nature of "strategic maneuvering" from a pragma-dialectical perspective. "Strategic maneuvering" uses "the opportunities available in the dialectical situation for steering the discourse rhetorically in the direction that serves their own interest best" (p. 151). Thus, strategic maneuvering enables the parties to maintain the persuasiveness in the discussion without neglecting the standards of the argumentation. This approach has been studied recently in the cognitive field of argumentative structures such as the *ad hominem* argument (van Eemeren et al., 2012) and the straw men fallacy (Lewiński and Oswald, 2013).

TESTING THE ABUSIVE AD HOMINEM ARGUMENT USING STRATEGIC MANEUVERING

van Eemeren et al. (2012) studied the factors contributing for an abusive *ad hominem* attack to look less unreasonable. The authors describe the abusive *ad hominem* attacks as a mode of strategic maneuvering which takes on a reasonable appearance in real-life situations by mimicking legitimate critical reactions to authority argumentation. Thus, they hypothesized that the abusive *ad hominem* attack would be judged as less unreasonable when it is presented as a critical questioning of the authority exerted by the party under attack. In other words, abusive *ad hominem* argument (i.e., clearly fallacious) may be disguised as instances of non-fallacious versions of this argument form.

This hypothesis was tested in two experiments where participants saw a group of situations that included a contextual description followed by a dialog between two speakers. The instruction was to judge how reasonable or unreasonable they found the discussion contribution of the second speaker in the dialog by means of a 7-point scale. Importantly, in the contextual description of the dialogs, the first speaker was presented as knowledgeable about the topic under discussion.

In the first group of dialogs, an abusive *ad hominem* argument in disguise was included, where, the first speaker never argues by exerting authority. Since the arguer does not present themselves from a position of authority, these situations are referred to as disguised *ad hominem* argumentation. The next is an example of such an abusive *ad hominem* attack, presented as criticism to the authority in disguise:

The art museum is renovated and that is the reason why it has been inaccessible to the public for some time. The museum curator discusses this with a journalist.

Curator: I think the museum can be open again for the public. The building is in excellent shape now and it is perfectly safe.

Journalist: As a curator you may know about art but you are not knowledgeable about the safety of the building (p. 359).

Importantly, a group of dialogs containing a reasonable personal attack were included in the experiment. In those, a standpoint is defended by means of authority argumentation in which the speaker refers to themselves as an expert. Then, the second speaker replies by making a critical reaction to the relevant authority argumentation. The following is an example of a reasonable personal attack as a justified reaction to authority argumentation:

A divorce lawyer is talking with a friend about a criminal who is under trial

Divorce lawyer: I really think that this man will be charged with at least 12 years. As a lawyer I know these things.

Friend: You are a divorce lawyer not a criminal lawyer. Why should I believe you? (p. 359)

As predicted, the authors found that abusive *ad hominem* arguments were scored as less unreasonable in disguised dialogs as compared to situations where the first speaker refers to themselves as an expert. In fact, while the abusive attacks were judged as an unreasonable argumentative move when the arguer had exerted authority, their counterparts in situations where the authority was disguised were considered neither reasonable, nor unreasonable.

In conclusion, when the *ad hominem* argument is presented as a criticism to straightforward arguments of authority, it is perceived to be less reasonable. This study shows that pragma-dialectical account is starting to take into account more contextual, ecological and daily-life settings for studying argumentation experimentally. This approach stands in contraposition to the classical Argumentation research, which focuses solely in normative issues.

DISCUSSION

PSYCHOLOGY OF ARGUMENTATION AS AN INTEGRATIVE SCIENTIFIC ACCOUNT

In this article, we have focused on the Bayesian analysis of the slippery slope argument and the pragma-dialectical analysis of the *ad hominem* argument in order to exemplify the merits of the experimental approach for describing the cognitive mechanisms of argumentation.

However, a general point to clarify is whether psychology of argumentation is either (a) a new perspective on argumentation, combining both normative and descriptive elements, or (b) a descriptive approach in opposition to the normative stances of logic, rhetoric, and dialectic. We claim that psychology of argumentation is an integrative scientific account. It is neither a new perspective nor a combination of perspectives. In fact, psychology of argumentation possess descriptive elements and also recognizes the necessity of normative accounts when, for instance, epistemic vigilance (see Sperber et al., 2010; Mazzarella, 2013; Padilla Cruz, 2013) is required as a consequence of the effectiveness of certain fallacies.

The quest for a more complete explanation of the concept of fallacy in order "*to bring the normative dimension better into relation with the psychological dimension*" (Walton, 2010, p. 160) is not new. For instance, Walton (2010) explores the possibility of elucidating the misleading nature of many informal fallacies of reasoning in terms of their connections to cognitive heuristics (Walton, 2010; but see also Correia, 2011). Walton's approach postulates argumentative heuristics without using recent cognitive psychology research to support his view. A heuristic is a *mediating concept between the notion of fallacy and 'retractable argumentation'* (Walton, 2010). To explain this mediating role, Walton introduces the notion of a parascheme, *a device that can be used to represent the structure of a heuristic as a fast inference instinctively linking a conclusion, and that is commonly used to make decisions* (Walton, 2010).

In this light, producing a fallacy is not about doing something inherently "wrong," but rather the result of not selecting the optimal strategy given the circumstances. A genuinely cognitive explanation of fallacies, therefore, must not only explain how these biases operate, but also specify the conditions under which they operate and become argumentatively and epistemically disadvantageous (Oswald and Maillat, 2011). Oswald and Maillat (2011) hence argues that the study of fallacies also needs a normative dimension, which helps identify clear criteria to distinguish consistent from fallacious arguments.

For Mercier and Sperber (2011) the role of argumentation is not truth seeking, but rather helping defend a point of view. In other words, argumentation plays essentially a psychological function. Still, quite a few argumentation theorists sustain the opposite view. For example, Morado (2014) states that "*if a bad argument is convincing* [it] *is precisely because it appears to help find the truth.*"

Mercier and Sperber (2011) consider the evolution of reasoning is linked to the evolution of human communication. Reasoning allows humans to produce arguments to convince recipients in accepting or trusting what they are told. And at the same time, it allows recipients to assess the strength of these arguments and accept valuable information that would otherwise be suspicious (Mercier and Sperber, 2011; as a cautionary side note, see Navarrete and Santamaría, 2011 for a comment on why such evolutionary arguments should be treated with special care). Despite the obvious relevance of cognitive perceptions to the study of argumentation, research on cognitive aspects of reasoning (and by extension those of argumentation) has traditionally been kept within the limits of cognitive psychology, from Wason seminal works in the 1960s (Wason, 1960, 1966) and the pioneering work of Tversky and Kahneman (1974) on cognitive heuristics.

In this sense, Mercier and Sperber (2011) proposal is close to that of the rhetorical perspective to argumentation. It understands argumentation as a natural process of persuasive communication (Wenzel, 1990). Sperber et al. (2010) argue that humans "*have a set of cognitive mechanisms for epistemic vigilance, at risk of being misinformed by others*" (p. 359). These cognitive filters are taken to monitor incoming information and calibrate confidence in their source while simultaneously evaluating the consistency of

the message. Such a role is akin to the fallacies associated with the source in a theoretical framework in which the rhetorical effectiveness is seen as a product of cognitive limitations and biases (Hart, 2011; Oswald and Maillat, 2011).

To summarize, the psychology of argumentation could be defined as a research program involving a dual-process account of reasoning and Bayesian reasoning representation systems as models that provide an explanatory framework for interpreting the rhetorical effectiveness of fallacies. Fallacies can be characterized by the kind of consequences that lead to epistemic vigilance (Sperber et al., 2010). Hence, we can differentiate the psychology of argumentation as a separate field as opposed to a particular cognitive approach, or a philosophical logic-based and apriorist stance against the preponderance of the evolutionary grounded search for truth.

A THEORETICAL FRAMEWORK FOR THE DESCRIPTIVE AND NORMATIVE ACCOUNTS OF ARGUMENTATION

In Argumentation, the mechanisms underlying persuasive arguments have been traditionally studied by employing philosophical accounts (e.g., rhetoric, dialectics, and logics). Furthermore, these philosophical accounts have traditionally postulated models of argumentation based on an *idealization* of the phenomena (Hansson, 2007). Thus, we can distinguish two types of idealization: (1) a "simplified idealization" which neglects several relevant aspects of real life complexity; or (2) a "perfectionist idealization" which attempts to satisfy higher rationality standards than those that are actually affordable by real agents.

Following this idea, the type of idealization of the normative approaches would fit in the first category, i.e., a simplified, reductionist idealization. Since their theoretical distinctions are made on a constrained, normed language (e.g., the "fallacious" character of an argument is because it violates a logical rule), normative views neglect the cognitive complexities of the agents involved in a real, spontaneous argumentative discussion. Here, we have shown how cognitive models and probabilistic tools are starting to take into account these complexities by embracing a more analytical and descriptive account of argumentation.

The experimental account we advocate here is in line with the so-called "practical approach of logical reasoning" of Gabbay and Woods (2003). The idea of a practical logic of reasoning is based on the description of a set of behavioral aspects of practical agents under particular cognitive conditions. In Gabbay and Woods (2003) words:

A cognitive agent is a being capable of perception, memory, belief, desire, reflection, deliberation, decision and inference. A practical cognitive system is a cognitive system whose cognitive agent is a practical agent in our sense, that is, an individual. A practical logic gives 'a certain kind of description' of a practical cognitive system. (p. 7)

In this view, a cognitive system can be defined as a 3-tuple: a cognitive agent, cognitive resources, and cognitive tasks performed dynamically in real time. This 3-tuple represents a plausible cognitive model for describing argumentative structures such as the slippery slope argument and the *ad hominem* argument. First, a cognitive agent or agents are present (the speakers). Second, these agents perform a task in real time by evaluating the persuasiveness of the slippery slope argument or the degree of unreasonableness of the *ad hominem* argument (e.g., they are being influenced by perception, memory, beliefs, desires, deliberation, decision, and inference). Third, other cognitive tasks are involved in the evaluation process, such as comparing the similarity between antecedents in an argumentative structure in the case of the slippery slope (Corner et al., 2011); or judging a personal attack as less unreasonable when the *ad hominem* argument is presented as criticism against arguments by hidden authority (van Eemeren et al., 2012).

The above model allows for what Woods (2013) called the "naturalization of logics." The two main components of this research program are *heavy-equipment mathematics*, i.e., more powerful mathematical techniques available for representing knowledge (e.g., the formalisms of normative theories); and cognitive models promoting a naturalist description of the argumentative phenomena (e.g., the Bayesian and pragma-dialectics experimental accounts).

In terms of our proposal, this approach is particularly useful since it represents a potential common framework in which cognitive and normative accounts in psychology can converge.

CONCLUSION

Here we show how descriptive approaches can shed light on the psychological mechanisms of argumentation by analyzing experimental evidence related to two classical argumentative structures. Furthermore, we argue that psychology of argumentation provides an integrative scientific perspective unlike normative or aprioristic approaches. This integrative approach brings a wide swath of aspects of psychological literature (e.g., emotions, decision making) into a single comprehensive framework, reconceptualizing classical rationality in a framework that allows for experimental testing (e.g., using Bayesian theory). All in all, we believe employing more descriptive and experimental accounts of argumentation would help Psychology to "keep on" bringing the cognitive and normative accounts of argumentation closer, with the final goal of establishing an integrated area of research on the psychology of argumentation.

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Cognition from life: the two modes of cognition that underlie moral behavior

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We argue that the capacity to live life to the benefit of self and others originates in the defining properties of life. These lead to two modes of cognition; the coping mode that is preoccupied with the satisfaction of pressing needs and the co-creation mode that aims at the realization of a world where pressing needs occur less frequently. We have used the Rule of Conservative Changes – stating that new functions can only scaffold on evolutionary older, yet highly stable functions – to predict that the interplay of these two modes define a number of core functions in psychology associated with moral behavior. We explore this prediction with five examples reflecting different theoretical approaches to human cognition and action selection. We conclude the paper with the observation that science is currently dominated by the coping mode and that the benefits of the co-creation mode may be necessary to generate realistic prospects for a modern synthesis in the sciences of the mind.

Keywords: autopoiesis, enactivism, morals, intelligence, sustainability, resilience, understanding, wisdom

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Introduction

Humans have a moral capacity to live life to the benefit of self and others. The question we address in this paper is "where does this capacity originate from and what are its defining features?" We argue that "the capacity to live life to the benefit of self and others" is a direct consequence of the defining properties of life that originated when individuals in overlapping habitats became to exist. In fact, we argue that the main constraints on behavior – and with that much of psychology – originated in the defining properties of life itself. This paper investigates the features of these essential "sub-psychological" or "pre-neural" roots and uses them to reinterpret results related to selection of behavior. As a whole the paper aims to provide a novel and productive framework to address issues related to how agents – whether human, animal, or artificial – decide on their behavior in an open world and outside the confines of controlled environments such as laboratories. In addition, we show that our framework provides, conform the call for papers, prospects for a modern synthesis to the sciences of the mind.

A main message of this meta-theoretical paper is that the definition of agentic life leads to two modes of cognition: a 'coping mode' and a 'co-creation mode.' The coping mode exists to address pressing needs and is a way to survive on the short term. The co-creation mode is prominent whenever all pressing needs are satisfied. It exists to explore the opportunities of the habitat and co-creates an environment in which the emergence of pressing needs becomes less likely. Co-creation requires agents to take both the long term as well as an extended

spatial environment into account. We argue that human morality originals from the contributions of these two modes. Individuals in the coping mode are preoccupied with their very own existence and as such they may become locally oriented, short-term "egocentric" sources of potentially destructive, yet immediately self-saving, behavior. On the other hand individuals in the co-creation mode are concerned with the overall quality and dynamic stability – resilience – of the Umwelt (von Uexküll, 1992) and the possible futures it entails for them and others. As such they benefit from others in the co-creation mode and they promote the reduction of the number of connected individuals who are in or are likely to slip into the coping mode. We argue that these two modes of cognition are not only the roots of moral behavior, but also define the dynamic that stabilizes the whole biosphere.

Paper Structure

The development of ideas in this paper is as follows: we will conclude the introduction with an important postulate – the Rule of Conservative Changes – that we use to justify the continuity between the definition of life and modern humanity.

In the Section, "Cognition from Life," we outline a number of key concepts of the enactive approach to cognition (Thompson, 2007) that forms the theoretical underpinning for the two basic modes of cognition that we identify: the 'coping mode' and the 'co-creation mode.' Together these define 'core cognition' (see **Figure 2**).

In the Section "Unicellular Cooperation Virtues," we start with connecting the roots of human morality by assuming that groups of unicellular individuals can have varying fractions of individuals in the coping and the co-creation mode. Cooperation and interaction may play out differently given the (combination of) different modes.

