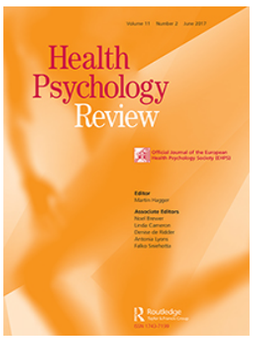

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What are psychological constructs? On the nature and statistical modelling of emotions, intelligence, personality traits and mental disorders

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Many scholars have raised two related questions: what *are* psychological constructs (PCs) such as cognitions, emotions, attitudes, personality characteristics and intelligence? And how are they best *modelled* statistically? This commentary provides (1) an overview of common theories and statistical models, (2) connects these two domains and (3) discusses how the recently proposed framework *pragmatic nihilism* (Peters & Crutzen, 2017) fits in.

For this overview, I use an inclusive definition of the term 'psychological construct' that also encompasses mental disorders, similar to Cronbach and Meehl (1955). This is consistent with recent efforts such as the research domain criteria (RDoC) that aim to refine such constructs (Cuthbert & Kozak, 2013), and is relevant given many recent discussions on the nature of psychopathology.

Psychological kinds

Four common accounts have been put forward: PCs are natural, social, practical or complex kinds.

Natural kinds

Natural kinds are unchanging and ahistorical entities that exist whether or not they are recognised as such. They have intrinsic properties that establish a natural set of kind members, making them the thing they are. The element gold, for instance, has 79 protons, and everything with 79 protons is gold; this internal feature is necessary and sufficient to define kind membership. In psychology, basic or primary emotions such as fear, anger or disgust are often seen as natural kinds (Barrett, 2006). Among others, Ekman and Cordaro (2011) suggested that 'emotions are discrete [and] can be distinguished fundamentally from one another' (p. 364). Mental disorders are a second example of PCs. In recent years, they have been described increasingly as *brain disorders* (Insel et al., 2010), and the search for biological markers presupposes that these disorders exist as natural kinds that can in principle be discovered; that is, the notion of brain disorders assumes a realist ontology about mental disorders. Personality characteristics have also been conceptualised as natural kinds by, among others, McCrae and Costa (e.g., McCrae et al., 2004; cf., Mõttus & Allerhand, 2017, for a detailed discussion).

Social kinds

The idea that psychological kinds are socially constructed – socially agreed upon definitions – is more common in the social sciences. Emotions, personality domains or mental disorders do not carve nature at its joints: they are *produced*, not *discovered*. Berger and Luckmann's seminal book on the

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topic states that all knowledge, even the most basic insight, is derived and maintained by social interactions (1966). As an example for PCs, Szasz posited that all mental disorders are socially constructed (e.g., Szasz, 1961; cf., Hacking, 1999, for a more nuanced perspective).

Practical kinds

Instrumentalists such as James, Dewey and Zachar understand PCs as *practical kinds*, a position referred to as pragmatic nominalism. From this perspective, emotions (Zachar & Bartlett, 2001), personality characteristics (Zachar, 2002) or mental disorders (Kendler, Zachar, & Craver, 2011) should be judged in terms of practical scientific success, not whether they correspond to an independent reality. Above anything, constructs should be *useful.* Socioeconomic status (SES) hardly represents a 'real' entity in a metaphysical sense, but provides important insights because it predicts adverse social and health outcomes such as injury, poverty, morbidity and mortality. Instrumentalists argue that unlike social kinds, practical kinds are not just 'made up': the goal is to identify scientifically useful categories. Many PCs such as emotions (Zachar & Bartlett, 2001) or mental disorders (Zachar & Kendler, 2007) have been discussed as practical kinds.

Complex kinds

Boyd (1991, 1999) understood biological species as *homeostatic property clusters* (HPC). Biological features often occur together in nature because the presence of one property tends to favour the presence of another, forming clusters. This means that beavers are aggregations of features that reliably occur together because of underlying causal processes. The same can be argued for depression: symptoms co-occur because the presence of one likely leads to others. Relationships between properties are probabilistic and not deterministic, and imperfect aggregations of properties are common: not all beavers have identical biological features, and not all depressed patients have the same symptoms. In this aspect, HPCs are different from natural kinds (which have necessary and sufficient features), but like natural kinds, they are non-arbitrary. Recent work suggests that a wide range of PCs may best be understood as HPCs: mental disorders (Borsboom, 2017; Kendler et al., 2011), personality characteristics (Mõttus & Allerhand, 2017), attitudes (Dalege et al., 2016) and intelligence (van der Maas et al., 2006; van der Maas, Kan, Marsman, & Stevenson, 2017).

Statistical models

The question what a PC is guides the type of statistical model that is appropriate. Three common models are described, along with their relationships to psychological kinds. Since constructs in

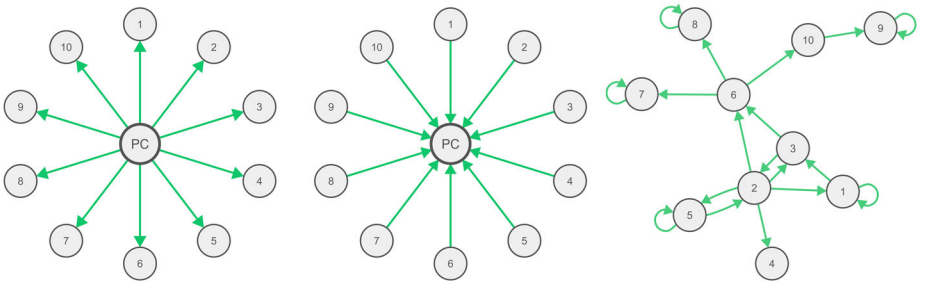

Figure 1. Schematic visualization of three types of statistical models for psychological constructs (PC). Left: reflective model where the latent variable (thick border) 'PC' is the common cause for the 10 observed indicators 1–10 (thin borders). Centre: formative model where the latent variable is constructed from the indicators. Right: network model where the co-occurrence of all observed items is due to causal processes; there is no latent variable, and self-loops indicate that items cause each other over time.

psychology are usually unobserved, they are referred to as *latent* variables in the statistical literature. The three models are summarised in Figure 1.

