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MAPPING THE PATIENT'S EXPERIENCE: AN APPLIED ONTOLOGICAL FRAMEWORK FOR PHENOMENOLOGICAL PSYCHOPATHOLOGY

abstract

Mental health research faces a suite of unresolved challenges that have contributed to a stagnation of research efforts and treatment innovation. One such challenge is how to reliably and validly account for the subjective side of patient symptomatology, that is, the patient's inner experiences or patient phenomenology. Providing a structured, standardised semantics for patient phenomenology would enable future research in novel directions. In this contribution, we aim at initiating a standardized approach to patient phenomenology by sketching a tentative formalisation within the framework of an applied ontology, in the broader context of existing open-source Open Biomedical Ontologies resources such as the Mental Functioning Ontology. We further discuss a number of prevailing challenges and observations bearing on this task.

keywords

patient phenomenology, symptomatology, applied ontology, big data, classification

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If psychopathology is reduced to a list of commonsensically derived and simplified operational features, further progress of pathogenetic research will be seriously impeded. What is needed is a complex psychopathology capable of mediating between symptom level and process level, and of developing models of the inherent structure and possible disturbances of conscious experience.
(Fuchs 2010, p. 269)

1. Introduction

Disabilities related to mental health are among the overall fastest growing threats to global health (Patel, *et al.* 2018; Whiteford, *et al.* 2013). According to the World Health Organization, depression is "the leading cause of disability worldwide" (WHO 2017). While the growing challenge of mental health is evidently perpetuated by a number of complex and unique variables, such as limited access to efficient treatments (Wainberg, *et al.* 2017), recent observations also point to a more fundamentally troubling aspect of the problem, namely, a stagnation of scientific progress in understanding mental disease and disorder, paralleled by a halt in treatment innovation (Cuthbert & Insel, 2013; Frances, 2014; Nemeroff, 2013).

This stagnation of research progress is arguably attributable in part to unresolved issues pertaining to the diagnosis and classification of conditions and symptoms affecting mental health (Insel, *et al.* 2010; Lilienfeld, Smith & Watts, 2013; North & Surís, 2017). There is widespread disagreement on how to define and delineate psychiatric illness in general (e.g. Kendler, Zachar & Craver, 2011; Lilienfeld, Smith & Watts, 2013), how to classify individual diagnoses and symptoms (e.g. Clark *et al.*, 2017), and there is even disagreement on whether psychiatric phenomena can at all be reliably defined (e.g. Kendler, 2016; Wrigley, 2007). Aside from these unresolved issues, the current practice is to use operationalized or utility-driven tools to demarcate the scientific and clinical subject-matter, but these are contested as to their validity, i.e. their ability to reliably pick out real shared pathology (e.g. Kendell & Jablensky, 2003). If uncertainty exists on how to classify an instance of, say, depression and its individual symptoms, how would it then be possible to find a proper research sample for scientific experimentation or treatment development? Trivially, the quality of research and psychiatric efforts is directly dependent on the quality of diagnostic classification and symptomatology. One aspect of improving diagnostic classification in psychiatry is determining how to reliably and validly account for, and do justice to, the subjective side of patient symptomatology, that is, the patient's intimate experiences of her/his symptoms, often referred to as *patient*

phenomenology (e.g. Fuchs, 2010; Parnas & Zahavi, 2002; Parnas *et al.*, 2013; Patrick & Hajcak, 2016). Indeed, although psychiatric illness must be assumed to be robustly rooted in biological processes (and researchers are right to include such aspects in diagnostic classifications as far as they have been determined), psychiatric illness is qualitatively different from purely somatic illnesses in that the details of the patient's subjective experience is an unavoidable source of evidence relevant for etiological research and treatment innovation (e.g. Fernandez, 2018; Messas, Tamelini, Mancini & Stanghellini, 2018; Stanghellini & Rosfort, 2013). Put simply, where the experiences of nausea, headache and fatigue can be important indicators for the diagnosis of diabetes, they are not in themselves considered fundamental for diabetes research or treatment. By contrast, meticulous attention to qualitative differences in patient symptoms and experiences are central in demarcating the severity of a mental health condition (e.g. *how* depressed is the patient?), or to distinguish one type of disorder from another (e.g. differentiating between neurosis and psychosis).

While some aspects of patient phenomenology are included as symptoms in diagnostic classifications, the focus is usually on tracking outwardly observed behaviours. But more fundamentally, as some researchers have noted, the presiding approach to psychiatric classification is to describe its subject-matter in a third person perspective, that is, through the eyes of the healthcare professional or clinical observer (e.g. Fernandez, 2018; Fuchs, 2010; Pallagrosi, Picardi, Fonzi & Biondi, 2018; Parnas, Sass & Zahavi, 2013). So even when a diagnostic classification includes patient phenomenology, it usually does so in a simplistic observational manner that is poorly representative of the patient's actual, subjective experience (e.g. Høffding & Martiny, 2015).

According to Thomas Fuchs (2010), a consequence of lacking a sufficiently detailed description of patient phenomenology in research settings is that the gap between *symptom* and *explanation* widens. Effectively, this means that the diagnostic terminology and causal explanations that the mental health sciences yield become increasingly unrelated and detached from the patient experience, and in turn these sciences are then faced with an even harder problem of lacking tools to reliably and accurately sample patients with shared phenomenology; the very sampling cohesiveness that is necessary for genuine research development and progress. What is needed, Fuchs argues, is a precise and accurate framework that can "integrate single symptoms and neuropsychological dysfunction into a coherent whole of altered conscious experience." (Fuchs, 2010, p. 269)

In light of this consistent call for more patient phenomenology in psychiatric classification, we might ask why a systematic patient phenomenology remains somewhat peripheral in both research and clinical practices? One possible answer could be that this lack simply illustrates the underlying impossibility of developing a ready-made, systematic framework of patient phenomenology (e.g. Häfner, 2015; Ramos-Gorostize & Adán-Manes, 2013). Another answer could be that what has impeded the inclusion of patient phenomenology is not so much its practical and theoretical challenges, but instead the relative shortage of *actual* systematic standardisation and implementation efforts. Indeed, while there have been notable developments of such frameworks (e.g. Giorgi, Giorgi & Morley, 2017; Nordgaard, Sass & Parnas, 2013; Parnas *et al.*, 2005; Stanghellini, 2016; Stanghellini, Castellini, Faravelli & Ricca, 2012) these remain relatively peripheral contributions in mental health research and practice. If what is needed is a larger collaborative effort towards research and practical implementation, providing an overarching structured, standardised semantics for patient phenomenology would seem to be a step in the right direction.

In this contribution, we aim to initiate a standardised formalisation of central entities and relationships in patient phenomenology, applicable across the sciences and disciplines in mental health research and practice. We approach this standardisation effort with the method

of *applied ontology*, drawing on existing open-source resources from the Open Biomedical Ontologies (OBO) Foundry (Smith *et al.*, 2007), such as the Mental Functioning Ontology (Hastings *et al.*, 2012).

2. Background: Applied Ontologies in Interdisciplinary Research and Practice

In this section, we outline some general aspects of applied ontology, the method we propose for developing a standard for the semantics of patient phenomenology. To motivate the use of applied ontologies as a suitable method for a standardisation of patient phenomenology, we will remark on some of the interdisciplinary complexities and challenges facing the field of mental health research and practice; features that, in our opinion, make applied ontologies particularly appealing.

Mental health research and practice is a thoroughly *interdisciplinary* field. What this essentially means is that clearly demarcated scientific *objectives* such as mapping etiological processes or developing patient care programs will not necessarily rest on correspondingly clearly demarcated scientific *disciplines*. For example, uncovering the etiology of mental diseases is not a task exclusive to neurobiology, but involves insights from many other sciences, e.g. genetics, endocrinology, immunology, molecular biology, psychology, etc. Likewise, developing treatment strategies is not a task exclusively reserved for psychiatry, but must eventually be informed by the relevant aforementioned natural and behavioural sciences.