In the Section "Human cognition from Life" we skip a number of billion years and we scale-up the number of cells in the organism by a factor of 10^{14}. At the same time we predict, on the basis of the Rule of Conservative Change, that nothing fundamental ("essential") has changed: humans implement core cognition just as bacteria do. We explore this prediction with five examples reflecting different theoretical approaches to human cognition: (1) how the cerebral hemispheres understand the world, (2) how theories of 'dual type processing' of higher cognition relate to the two modes, (3) the origin of concepts such as power and wisdom, intelligence and understanding, and authority, (4) the unicellular cooperation origin of the 2+3 structure preserved in human moral values, and (5) we link the structure of positive emotions to the logic of the co-creation mode.

We conclude with the section "Prospects for a 'Modern Synthesis' in the Sciences of the Mind," stating that a search for unity in science should start with unity of existence. A prominent role for the co-creation mode in science allows to progressively specify, adapt, and enrich this unity more and more by encompassing evermore theories and phenomena.

Meta-Theoretic Departure Point

The Rule of Conservative Changes (Ghysen, 2003) states that in evolution new functions scaffold on older functions and as such preserve the essential from the very beginning. It represents the essence of our argument to connect the definition of life to moral and political behavior. Ghysen formulated the Rule of Conservative Changes as a necessary consequence of the complexity of the developmental programs, both ontogenetic and phylogenetic, of evolution[1]. The very complexity of the developmental programs demands that the basic infrastructures on which evolutionary more recent functions rely must be "extremely stable so that they can withstand substantial variation without collapsing." According to Ghysen:

> The rule of conservative changes states that only those changes can be tolerated, that change essentially nothing. This rule applies to any set of interacting elements, where changes in any one component will alter all the interactions in which this component is involved, and adversely affect the function of the entire set. The stringency of this rule will obviously increase with the number of interactions, as it becomes more and more unlikely that a single change in one element can improve, or at least not harm, the result of the total sum of all interactions.

The rule in its most stringent form entails that whatever set of functions that initially determined what is good or bad for life must be conserved throughout evolution: it only tolerated changes that "change essentially nothing." Yet, the same strict application of the rule will guarantee a very stable basis for innovations to rely on. Consequently, if the Rule of Conservative Changes applies, our moral values – suitably formulated – should reflect what is good or bad for life and have a stable, evolutionary old, basis. We will show that the structure of the unicellular level "morals" is still reflected in the structure of human moral virtues as formulated by Haidt (2007). Of course, a few billion years of evolution have allowed humans to come up with extremely intricate and convoluted ways to "change essentially nothing."

Ghysen's Rule of Conservative Changes imposes extreme stability constraints on the set of foundational older functions and the rule demands that new capacities help to improve the execution of older functions (while changing essentially nothing). However, it provides neither a starting point nor a direction. The starting point we will use here is the definition of life as formulated in the field of autopoiesis (Maturana and Varela, 1991). To impose limits on the direction of life's development, we will use the enactive cognition approach (Di Paolo and Thompson, 2014). As such we build on the idea that the very notion of life, or more precisely living agency, already defines many of the properties of mind and our capacity to act in the world (Thompson, 2007). This paper follows up on the suggestion of Froese and Ziemke (2009) who conclude:

> In order to develop a better theory of the biological roots of intentional agency we first need to gain a better understanding of bacterium-level intelligence. Only by returning to the beginnings of life itself do we stand any chance of establishing a properly grounded theory of intentional agency and cognition.

[1] Ghysen limited himself to the evolution of metazoa (all animals except protozoans and sponges). We apply the rule to all functions of life.

Cognition from Life

This section builds on the Enactive approach to cognition (Varela et al., 1993; Thompson, 2007; Froese and Ziemke, 2009; Di Paolo et al., 2010). The enactive approach to cognition is based on the premise that cognition depends constitutively on the living body, understood as an autonomous system operating in a complex open environment. The enactive approach is based on concepts like autonomy, embodiment, sense-making in an environment and the activities it comprises, and the emergence of functions and behaviors originating from the interactions between the individual and its environment (Di Paolo et al., 2010).

The core of the paradigm is probably most succinctly summarized by the phrase "being by doing" (Froese and Ziemke, 2009). Consequently, for an enactivist, a system is cognitive if its behavior sustains its existence; a notion that we will take quite literally in this section. This section addresses a number of core concepts of the enactive approach (autopoiesis, viability, agency, behavior, needful freedom, adaptivity) and, if necessary, reformulates, or reinterprets them in such a way that they can be used in a wider context while still be applicable in the original context. In addition, we separate two modes of cognition: one in which behavior sustains existence in the long run and one that protects existence in times of adversity. Together these two modes address existential needs in both the long and short term.

Autopoiesis: Needs, Identity, and Normativity

"Autopoiesis' (from Greek meaning "self creation" or "self-production") refers to a system capable of regenerating and maintaining itself. The term was introduced in 1972 by Chilean biologists Humberto Maturana and Francisco Varela to define the self-maintaining chemistry of living cells (Maturana and Varela, 1991). Autopoiesis refers to:

> A network of processes of production (synthesis and destruction) of components such that these components:
>
> (1) Continuously regenerate and realize the network that produces them, and
> (2) Constitute the system as a distinguishable unity in the domain in which they exist.

Thermodynamic constraints demand that a living self-maintaining system is far from equilibrium; consequently it requires a continual supply of energy. The moment the system looses its self-maintaining character, for example because it can no longer maintain its energy supply, it dies and eventually becomes an indistinguishable part of the environment. But as long as it is alive, autopoiesis necessarily also implies (Paolo, 2006):

(1) The establishment of a distinct "self" for which being is its own doing and with physical and organizational distinctions between inside and outside,
(2) An entity which is in constant environmental challenge, is in need of material turnover and with the freedom to achieve it, and
(3) The establishment of a normativity following the logic of metabolism according to which otherwise neutral events, both internal and external, can be good or bad for the continuation of the organism.

This implies the emergence of a "self" as a living entity that is constantly challenged by its environment, for which the events that influence it can now be evaluated in terms of facilitating or hindering its continuation. With the "self" comes a unique perspective or viewpoint, which implies for each living individual a unique history, a unique perspective, and a unique way to ensure its continuation. In short: with life comes an identity, the need for material throughput, and norms about what is good or bad in terms of consequences for the identity's continued existence.

Agency and Behavior

However, an autopoietic entity, although autonomously responsible for its own self-constitution, can still be limited to a fixed or externally controlled dynamic over which it has no control. As such, it may be unable to co-determine the conditions in which is exists. For co-determination, the entity needs to take control over the way it interacts with its environment: it needs '*agency.*' Barandiaran et al. (2009) define an agent as:

> An autonomous organization that adaptively regulates its coupling with its environment and contributes to sustaining itself as a consequence.

Being agentic, or not, corresponds to being a passive recipient of environmental challenges or to (pro-)actively controlling and selecting these environmental challenges (Paolo, 2006). Only the second mode of interaction fully deserves the name '*behavior*' (Paolo, 2006), because it is the agent that regulates its relation to the environment. This agent-controlled regulation of the coupling with the environment gives the organism whole new levels of freedom to continue its existence. We will refer to his strategy as 'living agency' (or 'agency' for short).

Needful Freedom

The relation between a living organism, as a dynamically maintained material structure, and the matter on which it depends, leads to a form of existence that has been called '*needful freedom*' (Froese and Ziemke, 2009):

> This relation is best expressed through the fact that, while the existential form of an organism is independent of any particular configuration of matter through which it passes in virtue of its metabolism, it is nevertheless dependent on the continual perpetuation of this ongoing flow of material configurations. If this flow ceases and the organic form fully coincides with its current material configuration then it is no longer living.

Formulated like this, *life is about need satisfaction*: as long as an entity exists that has the need for an ongoing material throughput and sustains this throughput itself, it is alive and viable. The moment the ongoing flow cannot be sustained, the entity becomes, again, part of its environment and looses its identity.

Needful freedom allows living agents the liberty to engage with its environment in any of a multitude of ways to satisfy its metabolic needs. This is the basis of the individual's autonomy and freedom that Di Paolo (2009) describes as follows:

> The fact that metabolism sustains a dynamic form of identity (not coinciding with its material constitution at any given time except at the time of death) allows an organism to become free. This freedom is expressed in the capability of the organism to engage with its medium in terms of the significance of a situation, thus contributing to its continuing dynamical autonomy and even opening up the possibility of novel value-making. However, this freedom is allowed by very strict and specific material needs. It is a needful freedom.

Needful freedom severely constrains behavior, because viability may never become zero. The organism should in fact always aim to remain as viable as possible, because close to the viability boundary (e.g., at birth or death) it has more pressing and more specific material needs and is even more dependent on the particulars of its immediate environment to satisfy its immediate needs.

This suggests the need for two complementary sets of need satisfaction strategies. One set to effectively satisfy *particular* material needs and another set to create the conditions in which *all* needs can be satisfied as well as possible. Both strategies give existential significance – meaning – to the particulars of the (immediate) environment. This process of meaning-giving or sense-making forms the basis of the individual's uniqueness, because each individual exists in a (slightly) different environment and must create a unique history of strategies to engage it. This history of activities also provides the individual a unique learning history to benefit from.

Two Modes of Cognition

Within the enactive approach the terms 'cognition' and sense-making are equated with autopoietic performance (Maturana and Varela, 1991). For example Di Paolo and Thompson (2014) conclude:

> Cognition, in its most general form, is sense-making—the adaptive regulation of states and interactions by an agent with respect to the consequences for the agent's own viability.

Within enactivism, cognition is not so much a function but an ongoing process of sense-making: valuing the opportunities of the environment in terms of contributions to an organism's continued existence. If at all possible, this cognitive process must lead to the creation of conditions of sustained high viability due to successful long-term need satisfaction.

This leads to a definition of cognitivity (Di Paolo and Thompson, 2014):

> A system is cognitive when its behavior is governed by the norm of the system's own continued existence and flourishing.

This definition of cognitivity suggests two modes of cognition. The first mode is governed by "the norms of the agent's continued existence" and corresponds to what we will refer to as the 'coping mode of cognition' because it is aimed at the *satisfaction* of—pressing—'deficiency needs.' The second mode of cognition is aimed at *preventing* pressing needs, while being "governed by the norms of the agent's flourishing," and will be referred to as the 'co-creation mode of cognition.'

Cognitivity is defined for the domain of complex systems (Kauffman, 1995): systems characterized by many interacting entities (Strevens, 2006), the absence of central control, and long-term system inpredictability. The co-creation and the coping mode have different scopes and objectives that correspond to the difference between 'resilience' and 'stability.'

> Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist. Stability, on the other hand, is the ability of a system to return to an equilibrium state after a temporary disturbance (Holling, 1973).

The resilience of a system leads to a persistence of relationships that allow cognitive agents to rely on the overall dynamics of that system. By enhancing beneficial over detrimental relationships, the co-creation mode can set-up the conditions for its continued existence and flourishing. The scope of co-creaction is therefore holistic, because it involves all aspects and all timescales of agent and environment. The coping mode in contrast aims for the return of *particular* equilibrium states in the agent (basic need fulfilled) and its scope is limited to what is necessary for the realization or maintainance of these stable states when required. While the coping mode is 'reactive,' the co-creation mode of cognition is 'proactive.'

Resilience can be defined at many levels of description and the concept has many different domain specific definitions (Brand and Jax, 2007). In our case (a) the level of the individual – for humans ego-resilience (Cohn et al., 2009) – and (b) the social ecological system (Walker et al., 2004; Folke et al., 2010) it is part of, are the most relevant. In particular, resilience as defined as *"the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks"* (Walker et al., 2004) is appropriate. Note that we could also refer to the co-creation mode of cognition as "resilience build-up" or as 'being cognition' (Maslow, 1962, 1963), because it sets up the conditions for successful *'being.'* Equally the coping mode could have been referred to as 'deficiency cognition' (Maslow, 1962, 1963).

Long Term Viability

The definition of cognitivity leads to a long-term viability measure: high quality autopoietic performance entails satisfied long-term needs, while low quality autopoietic performance is apparent as frequent or continually pressing immediate needs. The

more a system is in the co-creation mode, the higher its viability and vice versa. This quality measure is depicted in **Figure 1**.

Note that this is a quality measure related to well-being (in terms of satisfied needs) and not directly to fitness or evolution (the theory of autopoiesis defines life, not the strategies life has found to remain alive). However, it is safe to assume that high well-being is conducive for the generation of healthy and procreating offspring. Also, the average lifespan of individuals who regularly approach the boundary of their viability, i.e., are in mortal danger, will be lower, just as their window to procreate.

Adaptivity and Sustainability

Both modes of cognition, coping, and co-creation, are concerned with the prevention of an adverse future and are, as such, reflections of the essentially anticipatory nature of life (Vernon, 2010). The main proponent of the central role of anticipation in biology was Robert Rosen who defined anticipatory systems as follows (Louie, 2010):

> An anticipatory system is a natural system that contains an internal predictive model of itself and of its environment, which allows it to change state at an instant in accord with the model's predictions pertaining to a later instant.

Cognition then relies on an internal predictive model (also Vernon, 2010), involving the relations between self and environment, for the identification of viability impacting likely future states and the development of a decision strategy to select a beneficial future state while avoiding detrimental future ones.

This demand is covered by the term '*adaptivity*' (Di Paolo, 2009) for, in particular, the coping mode of cognition of autopoietic systems. Di Paolo defines adaptivity as follows:

> Adaptivity: A system's capacity, in some circumstances, to regulate its states and its relation to the environment with the result that, if the states are sufficiently close to the boundary of viability,
>
> (1) Tendencies are distinguished and acted upon depending on whether the states will approach or recede from the boundary and, as a consequence,
> (2) Tendencies of the first kind are moved closer to or transformed into tendencies of the second and so future states are prevented from reaching the boundary with an outward velocity.

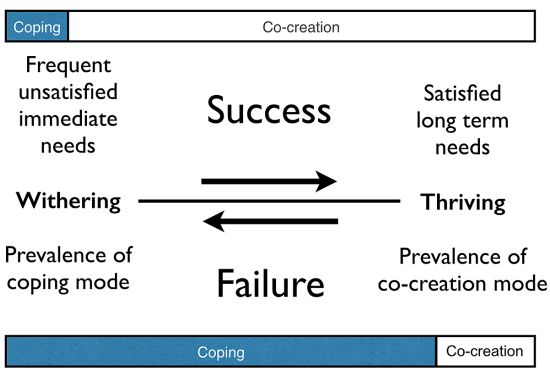

FIGURE 1 | Long-term viability measure. The more prevalent the co-creation mode, the higher autopoietic quality. The states on the right correspond to thriving and the states on the left to withering.

In this definition tendencies refer to likely futures. Interestingly, this definition only distinguishes tendencies if they are sufficiently close to the boundary of viability, which suggests that adaptivity is only needed in situations of immediate danger. However this does not cover the conditions in which the system flourishes.