Reflective models

Conceptualising a PC as a natural kind implies a clear causal model: the latent variable causes a set of observable indicators, and a person's position on the latent variable can be inferred by measuring these indicators (Figure 1, left). To assess mathematical intelligence, for instance, a battery of math items (e.g., 'what is 4 + 4') can be used. For extraversion and schizophrenia, researchers can measure extraversion items (e.g., 'I like going to parties') and schizophrenia symptoms (e.g., 'I hear voices'), respectively. Statistically, such models are called *reflective latent variable models*, because the items reflect the manifestation of an underlying PC (Edwards & Bagozzi, 2000). While the use of reflective models follows from a natural kind perspective, not all reflective models represent natural kinds. Being rich can be understood to be socially constructed: some societies attribute monetary value to pieces of paper or digits on bank accounts, while others attribute value to oddly shaped wooden sticks. It is possible to infer if someone is affluent (the latent variable) via observable indicators such as the quality of clothing, the frequency of vacations, or by counting how many oddly shaped sticks a person carries.

Formative models

The *formative model* is the causal opposite (Figure 1, centre): indicators determine the latent variable (Edwards & Bagozzi, 2000). I used SES as an example for a practical kind, and it fits the bill of a composite variable. SES is *constructed* via indicators such as occupation, education and income: if a person's income increases, so does the SES, but it is not possible to increase a person's income by changing the latent variable. The opposite holds for reflective models: changing mathematical intelligence in the brain (if possible) would change a person's performance on math questions, but interfering with a person's ability to do well on a test (e.g., lack of sleep) does not diminish the person's actual mathematical ability. Note that such interventions have been proposed as a way to determine whether a PC is 'real' (Hacking, 1983): if researchers feel comfortable manipulating it in an experiment to investigate something less known, it can be considered real.

Network models

From the perspective of HPC, extraversion items do not co-occur because of an underlying PC – they are related because they influence each other (Mõttus & Allerhand, 2017) (Figure 1, right). Likewise, mental disorders such as schizophrenia or psychosis can be conceptualised as clusters of symptoms with causal interactions and vicious circles that can form stable systems (Borsboom, 2017; Cramer, Waldorp, van der Maas, & Borsboom, 2010; Fried et al., 2016), rather than as passive indicators of a brain disorder. Instead of modelling PCs as a reflective or formative latent variable, network models for cross-sectional (Epskamp, Borsboom, & Fried, 2017) and longitudinal (Bringmann et al., 2013) data have been developed recently that allow for modelling complex systems of observable items. It has also been suggested that the environment plays an important role in such networks, and that it may lead to stable networks (Mõttus & Allerhand, 2017; van der Maas et al., 2017).

Pragmatic nihilism

A major shortcoming of the empirical literature on PCs is the lack of clarity regarding how researchers understand what they study. For personality traits and mental disorders, for instance, researchers predominantly use reflective latent variable models, but they remain largely silent about what 'extraversion' or 'neuroticism' factors are, or what a 'cognitive depression' factor is with symptoms like

worthlessness, hopelessness, guilt and pessimism. Do these latent variables cause their indicators, and what is their ontology?

The question what psychological kinds are is also at the core of Peters and Crutzen's (2017) idea of pragmatic nihilism (from here on P&C). The authors do not refer to the large corpus of literature on the topic, and I hope the brief overview above is helpful to embed their ideas into prior work.

The first tenet of pragmatic nihilism is that PCs are 'useful metaphors in understanding and modelling the world', but need not actually exist. This resembles a practical kinds view: pragmatic nominalists have long argued that 'realness' does not add anything relevant to a construct (Fine, 1984), and that constructs should be, above all, useful. Second, pragmatic nihilism pertains to definition, measurement and operationalisation of constructs: how researchers define them determines how they should be measured. This calls for attention to operationalisation: if PCs are not necessarily real, and the goal is to create useful metaphors rather than to discover truths, the operationalisation of a construct *defines* it. Depression rating scales, for instance, differ considerably in symptom content (Fried, 2017), and P&C would likely argue that these different scales measure somewhat different 'depressions'. This focus seems to call for formative instead of reflective latent variable models, which contrasts with the widespread use of exploratory and confirmatory (i.e., reflective) factor models in the psychological literature. Third, P&C argue that 'cognition and emotion […] exist as emergent properties in a distributed network of neurons', but they 'cannot be pinpointed physically in people's brains'. This raises the question whether the authors understand PCs as *identical* to their neurological realisations, or whether they supervene on neurological processes (cf., Kievit et al., 2011).

My main concern is this: *there is nothing better than a true theory*. Discovering truths about the universe, such as the table of elements, has facilitated – and in many cases enabled – scientific progress. If there is nothing real about psychological processes, psychology can only ever describe, but never understand, which may greatly limit prediction and intervention. I'm not quite ready to give up on the notion that psychology can discover truths, and find the idea that all PCs are made-up disheartening … but that's what you get messing about with nihilism, I suppose.

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