As a result of this interdisciplinarity, a shared semantics (e.g. diagnostic vocabularies) and general scientific consensus across the disciplines is needed in order for these researchers to work practically and efficiently together, insofar as these collaborations entail facilitating intercommunication and integration of research efforts. Many such standardisation efforts already exist, for example, the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5), which aims at delineating discrete classes of psychiatric signs and symptoms. The core strength of the DSM-5 is that it makes it possible for two (or more) researchers from different disciplines to communicate clearly about instances of, say, Major Depressive Disorder, given its defined signs and symptoms in the DSM-5. Thus, when empirical testing is carried out on patient samples with this diagnosis, researchers from different disciplines can then be certain (to the degree the DSM-5 is clinically reliable) that they are, as a minimum, testing people with the same type of signs and symptoms; and research results can therefore be meaningfully aggregated and analysed.

However, much of the existing interdisciplinary standardisation and consensus in the field is both imperfect and contested (e.g. Sullivan, 2017), causing real practical problems for research communication and integration (e.g. Bluhm, 2017). Indeed, in the absence of a scientific consensus, fundamental hurdles for scientific progress necessarily occur. For example, if one discipline understands the term "disorder" as an evolutionarily defined abnormality in organic tissue, and another discipline understands "disorder" as a type of clinical diagnosis, the effective result is a creation of potential misunderstandings when these two disciplines are working together. When enough of these non-shared, discipline specific idiosyncrasies are manifest in a specific subject-matter, it will eventually impede interdisciplinary efforts in various ways.

The problem of non-shared, non-standardised semantics might seem trivial and solvable insofar as one could suggest that researchers simply need to be more mindful about the uniqueness of their professional lingo when communicating outside their traditionally defined disciplinary boundaries. Such a response, however, drastically underestimates the real practical scope of the problem. The more developed and detailed individual scientific disciplines become, the more large-scale and heterogeneous the resulting scientific data output also becomes. In light of this expansion, the problem of navigating the complexity within and across disciplinary boundaries becomes not so much a challenge for scientists to

be *mindful about*, as it becomes a challenge practically impossible for any one single human researcher to solve (e.g. Poldrack *et al.*, 2017).

In many research domains today (e.g. brain anatomy), the quantity and complexity of the data output is increasing with exponential pace, and researchers must now implement and base their research efforts on an extensive and fundamental use of computational software (e.g. Gorgolewski *et al.*, 2016). So, where researchers used to share and integrate knowledge through traditional communicative means such as research publications, contemporary research is becoming digitalized, transforming some aspects of scientific conversations into algorithmically driven operations on large data models. For example, in order to fully account for the basic processes in the central nervous system involved in, say, emotion processing, a computational model must be built that can include and integrate data from neurobiology, endocrinology, behavioural sciences, and so forth.This *digitalization* of contemporary research necessitates standardisation, as in order for data to be properly handled by computational processes, data must be annotated with consistent, pre-established semantics. And it is exactly in this process that semantic inconsistencies potentially migrate into scientific efforts with ensuing negative effects. Certainly, where two conversing individuals may be able to notice and correct misunderstandings, for instance, that they each meant slightly different things when they used the term "disorder", this type of ad-hoc semantic flexibility is simply not tenable when using computational processes.

Consider, for instance, two independent groups of researchers studying the same *phenomenon A* in a population sample. The first group of researchers decides to digitally label this phenomenon as "anxiety" and the other group of researchers annotate the same *phenomenon A* with the label "fear" (i.e. two different terms/labels for the same phenomenon). These two research projects would then, according to the underlying algorithm, be dealing with two different phenomena. Consider now thousands of researchers across hundreds of research groups dealing with datasets consisting of millions of labels and trillions of data points, with similar uniqueness in their annotation scheme as just described. In such a case, automatic integration and aggregation of data output (across research efforts) will then either be impossible (due to idiosyncrasies creating algorithmic errors) or, at best, require an extremely laborious post-hoc gerrymandering of individual datasets (e.g. manually detecting where datasets factually overlap, but are annotated with differing labels, a process often referred to as *harmonisation* [Spjuth *et al.*, 2015]).

These are some of the fundamental problems that mental health research and practice is facing. One ideal way to get around this problem is for all researchers to operate with a shared semantics, agreeing on what differentiates one label from another (e.g. what makes "fear" different from "anxiety"). In such a scenario, the datasets will be straightforward to integrate. Scientists are recently becoming more conscious of this data integration problem, which has led to large scale initiatives aiming to create standardised semantics beyond the DSM-5 classifications. For example, the *National Institute of Mental Health* (NIMH) Research Domain Criteria (RDoC) project is largely motivated by such standardisation objectives (e.g. Insel *et al.*, 2010). Through its many funding opportunities, the NIMH directly encourages (and to some extent requires) research efforts to be structured according to predefined semantic definitions from this framework, the goal being that interdisciplinary research becomes more integrated, and therefore may yield a more detailed understanding of psychopathology, with expected positive outcomes for treatment development (e.g. Clark *et al.*, 2017).

It is within this interdisciplinary landscape that applied ontologies offer a promising approach to improving research procedures. Applied ontologies are computational tools for the organisation, structuring, and standardisation of terminologies for data annotation, used in a broad range of different fields for both research and practical purposes (Hastings, 2017; Munn

& Smith, 2008; Arp, Smith & Spear, 2015). In essence, applied ontologies are computational structures which formally capture the definitions and meaning of terminology used in a given field, including logical relationships between terms. In turn, this formalisation makes applied ontologies powerful tools for use in diverse applications, from end user software (e.g. clinical information systems) to data aggregation (e.g. shareable data repositories) to applicable research purposes (e.g. data mining algorithms for research and precision medicine) (see also Haendel, Chute and Robinson, 2018). Applied ontologies are already widely implemented across sciences that face some of the same (interdisciplinary) complexities we find in mental health research and practice (biology being the most prominent example, e.g. Ashburner *et al.*, 2000), making the method a *de facto* sound point of departure.

Each applied ontology serves a particular semantic scope or *domain*, and has an integrative purpose. Thus, it is developed not so much with reference to specific *theories* (say, of what mental disease *is*), but, to the greatest extent possible, as an *a-theoretical* consensus taxonomy of clearly defined entities and their relationships (Figure 1). At the heart of efficient and applicable ontology development is the aim of enabling different scientific disciplines to harvest the benefits of ontologized, semantic standardisation regardless of what *theory* individual researchers subscribe to, by following careful methodological principles (e.g. Smith & Ceusters 2010). Applied ontologies are developed with the goal to delineate and define *all relevant* entities and their relations within a specific domain. Content is structured both hierarchically and through the use of formal relationships.

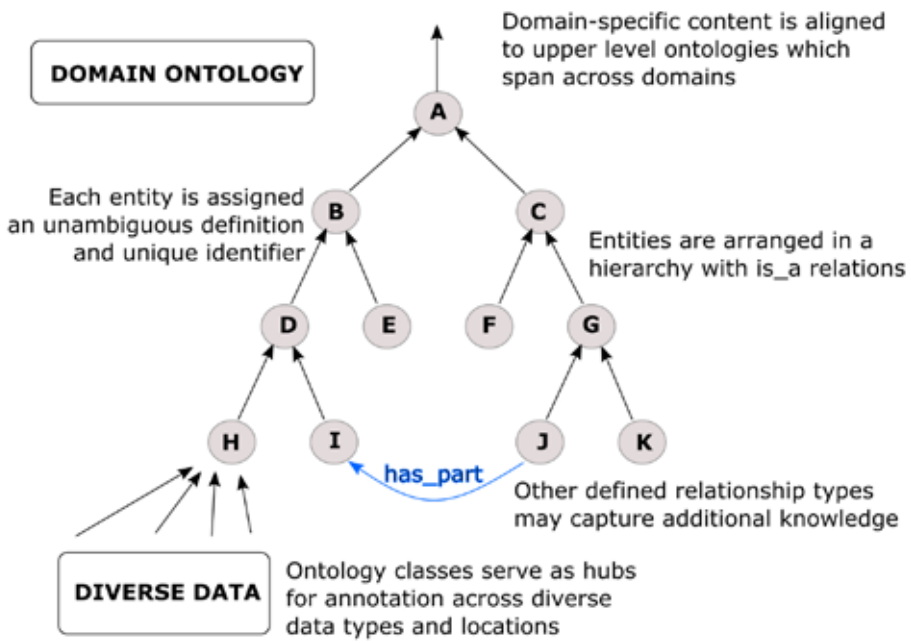

Figure 1. A generic example of the taxonomic structure of an ontology. The ontology captures entity definitions and relations in a hierarchical structure underpinned by a logical language. Many different semantic relationships may be used to define and interconnect entities, and domain-specific ontologies exist for different domains, yet are unified through alignment with common upper level ontologies. Ontologies serve as hubs for data annotations.

