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Can we model organismic causes of working memory, efficiency and fluid intelligence? A meta-subjective perspective ☆

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ABSTRACT

I critically examine the target paper by Demetriou et al. (2013) noticing that their epistemological perspective is meta-empiricist (i.e., taking the viewpoint of an external observer). This viewpoint is contrasted with to a metasubjective perspective (i.e., that of the subject-matter itself — organismic processes). I explain working memory (whose key developmental determinant is mental – M – attention), as well as processing speed, and Gf from a metasubjective perspective; and I emphasize that difficulty of an item/task is relative to the trade-off level between its item/task mental–attentional demand and the participant's mental–attentional capacity. I list principles of measurement for proper assessment of mental/executive/endogenous attention (M-capacity) and explain some of the results of Demetriou et al. as resulting from inadequate control of this M-demand/M-capacity trade off in their tasks. Demetriou et al. have achieved clear demonstration that WM, Gf, and processing speed are distinct latent variables whose interrelations change with age. To clarify further their organismic causal determinants they should make a "metasubjective turn" in their theorizing.

> "In summary, empiricism begins with the record of plain facts, science denounces this evidence to discover hidden laws. *There is no science but of that which is hidden*" (Bachelard, 1975/1949, p.38, my translation, italics in the original).

1. Introduction

Much of current research in Psychology is meta-empiricist. Empiricism is the approach to science that values empirical method above rational method, adopts an observer's perspective to describe facts and data, and prefers theories that are locally anchored to the situations where they should be applied (and so general theories are scarce or too global); it tends to describe its constructs as objects or object-like concepts or models — as (figurative) representations. From this empiricist perspective, the operative/functional processes that bring about or change representations are understated or minimized in their explicit description. Further, empiricism has a tendency to assume that its descriptive representational constructs (along with their often implicit operative processes) are causal — i.e., they are descriptive of relevant organismic processes involved in the subject-matter at hand, even though explicit methods of process/task analysis are very rarely used.

Meta-empiricism is the much refined contemporary version of this epistemology. It is "meta" because it is keenly aware of the complexity of hidden psychological/organismic dynamic structures, and because it uses complex methods and technology (psychometrics, mathematical, neuroscientific, mechanical or computer modeling, comparative biological evolutionary methods, etc.) in an attempt to describe *from outside*, *from an observer's perspective*, credible models of the data and their hidden (organismic) causal processes.

The epistemological (i.e., rational–methodological) counterpoint of meta-empiricism is what many call *constructivism* (Pascual-Leone, 2012a), i.e., a dynamic, organismic, empirical–rationalist approach to cognitive learning (nowadays often

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called neuroplasticity). Unlike meta-empiricism, constructivism attempts to describe *from within the organism, from a dynamic meta-subjective perspective*, both operative and figurative organismic processes, which in their interaction might causally produce facts and data uncovered by researchers. To emphasize this point, I contrast the meta-empiricist observer's perspective with a constructivist's metasubjective perspective.[1] Both epistemological approaches are needed in science: They are two limbs allowing science to walk and advance.

A metasubjective description can be aided by obtaining in human subjects their own introspective/phenomenological description of how they do or might mentally proceed with the task — verbal reports of problem solving, including errors in understanding. These subjective analyses are clarified vis-à-vis their intended task by a rational, semantic–pragmatic (i.e., information processing) analysis of internal constraints necessary to produce the intended results, i.e., which can satisfy resistances (external constraints) of the task at hand. This semantic–pragmatic analysis (a rational reconstruction — perhaps a priori), turns the analysis into *metasubjective modeling* guided by inference and abduction (as Peirce might have described it — Apel, 1995; Rennie, 2012).