By adding a third component to Di Paolo's definition of adaptivity, the co-creation mode of cognition is also covered. This leads, after a slight reformulation in italic, to a new concept that we will call '*sustainability*' (of self and the environment).

> Sustainability: A system's capacity, in some circumstances, to regulate its states and its relation to the environment with the result that
>
> (1) *Anticipation:* Tendencies are distinguished and acted upon depending on whether the states will approach or recede from the boundary of viability.
> (2) *Coping: If the states are sufficiently close to the boundary of viability,* tendencies of the first kind are moved closer to or transformed into tendencies of the second and so future states are prevented from reaching the boundary with an outward velocity.
> (3) *Co-creation: If the states are sufficiently far from the boundary of viability, tendencies of the second kind are used to create an ever more spatially and temporally extended environment for proactive need satisfaction.*

Sustainability, defined as such, complies with and even extends the usual use of the term because it is a recipe not just to *conserve*, but also to actually *create*, a stable and reliable ecological dynamic. Applied to a global scale with overlapping and structurally interwoven habitats, it implies the Gaia hypothesis (Lovelock and Margulis, 1974), which proposes that all organisms and their inorganic surroundings on Earth are closely integrated to form a single self-regulating complex system that maintains the conditions for life on the planet (i.e., life itself sets up the conditions for its proactive need satisfaction). This dovetails with Margulis and Sagan (1995) who wrote:

> "Darwin's grand vision was not wrong, only incomplete. In accentuating the direct competition between individuals for resources as the primary selection mechanism, Darwin (and especially his followers) created the impression that the environment was simply a static arena."

Indeed, the competition (coping mode) takes place in a complex environment continually maintained and co-created by life for its own benefit (co-creation mode).

The three aspects of the definition of sustainability – anticipation, coping, and co-creation – deserve some more attention.

Anticipation: Original Perspective

Any agent develops a history of activities by which it is at any instant constrained, so it always builds on its earlier activities. Or put differently: it is for better or for worse, always confronted with the consequences of its own actions. By selecting its activities well, i.e., timing its behaviors well, the agent can, at least for some time, avoid states it cannot handle and select or co-create states that allow it to thrive. Consequently, the anticipatory nature of successful autopoiesis requires the prediction of possible viability developments through some model of itself in relation to the environment.

Since the simplest predictive model is only based on the aggregate of internal and external states, the earliest perception-action models were based on the aggregate of internal and external influences and were therefore unable to separate these. On top of this "holistic" evaluation more advanced perceptual mechanisms have evolved that, eventually, could separate internal from external influences (including influences from other agents). One essential property of this 'original perspective' is that it is holistic and context sensitive. This theoretical consideration will be applied a number of times in the rest of this paper.

The original perspective was not only holistic and context sensitive, but also essentially subjective: it was both individual and deeply value-laden in terms of whether it reflected tendencies that approach or recede from the *individual* boundary of viability. This can be interpreted as a perspective on the safety of the individual that it in part should learn through exploration (a form of participation in the environment). The development and initiation of appropriate (tendency transforming) activities depend therefore on the individual's history and are unique for the individual.

This (again) entails that each individual is its own sense-maker in terms of how it interprets tendencies as beneficial (good), detrimental (bad), or irrelevant, depending on whether they recede or approach the boundaries of viability. Yet, although each individual is its own sense-maker, it is also a member of a species and it shares many essential aspects with other life forms, entailing the existence of general sense-making strategies. These commonalities form the basis for morality defined as "the extent to which an action is right or wrong" (New Oxford Dictionary) on which we will build.

Coping

In situations that are experienced as indicative of immanent danger of viability loss, the agent is confronted with one or more unsatisfied needs as pressing problems to address; even if this goes at the cost of other aspects that are currently not critical. The coping mode prioritizes and as a result is focused and sequential. Coping favors the certainty of control over improvisation and as such the autopoietic system will tend to keep or bring all essential parameters within the bounds of normal functioning, using whatever reliable utility (in- or external) it has access to. This entails that the coping mode of cognition is essentially conservative: to protect the essential, it will sacrifice the unessential and/or currently worthless as an inevitable side effect. Concepts that aptly describe the functioning of the coping mode are 'trying to control the situation,' 'reactive problem solving,' 'prioritizing,' 'conservation of the essential,' 'short-term utility for self-preservation,' and 'acceptance of adverse side effects.'

Following Di Paolo's (2009) 'adaptivity,' life on earth started as a perpetual "reactive struggle" that could only exist in the most favorable conditions. Life could become only stable and comfortably established when the aggregate of living individuals succeeded in *proactively* co-creating and maintaining—eventually earth-wide—the conditions for their own existence: life extended 'adaptivity' to 'sustainability.' This line of reasoning suggests that the coping mode has older evolutionary origins and that the co-creation mode evolved as a safer strategy by ever-expanding the "scope of normality."

Co-creation

The need to activate the coping mode is indicative of a failing or inadequacy of the co-creation mode. Apparently the agent failed, through its own fault or not, in proactively maintaining a situation without pressing needs, which forced the coping mode to reactively solve the problem. Since the coping mode of cognition is essentially a fallback in case of a failing co-creation mode—with the ultimate objective to preserve agency or life by conserving the *essential* at the cost of the currently not essential and bringing it back within the scope of normality—the core task of the co-creation mode is to restore the *overall* functioning of the system, and to consolidate the whole system after insult.

After the autopoietic system has consolidated itself and is fully viable again, the priority shifts back to co-creation to prevent new insults or to come up with ways to mitigate their effects proactively to optimize the long-term viability of the autopoietic system in its environment. Thus the co-creation mode builds on the holistic and context sensitivity of the original perspective. Concepts that describe the co-creation mode are 'prevention of problems,' 'holistic optimization,' 'context sensitivity,' 'consolidation after repletion,' and – as much as possible – the 'creating and maintaining of a safe and sustaining environment with long-term benefits.'

This suggests a way to introduce concepts like 'good' and 'bad' in terms of resilience. A 'good' influence increases *"the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedback"* (Walker et al., 2004) while a 'bad' influence erodes, or in extreme cases destroys, this capacity. In fact we can call tendencies that move agents to the left in **Figure 1** 'bad' and tendencies to the right 'good.' Note that what is good for a system defined on one aggregation level can be bad on another (and the same with short and long term).

Summary of Cognition from Life

The subsection above discussed that a living agent decides, in part, on its own future via behavior that selects advantageous reachable future states according to its own norms and on the basis of some sort of predictive model that optimizes future viability. Cognition boils down to the selection and execution

of activities promoting the individual's continued existence and flourishing, which encapsulates the enactive approach as "being by doing" (Froese and Ziemke, 2009). We propose two modes of cognition: a coping mode of cognition focused on keeping a living agent in mere existence, and a co-creation mode of cognition focused on the flourishing of a living agent. Together, we will refer to these two modes and the concept that emerge from them as 'core cognition.'

Figure 2 represents a visual summary (concept map) of 'core cognition.' The definition of sustainability is the "starting point" (top-middle). From there contrasting, but not necessarily similar or complementary, consequences of coping (left) and co-creation (right) branch out to the side and below. Both the concepts 'agency' and 'Umwelt' are common for the two modes. The concepts in the lower square ('authority,' 'intelligence,' 'understanding,' 'power,' and 'wisdom') are typically attributed to human cognition and emerge quite naturally and without the need for intermediate steps or levels, which will be discussed in Section "Human Cognition from Life."

Unicellular Cooperation Virtues

In this section, we remain at the unicellular level, but unlike Section "Cognition from Life" we focus on relations between individual living agents. In particular we address cooperation from the viewpoint of the coping and the co-creation mode. We first discuss the need for cooperation, then the resulting group perspective, and finally a number of unicellular cooperation virtues. We will compare these virtues with human moral values in Section "Haidt's Moral Virtues."

Unicellular Cooperation

One essential activity of living agents with important consequences is procreation. Unicellular organisms procreate by dividing and thus end up as neighboring individuals. After a number of generations in favorable situations – conditions in which all needs are satisfied and therefore indicative of the co-creation mode – this results in many individuals in overlapping habitats. This success leads, inevitably, to problems associated with the autopoietic demands for material throughput: a growing demand (per volume) for nutrients and energy and more waste products to dispose of. Yet, it makes cooperation possible. Sociality is therefore both a challenge and an opportunity for life and as such it offers the possibility for a self-stabilizing dynamic.

As stated before, the predictive models of the most primitive unicellular life forms are holistic and unable to separate in- and external states. Individuals of early life forms based activities on holistic predictive models that account for the state of the individual in its environment (whether social or not). As a consequence, sociality does not require qualitative different decision processes compared to "individual-level decisions." As long as the predictive model can learn to select advantageous strategies, given the environment, it will serve the individuals (and the species alike).

However, what is advantageous differs between the co-creation and the coping mode. The co-creation mode favors *prevention* of problems, consolidation after repletion, and the creation and maintenance of a safe and sustaining environment with long-term benefits. In contrast, the coping mode involves increasing *control* over the situation, to prevent one from becoming an inadequate or even dead agent. The coping agent does this through conservation of the essential, exploiting short-term utility for self-preservation, and ignoring or accepting adverse side effects in the course of pressing need satisfaction.

Based on the composition one can imagine three types of groups: all resilient, all coping, or a mixture of individuals in the co-creation and the coping mode. When *all* individuals are in the co-creation mode (which might not often be realistic) this can result in a combination of cooperation and individual or group-wise exploration with the creation and maintenance of an environment that is as safe and sustaining as possible. If, however, *all* individuals are in the coping mode, this may lead to a relentless competition between opportunistic individuals with as consequence the survival of the "fittest" (actually the survival of those that cope/compete best given the environment). Or alternatively, they can cooperate conform the strengths of the coping mode and engage in highly regimented behaviors that may be very effective in addressing the (now) shared needs. However, unlike the co-creation mode this behavior is not necessarily without adverse side effects.

In situations with individuals in both modes, the balance between cooperation and self-enhancing benefits determines the outcome. For example, Cremer et al. (2012) observes a typical three phase repetitive cycle of bacterial population dynamics. The cycle starts with relatively few and independent bacterial cells that do not procreate. In procreation promoting conditions, individuals form groups according to chance. These groups develop differently according to the fraction of individuals more inclined to the coping mode – who focus on pressing need satisfaction and who Cremer refers to as cheaters or defectors – versus those in the co-creation mode – who optimize the aggregate of self and the environment (cooperators). Cremer et al. (2012) observes two characteristic features of the groups' internal dynamics:

> "First because of the costs for providing the benefit, cooperators have a selection disadvantage, compared to cheaters in the same group. In particular, cooperators reproduce slower than cheaters and hence the fraction of cooperators decreases within each group (intra-group evolution). Second, considering the benefit of cooperation, groups with more cooperators grow faster and can reach a higher maximum size (carrying capacity) than groups of mainly cheaters (inter-group evolution)."

The moment the conditions for growth are no longer maintained, the groups dissolve and the individuals become again more independent, but now in new numbers of cheaters and cooperators.

We can conclude that for individuals in the co-creation mode it is highly beneficial to have as many others as possible in the co-creation mode as well, which implies that if coping is not dominant, a community of individuals can thrive. This entails that 'caring' behavior, which helps individuals shift from the coping mode into the co-creation mode, is a viable tactic in

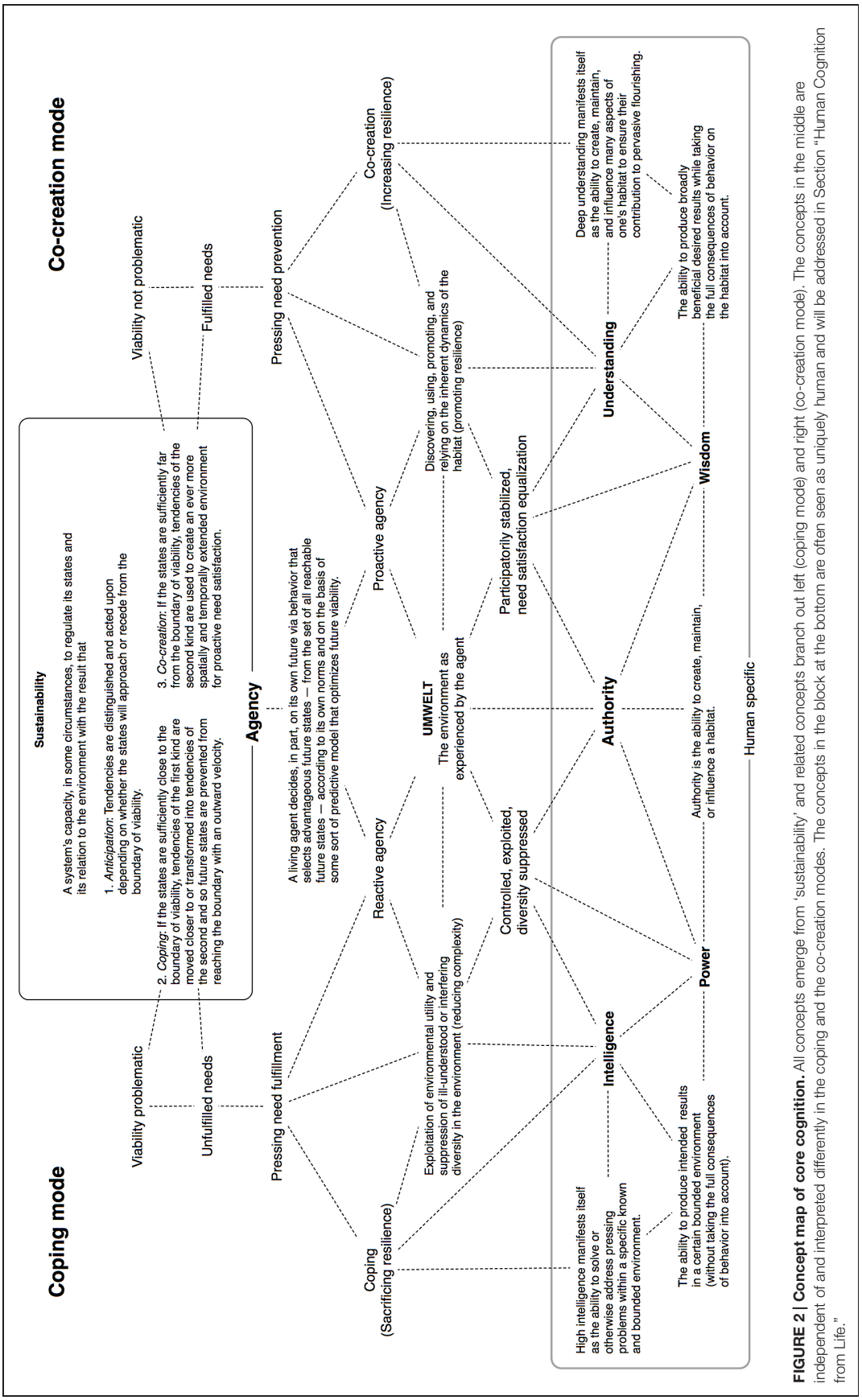

FIGURE 2 | Concept map of core cognition. All concepts emerge from 'sustainability' and related concepts branch out left (coping mode) and right (co-creation mode). The concepts in the middle are independent of and interpreted differently in the coping and the co-creation modes. The concepts in the block at the bottom are often seen as uniquely human and will be addressed in Section "Human Cognition from Life."

the co-creation mode to effectively promote overall thriving. Conversely when coping becomes dominant, thriving becomes increasingly rare. This is a rephrasing of the long-term viability measure (**Figure 1**), but now on a group level.