The structure of applied ontologies offers multiple advantages. For example, entities are arranged hierarchically such that, logically, everything that is true about an upper-level entity is also true about a classified lower level entity (e.g. A vs. B in *Figure 1*). Furthermore, what distinguishes the lower-level entity from the immediate upper-level (e.g. what makes B different from A in *Figure 1*) is also formulated in logical terms: B is an A that Cs. This logical structure enables algorithms to make efficient automated inferences across large-scale datasets. Ontologies also include other logical relationships between entities, as indicated by the blue arrow (i.e. has_part) in *Figure 1*, allowing for additional inferences within and between ontologies (e.g. Larsen & Hastings, 2018).

One relevant benefit of how ontologies make relationships between entities explicit in and across domains, is that it allows for mapping together different scientific *levels* or *granularities* (Bittner & Smith, 2003). For example, an ontology of neurobiological entities can be mapped explicitly onto entities in an ontology concerning subjectively experienced emotion processes; or a gene ontology may map entities (e.g. gene products) onto specific entities in a mental disease ontology (e.g. specific symptoms of Alzheimer's Disease). This is appealing because the method is interdisciplinary by design, allowing for sufficiently complex interconnections of the subject-matter within an entirely dynamic framework; one of the central qualities lacking in current data structuring methods (i.e. a criticism that has been directed at the aforementioned RDoC project, e.g. Ceusters, Jensen & Diehl, 2017; Larsen & Hastings, 2018; Lilienfeld, 2014; Lilienfeld & Treadway, 2016; Parnas, 2014).

These integration efforts are especially eased when ontologies are developed in accordance with a shared so-called *upper-level* formal ontology, for instance, such as the open-source *Basic Formal Ontology* (BFO) (Arp, Smith & Spear, 2015). An upper-level formal ontology is essentially a metaphysical framework, which, when used for building applied ontologies, streamlines or categorises the subject-matter of a domain onto this basic metaphysical structure. For example, the BFO explicitly distinguishes between *continuants* and *processes*, and when an applied ontology is developed, say, of mental health entities, we can then speak of etiology as a *process* and the presence of a disease in the organism as a *continuant* (for a review of the metaphysical backbone of BFO, see Smith & Ceusters, 2010).

Developing applied ontologies under a basic metaphysical structure may seem to contradict the earlier claim about ontologies being *a-theoretical*. Of course, a metaphysical description of the world is indisputably a theory about the world. However, by referring to ontologies as *a-theoretical* we are emphasising the way ontologies aim at describing all relevant entities in a domain, and by doing so, try to avoid making such a description theoretically dependent. That is, ontologies aim to account for entities in a domain, in a way that is independent of the truth value of any one theory (e.g. Hennig, 2008; Smith, 2008). To give an example of this, the *Emotion Ontology* (Hastings, Ceusters, Smith & Mulligan, 2011) aims to describe all the entities relevant for human emotional phenomena, e.g. motor behaviour, physiological signs, subjective feelings, etc., entities which researchers in the field would be generating data about, regardless of whether they adhere to *cognitive* or *non-cognitive* theories of emotion. To the extent that data are able to be integrated through ontological mapping regardless of which theoretical paradigm they arise from, the more it becomes possible to amass empirical evidence towards the broader objective of determining which theory is the most valid. Obviously, though, as soon as researchers start describing *entities*, they have already taken a metaphysical standpoint, whether they explicitly reveal this or not (this is trivially true since the mere claim that entities exist is a metaphysical standpoint). But the upside of building applied ontologies on upper-level formal ontologies is that the (unavoidable) metaphysical framework is explicitly disclosed, and therefore, may also be revised through a common peer-review process. For example, the BFO was launched in 2004 (Grenon, Smith & Goldberg, 2004), and has been revised in a community process culminating in the release of BFO 2.0 in 2012 (Arp, Smith &

Spear, 2015). By bringing this process out in the open, so to speak, we not only ensure that the underlying metaphysical backbone is being debated, we may also hypothesize that scientists in general will become more mindful about their underlying metaphysical commitments.
Aside from these positive side effects, it should be emphasized that the general incentive behind using upper-level ontologies is that if one domain has already been sufficiently described with the use of such a framework, this will then allow similarly structured ontologies to import relevant content where domains overlap, reducing the duplication of effort, and more importantly, allowing one domain to harvest the work already carried out in another. An example of such a network of collaborating ontologies (grounded in BFO) can be found in the OBO Foundry platform (Smith *et al.*, 2007), which currently includes more than 250 different domain-specific applied ontologies.
With respect to the present contribution, we suggest that a standardisation effort of patient phenomenology would benefit from connecting with already pre-existing efforts in the OBO community. Though the complete development of an *ontology of patient phenomenology* eventually can and ideally must draw on several OBO contributions, we can at this initial stage of the project point to the *Mental Functioning Ontology* (MF)[1] as among the most relevant pre-existing ontologies (see *Figure 2*).

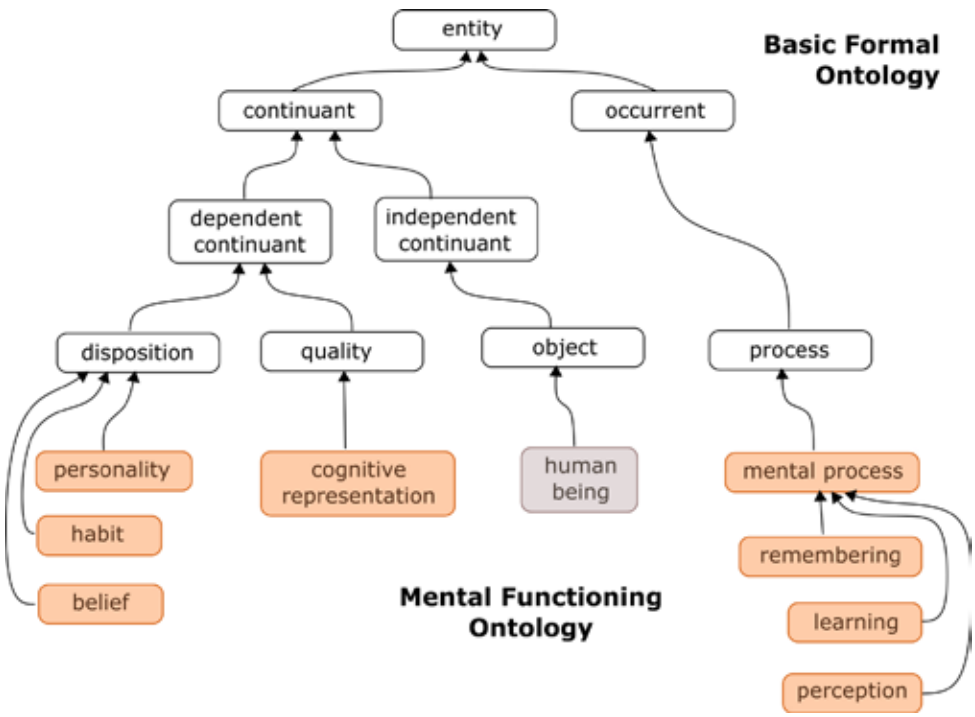

Figure 2. Excerpts from BFO and the MF. Black arrows indicate an *is_a* relationship. White boxes indicate entities from the upper-level BFO (shared with many ontology efforts), while orange boxes indicate entities from the MF.

1 The MF ontology can be downloaded in full from https://github.com/jannahastings/mental-functioning-ontology/, and is available for searching and browsing via ontology library interfaces such as the Ontology Lookup Service at https://www.ebi.ac.uk/ols/.

The MF is developed specifically for the domain of *subjective* mental functioning (Hastings *et al.*, 2012). It includes, for example, entities such as consciousness, perception, thinking, and believing, emphasizing primarily the *first-person* or *experiential* perspective of human mental functioning. However, many of the phenomenological entities that are typically perturbed in psychiatric conditions are currently not described in the MF. We will address this lack in what follows.