This example illustrates the key characteristics of the coping and the co-creation mode. The coping mode might favor unsustainable forms of cooperation, such as competition at the cost of, for example, fellow individuals who compete less well. The co-creation mode on the other hand realizes global benefits in the form of a higher carrying capacity. Both strategies have evolutionary advantages: the coping mode in times of adversity, in which a reduction of the number of individuals is actually beneficial given limited resources, and resilience enhancement (co-creation) in times of plenty. However, not all individuals may make the switch from one mode to the other at the same time and some may be more inclined to one particular strategy. Nonetheless individuals in different modes exhibiting quite different strategies can coexist.

The Emergent Group Perspective

Cooperation leads to the emergence of group-level agency and with that to the emergence of group-level meaning giving and sense-making. It also leads to a group-perspective in addition to the perspective of each individual. Without cooperation, the associated perspective is that of the unicellular individuals and behavior is selected from the set of all reachable future states per individual. A cooperating group creates a new perspective in which behavior is selected from all reachable future states of that group, which might be quite different and, at times, even conflicting with the demands at the unicellular level.

In particular the cooperative perspective creates an aggregate or group level to which one can ascribe the coping and co-creation mode. For example

> "myxobacteria are Gram-negative organisms that are capable of multicellular, social behavior. In the presence of nutrients, swarms of myxobacteria feed cooperatively by sharing extracellular digestive enzymes, and can prey on other bacteria. When the food supply runs low, they initiate a complex developmental program that culminates in the production of a fruiting body"
>
> (Kaiser, 2003).

In this case the bacteria start with a kind of loose cooperation (allowing for a diversity of individual activities) of independent agents in times of plenty – a group level co-creation mode – that develops into a highly regimented (uniform, predictable, and coordinated) and eventually even sacrificial collaboration to produce the spores that continue the species elsewhere at a later stage – a group level coping mode.

This suggests that in the co-creation mode individuals have maximal agency and freedom to pursue individual or collective futures, which may lead to the discovery of ever more versatile cooperative or individual strategies that progressively bring more and more situations within the scope of the co-creation mode. The group level coping mode results into individuals trading "freedom for security" and engaging in highly regimented behaviors with particular need satisfaction purposes such as "*accessing resources that cannot effectively be utilized by single cells, collectively defending against antagonists, and optimizing population survival*" (Shapiro, 1998).

Unicellular Cooperation Virtues

The factors that define the actual form of cooperation depend essentially on the scope of the cooperation benefits (for some ingroup or for all) and the degree to which the needs are pressing. A cooperating agent in the co-creation mode should not only maintain its internal network, but it must take the needs of its collaborators, as well as the overall state of the environment, into account. This quite naturally leads to a basic concern – a care – for a general well-being, including the capacity to prevent harming others, assist the suffering, and a concern for the shared environment (which it can because it is based on a holistic evaluation).

The "caring agent" will be sensitive to the needs of others and in particular be concerned about sufficient 'need satisfaction equality' among individuals in its Umwelt since 'unfulfilled need inequality' leads to diversity in behavioral strategies (co-creation versus coping) and as such to the undermining of (long-term) collaborative efforts and overall (group-level) stability. Strategies involving a shared *care* for a *fair* distribution of fulfilled (and unfulfilled) needs are highly self-stabilizing and resilience enhancing, while at the same time allowing for the discovery of new dynamically stable states.

Note that the scope of need satisfaction may not only involve ones own species, but in principle all living agents who contribute to the holistic situational awareness – Umwelt – on which action selection is based. These strategies are examples of the co-creation mode and may even underlie the emergence of Gaia as the global self-sustaining network of living entities that created and maintained the atmosphere and biosphere it relies on for its continued existence (Lovelock and Margulis, 1974).

The aggregate situational awareness characteristic of the first life forms are likely to be conserved according to the constraints imposed by the Rule of Conservative Changes. If so, this could be a basis for empathy (according to the New Oxford Dictionary "the ability to understand and share the feelings of another"): however, not limited to conspecifics, but conforming with the breadth of the holistic situational awareness, toward to the whole Umwelt. Empathy might therefore be understood in its original form as "the ability to understand and be influenced by the state of the whole environment." We will return to the concept of 'understanding' in a later section, where we define it.

Yet not all collaborative strategies may, in principle, be broadly beneficial. Some may explicitly promote the satisfaction of particular ingroup needs to the detriment of other groups or individuals and the strategies are examples of the coping mode. Coping strategies need a clear ingroup/outgroup distinction so that ingroup members are recognizable, loyal, and willing to disregard or exploit outgroups. In addition all group members are expected to identify and execute group roles properly (and without error). Finally, ingroup cooperation requires the behavior of all group members to be constrained by ingroup level rationality. In particular behaviors that stem from individual-level needs (i.e., make sense from rationality constraints at the level of the

individual) should be resisted if they exceed group-level norms or lead to group-level costs.

These behaviors give rise to two qualitatively different sets of standards of conduct for 'cooperation virtues.' The first set allows for broadly beneficial, i.e., global, cooperation through a care for all agents and their needs in the environment in combination with efforts to realize a by and large equal, or fair, distribution of satisfied needs. The second set of standards allows for effective within-group dynamics and even competition between in- and outgroups. In this mode, ingroup loyalty, ingroup role adherence, and ingroup-level rationality constraints on individual behavior are central. **Table 1** summarizes these group-level cooperation values.

Cooperation and Agency

In the co-creation mode, social individuals have maximal agency and freedom to pursue individual or collective future as long as they are, at the same time, sensitive and responsive to the needs of other agents in their Umwelt and promote more or less equal levels of need satisfaction. Within these bounds this mode may lead to the discovery of ever more versatile individual and cooperative strategies that progressively bring more and more situations within the scope of the co-creation mode and in doing so increases the carrying capacity of the environment. This results in widely shared benefits and the generation of evermore stable, reliable, and beneficial nested relationships between individuals, species, habitats, and even the global eco-system. In short: broad resilience built-up. A general state of thriving is the hallmark of the success of the co-creation mode. This form or cooperation relies essentially on individual-level agency as a resource.

In the coping mode (e.g., when food supply runs low) social individuals may choose to trade "freedom for security" in which they engage in highly regimented collaborative behavior with a particular need satisfaction purpose and particular stable states. This form of cooperation treats individual level agency as a stability threat that should be curtailed instead of stimulated. In this mode individuals treat the environment as a resource and a buffer of utilities to be exploited. More constructively, it can also lead to a particular form of constructive cooperation intended to benefit the ingroup (possibly at the costs of outgroups). This form of cooperation relies essentially on ingroup-level agency as a resource.

For later reference, the previous can be summarized as follows:

Global versus Local Optimization Caring for all (global) versus caring for oneself or for a particular ingroup (local) relates directly to cognitive modes that drive behavior and thus determine the type of cooperation. Agents in the co-creation mode engage in long-term optimization of the opportunities and dynamic stability – resilience – of the combination between self and the environment. Their cooperation, involves all agents in the context of their Umwelt. To do so cooperating individuals should be generally caring and promoting equality of need satisfaction levels. On the other hand, unsatisfied needs and inequality in need satisfaction levels promote a prevalence and diversity of individuals in the coping mode. These are motivated by short-term, small-scope, ingroup, and situation specific goals.

We will return to this summary in the next section when we address moral virtues.

Human Cognition from Life

As we suggested in the Introduction, we will now skip a few billion years and scale-up the number of cells of the organism by 14 orders of magnitude. We assume, on the basis of the Rule of Conservative Changes, that *nothing fundamental ("essential") has changed*, entailing that both unicellular and human behavior can be described by the two cognitive modes, i.e., the coping and co-creation mode that define core cognition. In this section we substantiate this, at first glance quite extraordinary

TABLE 1 | Cooperation virtues formulated from unicellular level cognition.

Scope of optimization Cognitive mode	Cooperation virtue	Description
Global – long term Co-creating and maintaining conditions for pervasive need satisfaction	1 – Care	Concern and shared responsibility for the need satisfaction in others in particular through preventing harm in others, assisting those in need, and care for the environment in general (promoting the co-creation mode).
Co-creation mode	2 – Fairness	Promotion of equality in terms of the level of satisfied needs to prevent a diversity of unsatisfied needs (preventing the coping mode).
Local – short term Creating and maintaining conditions suitable for effective ingroup coping	3 – Ingroup loyalty	Showing/proving you are a member of the ingroup through signification, self-sacrifice, ingroup loyalty, and disregard or exploitation of outgroups.
	4 – Ingroup role adherence	Proper identification and execution of ingroup roles and norms (prevention of mistakes), submission to ingroup consensus, or a central coordinating center.
Coping mode	5 – Ingroup rationality constraints	Self imposed limits on behavior according to ingroup-level rationality. For example resistance to pursue individual-level selfish needs that exceed ingroup norms or tempt others to exceed ingroup constraints as well.

This table can be compared to the ***Table 2*** *(Haidt's moral values).*

prediction, with five examples of well-known phenomena and theories reported in modern psychology that all pertain in some way to "the capacity to live life to the benefits of self and others."

We consider these clear examples of modern day manifestations of core cognition (the upper part of **Figure 2**) and in particular of the long-term viability measure (**Figure 1**), the co-creation and coping mode, and unicellular level cooperation virtues (**Table 1**). The given examples build on each other and are intimately related because they are manifestations of core cognition. We will address:

(1) The bihemispheric structure of the brain (McGilchrist, 2010) implementing two attitudes toward a complex world.
(2) Dual type processing in relation to the coping and the co-creation mode.
(3) The derivation of the concepts of 'intelligence' and 'power' from the properties of the coping mode and the concepts of 'understanding' and 'wisdom' from the co-creation mode.
(4) The interpretation of the structure of human (strictly speaking American) moral values as straightforward extension of unicellular cooperation values (Haidt and Graham, 2007).
(5) The broaden and build theory of positive emotions (Fredrickson and Branigan, 2005; Cohn et al., 2009) reflecting key properties of the co-creation mode.

In a recent paper called "Learning autonomy in two or three steps: linking open-ended development, authority, and agency to motivation" (Andringa et al., 2013), we already combined many of the key concepts in these five examples. The Learning Autonomy paper focused on the development of human cognition and autonomy during a life span (ontogenesis). The present paper addresses the evolution of cooperative behaviors of individuals in groups, and groups in an environment (the phylogenesis of behavior). The present paper thus allows us to understand *why* the concepts emerged in Learning Autonomy the way they did. We will refer a number of times to that paper. Together – combining ontogenesis and phylogenesis – these two papers bolster our claims even further.

Note that we cannot really proof our prediction. What we aim for is to show the existence of a high degree of consistency between unicellular level cognition – core cognition – and results from modern Psychology. Consistency and similarity, even to an uncanny level, are indicative but not conclusive proof of the prediction that since the stable emergence of life nothing essential has changed and thus that the definition of life already contained the determinants of cognition. So, for the moment, it is not proof but plausibility we aim for.

Example 1: Two Attitudes Toward the World and Two Brain Hemispheres

In Learning Autonomy (Andringa et al., 2013) we observed that *successful* life span development is characterized by an ever-improving understanding of reality in combination with an urge (and proven ability) to improve and shape the Umwelt. This fits the description of the co-creation mode that we coupled to the "prevention of problems, consolidation after repletion, and – as much as possible – the creation and maintenance of a safe and sustaining environment with long-term need satisfaction potential." In Learning Autonomy we interpreted cognitive development (in humans and human-like artificial agents) as learning to master the complexity of the world.

Life is always near the 'edge of chaos' (Mora and Bialek, 2011) and if the complexity of the current situation is judged too high we benefit from coping strategies that reduce its complexity and make the situation more tractable and predictable. In Learning Autonomy we referred to the form of cognition that allows us to curtail a complex world as "cognition for order," "cognition for certainty," or "control cognition." We associated this form of cognition with fear and anxiety, detachment, abstract manipulation, and the personality trait 'closed to experience.' This description matches with the concepts that we used to describe the coping mode: 'trying to control the situation,' 'reactive problem solving,' 'conservation of the essential,' 'short-term utility for self-preservation,' and 'acceptance of adverse side effects.'

Yet at other moments we can deal with some additional complexity and allow ourselves to explore the possibilities of the world. Successful, typically playful and purposeless, exploration leads to the discovery of new, generic or invariant structures that make the world a bit more tractable and accessible to agentic influences. This expansion of the understanding of the world fits with the holistic nature of the co-creation mode.

In Learning Autonomy we observed that the two modes we identified matched the description of differences in the way the left and right cerebral hemispheres understand the world and contribute to our existence according to the seminal work "The Master and His Emissary" by McGilchrist (2010). Table 1 of Learning Autonomy provides an comprehensive summary of the reported differences between (and complementarity of) the attitudes toward the world associated with the left and the right hemispheres that exemplifies how the coping and the co-creation modes are implemented in modern humanity (and in particular the brains of human individuals).

McGilchrist (2010) argues that our Western societies have become characterized by an ever growing dominance of the left-hemispheric – coping – world-view that favors a narrow focus over the broader picture, specialists over generalists, fragmentation over unification, knowledge and intelligence over experience and wisdom, technical objects over living entities, control over growth and flourishing, and dependence over autonomy. Apparently, despite the huge cultural progress that has been made in the last millennia, humanity shifted more and more toward the coping mode. According to the summary in **Figure 1** this is a neither a sign of autopoietic success, nor of viability: on the contrary. Apparently, our understanding of society has not matched society's complexity growth.

This erosion of the co-creation mode of cognition, and, directly coupled, the resilience reduction of our natural environment, may in fact explain why humanity faces a number of existential problems and in particular has difficulties in realizing a sustainable long-term future: the coping mode, with a focus on pressing problems, intolerance to diversity, and its insensitivity to adverse side-effects as key characteristics, is simply unsuitable to setup the conditions for easy and reliable future need satisfaction.

Example 2: Dual Type Processing

The previous section may have suggested that the coping mode is an inferior mode of cognition that is mainly useful in situations where the co-creation mode is inadequate and long-term adverse side effects are the least of one's worries. On a long-term strategic level this may be true, but in the short-term of daily mental processes we propose that the interplay between both modes allows ever-improving action selection. We do this by connecting to dual-process theories of higher cognition.

Dual-process or dual system theories of higher cognition (Evans, 2003; Evans and Stanovich, 2013) rely on the existence of two qualitatively different systems that, together, span the full scope of mental processes. These theories are still under development and not without criticism (Keren and Schul, 2009), yet they easily fit in our discourse. In a recent paper addressing this criticism Evans and Stanovich (2013) separate defining and correlative features of two types of mental processes (that each may have hemispheric biases, but that are definitely *not* exclusively associated with a single hemisphere).

According to Evans and Stanovich (2013) the defining properties of type 1 – intuitive – processes are that they are autonomous and do not require working memory, while type 2 – reflective – processes do require working memory and allow for cognitive decoupling from the here and now to allow "hypothetical reasoning and cognitive simulation" (Stanovich et al., 2011).

We summarized the Section "Cognition from Life" with the following conclusion about living agency:

> A living agent decides, in part, on its own future via behavior that selects advantageous future states (of the aggregate of self and environment)—from the set of all reachable future states the agent has access to—according to its own norms and on the basis of some sort of predictive model that optimizes its future viability.

We propose that an intricate interplay between type 1 and 2 processes, a few billion years later, implements this. Type 1 processes bring and keep the agent autonomously—without central control – from the set of all possible states of reality into a mindset appropriate for the here-and-now. This mindset *presents* reality (McGilchrist, 2010; Andringa et al., 2013, Table 1) and especially its most salient and potentially meaningful or otherwise pressing aspects as Umwelt. Type 1 processes set up the stage for all action selection and are a manifestation of the original (holistic) perspective. Automatic behaviors like walking or habits like brushing your teeth rely on the autonomy and situational awareness of type 1 processing. We have partial conscious access to the outcomes of type 1 processes as a holistic experience (Kaplan, 1995), direct perception (Gibson, 1986), or as gist phenomena (Oliva, 2005).

Type 2 processes take the generated Umwelt as basis for non-automatic and non-habitual action selection to propose an even more beneficial future than automated or habitual, type 1, responses can realize. This more complex action selection process involves the comparison of viability benefits of multiple scenarios as an outcome of hypothetical reasoning and cognitive simulation. In fact, "we create temporary models of the world and test out actions (or alternative causes) in that simulated world" (Stanovich et al., 2011) by harnessing knowledge abstracted from previous experiences. Since type 1 processes are more or less confined to the here and now, type 2 processes need an independent structure to "decouple" (Stanovich et al., 2011) from it. Apparently working memory provides this simulation infrastructure.

In the Section, "Two Modes of Cognition," we coupled the key differences of the co-creation and coping modes to the difference between 'resilience' and 'stability.' Reapplying this notion here suggests that type 1 processes use the resilience of the "generated" Umwelt as a quality measure so that increasingly resilient beneficial properties of the Umwelt are suggestive of desirable action outcomes. Similarly type 2 processes search for particular forms of stability and predictability; for example through discovering phenomena and their properties across many manifestations of the Umwelt.

Type 1 processes provide us with a rough sense of where we are, what is going on, and which acts will enhance or deteriorate the resilience of key components of the environment. Type 2 processes are the basis for explicit knowledge; in particular knowledge about the many interacting agents and processes that shape and define the Umwelt, its dynamics, and, via our acts, the world. By activating particular type 2 knowledge configurations as abstracted hypotheses of simulated Umwelt states, which feed back to type 1 processes as self-generated "input," type 1 processes can associate resilience estimates. In fact it seems that the brain has an infrastructure for this that switches between sensory and self-generated "input" (Buckner et al., 2008).

Type 2 processing has been shown to correlate with general intelligence, while type 1 processing does not (Evans et al., 2010; Evans and Stanovich, 2013). We propose that 'understanding' is associated with the ability of type 1 processes to predict resilience effects: a new concept is 'understood' if its resilience effects can be predicted in an open world. One understands the world deeply if one can use the resilience and fragility in the world to reliable select actions that contribute to a favorable future.

This general description allows us to argue that a number of phenomena from different domains of psychology are actually manifestations of the interplay of type 1 and 2 processes as defined above. For example experiments addressing the time course of visual perception (Greene and Oliva, 2009) indicate that general, often action-selection related, landscape properties such as naturalness, depth, possibilities for concealment, and navigability can be estimated from a shorter image exposure than basic-level categorizations like forest, mountain, desert, and lake. We interpret this as type 1 processes setting up the stage for action selection and are therefore aimed at the activation of a situationally appropriate action repertoire through answering the questions "Where am I?" and "What is my default response?" Consecutively, type 2 processes augment this with knowledge abstracted across many different previous situations to interpret the situation better and to propose "better than default responses" back to type 1 processes for appraisal and comparison with expected sensory details.

A very similar account, at a longer timescale, can be formulated for emotion research, considering the common definition of emotion as 'action readiness' (Frijda, 1986). Emotion researchers make a difference between basic and complex emotions, where

basic emotion arises directly as action readiness from the interplay between body and sensory stimulation (Izard, 2007). In contrast, complex emotions like emotional schemas "are defined in terms of the dynamic interaction of emotion and cognition" and "differ across individuals and cultures" (Izard, 2007). As such the actions they give rise to are not innate but learned from experience or imitation and thus they may represent vast amounts of tacit knowledge. Directly related to this distinction is the process of 'emotion regulation' (Gross and Thompson, 2007) in which deliberative processes change an initial emotion/action readiness into another more appropriate form. Both complex emotions and emotion regulation depend on the interplay between type 1 situational awareness, type 2 proposals for better than default outcomes, and type 1 evaluations of these proposals.

A third and last example involves mind wandering. It seems that people spend between 25 and 50% of their waking hours on thoughts unrelated to the here and now (Smallwood and Schooler, 2015). The 'default mode network,' directly associated with mind wandering, seems a fundamental function of the mammalian brain (Lu et al., 2012). "In the absence of an immediate need for goal-directed attention to the surrounding environment, our minds wander from recollection of past happenings to imagination of future events (Lu et al., 2012)." This can be interpreted as: when not in the coping mode, the mind wanders according to the dynamics of the co-creation mode (type 1), allowing the sequential reasoning about possibilities by type 2 processing, and performing resilience appraisal of these possibilities by type 1 responses.

The reported functions of mind wandering include prospection through simulating future activities, creativity via testing new solutions or perspectives, developing a meaningful life narrative, allowing for mental breaks, and to provide similar functions as dreaming (Smallwood and Schooler, 2015). A more abstract function, spanning decades and probably encompassing all reported functions, is the optimization of thought outcomes. Mind wandering, through its random nature, can be used to revisit, examine, and if need be improve, all knowledge and skills of a living agent and in doing so gradually upgrade one's unexamined and more or less accidentally acquired 'mental content 1.0,' into a critically examined more empowering 'mental content 2.0.' This is what Perry (1998) describes as a key feature of the liberally educated mind and Van Rossum and Hamer (2010) mean by crossing the epistemological 'watershed.' Whatever it is called: it contributes, most effectively, to the agentic essence of optimizing future long-term viability through improved action selection.

Example 3: Intelligence and Power versus Understanding and Wisdom

The concept of 'understanding' has emerged a number of times in this paper. Interestingly, well-developed understanding was always associated with the co-creation mode. Apparently well-developed understanding is not characteristic for the coping mode of cognition. However, due to the coping mode's focus on the solution or mitigation of pressing problems, the concept of 'intelligence' is definitely a key feature of the coping mode of cognition. Well-developed intelligence, as measured by an IQ-test, *reflects the capacity to solve problems with known and fixed outcomes (which are therefore closed-world problems)*. This leads to the supposition that 'intelligence' manifests itself as the ability to solve or otherwise address pressing problems within a specific known domain.

In contrast, well-developed 'understanding' should, conforming with the logic of the co-creation mode, manifest itself as the *ability to create, maintain, and influence many aspects of one's habitat with pervasive and long term flourishing as objective and measure-of-success.* Unlike intelligence, understanding is an open-world competence. Where intelligence is ideal for problem solving in known, fixed, and bounded contexts, understanding develops as one learns to grasp the general and invariant structures of unconstrained reality.

Coping is not only about solving problems, it is also about preventing an ill-understood world from spinning out of control, i.e., making it more stable and predictable. It is therefore about "the ability to produce intended outcomes": the definition of 'power' as proposed by Bertrand Russell (Russell, 1938). In Learning Autonomy, we summarized Sternberg's (1998) definition of wisdom as "the ability to produce broadly beneficial desired results while taking the full consequences of behavior on the habitat into account." This suggests, in the context of this paper, to define power as "the ability to produce specific (often complexity reducing) intended results in a certain bounded environment without taking the full consequences of behavior into account."

This then leads to two sets of concepts pertaining to the core cognitive processes related to how individuals create, maintain, or influence their habitat, i.e., how authoritative they are as individuals (Andringa et al., 2013). The set associated with the *coping mode* is deficiency or need driven and aims to exploit (to satisfy a pressing need) or to control (to reduce the complexity) the environment. In this mode 'being authoritative' means 'exercising power' and its key cognitive ability is 'intelligence.' The set associated with the *co-creation mode* is about the creation of a future in which it is easy to satisfy needs and as such it aims, via participation in, discovery of, using, promoting, relying on, and dynamically stabilizing the inherent dynamics of, the Umwelt in ways that maximize 'resilience.' In this mode 'being authoritative' equals being 'wise,' which requires a deep and pervasive understanding of the self and the Umwelt, manifested as the ability to produce broadly beneficial long-term results.

The lower block in **Figure 2** visualizes the relations between these concepts. To our knowledge, this is the first time that core concepts of (human) cognition are defined from first principles (namely 'sustainability' as defining property of life). That the terms 'understanding' and to a lesser extend 'wisdom' have received little scientific attention compared to 'intelligence' and 'power' is probably another sign of modern days' narrow – coping mode associated – focus.

Example 4: Haidt's Moral Virtues

Haidt and Graham (2007) wrote a well-known article with the title "When Morality Opposes Justice: Conservatives Have Moral Intuitions that Liberals may not Recognize." They argue that in the USA liberals typically recognize care (e.g., harm–prevention),

and fairness as two key moral concerns. But, according to Haidt and Graham (2007):

> Conservatives have many moral concerns that liberals simply do not recognize as moral concerns. When conservatives talk about virtues and policies based on the ingroup/loyalty, authority/respect, and purity/sanctity foundations, liberals hear talk about theta waves. For this reason, liberals often find it hard to understand why so many of their fellow citizens do not rally around the cause of social justice, and why many Western nations have elected conservative governments in recent years.

Why are liberals generally oblivious of the moral motivators of conservatives? We propose that liberals make moral judgments using only the logic of the co-creation mode of cognition, while conservatives do not fully trust on the outcomes of the co-creation mode and default to varying degrees of the coping mode logic. The result is that conservatives seem to use $2 + 3 = 5$ moral virtues, while liberals rely on only two.

Haidt and Graham (2007) justify their five foundations of morality from an evolutionary point of view, but they do not go back further than mammalian care for young, and primate behaviors. We, of course, argue that the true foundations of the $2 + 3 = 5$ pattern of moral virtues can be found in the unicellular level cooperation virtues that we summarized in **Table 1**. In this table we formulated two cooperation virtues (care and fairness) that aim to dynamically stabilize the environment through preventing individuals from slipping into the coping mode. In particular we noted: "empathy might therefore be understood in its original form as the ability to understand and be influenced by the state of the whole environment." which translates as a concern for the state of and in particular the (potential) suffering of others and the environment in general.

However, for living agents that are in the coping mode we listed three more virtues for cooperation (ingroup loyalty, ingroup-role adherence, and self-imposed ingroup-rationality constraints) that allow ingroups to function as an effective and coherent whole. So we have a similar $2 + 3 = 5$ pattern and indeed very similar sounding virtues. **Table 2** provides our interpretation of the moral virtues given the logic of the coping and the co-creation mode. Note that we interpret "harm/care" as generalized empathy, which we defined earlier as "the ability to understand and be influenced by the state of the whole environment." Together with "fairness/reciprocity" this allows the implementations of "need inequality minimization" as key strategy of the co-creation mode.

The first column of **Table 2** provides Haidt's and Graham's moral virtues and their descriptions (Haidt et al., 2009). The second column gives our more generic interpretation of the moral virtues by connecting them to the cooperation virtues that we defined in **Table 1**. The third and fourth columns indicate the degree to which the moral virtues are valued given the logic of the conservative or coping mode and the logic of the liberal or co-creation mode.

In this fourth example we showed that unicellular level cooperation virtues seem to be, as we predicted on the basis of the Rule of Conservative Changes, fully preserved in the pattern of (human) moral behavior. And again the distinction between the coping mode and the co-creation mode is the defining factor.

TABLE 2 | Haidt's moral values (first column) compared to conservative and liberal morals.

Virtue	Interpretation	Conservative Coping mode	Liberal Co-creation mode
(1) Harm/care Basic concerns for the suffering of others, including virtues of caring and compassion.	Generic. Requires the ability to understand and be influenced by the state of the whole environment and the individuals in it.	Valued, but typically more for ingroups and on short and medium timescales, not a virtue extended to outgroups in times of anxiety.	Highly valued liberal key virtue, extended to unknown others, even in times of conflict.
(2) Fairness/reciprocity Concerns about unfair treatment, inequality, and more abstract notions of justice.	Generic. Requires understanding of adverse consequences of inequality.	Typically valued to prevent problems with unfair treatment of self or ingroup if not adequately justified. Not relevant for outgroups in times of anxiety.	Highly valued liberal key strategy, basis of mutual cooperation, extended to unknown others, even in times of conflict.
(3) Ingroup/loyalty Concerns related to obligations of group membership, such as loyalty, self-sacrifice and vigilance against betrayal.	Specific for (sub-)culture. Aimed at protection of one's (sub-)culture	Valued because the ingroup is the only environment in which one is adequate. Protecting and safeguarding the group is a form of complexity curtailment.	Somewhat valued, however the (in)groups are not sacred and to be protected at all costs.
(4) Authority/respect Concerns related to social order and the obligations of hierarchical relationships, such as obedience, respect, and proper role fulfillment.	Specific for (sub-)culture. Aimed at complexity reduction through maximizing centrally controlled behavior.	Valued since authorities are the ones who are responsible for a personal feeling adequacy and social complexity management.	Somewhat valued, however the need for authority is indicative of an unnecessary dependency (a weakness to be overcome).
(5) Purity/sanctity Concerns about physical and spiritual contagion, including virtues of chastity, wholesomeness and control of desires.	Specific for (sub-)culture. Self-imposed complexity reduction through minimizing deviant and group-eroding behavior.	Valued virtue associated with norm adherence and especially resistance to temptations to violate norms.	Somewhat valued virtue, however, it should not prevent opportunities for exploration and growth.