3. Patient Phenomenology in Psychiatry: Delineating the Subject Matter

Before we begin to address how to initiate and structure an ontology of patient phenomenology, we must first address what exactly is meant by patient phenomenology, and which aspects of this subject matter should be included in an applied ontological framework. The ideal way the subject matter of any ontology is delineated is through a community-wide discourse, but since this type of conversation (to our knowledge) has not yet taken place within the context of the development of an ontology (or similar semantic structure) for this domain, we can here only suggest a tentative outline, which we hope will be seen as an invitation to instantiate a more organized collaborative effort through, for example, workshops and conferences, as well as published proceedings and special issues in relevant academic journals.

The use of the phrase "patient phenomenology" refers to using the method of *phenomenology* when accounting for mental health phenomena. Phenomenology is a philosophical method developed by Edmund Husserl in the early 20th century (Zahavi, 2003), and refined and expanded by Husserl's students and followers such as Martin Heidegger, Edith Stein, Max Scheler, Maurice Merleau-Ponty, and others (e.g. Zahavi, 2012; 2018a). Phenomenology as a method has a longstanding tradition of psychiatric application, i.e. *phenomenological psychopathology* or *phenomenological psychiatry*, which grew out of the expansion of early Husserlian phenomenology to include more qualitative aspects of perception and lived experience (e.g. Jaspers, 1913; Minkowski, 1970). Analogous to the use of phenomenology in philosophy and cognitive sciences as a method for mapping the formal structures of consciousness (e.g. Gallagher & Zahavi, 2012), the application of phenomenology in psychiatry aims at describing and accounting for both the *basic structural* and *qualitative introspective* aspects of the patient's *first-person* experience with regards to mental health or clinical phenomena (e.g. Fuchs & Pallagrosi, 2018; Parnas, Sass & Zahavi, 2013; Stanghellini *et al.*, 2018; Zahavi, 2018b).

Phenomenology is appealing as a psychiatric method due to its overarching framework of both providing a formal representation of how consciousness universally or canonically operates, and a detailed qualitative analysis of how human beings relate to the content of consciousness (e.g. Gallagher & Zahavi, 2012). The framework of phenomenology attempts to give a universal picture of how human beings formally process their sense-impressions into meaningful perceptions (i.e. structures of consciousness), and how these perceptions are qualitatively experienced (i.e. *what it is like* to have such perceptions). This overall framework, then, allows psychiatrists to perform many different analyses, of which we can highlight two with obvious psychiatric utility:

First, it makes it possible to form intelligible hypotheses about whether a specific phenomenon is psychiatrically *abnormal*. For example, if the way a person is processing their perceptions deviates from what phenomenologists believe to be universally true about human consciousness, we might then hypothesize that this is due to a pathology. Consider if a person is experiencing problems with retracting episodes from short-term memory, phenomenologists may then posit that this is abnormal insofar as short-term memory plays a central and reliable (i.e. canonical) role in the way humans experience and perceive the world (e.g. Bortolotti, 2010; Gallagher & Zahavi, 2012; Matthews, 2006).

Secondly, the phenomenological framework makes it possible to formalise a significantly more detailed understanding of the qualitative aspect of a patient's suffering by meticulously mapping and paying attention to the entirety of a specific mental health issue. For example, if a person has experienced a specific traumatizing episode that seems to be the root cause of a prolonged mental disability, phenomenologists will then take into consideration a network of different qualitative aspects such as: *how* was the trauma experienced as opposed or in addition to *what* caused the trauma; has the trauma affected the patient's *self-awareness* as opposed or in addition to merely mapping superficial symptoms; and so on. Because a phenomenologist understands consciousness as a vast network - as opposed to mere *rationality* - the phenomenological analysis of the qualitative aspect is therefore also described in similar network-like detail (e.g. Parnas, Sass & Zahavi, 2013; Rosfort & Stanghellini, 2014; Stanghellini & Rossi, 2014).

It is apparent that phenomenological psychopathology can be contrasted with two widely accepted paradigms in traditional descriptive psychiatry: the first paradigm being the clinician's external perspective on patient behaviour and experience (i.e. how the clinician diagnostically classifies the patient), and the second paradigm being how a scientific discipline is measuring physiological processes related to the pathology (e.g. how a neurobiologist would search for neurofunctional and/or neurostructural patterns underpinning specific diagnosis) (e.g. Fuchs & Pallagrosi, 2018; Wiggins & Schwartz, 2011). In contrast to these two paradigms, patient phenomenology aims at doing justice to, and describing in greater detail the *first-person level* of subjective experiences.

As mentioned, phenomenological approaches are typically under-emphasised in contemporary research and practice (e.g. Parnas, 2014), yet they hold the promise to reveal novel insights into the shared and distinguishing features of psychiatric conditions (e.g. Messas, Fulford & Stanghellini 2017). What a thorough patient phenomenology aspires to accomplish is multifaceted and complex, and we do not have the space to review this in full in the present contribution (but see, e.g. Fernandez, 2018; Giorgi, Giorgi & Morley, 2017; Parnas & Zahavi, 2002). However, Fuchs (2010) gives us some central pointers. He sees patient phenomenology as a cornerstone in achieving a long-standing, general aspiration in mental health research, the goal of creating a complex model of "psychopathology capable of mediating between symptom level and process level, and of developing models of the inherent structure and possible disturbances of conscious experience." (Fuchs, 2010, p. 269) In other words, by representing the complexity of first-person experiences, phenomenologists (such as Fuchs) hypothesize that more robust patterns in symptomatology will emerge, which in turn will inform and guide research and treatment efforts (for similar views, see Gallagher, 2003; Lutz & Thompson, 2003; Stanghellini & Rossi, 2014).

So, how do we achieve this ambitious goal set forth by phenomenologists? In our opinion, one foundational aspect that is needed is a *semantic framework* that makes it possible to sufficiently describe the main subject matter of phenomenology, namely: (1) the universal basic structures of *how* human consciousness functions, and (2) the content, or the *whatness* of lived, introspective experience. On a more *practical* or *operational* note, the objective is to provide a logically coherent, uniform, shared language - an applied ontology - for developing data annotation frameworks to capture psychiatric phenomenology, which in turn can form a basis for psychiatric assessment tools and patient tracking systems. Ideally, once a patient enters the clinic or a research facility, a mental health clinician can, with the use of purposely developed phenomenological interviewing methods and assessment tools (e.g. Høffding & Martiny, 2015; Parnas *et al.*, 2005) describe in detail the patient's lived experience for diagnostic and research purposes. And as long as these tools are developed using the same set of ontologized semantics (i.e. the same underlying applied ontology), data aggregation and analysis will be substantially eased compared to current practices.

By developing and making available such an applied ontology, phenomenologists will thereby be constructing the open-source backbone for the development of tools and resources that make it possible for practitioners and researchers to capture data about patient symptomatology in *uniform ways*, a prerequisite for contemporary interdisciplinary science (Figure 3).

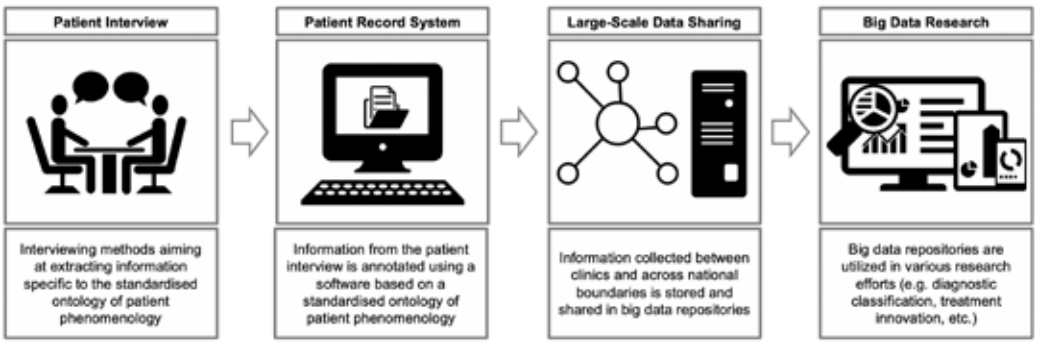

Figure 3. The process from patient interviewing to big data sharing and research initiatives. When data is collected using tools build on a shared applied ontology, data aggregation and analysis is substantially eased.

Standardising the domain of patient phenomenology will play a key role in weaving together the clinical subject matter and the research processes in order to further our understanding of mental health and developing new treatment strategies. For various reasons, none of the phenomenologically oriented data-structuring standards developed thus far (e.g. Parnas *et al.*, 2005) have been developed to the extent that they are able to sufficiently describe the various patient phenomena we encounter in the clinic, as often these approaches have been preliminary in nature, or explicitly developed for one type of disorder. Unlike existing tools, applied ontology offers a flexible and adaptable approach to standardisation that is well suited to capture the subject matter. In what follows, we offer a first step towards capturing such a standard, and discuss how this relates to other types of standards in psychiatry.