Example 5. The Role of Positive Emotions

The co-creation mode is associated with autopoietic success and, by extension, the co-creation mode of cognition in humans is associated with human thriving. Thriving is not a fixed or stable state of being. On the contrary, it is a dynamically developing process of succesfully fostering, cocreating, and maintaining relations between individuals and their environment to fully satisfy immediate and future needs alike. Yet for all its inherent complexity, reaching and maintaining thriving states should be the most natural thing to do: it is what life aims for, it is life's measure of success. So what are the drivers and motivators of succesful living? One definite candidate is the set of positive moods and emotions. While negative moods and emotions are associated with states we want to avoid or end, positive moods and emotions are associated with states we actively seek or aim to perpetuate. This subsection investigates whether our understanding of positive emotions complies with the structure and role of the co-creation mode of cognition.

"Relative to negative emotions, positive emotions are few in number and rather diffuse (Fredrickson, 1998)," which makes sense because unlike the coping mode's clear need satisfaction goals and focused activities, the co-creation mode is not immediately need driven, but associated with the discovery and maintenance of relations with other individuals and the habitat as a whole. We expected that the role of positive emotions could be framed in terms of the coping and co-creation mode, and indeed Fredrickson's Broaden-and-Build Model of Positive Emotions (Fredrickson, 1998; Fredrickson and Branigan, 2005) does just that. In fact Fredrickson and Branigan (2005) frame negative and positive emotions surprisingly similar to our description of the coping and the co-creation mode. They write:

> Whereas many negative emotions narrow individuals' momentary thought-action repertoires by calling forth specific action tendencies (e.g., attack, flee), many positive emotions broaden individuals' momentary thought–action repertoires, prompting them to pursue a wider range of thoughts and actions than is typical, e.g., play, explore, savor, and integrate (**Table 2**).
>
> Whereas the narrowed thought–action repertoires of negative emotions were likely adaptive to our ancestors within specific threatening instances, the broadened thought–action repertoires of positive emotions were likely adaptive over the long-run. Broadened thought–action repertoires gain significance because they can build a variety of personal resources.

This coheres our description of the core function of the co-creation mode that we described in **Figure 2** as "Discovering, using, promoting, and relying on the inherent dynamics of the environment (promoting resilience)" for which the development of understanding is characteristic. Positive emotions spur us to engage in our environment, to learn its properties, and stabilize it through participation. The description of the four positive emotions that Fredrickson and Branigan (2005) describe in detail complies with this. In **Table 3** we present representative quotes pertaining to 'joy,' 'interest,' 'contentment,' and 'love' and interpret the quotes in terms of the co-creation mode.

Interestingly, in a more recent paper Cohn et al. (2009) study the term 'ego-resilience' which they describe as "a fairly stable personality trait that reflects an individual's ability to adapt to changing environments." They conclude, in complete agreement with our discourse:

TABLE 3 | Positive emotions and the co-creation mode.

Positive emotion	Description in relation to building and broadening of thought-action repertoire. All quotes from (Fredrickson, 1998)	Interpretation in terms of the co-creation mode.
Joy	*Joy, then, not only broadens an individual's momentary thought–action repertoire through the urge to play, but also, over time and as a product of recurrent play, joy can have the incidental effect of building an individual's physical, intellectual, and social skills.*	Play; exploring and learning to rely on the inherent dynamics of the environment.
Interest	*The momentary thought-action tendency sparked by interest, according to Izard (1977) is exploration, explicitly and actively aimed at increasing knowledge of and experience with the target of interest. Interest generates "a feeling of wanting to investigate, become involved, or extend or expand the self by incorporating new information and having new experiences with the person or object that has stimulated the interest."*	Discovering and exploring experiences and sources of knowledge in the zone of proximal development (cf Vygotskiĭ, 1978)
Contentment	*Contentment, one could argue then, is not simple passivity, but rather a mindful broadening of a person's self-views and world views. Moreover, contentment appears to be the positive emotion that follows experiences that Csikszentmihalyi (1990) described as flow (described in connection with joy): "when the flow episode is over, one feels more 'together' than before, not only internally but also with respect to other people and to the world in general.... The self becomes complex as a result of experiencing flow."*	Process of consolidating newly discovered relations to extend the scope of understanding the living-environment
Love	*In the moment, exploring, savoring, and being playful with loved ones seems to have no obvious aim other than intrinsic enjoyment. Over time, however, the interactions inspired by love no doubt help to build and strengthen social bonds and attachment. These social bonds are not only satisfying in and of themselves, but are also likely to be the locus of subsequent social support. In this sense, love and the various positive emotions experienced in love relationships (i.e., interest, joy, and contentment) build and solidify an individual's social resources.*	Developing and nurturing strong long-lasting bonds of trust and reliance to dynamically stabilize the (shared) environment.

> Positive emotions are a powerful source of growth and change, predicting both individuals' judgments about life and their skills for living well. [. . .] it is not sufficient to appreciate or approve of one's life in a general way; lived experiences such as joy and interest are what start the process of exploring, learning, connecting, and ultimately building new resources. Those resources can later improve one's life, offering up new opportunities for enjoyment and resource building.

As is typical for Psychology, this deep insight, associated with resilience buildup, could have been generalized to the role of the co-creation mode of cognition as we have defined it. Yet it is not. Psychologists (and other specialist) have been trained not to venture outside of the bounds of their discipline. Which brings us back to the call topic.

Prospects for a 'Modern Synthesis' in the Sciences of the Mind

> *True, true, with no room for doubt, certain, worthy of all trust.*
> *See, the highest comes from the lowest, and the lowest from the highest; indeed a marvelous work of the tao.*
> *See how all things originated from it by a single process.*
> First three lines of a hypothetical original of the Emerald tablet of Hermes (Needham and Ping-Yu, 1980).

"As above so below" has been a valuable truth in esotericism and alchemy for many centuries. We have used the Rule of Conservative Changes to connect the "lowest and oldest" with the "highest and newest" and in doing so we have formulated life's capacity to survive and thrive as the process that not only originates all of the biosphere, but that also defines human behavior. Starting from the unity of existence is, in our opinion, just as valuable today as was for the ancient minds that tried to understand the diversity of existence.

Starting from the unity of existence might be the only, and actually perfectly logical, method to avoid the fragmentation of knowledge so characteristic of modern day Psychology (Newell, 1973) and other fields of science. Yet the fragmentation of knowledge underlies the need for call topics like the current one: "Prospects for a 'Modern Synthesis' in the sciences of the Mind." As we noted in example 1, our Western "left-hemispheric" – coping – world-view favors a narrow focus over the broader picture, specialists over generalists, fragmentation over unification, and knowledge and intelligence over experience and wisdom. For science this is also the case. To quote Einstein, "Problems cannot be solved with the same mind set that created them."

Although we hope that this paper is an example of the strengths of the coping mode (i.e., the scientific method), it did essentially depend on the co-creation mode of cognition and more specifically on the positive emotions that guided us through the process. It was the *joy* of playing with the concepts and results of other thinkers that motivated us and kept us going in the absence of tangible results. It was our *interest* in phenomena just out of reach and in tantalizingly vague associations between disparate fields of science that gave us direction. And we felt *contentment* after hours of flow as a sign of achievement without us being able to specify what we actually had achieved. Finally, our *friendships* allowed us to be scathingly critical and supportive at the same time, to be patient with each other's inability to formulate gut feelings in a clear manner, and turn this into a collaborative project.

Although not generally acknowledged, these positive emotions, motivations, and gut feelings are a normal part of science (Scheffer, 2014). They should become a *central* part of science if we really want to pool the insights and wisdom of (among others) scientists to allow us realistic "prospects for a conceptual synthesis or convergence of research focused on understanding mind and mindedness" (cf the call text).

What is probably not (yet) a normal part of science is our disrespect for arbitrary disciplinary boundaries. If the aim is a unity of science, it makes little sense to start with arbitrary (or opportunistic) disciplinary boundaries and then hope that one or a few new disciplines or research hypes will, uncharacteristically, not add to more fragmentation but lead to unification instead. Just as unlikely is some sort of "miracle" or super insight that allows us to mentally reconstruct a city by combining the rubble of more and more individual buildings.

Instead we argue for a complementary approach: a search for unity based on the essential and the invariant. We should start with the unity of existence and add detail only when we know how the details relate to the whole. Of course we do not know what is most essential and invariant. Yet, as the quote above suggests, we are also not fully unaware. What is really essential and invariant has influenced life in general and humanity in particular over its existence. The essential and the invariant define us and are as such coded deep in each of us. In fact our Western culture, for all that it brought us, might have obscured the essential and allowed us to live according to the logic of the coping mode while maintaining the illusion that we thrive and understand our existence (McGilchrist, 2010).

In this paper we used the Rule of Conservative Changes and the defining properties of life as invariant 'truths" that allowed us to come up, among other connections, with the concept map in **Figure 2** that connects and specifies a number of core concepts of the behavioral sciences. While we expect that these two concepts are "pretty essential" and as such highly productive, we do not yet dare to claim that they go to the very core. This requires much more work, and probably reformulations of concepts and a sharpening of our reasoning. It needs a lot of reflecting and wrestling (playing actually) with results, insights, and hunches to make them all fit. Above all it requires the freedom and friendships to do so.

Finally, to answer the question that we started with: the origins of "the capacity to live life to the benefit of self and others" are not uniquely human. These originate in the defining properties of life and more explicitly in the inability of early life to evaluate its state separately from its environment. This "original

perspective" allowed life to improve its own state by contributing to an easier-to-live-in environment and eventually to the creation of the biosphere. In humans this holistic understanding is preserved as empathy and wisdom. And although wisdom is still informing our ethical and political choices, it has to compete with pressing demands and the coping mode's intelligent exploitation of environmental utility. Yet if intelligent power play wins too often it will destroy our environment as an adverse side effect. Only our "inability to separate us from our environment," and the wisdom it leads to, can prevent this.

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The neurosciences and the search for a unified psychology: the science and esthetics of a single framework

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The search for a so-called unified or integrated theory has long served as a goal for some psychologists, even if the search is often implicit. But if the established sciences do not have an explicitly unified set of theories, then why should psychology? After examining this question again I argue that psychology is in fact reasonably unified around its methods and its commitment to functional explanations, an *indeterminate functionalism*. The question of the place of the neurosciences in this framework is complex. On the one hand, the neuroscientific project will not likely renew and synthesize the disparate arms of psychology. On the other hand, their reformulation of what it means to be human will exert an influence in multiple ways. One way to capture that influence is to conceptualize the brain in terms of a technology that we interact with in a manner that we do not yet fully understand. In this way we maintain both a distance from neuro-reductionism and refrain from committing to an unfettered subjectivity.

Keywords: unification, psychology, methodology, neurosciences, science studies

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Will the Neurosciences Save Psychology or Can We Finally Give up the Search for a Single Framework?

In *The Shaking Woman* novelist and essayist Siri Hustvedt (2010, p. 3) described her experience of giving a talk in honor of her father some years after his death,

> Confident and armed with index cards, I looked out at the fifty or so friends and colleagues of my father's who had gathered around the memorial Norway spruce, launched into my first sentence, and began to shudder violently from the neck down. My arms flapped. My knees knocked. I shook as if I were having a seizure. Weirdly, my voice wasn't affected. It didn't change at all. Astounded by what was happening to me and terrified that I would fall over, I managed to keep my balance and continue, despite the fact that the cards in my hands were flying back and forth in front of me. When the speech ended, the shaking stopped.

Hustvedt (2010) describes her journey in coming to an understanding of this strange phenomenon, aptly captured by the subtitle of the book "a history of my nerves." Moving through the worlds of neuroscience, psychoanalysis, psychology, psychiatry, and history, no one of them singly ever explains her strange experience. Of course the narrative is what matters in such accounts, the search through a contemporary knowledge of the brain and/or the mind, depending on one's orientation, for a solution that no discipline by itself can easily muster. Instead, it becomes a story of how a self mysteriously aligned with a brain makes sense of unusual or difficult experiences. Such narratives are numerous; they populate not only the works of such well-known authors as Oliver Sacks, but constitute a genre by itself—the "brain memoirs" (Tougaw, 2012).

Variants of illness narratives, these accounts are important for helping us understand the explosion of science as well as its limits. For if there were a straightforward neurobiological explanation there would be less of a detective story to tell and we would have more of a straightforward illness narrative instead.

What these narratives provide by way of a subplot is the failure of the mind/brain sciences to understand the complexities of the non-representative and non-standard case. But for authors, such as Hustvedt, who have immersed themselves in the philosophy and science of the brain, there is a keen awareness of the various sciences grappling with its subject matter. Such brain memoirs make fascinating reading not only for the overlapping questions of a self and its brain, but of the sciences of those selves and brains that are forever tripping over themselves to make the necessary connections between that self and that brain. And there are those who are now quite confident that the solution to all such mysteries lies in these brain sciences. Indeed, once remote and inaccessible, it now appears to certain authors, psychologists, and neuroscientists (Churchland, 2007) that the brain will soon integrate the various elements of psychology into a coherent science—finally a dream come true, one that has been articulated from the time of Julien de La Mettrie through to Karl Pribram and Antonio Damasio, and perhaps even Nikolas Rose. If we have seen this optimism before, it is likely because other projects were announced with equal optimism– behaviorism, cognitivism, and evolutionary psychology to name but a few. However, before I address these claims, I wish to ask instead what previous attempts at a grand synthesis have left us, and how much faith one ought to place in such attempts, for it is faith indeed that is required. Then I would like to dispel any entirely negative case by noting that certain kinds of synthetic frames can't help but emerge from the neurosciences. The task is not to reject them but to understand and utilize those frames as appropriate tools.

Modern Synthesis?

The possible options that qualify for a "modern synthesis[1]" seem more numerous today than even 30 years ago, when a version of evolutionary theory in its infancy, was one candidate. Psychology was largely dominated by a representationist and computational science of cognition. Do any of these, once hailed as revolutionary options, come close to providing us with a synthesis? This is a question that cannot be answered to any degree of satisfaction and we are far too early in the game to come to such a conclusion. It will be helpful, however, to consider other recent attempts to "unify" psychology. These will be useful for judging the adequacy of any particular attempt at "synthesis" be it neuroscientific or otherwise.

Let me make a simple claim at the outset. Historically sciences have 'synthesized', if at all, or become more or less integrated when they have found a problem or set of problems that promised resolution around some conceptual–methodological framework. Newton's *Principia* is the token example and became a model for all subsequent attempts to resolve the question of just what a science ought to do to build a coherent framework. The many "Newtons" in natural philosophy who attempted to bring some rapprochement to the question of mind (think Kant and Hume, for example) only solidified this goal of a unified, mathematized vision of a science to which all should aspire. The messier biological sciences were never taken to be an aspirational model, although the modern synthesis in biology that united population biology with Mendelian genetics in the first half of the 20th century comes a close second (Mayr, 1942).