4. Ontology of Patient Phenomenology: A Tentative Prototype

In this section, we aim to give a brief, tentative sketch of some ontological entities and their relations for the domain of patient phenomenology. When building an applied ontology, a number of practical steps are necessary (e.g. Arp, Smith, & Spear, 2015). One crucial aspect is that the entities (i.e. terms and relationships) included in the ontology must ultimately be selected and defined by domain experts, ideally in the context of a community-wide conversation. In the domain of patient phenomenology, these experts are philosophers, psychologists, and psychiatrists with theoretical and practical knowledge about phenomenology. The reliance on domain experts is to ensure that the selected entities make up the best representation of the current (peer-reviewed) knowledge. What follows in this section is therefore only a *tentative first-step* in this process.

Our approach towards initiating this process was to survey the literature on applied patient phenomenology in an effort to identify existing attempts to standardise patient phenomenology. We worked from the assumption that the standardisation efforts we located reflected proper patient phenomenology entities, which we then categorised in the context of the broader grouping of mental functioning entities in the MF. Through this approach we

intend to demonstrate two things: First, how the semantics of patient phenomenology can be ontologically structured, and second, how existing tools (and existing practices surrounding these tools) in phenomenological psychiatry can be harnessed to achieve the aim of building an ontology of patient phenomenology.

Messas and colleagues (2018) provide an overview of some of the basic entities of lived, first-person experience typically included in a phenomenological framework, namely, the experience of *lived time*, *lived space*, *lived body*, *intersubjectivity* and the sense of *selfhood* (Messas *et al.*, 2018, p. 2). In a phenomenological psychiatric framework, these entities refer to basic structures of first-person experience, which are easily overlooked when they are functioning normally, but are related to the most obvious, profound psychiatric disturbances when they malfunction. For example, we may understand our sense of having *selfhood*, that is, a specific core identity, as a trivial fact of our lived experience. But in some psychopathological instances, it can be this very notion of experienced *selfhood* that is abnormal, for instance, the feeling of disintegrated identity (e.g. Parnas *et al.*, 2005).

According to the MF, all mental processes give rise to cognitive representations, that is, they are *intentional*. In the MF, consciousness is an inseparable part of mental processes (Hastings *et al.*, 2012), and it is consciousness that confers intentionality. However, mental processes include further structural parts, which are not separable but are nevertheless distinguishable from the conscious (or representational) *content* of a mental process, capturing the ways that the representational content is presented, shaped or organised to its bearer. Table 1 lists relevant entities from the MF ontology which form the basis for our annotation of entities of relevance for a phenomenological framework.

Entity	Parent	Definition	ID
mental disposition	bodily disposition	A bodily disposition that is realized in a mental process.	MF:0000033
mental process	bodily process	A bodily process that is of a type such that it can of itself be conscious.	MF:0000020
mental quality	bodily quality	A bodily quality that inheres in those structures of the extended organism that are essential for mental functioning.	MF:0000075
intentionality	mental quality	The fundamental quality of conscious mental processes of always having content (i.e. mental processes are always directed towards, or about something).	MF:0000073
consciousness	mental process part	Consciousness is an inseparable part of all mental processes. It is that part of the mental process that: a) confers a subjective perspective, a phenomenology, an experience of the mental process of which it is a part; and b) intends the object or event that the mental process is about, should such exist; i.e., it confers intentionality on the mental process.	MF:0000017

Table 1: Entities in the MF ontology of relevance for phenomenology. Column descriptions: "Entity" includes the ontology entity label; "Parent" the ontology entity's semantic parent relation; "Definition" is the definition of the entity as it is included in the ontology; "ID" is the unique identifier for the entity.

We then included the entities from Messas *et al.* (2018) in the MF as further structural parts of mental processes. For example, we added the entity *Time Awareness* to MF, defined as "The subjective experience of time as a coherent process inhabited by oneself as an embodied thinking being." Another example is *Body Awareness,* which is defined as "The subjective experience of being an embodied entity". Furthermore, each entity is classified beneath its respective *parent entity*. For example, *Time Awareness* is a subtype of *Higher Order Consciousness*, which is defined as "consciousness of one's own mental states, a self-reflexive consciousness of the experience of being conscious, of having mental processes ongoing". Table 2 (below) lists examples of entities that have been added to the MF to represent the structural aspects of conscious mental processes.

Entity	Parent	Definition	ID
time awareness	higher order consciousness	The subjective experience of time as a coherent process inhabited by oneself as an embodied thinking being	MF:0000072
space awareness	higher order consciousness	The subjective experience of the spacial surroundings one inhabits as an embodied entity.	MF:0000077
body awareness	higher order consciousness	The subjective experience of being an embodied entity.	MF:0000078
inter-subjectivity	higher order consciousness	The subjective experience of other beings as self-aware entities.	MF:0000079
consciousness of self (selfhood)	consciousness	The subjective experience of having a time persistent personal identity.	MF:0000067

Table 2: New entities added to the MF. Column descriptions: "Entity" includes the ontology entity label; "Parent" the ontology entity's parent entity; "Definition" is the definition of the ontology entity; "ID" is the unique identifier for the entity.

These basic structures of phenomenology have been added to the MF ontology, as opposed to including them in a separate ontology of patient phenomenology, since they are parts of ordinary mental functioning and are thus within MF scope. On the other hand, for those aspects of patient phenomenology that concern *disturbances* of MF entities (i.e. disturbances of mental functioning), we suggest the creation of an Ontology of Patient Phenomenology separate to the MF, but semantically and logically connected to it.

To identify examples of such entities (i.e. disturbances of mental functioning entities), we surveyed the literature and found a number of existing efforts in applied patient phenomenology. Two clinical tools were of obvious relevance: *The Examination of Anomalous Self-Experience* (EASE) scale, and the *Identity and Eating Disorders* (IDEA) self-report measure. Both are clinical assessment tools developed by phenomenological psychiatrists and philosophers for the standardised capture of psychiatric phenomena. The EASE aims to assess disturbances of *self-experience* (Parnas *et al.*, 2005), and the IDEA targets experiences related to *embodiment* and how this shapes *personal identity* (Stanghellini *et al.*, 2012). The items from the EASE scale are listed in *Appendix A*, and items from the IDEA scale are listed in *Appendix B*. We used the items from the EASE and IDEA scales to derive initial examples of entities to be included in the Ontology of Patient Phenomenology.

For example, the entity *Thought Block* (EASE scale entity 1.4) can be defined as "the subjective experience of a sudden blocking of, or inability to feed with new thoughts, the stream of

consciousness". In the MF we have defined the entity *Stream of Consciousness* as "the cognitive structural capacity to experience one's thoughts as a coherent, uninterrupted process".
The MF and patient phenomenology entities are differentiated in a fairly straightforward manner: The MF entity suggests that the process of having a *coherent stream of consciousness* is a universal capacity in the human organism that should, all things considered, be functioning (i.e. processing) reliably. So, when a patient is undergoing an instance of *Thought Block*, then, this would be characterised as a disturbance of said MF capacity.
Consider also semantically and logically similar examples: the entity *Body Estrangement* (EASE scale entity 3.3) could be defined as a type of disturbance of the MF-entity *Bodily Awareness*; the entity *Self Awareness by Others* (IDEA Factor 1) could be defined as a disturbance of the MF-entity *Self Awareness*; the entity *Identity Confusion* (EASE scale entity 2.9) could be defined as a disturbance of the MF-entity *Self-Awareness*; and so forth. In *Figure 4* (below), we illustrate how selected entities from BFO, MF, and the (prototype) Ontology of Patient Phenomenology may be linked.