Nonetheless, it should be obvious that even after such unifications or syntheses the sciences in question did not fall into line. Physicists continued to argue, as did chemists and other practitioners of the new sciences in the 19th century. Hence, a synthesis was often a broad framework or set of problems that provided the necessary grounding for groups of scholars and scientists to proceed with the work of clearing the ground for further research. In the Kuhnian tradition, this came to be known as "normal science", that is the science that carries on solving puzzles that might remain while some set of larger questions have been acceptably resolved (Kuhn, 1962/1996). So-called "revolutions" according to Kuhn (1962/1996) were major breakthroughs in the way in which science constituted its subject matter. Although Kuhn's (1962/1996) version of this has in retrospect appeared overly simplistic and has been thoroughly debated, the question remains of just how major shifts in science occur and if they are at all predictable. For example, Mendeleev's contributions to the table of elements not only appeared to "unify" chemistry but created the framework for discovering other elements that were not yet included in the table and would continue to be added to it—as they actually were as recently as only a few years ago. But not everyone is happy with the table of elements, for example earth scientists have found the traditional table to be quite limited in its applicability to geochemistry, mineralogy, aqueous chemistry, and related sciences. Hence these sciences have structured the table quite differently, often repeating elements and organizing these by charge (Railsback, 2003). In short, while working out of a "synthesis" such a synthesis is never totalizing, or complete. It shapes the established sciences by framing a broad consensus but any aspect of that consensus could break open at a moment's notice under the right conditions.

It is obvious that the human sciences have never had such a stable framework. One might argue that the very idea of a human science, and a science of psychology in particular, was made possible by virtue of its ability to ignore much of what was relevant and important to human subjectivity by focusing, as Wundt originally had it, on the most simplified forms of human activity in the realm of perception and sensation. Already in the late 19th century the German debate about the relative importance of *verstehen* vs. *erklären* indicated a deep divide between what would inform, in part, a distinction between the human and natural sciences. Can one ever explain primary experience, consciousness and the like or are we, as participants in the phenomena we wish to explain always laboring on the margins of what is better understood from

[1]The phrase "modern synthesis" is of course a reference to a term coined by Huxley (1942) who along with numerous others combined genetics with population biology to create the conditions for this synthesis. I am using it here in this sense, the unification of disparate elements into a single unified framework or theory.

the first person perspective? When Snow (1959) turned his Rede lecture into an influential book (*The two cultures and the scientific revolution*), the divide between what we may call two fundamental forms knowing was considerable[2]. Psychology has continually attempted to straddle that divide, with occasional successes but largely with an inability to address the interpretive nature of human subjectivity at the expense of finely honed studies that address questions manageable or manufactured in the laboratory (Gergen, 1973; Robinson, 1985; Stam, 2012).

Every major development in the history of 20th century psychology has sold itself as a complete psychology. From behaviorism to evolutionary psychology through cognitive science and its multiple variants, the promulgation of a vast new theoretical framework was often accompanied by broad claims for its ability to be an absolute psychology. The failure of these projects was sometimes grand, as in the case of behaviorism, but often took the form of a disappointment that slowly led to the abandonment of whatever research models and projects were at hand. Business as usual in psychology was a "business" of determining just what constituted the phenomenon under investigation. This led to debates about intellectual territory, ideas, but most often, practices. For it was in the practice of psychology that the greatest advancement was to be found, the technologies of testing, behavior modification, therapy, counseling, personnel selection, and so on. These practices made enduring inroads into public acceptance and gradually managed to convince contemporary liberal democracies that psychology was an important if not always exact science that had much to offer in the form of technologies of classification, theories that focused on individuals as sources for problems of living, and general forms of practice the fit well with industrial and post-industrial societies. Hence while academic and research psychologists continued their long argument, applied psychologists got down to business and took care of their charges in clinics, schools, factories, offices, government, and elsewhere (Leary, 1987). It is not surprising then that contributions to theory were sometimes the outcome of broader changes in applied areas (e.g., the advances in statistical tools and interpretations derived from them that originated in applied fields of testing). This while psychologists in charge of the training of neophytes in the academies could not agree exactly on the nature of their science, nor on the precise mechanisms of intervention in the world.

This history is well known and I have merely given a brief summary here (Bühler, 1927; Vygotsky, 1927/1987; Koch, 1959–1963). But it has meant that from time to time there have been attempts to "unify" psychology under some banner or other so that, at the very least, the stories told to the public by both academics and practitioners would match. The claim is that psychology is not unified and this hurts both its practitioners and its status as a science (Staats, 1991; Henriques, 2008)[3]. A quick and simplistic comparison is then drawn with the natural sciences wherein physics is taken to be exemplary but even biology will do as a standard. This is then contrasted to psychology's squabbles and the lack of a consensus on the status of just what is scientific and what counts as pseudo-science and, goes the argument, it is high time to clean up the mess. Some one or another scheme is then proffered for replacing many small but recalcitrant theories in the discipline and this over-riding scheme is usually packaged as superior because of its ability to unite, provide a foundation, or otherwise cohere the many strands that make up the contemporary discipline.

Although not numerous, such schemes usually include a list of reasons why this is a problem or why psychology is a "disunified science" in Staats's (1991) words. After some broad generalizations, lumping all areas of psychology together, a wide variety of propositions or arguments have been put forth to unify the discipline. In Staats's (1994) case, this was a "unified positivism" or a "psychological behaviorism" depending on what phase of Staats's career one is reading. Ultimately it was an attempt to fuse multiple areas and features of psychology into a single "unified science." Others of more recent vintage have attempted to keep these projects alive, or at least to put their personal stamp on such a project for every unification project seems to require that its proponent think through the problem anew. In recent years, Sternberg and Grigorenko (2001), Goertzen (2008) and Henriques (2008) among many others have continued to write on these questions, providing variations on the problem (is there a "crisis" of unification?) and offering numerous solutions (e.g., the "tree of knowledge,"—Henriques, a "unified psychology approach"—Sternberg), and so on (see Stam, 2004 for one critique).

The problems with these projects are (i) they are not responses to genuine problems in psychology but an attempt to impose order on disorder from an abstract vantage point, (ii) their relationship to empirical research is thin, and (iii) they rarely amount to more than a singular project or a personal vision of some abstract structures and/or institutional and political processes that might solve the so-called "crisis of disunification" (Green, 2015). But all of these, it is important to note, have also been proposed at a high level of abstraction without solving any particular, single, concrete problem in the discipline. Indeed what characterizes such projects is their considerable remove from the world of minute, everyday psychological phenomena.

To understand the way in which a modern synthesis might work it is important to understand first how it will *not* work. It is quite clear that all attempts at unification have been failures for multiple reasons. First, no serious science has ever been "unified" (assuming we actually know what this means), by a de facto decree. The history of science, however, is replete with examples, as noted above, of sciences that have coalesced around real problems that were genuinely altered by new methods, techniques, and theories that slowly—or quite suddenly—opened up new ways of examining traditionally recalcitrant problems. The closest to the sciences of the mind that might be relevant for all future investigations of syntheses is biology. It found its professional voice in the 19th century following the gradual acceptance of Darwin's theory of natural selection and then found

[2]It was Koch (1964) who noted in a rather wistful manner that psychology seemed entirely untouched by the debate unleashed by Snow's (1959) thesis of the divide between the humanities and the sciences.

[3]It should be noted that there are very straightforward claims to the contrary, namely, in favor of something like explanatory pluralism of the sort expressed by Dale et al. (2009).

new momentum in the 20th with, as noted, the modern synthesis, or the combined forces of population biology and genetics which supported a broad understanding of evolution (Mayr, 1942). Nonetheless, in biology unification is still far off even if this has not prevented certain strategies of integration (Mitchell and Dietrich, 2006). This distinction between unification and integration is useful for the integration is based on actual empirical problems and examples, whereas unification is often an abstract proposal imposed from above. As Mitchell and Dietrich (2006, p. S78) note,

> There are multiple mechanical triggers for behavior for a complex system. Which ones are present and active may well be a function of the ecological context in which the system is located. Explaining complex, evolved biological systems is not a "one-size- fits-all" enterprise.

In comparison, psychology has more or less shifted from one project to another, never entirely abandoning what went before but attempting each time to begin again on a new footing. Behaviorism incorporated elements of functionalism just as the new cognitive psychology adopted elements of Hullian behaviorism. These were always partial appropriations, and rhetorically behaviorism differentiated itself from functionalism just as cognitive psychology differentiated itself from behaviorism. Nevertheless, these breaks were never quite as clear as they appeared on the surface. However, more to the point, as Koch (1971, pp. 690–691) noted, "as for the *subject* matter of psychology, it is difficult to see how it could ever have been thought to be a coherent one under any definition of the presumptive 'science,' whether in terms of mind, consciousness, experience, behavior, or, indeed, molecule aggregates or transistor circuits". Forgotten in all of this too is that there is no longer any center to the discipline of psychology, if there in fact ever was. To quote Koch (1971, p. 695) again, who proposed,

> that the essential non-cohesiveness of the activities denoted by the term "psychology" be acknowledged by replacing it with some locution as "the psychological studies." Students should no longer be tricked by a terminological rhetoric into the belief that they are studying a single discipline or any set of specialties rendered coherent by any actual or potential principle of coherence.The current "departments of psychology" should be called "departments of psychological studies".

Unified After All?

Despite this seeming disarray and 'disunity' of the discipline called psychology, there are in fact features that artificially but successfully have held the discipline together for more than half a century. For despite all the calls of crisis, psychology has been hugely successful if one only counts the number of psychologists plying their trade in such diverse domains as the classroom, the clinic, the workplace, and a multitude of laboratories around the world. As sociologists of the professions note, to be a successful discipline requires first, that one have a marketplace within which one can disseminate symbolic capital, second, an acceptable manner of producing knowledge, and third, a system of training to reproduce members of the discipline (Freidson, 1986). Psychology has had all three in abundance, and hence continues to thrive. But it is not enough to produce a stable discipline for, after all, phrenology also had all three but is no longer in evidence despite its immense popularity in the 19th century. We must look further then for the roots of this stability.

The other deeply rooted features of psychology that are easily reproduced even in such cases where no two psychologists agree on a fundamental framework are (i) psychology's methods and (ii) its functional interpretation of just about any and all of its conceptual elements (Stam, 2004). The first is obvious, the second is much more subtle.

First, methods have become remarkably stable in the face of continuing disagreements and debates about the subject matter of psychology. It is as if, by tacit agreement, psychologists have come to realize that methodology is what holds their discipline together in the absence of any agreed upon frames of reference, common vocabulary or shared theoretical understandings (sometimes referred to, at least since Gordon Allport, as *methodolatry*). These methods include not only the common variety of methods taught in our universities, such as those associated with experimentation and quasi-experimentation but also include the statistical tools that are symbiotic with these methods, such as the analysis of variance in all its forms, regression models in its linear and non-linear forms, and also the multiple ways of producing items for such tools as psychometric instruments. More recently it has come to include, slowly but surely, the new forms of qualitative analyses and research, such as discourse analysis, grounded theory and so on. That this constitutes a common vocabulary of sorts for much of psychology is readily appreciable when one considers that the one feature psychologists from diverse fields hold in common is their common educational history in methods classes. They may not understand what their colleagues are up to but they can still critique their faulty use of a regression analysis!

Second, the general use of functional accounts (what I have called *indeterminate functionalism*; Stam, 2006, 2015), which have impregnated almost all forms of psychological work and theorizing, has rarely been the subject of much discussion.

Without them, however, it is hard to imagine how psychology would continue to reproduce itself. This is much less obvious nor as readily acknowledged among the halls of academe or in the clinics or workshops of the psychologist. A functional vocabulary refers to the notion that we are primarily interested in the functional properties of whatever it is we are investigating, treating, predicting, or otherwise describing. This is as true for behavioral, neuropsychological, cognitive, developmental, school, social, and whatever other areas of psychology that make up the contemporary discipline (it is not, however, universally true, there are exceptions). The point is that when we describe, say, a memory as a research object we do not have a material object in mind. We mean by a memory a kind of activity that is specified in research or practice as a recallable item of some sort that was either learned as part of an experiment or that involves some restricted or constrained recall of personal knowledge or events. But there are no objects called "explicit memory," "short-term memory," "procedural memory," and so

on in the way that we have, for example, mitochondria, or aminoglycosides or even something as complex as particles in linear accelerators that are only hypothesized to exist[4]. Our functional vocabulary identifies a psychological object by virtue of its existence as a function of some set of activities. This is as true for broad categories of psychological objects as for more delimited ones such as episodic memory. Think of extraversion, which is a standard component of many personality scales and has been for at least 60 years. We determine that someone is extraverted not from their conversational skills or their unwillingness to stand up and speak in public, but from their avowal or disavowal of items on a standardized personality inventory such as "I talk to a lot of different people at parties[5]." In the act of agreeing with such items we come to recognize the object "extraversion" and assign it to individuals as an aggregate score whose value lies in its status as a normative score on some dimension, that is, a score that then allows us to compare this person to others who have responded to the same questions.

Thus far this is rather mundane if not obvious to students of psychology. How could it be otherwise one might ask? Well, various attempts have been made to provide more certain foundations for the choice of psychological objects, either in the form of a serious materialist reductive program, a radical behaviorist program or certain versions of cognitive psychology. Wouldn't it be more stable if all psychologists ceased relying on any "verbal report" and instead chose to rely strictly on behavioral indices. Unfortunately the history of behaviorism has shown us that "behavior" is equally interpreted. When does a movement constitute behavior? How do we distinguish aggressive behavior from nurturing behavior except through a series of interpretive functional accounts we create in research studies. Suffice it to say that the vast majority of psychological theorizing takes place in the form of a functionalist framework, carrying on a long tradition that has its origins in 19th century physiology. On that score Wundt was certainly original insofar as he was able to bend the vagaries of certain psychological properties to his will by subjecting them to an experimental investigation and a functional account.

There is an obvious benefit to the way in which functional accounts are structured: the inherent flexibility of such accounts makes it possible to rapidly expand one's theoretical armamentarium. For example, there are several hundred different kinds of memory (Tulving, 2007), dozens of types of personality scales with different numbers of not items but factors, innumerable variables under investigation in social psychology such that researchers have specialized in a few in their limited domain since no one can possibly grasp the whole, and so on. I can do a study on psychological factor x and decide legitimately that x is really not one but two factors, so I create x' and y'. Someone else continues in this research and adds another variable to this configuration that is presumably responsible for both x' and y', and calls it z''. And before long we have not just a difference between episodic and semantic memory but also a distinction between declarative and procedural memory, explicit and implicit memory, short-term and long-term memory, and so on. Not that memory researchers start out with a single system and branch out, but that given any kind of memory, it is not difficult to refine and distinguish another memory based on variations in procedures used to elicit the memory.

It should be obvious that the inherent flexibility in identifying new functions that can be created in a research settings and then named as part of some functional account is not just important for its flexibility but is a process that can be carried on indefinitely.