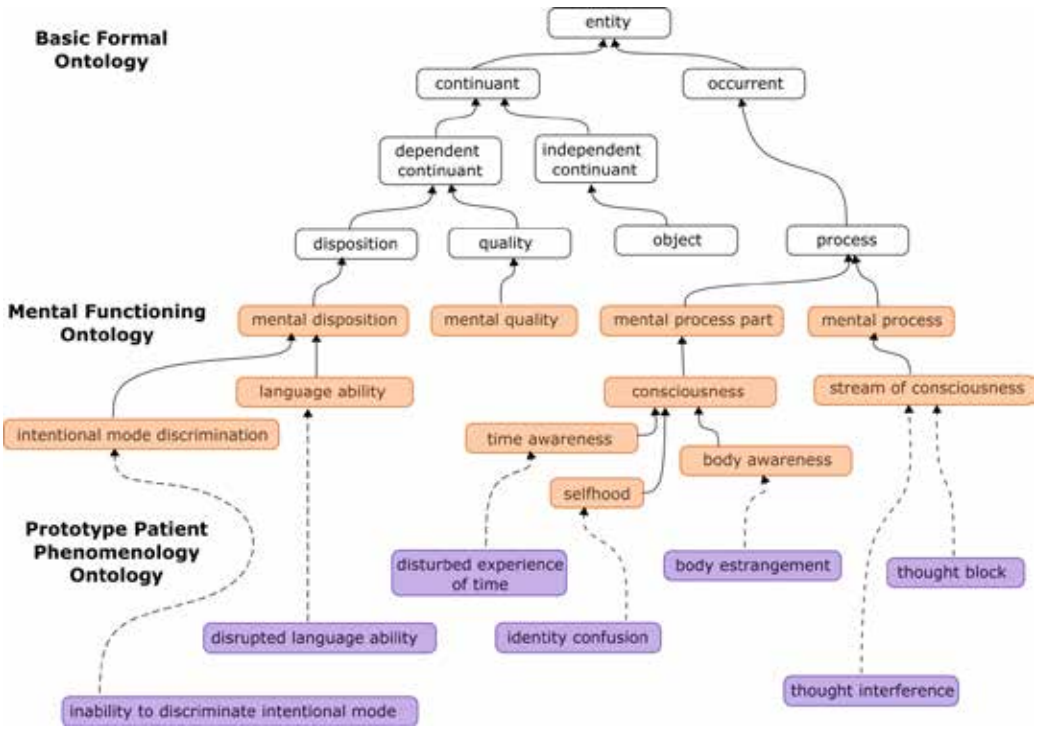

Figure 4. Illustration of entities in the prototype Ontology of Patient Phenomenology: Black boxes represent BFO entities, orange boxes MF entities, and purple boxes candidate entities from the prototype ontology of patient phenomenology. Solid arrows represent 'is a' relation, while dashed arrows represent the relation 'disturbance of' which links between the patient phenomenology entities and the corresponding MF entities.

As emphasised earlier, the final ontological mapping and definition of these entities must be worked out through a community-wide participatory process, which is an ongoing effort. This process is being guided by the well-established standards for building ontologies with BFO (Arp, Smith, & Spear 2015), as well as best practices for creating ontological definitions (e.g.

Seppälä, Ruttenberg & Smith, 2017). Finally, the Ontology of Patient Phenomenology will be maintained through a transparent editorial work of community-wide contributions, which includes introducing new entities (i.e. terms and relationships) into the ontology when these have been conventionally defined, as well as carrying out modifications to already existing entities when these have been agreed upon (for article on how this work in practice, see Dessimoz & Škunca, 2017).

5. Discussion and Conclusion

In this paper we have sketched a preliminary outline of an approach to standardise the semantics of patient phenomenology as an applied ontology. One of the advantages of using an applied ontological framework, we argued, is the utility, flexibility and adaptability of ontologies in general, but also the existing basis in already developed ontologies (e.g. the MF) alongside the computational infrastructure designed for open source sharing and reuse of content. Alongside the formal task of developing an applied ontology, there will be a substantial number of issues that need to be sorted out through the usual scientific and philosophical discourses. In this section, we shall briefly address some foreseeable questions, limitations and challenges.

Data-driven *researchers* may see an applied ontological standard as a general blessing insofar as it is implementable in any psychiatric clinic and thus facilitates a potentially much more detailed data collection. But ontologies are not always unproblematic for *practitioners*. Standardised semantics may, if not developed in close connection with practitioners, disrupt operational standards that practitioners have been accustomed to using. Therefore, in developing an applied ontology, contributors must include interests from stakeholders across the professional spectrum. An ontology is only useful if it is broadly endorsed and applied. Implementation, with good interfaces and systems designed for ease of use with the end-user in mind, will be key.

Alongside these implementation issues, there exists a suite of challenges regarding proper clinical use and application. The development and use of a semantic framework does not guarantee that data collection or assessment is *reliable*. For example, annotating reliably (and validly) that a patient is experiencing, say, *Thought Block*, will fall predominantly on the shoulders of the practitioner. It is therefore imperative that the development of an applied ontology is supplemented with a likewise serious effort in clinical training to maintain a high level of reliable data annotation. These challenges are not unique to assessing and annotating patient phenomenology entities, but are well-known problems in data handling in mental health practice and research (e.g. Lilienfeld, Smith & Watts, 2013). Indeed, just because a domain has been standardised (e.g. diagnostics in the DSM-5) it does not follow that its entities are also appropriately applied. Challenges pertaining to clinical reliability will call for further standardization in patient interviewing and reporting practices, for which the EASE and IDEA scales provides a relevant starting point (see also, Høffding & Martiny, 2016; Stanghellini, 2016).

Relatedly, advocates of patient phenomenology can at times be read as if they suggest that *first-person* perspectives must substitute or replace the *third-person* perspectives that dominate the existing clinical standards (e.g. the DSM-5, RDoC, etc.). However, this view is inherently problematic. Psychiatric patients may, for various reasons, not always be the best interpreters of their own situation, and known disconnects may arise between patient self-reports of experience and clinician's observations of the same phenomena. For example, a person suffering from bipolar disorder may have episodes where, from their own perspective, they are experiencing an uncanny calmness and lucidity, while a clinician may observe that they are outwardly acting as if they are undergoing a manic episode. Ceusters and Smith (2010) highlight the need to annotate and be mindful of these different *levels* of description, namely,

the patient's own experience (e.g. lucidity), the clinician's assessment (e.g. manic episode), and the relation between these two data points. In contrast to existing diagnostic systems, applied ontologies can provide the methodological framework to enable the annotation of such a complex (multi-level) phenomenon.

As mentioned, existing clinical standards (e.g. DSM-5, RDoC, etc.) already include some (though few) references to patient phenomenology. One advantage of an ontology of patient phenomenology is that it can be used to draw logical relationships between already existing clinical standards, e.g. between entities in the EASE and the DSM-5 category of schizophrenia (see also, Larsen & Hastings, 2018). This integrative ability has a number of advantages, of which we may highlight two:

First, often when a new standard is introduced, it will typically mean that former, older standards must be disregarded in favour of the new one. This naturally leads to inconsistencies and discrepancies in the field as not all researchers and practitioners will favour the new standard and decide to stick to former practices. However, by introducing a new standard in form of an applied ontology, this allows for the incorporation of the existing data sets that are based on former standards, by simply *semantically bridging*, or creating cross-references between, these data points/sets into the new standard. The fact that applied ontologies have this flexibility seems to be an especially strong aspect allowing for synthesising and building on already existing research efforts, as opposed to "starting from scratch", so to speak.

Second, the integrative ability of applied ontologies may ease the clinical implementation effort insofar as when introducing new standards there will not only be straightforward overlapping elements, but practitioners will be able to utilize pre-existing tools as long as they please due to their semantic bridging into the new standard. While some practitioners might find the new standard more appealing and intuitive, other practitioners might disagree. With an applied ontological framework, the explicit use of a new standard is not mandatory; moreover, what is essential is that earlier standards are - below the surface - semantically connected, something that an applied ontological framework is developed to facilitate.

It should be re-emphasized that one of the central challenges will be to practically implement the new semantics so it is used by both practitioners and researchers in mental health in a joint effort to collect and share large-scale, quality data through data repositories. As mentioned, an applied ontology is only useful if it is actually used for what it is designed to do (i.e. taxonomizing domain-specific data into a logical and relational structure). If only researchers, and not practitioners, decide to use these standards; or even worse, if only some individuals from different groups choose to do so, an applied ontology is bound to generate just as much confusion as it offers to clarify. One way to ease and facilitate the implementation of an applied ontology is to keep it as an open-source resource, which software developers can then use when creating patient data, tracking and record systems for practitioners, or automated data annotation programs for various disciplines (e.g. neurobiology, genetics, etc.). For example, when a neurobiology research group conducts an experiment on patients with, say, Major Depression Disorder (from the DSM-5), software can then be developed that utilizes the Ontology of Patient Phenomenology allowing for a much more detailed capturing of the patient's symptoms. That is, instead of tracking neurological functioning (e.g. fMRI) in people with five or more of the nine third-person described symptoms in the DSM-5 classification (or any other similar scale), research software built on the Ontology of Patient Phenomenology will then allow for a much more detailed account of the patient that is performing or undergoing the neurofunctional testing; which in turn is a much more detailed representation of the phenomenon, making it possible to execute much more profound statistical analysis of symptom patterns (see also Gallagher, 2003; Stanghellini & Rossi, 2014).

Lastly, and as mentioned earlier, the phenomenology community will play a crucial role in

developing the first full version of the Ontology of Patient Phenomenology. Mirroring the complexity of mental health research, patient phenomenology is too complex for any one researcher to fully and sufficiently map, and quality is therefore dependent on community-wide participation. Moreover, an operational version will, due to this complexity, always be viewed as an *adequatist* product, aiming for a pragmatic solution to the task of representing patient phenomenology. Importantly, an ontology is in this sense never complete, but must undergo constant revisions based on appropriate community feedback. In this contribution, we discussed the moderate goal of initiating the building of an applied ontology, which we aim to follow up by facilitating extensive community-wide participation through workshops and conferences.

REFERENCES

Arp R., Smith B. & Spear A. D. (2015). *Building ontologies with basic formal ontology*. Cambridge, MA: MIT Press;

Ashburner M., Ball C. A., Blake J. A., Botstein D., Butler H., Cherry J. M., ... Sherlock G. (2000). Gene ontology: Tool for the unification of biology. The Gene Ontology Consortium. *Nature Genetics, 25*(1), pp. 25-29;

Bittner T., & Smith B. (2003). A theory of granular partitions. In M. Duckham M. F. Goodchild & M. F. Worboys (eds.), *Foundations of geographic information science* (pp.117-151). London: Taylor & Francis;

Bluhm R. (2017). The need for new ontologies in psychiatry. *Philosophical Explorations, 20*(2), pp. 146-159;

Borrell-Carrió F., Suchman A. L. & Epstein R. M. (2004). The biopsychosocial model 25 years later: Principles, practice, and scientific inquiry. *Annals of family medicine, 2*(6), pp. 576-582;

Bortolotti L. (2010). *Delusions and other irrational beliefs*. Oxford: Oxford University Press;

Ceusters W., Jensen M. & Diehl A. D. (2017). Ontological realism for the Research Domain Criteria for mental disorders. *Studies in Health and Technology Informatics, 235*, pp. 431-435;

Clark L. A., Cuthbert B., Lewis-Fernández R., Narrow W. E. & Reed G. M. (2017). Three approaches to understanding and classifying mental disorder: ICD-11, DSM-5, and the National Institute of Mental Health's Research Domain Criteria (RDoC). *Psychological Science in the Public Interest, 18*(2), pp. 72-145;

Cuthbert B. N. & Insel T. R. (2013). Toward the future of psychiatric diagnosis: The seven pillars of RDoC. *BMC Medicine, 11*(1), pp. 126-126;

Ceusters W. and Smith B. (2010). Foundations for a realist ontology of mental disease. *Journal of Biomedical Semantics, 1*(1):10;

Dessimoz, Christophe & Škunca, Nives (Eds.). (2017). *The Gene Ontology handbook*. New York: Humana Press;

Engel G. L. (1977). The need for a new medical model: A challenge for biomedicine. *Science, 196*(4286), pp. 129-136;

Fernandez A. V. (2018). Phenomenological approaches to psychiatric classification. In G. Stanghellini, M. Broome, A. V. Fernandez, P. Fusar-Poli, A. Raballo & R. Rosfort (Eds.), *The Oxford handbook of phenomenological psychopathology*. New York: Oxford University Press;

Frances A. (2014). RDoC is necessary, but very oversold. *World psychiatry: Official journal of the World Psychiatric Association (WPA), 13*(1), pp. 47-49;

Fuchs T. (2010). Subjectivity and intersubjectivity in psychiatric diagnosis. *Psychopathology, 43*(4), pp. 268-274;

Fuchs T. & Pallagrosi M. (2018). Phenomenology of Temporality and Dimensional Psychopathology. In M. Biondi, M. Pasquini & A. Picardi (Eds.), *Dimensional Psychopathology* (pp. 287-300). Cham: Springer International Publishing;

Gallagher S. (2003). Phenomenology and Experimental Design: Toward a Phenomenologically Enlightened Experimental Science. *Journal of Consciousness Studies, 10*(9-10), pp. 85-99;
Gallagher S. & Zahavi D. (2012). *The Phenomenological Mind: An Introduction to Philosophy of Mind and Cognitive Science* (2 ed.). New York: Routledge;
Giorgi A., Giorgi B. & Morley J. (2017). The descriptive phenomenological psychological method. In C. Willig & W. Rogers (Eds.), *The SAGE handbook of qualitative research in psychology* (pp. 176-192). London: SAGE Publications;
Gorgolewski K. J., Auer T., Calhoun V. D., Craddock R. C., Das S., Duff E. P., ... Poldrack R. A. (2016). The brain imaging data structure, a format for organizing and describing outputs of neuroimaging experiments. *Scientific Data, 3*, 160044;
Grenon P., Smith B. & Goldberg L. (2004). Biodynamic ontology: Applying BFO in the biomedical domain. *Studies in Health and Technology Informatics, 102*, pp. 20–38;
Haendel M., Chute C. & Robinson P. (2018). Classification, ontology and precision medicine. *New England Journal of Medicine, 379*, pp. 1452-1462;
Häfner H. (2015). Descriptive psychopathology, phenomenology, and the legacy of Karl Jaspers. *Dialogues in Clinical Neuroscience, 17*(1), pp. 19-29;
Hastings J. (2017). Primer on Ontologies. In C. Dessimoz & N. Škunca (Eds.), *The Gene Ontology handbook* (pp. 3-13). New York, NY: Springer New York;
Hastings J., Ceusters W., Jensen M., Mulligan K. & Smith B. (2012). *Representing mental functioning: Ontologies for mental Health and disease.* Proceedings of the Third International Conference on Biomedical Ontology, Graz, Austria: University of Graz, 2012;
Hastings J., Ceusters W., Smith B. & Mulligan K. (2011). *Dispositions and processes in the Emotion Ontology.* Proceedings of the 2nd International Conference on Biomedical Ontology, volume 833 of CEUR Workshop Proceedings, 2011;
Hennig B. (2008). What is formal ontology? In K. Munn & B. Smith (Eds.), *Applied ontology: An introduction*. Frankfurt: Ontos Verlag;
Høffding S. & Martiny K. (2016). Framing a phenomenological interview: What, why and how. *Phenomenology and the Cognitive Sciences, 15*(4), pp. 539-564;
Insel T., Cuthbert B., Garvey M., Heinssen R., Pine D. S., Quinn K., ... Wang P. (2010). Research Domain Criteria (RDoC): Toward a new classification framework for research on mental disorders. *American Journal of Psychiatry, 167*(7), pp. 748-751;
Jaspers K. (1913). *General psychopathology*. Baltimore: Johns Hopkins University Press;
Kendell R. & Jablensky A. (2003). Distinguishing between the validity and utility of psychiatric diagnoses. *American Journal of Psychiatry, 160*(1), pp. 4-12;
Larsen R. R. & Hastings J. (2018). From affective science to psychiatric disorder: Ontology as a semantic bridge. *Frontiers in psychiatry, 9*, p. 487;
Lilienfeld S. O. (2014). The Research Domain Criteria (RDoC): An analysis of methodological and conceptual challenges. *Behavior Research and Therapy, 62*, pp. 129-139;
Lilienfeld S. O. & Treadway M. (2016). Clashing diagnostic approaches: DSM-ICD Versus RDoC. *Annual Review of Clinical Psychology, 12*, pp. 435-463;
Lilienfeld S. O., Smith S. F. & Watts A. L. (2013). Issues in diagnosis: Conceptual issues and controversies. In W. E. Craighead, D. J. Miklowitz, & L. W. Craighead (Eds.), *Psychopathology: history, diagnosis, and empirical foundation* (2 ed., pp. 1-35). Hoboken: John Wiley & Sons;
Lutz A. & Thompson E. (2003). Neurophenomenology: Integrating subjective experience and brain dynamics in the neuroscience of consciousness. *Journal of Consciousness Studies, 10*(9-10), pp. 31-52;
Kendler, Kenneth S. (2016). The nature of psychiatric disorders. *World Psychiatry, 15*(1), pp. 5-12. doi:10.1002/wps.20292;