There is no in principle limit to the kinds and number of functional ascriptions possible. Note that this is not a statement about the limits of science. There is also no in principle limit to the kinds and number of elements in the periodic table of elements. However, there is both a theoretical limit and an empirical constraint on just how large such a table can be despite the many additions to the table since Mendeleev's time. In psychology, the empirical constraints are missing, one can always devise a new procedure in one's research that will bring the new function into existence. One can devise, for example, a new memory task that will allow for the demonstration of a new form of remembering.

And the procedure of expanding the kinds of memories that exist would simply move forward. In that case we cannot speak of 'empirical adequacy' as it is sometimes used to describe a key characteristic of science. For the empirical procedure that calls the function into existence (e.g., episodic memory for events and experiences) is the same as the criterion of empirical adequacy, which demonstrates the fact of episodic memory. We are caught in a vicious circle since we have no ontological *a priori*.

It is generally assumed that functional accounts keep from slipping into dualism by virtue of their appeal to a series of promissory notes whose claim is that, eventually, a truly reductive account will reveal all. And memory researchers have, of course, provided numerous neurological candidates for various memory models (Eichenbaum and Cohen, 2004; Aggleton and Brown, 2006; Cohen, 2015). Hence, indeterminate functionalism could be made more determinate by fixing certain categories to neurological structures. This is after all one aim of cognitive neuroscience. It should be noted, however, that even when 'fixed' in this manner functional categories remain ambivalently indeterminate by virtue of the fact that they exist as procedures, not as objects.

In short, between our methods and our functional vocabularies and explanatory strategies, psychology is much more unified than seems the case on the surface. But it is also relatively incoherent; since that is what I think is often meant by "disunified." The incoherence is the direct outcome of a lack of agreement on just what psychological objects are and how we might define them. Our functional strategies allow us to define new variables ad infinitum. Psychology appears to be all epistemology without a clear ontology.

[4]I am grateful to a reviewer who noted that different memory systems have been proposed for very different purposes. These systems do not always compare easily and hence lack an overarching framework.

[5]This is a hypothetical example.

Applied Psychology: Applications of a Science?

Although this may seem a different question altogether, one driver of the flexible research programs that psychology promulgates has been the rather lopsided relationship between researchers and practitioners. The vast majority of psychologists currently active in the world work as practitioners. This means that they could be anything from clinical psychologists, counseling psychologists, educational psychologists, personnel psychologists, military psychologists, industrial psychologists, or a host of other applied professional psychologists working in varied settings. Numbers here are dubious, given that no one body is responsible for, or concerns itself with, tracking exact global numbers for professions. However, given that at least a quarter of psychologists in the world live and work in the US (about 160,200 by last count, Bureau of Labor Statistics, 2014), the vast majority (up to 90%) is estimated to be engaged in clinical, counseling or school activities or in health service provider and industrial–organizational activities.

These numbers generally reflect trends in the North Atlantic regions and demonstrate that psychologists who dominate the discipline are little concerned about the arcane features of academic debates that interest those in universities and research-only settings. It should be clear that practicing psychologists receive their education in universities but are generally not beholden to such principles as promised by a "scientist practitioner" model or the more recent minority view, the "clinical scientist" model. The question then is, can there ever be a genuine intellectual revolution that will provide a kind of synthesis for this wide range of activities. Koch thought it was an impossible task since there was no single discipline to unify. I wish to enquire what the neurosciences might offer.

The Neuroscientific Synthesis

The spectacular advances in imaging techniques made possible by not only the refinement of electroencephalography (EEG) measures but by the addition of positron emission tomography (PET), computerized tomography (CT), optical tomography and functional magnetic resonance imaging (FMRI) scans has greatly advanced the "visibility" of brain processes even though each of these techniques are dependent on sophisticated statistical and constructive mathematical and computerized processes. These have gone with equally swift advances in research in the neurosciences, but as numerous "neuroskeptics" have pointed out (eg., Boekel et al., 2015), the science is hardly optimal and replications often fail. We are a long way from understanding just what the brain does and how it does it, but there is a general optimism that the neurosciences will save psychology and psychiatry from the repeated adoption of fad-like theories that are typically discarded after one or two generations (Bickle, 2003; Caruso, 2012; Reardon, 2014; but see Machamer and Sytsma, 2007). That optimism notwithstanding, the neurosciences indeed are a formidable interdisciplinary, multipronged and richly funded matrix of research, tools, and practices whose imagery creates at least the appearance of a science slowly but surely removing the veils of ignorance that have kept us from understanding ourselves.

And as Wittgenstein noted in a different context, it is just such an image that can hold us captive.

The question here is to what degree can the neuroscientific project renew and synthesize the disparate arms of psychology? Although popular books and articles appear at a steady rate, we are far too early in the game to provide any kind of answer to this question. What the neurosciences are unlikely to do is mimic their colleagues in evolutionary psychology, which has gone through a rather marked decline in the past decade. Following the revival of sociobiology under the guise of a modular evolutionary psychology (Tooby and Cosmides, 2005), it promised to be the new model for a revived integrated psychology. That this has not happened is due to many features of this new approach, not least of which is the rerun of similar issues that bedeviled sociobiology. Mostly, however, evolutionary psychologists relied heavily on the language of genetics to provide the justification for their hypotheses. Genuine genetic analyses were remarkably absent, however, from the work of evolutionary psychology (Dagg, 2005) and the recent science of epigenetics has made problematic much of evolutionary psychology's claims [for a definition of epigenetics see Berger et al. (2009)]. As is the case for most theories, adjustments can and will be made to save the theory, however, it's simplicity and purported broad applicability will suffer as a consequence.

Critics have worried that the neurosciences are either reductionist in their intent, with all of the problems that follow from this (Choudhury and Slaby, 2012), or they are subject to the mereological fallacy in which powers and activities are attributed to brains or parts of brains when these are normally ascribed to persons as a whole (cf. Bennett and Hacker, 2003; Gergen, 2010). Such critiques have their place, for surely much neuroscience is reductionist in intent. And the reductive language cannot help but fail to replace a language of meaning and intent. That is, a reductionist neuroscientific language cannot replace the reporting role of ordinary language, the language of intentions, semantics, and sentience. If it could, it would have to be as contextually sensitive as ordinary language and we would be back to where we began. However, reductive strategies for certain purposes are not only useful, as for example, in locating and treating disorders that may have their origin in the brain, but also for understanding the structure, function and neuropharmacological properties of brains.

Other critics have noted the limitations of neural processes in explaining complex social activities. For example, Coey et al. (2012) have noted that understanding the context of social interactions requires understanding their "embodied-embedded" constraints. These authors argue that the organization of human behavior, particularly its self-organizing processes, requires something much more dynamic than a neural account.

Given these limitations there will always be doubts about the overall "synthesizing" potential of the neurosciences. It would be a mistake, however, to dismiss the impact of the neurosciences on psychology and the shift that it will force on the discipline in the coming years. I take here as telling

that Nikolas Rose is ambivalent since he is generally a critic of psychology and all "psy" disciplines, that is, those disciplines that are engaged in processes that he argues are invoked in practices of "governmentality" after Foucault, that refer in particular to the creation of subjectivities through the organized practices of a society. But, according to Rose and Abi-Rached (2013, p. 21), "despite their apparent contradictions, neurobiological research emphasizing the role of non-conscious neural processes and habits in our decisions and actions can-and does—happily coexist with longstanding ideas about choice, responsibility, and consciousness that are so crucial to contemporary advanced liberal societies." That is, neuroscience has not removed from us our responsibility to be actors whose fates are not captured only by processes that occur outside awareness in our brains, but also has not lessened the requirement that we govern those forces through an endless process of self-discipline. Despite the fact that the neurosciences constitute "psy" disciplinarity by other means, it should be obvious argue Rose and Abi-Rached (2013, p. 21) that "human brains are both shaped by, and shape, their sociality". What this leads to is a discourse (my term) of neuroscience that will ultimately move beyond a neuro-reductive language to one that will address "questions of complexity and emergence, and to locate neural processes firmly in the dimensions of time, development, and transactions within a milieu" (Rose and Abi-Rached, 2013, p. 23). In other words, the picture of our brain as plastic and ultimately social is a revisionist one that can be used for multiple ends.

In a related vein both Moore (2006) and Derksen (2011) have urged an alternative view of brains and evolution. Moore argued that it is more productive to think of evolutionary psychology as the outcome of the design and production of technical systems rather than engineered mechanisms. Its originality lies in its amalgamation of so-called standard adaptationist accounts of evolution with those that are interactionist and typically critical of adaptationist accounts. It hinges on a conception of technology as a set of social relations, leading to an evolutionary psychology that can account for the emergence of mindedness and sociality (Moore, 2006). Taking the argument of biology as technology seriously, Derksen (2011, p. 844) notes along with Andy Clark that "A technological conception of the brain leads away from neuro-reductionism rather than toward it, as long as one keeps an eye on the relational nature of the mechanisms that make up the mind, and one is willing to see the extension of the mind beyond the 'skinbag' into a growing network of tools" . The brain-as-instrument is an unusual reconceptualization argues Derksen (2011) because we are both identified with our brains and treat it as something external to us. The brain as instrument is an attempt to steer between a version of personhood that makes us neither the passive bystanders of what happens in "our brain" nor does it make us able to 'use' the brain just as we will.

Perhaps a return to one of Latour's (2004) formulations might help here. Using the example of developing a "nose" for perfume he argues that what matters in learning to differentiate among many odors is the ability to *articulate* different odors after lengthy practice. It is not a question, for Latour, of determining the exact, precise chemical foundation of an odor, that is, to develop an *accuracy of reference*. As Latour (2004, pp. 210–211) argues, "the decisive advantage of articulation over accuracy of reference is that there is no end to articulation whereas there is an end to accuracy."

Transposed to the brain sciences, what a technological conception provides us with is an ever greater possibility of articulation of just what the brain is capable of, how it makes a difference in life, what it allows us to do, and so on, without having to immediately decide that one is being neuro-reductionist or that one must defend against such a stance. Instead, brains, like eyes, ears, and noses, make articulations possible in ways we have not fully realized. Again, in the words of Latour (2004, p. 226), "It is not a fight against reductionism nor a plea for the whole personal, subjective body that should be respected instead of being 'cut into pieces'." Reductionism is on his account, simply an impossibility, just as having no body is an impossibility. So rather than creating a sharp division between reductionist science on the one hand and a militant subjectivity on the other, the question of the body (and the brain) is one of articulating the multiple possibilities and positions that emerge from the new sciences, not to determine where the objective body ends and the subjective body begins (see the program for a neurophenomenology as one attempt to develop research methods appropriate to a slightly alternative strategy, e.g., Olivares et al., 2015).

What this position attempts to do is to escape from the Scylla of reductionism and the Charybdis of subjectivity. Must we, with Metzinger (2009) who, in echoing Julien Offray de La Mettrie's *L'homme machine,* proclaims that there is no self argue that we can never solve the problem of consciousness? Or must we privilege a stubborn subjectivity? What a technology or, perhaps better said, a techno-science position claims for the brain is nothing less than all there is to know about the brain. But all there is to know is not the end of the story, for what we come to know elides in multiple ways with the social world and is taken up as a problem for subjectivity. As a consequence we articulate, in Latour's sense, the world differently. Just as people articulated the world differently after discovering that a heart was better thought of as a sophisticated pump. Or when it was discovered that electromagnetic radiation of very short wavelengths could penetrate matter to become what we now refer to as X-rays, this knowledge and everything it has revealed to us about the human body has been integrated into our practical knowledge of ourselves. When an X-ray of our broken wrist is displayed, we understand that this too is a part of us—both as object and as problem. As a technology it is both distancing and revealing. It looks like something other than us, while we recognize that it also reveals who we are and is made possible by a vast network of medical practice that has shaped bodily existence in the 20th century and beyond.

The brain-as-technology question is compounded, however, if not confounded, by reflexivity. Brains are not only technology, they are us and at the same time they are not us (Dotov et al., 2010). Hence how the brain sciences become integrated into contemporary medical, psychological ('psy' disciplines), and social disciplines and practices will reveal and depend on the interests of multiple actors and interests. What they won't do is become the unifying theoretical edifice that psychologists have

dreamt of for so long. However, they can open up not only new avenues for inquiry but also reveal new ways of being human. These new ways will not just supplant our older forms of self-understanding but will likely become integrated into what we already know ourselves to be. Just as psychoanalysis did not destroy the western conception of personhood, it did open up alternative questions, modes of thinking, and moral frameworks that had not been obvious or present before psychoanalysis. Once psychoanalysis had become deeply embedded in contemporary culture there was no way back to a late-19th century view of mind and human nature, at least not for the citizen of the modern, that is, post-WWI western world. Psychoanalysis grew up with and has become ensnared in industrialized societies and as these societies shifted to broadly post-industrial, globalized forms of neo-liberalism the explanatory forms of psychoanalysis were unable to sustain the versions of personhood emerging. As the neurosciences feed into our contemporary versions of fragmented personhood, they too will elaborate, differentiate and contribute to renewed models of persons. Indeed, even psychoanalysis has become neuropsychoanalysis (Solms and Turnbull, 2011).

Perhaps the law can serve as an illustration. Neuroscience, like any science potentially, can affect legal cases wherever that science is relevant. But neuroscience has a unique role in so far as it will lead the legal system to question key notions of responsibility that are central to determinations of guilt or innocence. As Greene and Cohen (2004, p. 1775) argue,

> . . . . . neuroscience will probably have a transformative effect on the law, despite the fact that existing legal doctrine can, in principle, accommodate whatever neuroscience will tell us. New neuroscience will change the law, not by undermining its current assumptions, but by transforming people's moral intuitions about free will and responsibility. This change in moral outlook will result not from the discovery of crucial new facts or clever new arguments, but from a new appreciation of old arguments, bolstered by vivid new illustrations provided by cognitive neuroscience.

In the same way, psychology can accommodate "whatever neuroscience will tell us" but it affects so many aspects of what it is to be human that we will undoubtedly shift our conceptions of ourselves in the process. And it may be just around those moral intuitions that we will be most likely to shift.

Hustvedt (2010), in seeking an answer to her strange episode of shaking, scoured multiple disciplines and medical practices for an account of her affliction. The fact that no single one could provide her with a satisfactory account indicates just how, without rejecting a notion of something like a brain disease, it is a hopelessly incomplete explanation. It appeared to her, after the fact, as more of a "conversion disorder," but this too was unsatisfactory. And so the brain sciences, as they reshape how we view, manipulate, understand and investigate brains will also reshape our explanatory categories, but in ways we are unlikely to foresee. Hustvedt's (2010) account is so compelling because we can see the incomplete nature of the neurosciences just as that science grapples with a condition like the one Hustvedt (2010) described. And she recognizes that the condition is neither solely organic nor conscious/unconscious. It is both and neither, and we are in transition.

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