Kendler K. S., Zachar P. & Craver C. (2011). What kinds of things are psychiatric disorders? *Psychol Med, 41*(6), pp. 1143-1150;
Matthews E. (2006). Dementia and the identity of the person. In J. C. Hughes, S. J. Louw, & S. R. Sabat (Eds.), *Dementia: Mind, meaning, and the person* (pp. 163-178). New York: Oxford University Press;
Messas G., Fulford K. W. & Stanghellini G. (2017). The contribution of human sciences to the challenges of contemporary psychiatry. *Trends in Psychiatry and Psychotherapy, 39*, pp. 229-231;
Messas G., Tamelini M., Mancini M. & Stanghellini G. (2018). New perspectives in phenomenological Psychopathology: Its use in psychiatric treatment. *Frontiers in Psychiatry, 9*, p. 466;
Minkowski E. (1970). *Lived time: Phenomenological and psychopathological studies* (N. Metzel, Trans.). Evanston: Northwest University Press;
Munn K. & Smith B. (Eds.). (2008). *Applied ontology: An introduction*. Frankfurt: Ontos Verlag;
Nemeroff C. B., Weinberger D., Rutter M., MacMillan H. L., Bryant R. A., Wessely S., ... Lysaker P. (2013). DSM-5: A collection of psychiatrist views on the changes, controversies, and future directions. *BMC Med, 11*, p. 202;
Nordgaard J., Sass L. A. & Parnas J. (2013). The psychiatric interview: Validity, structure, and subjectivity. *European Archives of Psychiatry and Clinical Neuroscience, 263*(4), pp. 353-364;
North Carol S. & Surís Alina M. (2017). Advances in psychiatric diagnosis: Past, present, and future. *Behavioral Sciences*, 7(2), p. 27;
Pallagrosi M., Picardi A., Fonzi L. & Biondi,M. (2018). Psychopathological dimensions and the clinician's subjective experience. In M. Biondi, M. Pasquini, & A. Picardi (Eds.), *Dimensional psychopathology* (pp. 267-286). Cham: Springer International Publishing;
Parnas J. (2014). The RDoC program: Psychiatry without psyche? *World Psychiatry 13*(1), pp. 46-47;
Parnas J. & Zahavi D. (2002). The role of phenomenology in psychiatric diagnosis and classification. In M. Maj, W. Gaebel, J. J. López-Ibor, & N. Sartorius (Eds.), *Psychiatric diagnosis and classification*. New York: John Wiley & Sons;
Parnas J., Moller P., Kircher T., Thalbitzer J., Jansson L., Handest P. & Zahavi D. (2005). EASE: Examination of anomalous self-experience. *Psychopathology, 38*(5), pp. 236-258;
Parnas J., Sass L. A. & Zahavi D. (2013). Rediscovering psychopathology: The epistemology and phenomenology of the psychiatric object. *Schizophrenia Bulletin*, 39 (2), pp. 270–277;
Patel V., Saxena S., Lund C. ... Unützer J. (2018). The Lancet Commission on global mental health and sustainable development. *The Lancet, 392*, No. 10157;
Patrick C. J. & Hajcak G. (2016). RDoC: Translating promise into progress. *Psychophysiology, 53*(3), pp. 415-424;
Poldrack, Russell A., Baker, Chris I., Durnez, Joke, Gorgolewski, Krzysztof J., Matthews, Paul M., Munafò, Marcus R., ... Yarkoni, Tal. (2017). Scanning the horizon: Towards transparent and reproducible neuroimaging research. *Nature Reviews Neuroscience, 18*, pp. 115-125;
Ramos-Gorostiza P. & Adan-Manes J. (2013). The problem of psychopathology and phenomenology. What is viable and not viable in phenomenological psychiatry. *Actas Esp Psiquiatr, 41*(5), pp. 301-310;
Rosfort R. & Stanghellini G. (2014). How do you feel? Why emotions matter in psychiatry. *Journal of Psychopathology, 20*, pp. 381-392;
Seppälä S., Ruttenberg A. & Smith B. (2017). Guidelines for writing definitions in ontologies. *Ciência da Informação, 46*(1), pp. 73-88;
Smith B. (2008). New desiderata for biomedical terminologies. In K. Munn & B. Smith (Eds.), *Applied ontology: An introduction* (pp. 83-108). Frankfurt: Ontos Verlag;

Smith B. & Ceusters W. (2010). Ontological Realism as a methodology for coordinated evolution of scientific ontologies. *Applied Ontology, 5*, pp. 139-188;
Smith B., Ashburner M., Ceusters W., Goldberg L., Mungall C. J., Shah N., ... Leontis N. (2007). The OBO Foundry: Coordinated evolution of ontologies to support biomedical data integration. *Nature Biotechnology, 25*(11), pp. 1251-1255;
Spjuth O., Krestyaninova M., Hastings J., Shen, Huei-Yi H., Jani, Waldenberger, ... Harris J. (2015). Harmonising and linking biomedical and clinical data across disparate data archives to enable integrative cross-biobank research. *European Journal of Human Genetics, 24*, pp. 521-528;
Stanghellini G. (2016). Phenomenological psychopathology and care: From person-centered dialectical psychopathology to the PHD Method for psychotherapy. In G. Stanghellini & M. Aragona (Eds.), *An experimental approach to psychopathology* (pp. 361-378). Heidelberg: Springer;
Stanghellini G., Castellini G., Brogna P., Faravelli C. & Ricca V. (2012). Identity and eating disorders (IDEA): A questionnaire evaluating identity and embodiment in eating disorder patients. *Psychopathology, 45*(3), pp. 147-158;
Stanghellini G. & Rosfort R. (2013). *Emotions and personhood: Exploring fragility - making sense of vulnerability*. New York: Oxford University Press;
Stanghellini G. & Rossi R. (2014). Pheno-phenotypes: a holistic approach to the psychopathology of schizophrenia. *Current Opinion in Psychiatry, 27*(3), pp. 236-241;
Stanghellini G., Broome M., Fernandez A. V., Fusar-Poli P., Raballo A. & Rosfort R. (Eds.). (2018). *The Oxford handbook of phenomenological psychopathology*. New York: Oxford University Press;
Sullivan J. A. (2017). Coordinated pluralism as a means to facilitate integrative taxonomies of cognition. *Philosophical Explorations, 20*(2), pp. 129-145;
Wainberg M. L., Scorza P., Shultz J. M., Helpman L., Mootz J. J., Johnson K. A., ... Arbuckle M. R. (2017). Challenges and Opportunities in Global Mental Health: a Research-to-Practice Perspective. *Current psychiatry reports, 19*(5), 28-28. doi:10.1007/s11920-017-0780-z;
Whiteford H. A., Degenhardt L., Rehm J., Baxter A. J., Ferrari A. J., Erskine H. E., ...Vos, T. (2013). Global burden of disease attributable to mental and substance use disorders: Findings from the Global Burden of Disease Study 2010. *The Lancet, 382*(9904), pp. 1575-1586;
WHO. (2017). Depression. Retrieved from https://www.who.int/en/news-room/fact-sheets/detail/depression;
Wiggins O. P., Schwartz M. A. (2011). Phenomenological psychiatry needs a big tent. *Philosophy, Psychiatry, & Psychology, 18*(1), pp. 31-32;
Wrigley A. (2007). Realism and Anti-Realism about mental illness. *Philosophical Papers, 36*(3), pp. 371-397;
Zahavi D. (2003). *Husserl's phenomenology*: Palo Alto, CA: Stanford University Press;
Zahavi D. (Ed.) (2012). *The Oxford handbook of contemporary phenomenology*. New York: Oxford University Press;
Zahavi D. (Ed.) (2018a). *The Oxford handbook of the history of phenomenology*. Oxford: Oxford University Press;
Zahavi D. (2018b). Getting it quite wrong: Van Manen and Smith on phenomenology. *Qualitative Health Research, 26*(6), pp. 900-907.