A classic example of how these two complementary approaches (meta-empiricist and metasubjective) collaborate dialectically (Pascual-Leone, 2012b) in advancing science, is found in Copernicus' revolution. The intuitive insight that might have driven Copernicus to his heliocentric viewpoint (Feyerabent, 1978) may illustrate why *meta-subjective turns* (i.e., *constructivist* thinking) are necessary for advancing science. Ptolemy's intuitions about the movement of the sun were much more congruent with everyday experience of people who walk about, look at the sky, and watch sun, moon and stars moving relative to them. Copernicus rejected such observer's perspective and placed himself intuitively within the cosmos itself, experiencing dynamic relations in this cosmos from within — *a metasubjective turn*. Thus, against sensorial appearances, he anticipated rationally that taking the sun as rotation axis in our planetary system would be more congruent with reality. He took this decision even though (Feyerabent, 1978) the Ptolemaic system at the time could make more precise, albeit empiricist, predictions.

The meta-subjective turn promotes a different form of empirical research — the constructivist one. Here the subject matter is not appearances, but the *causal* constraints or *resistances* to action/interaction (be they affordances or encumbrances) presented to human activities by the organism and certain contexts or tasks. Metasubjective theories aim to clarify and epistemologically reflect these (often relational) resistances. As Bachelard (1960/1953, p. 10) has said: "The first specific instance of the notion of matter is the *resistance*" (my translation, italics in the original). And this is apparent in some situations: *resistances* of the real world are obvious when we get into an accident. But this occasional obviousness does not imply that the structure of appearances is the structure of *hidden causal processes* (Bachelard, 1975/1949, 1981/1940; Bohm, 1980).

Thus valid theoretical constructs epistemologically reflect (perhaps hidden) causal resistances of the subject-matter (including inter-relations that must hold among the constructs). This is what Demetriou et al. (2013), using a mechanical-engineering metaphor popular in neuroscience, call "alignment" – one of their three key hidden-process constructs ("AACog" — their ultimate organismic functional causes) – which explains the emergence of intelligence and cognitive development. Demetriou et al., however, maintain a meta-empiricist perspective and do not make a metasubjective turn as Copernicus did. Consequently, as I will suggest, their organismically deeper theoretical constructs, AACog and even their more empirical category constructs (i.e., Representations, Speed of processing, Gf, and Age) remain organismically fuzzy and unexplicated.

Incorporating in their theorizing verbal/phenomenological reports with metasubjective analysis could reduce fuzziness in the explanations. Furthermore, from a metasubjective perspective the distinction between "correct" and "incorrect" response/performance is relative to the observer's criteria (whether arbitrary or logically true). Both sorts of performance result from basically the same processes; but "incorrect" performances tend to be more informative with reference to causal mechanisms (expressing some missing regulation and/or process), whereas "correct" performances are more useful in estimating skills or the capacity level of participants. Analyzing both sorts of performance metasubjectively, and obtaining verbal reports could be useful to Demetriou et al. (2013) for making their theorizing more metasubjective.

2. The novel empirical results

These problems are absent in their empirical data — with the elegant statistical modeling methods they use. Even though their three studies may not have been designed as an integrated totality (and so their data presentation is complex and hard to grasp[2]), they manage to show *across content domains* (with clarity, when others have not) that working memory (WM) is not reducible to speed of processing; and that in coordinated interaction with Gf (with which it shares much variance) WM might be the main independent contributor to stages/levels of processing and developmental cognitive growth — except for age, a causally-problematic *descriptive* variable. Notice that working across content domains to seek (aided by statistical modeling) functional *invariants*, i.e., recurrent across-domain *alignments* of processes (operations, patterns, etc.) that together synthesize similar intended performances, leads Demetriou

[1] Note that "subjective", in the term "metasubjective", refers not just to psychological subjectivity but much more broadly to what is often called the subject-matter of an issue at hand. When using the terms "subject" and "subjective" I refer to this subject-matter in question. There is no intended reference to psychological subjectivity, although this too can be studied metasubjectively. "Metasubjective" refers here to thinking and theorizing (metacognition) from within the perspective of the given subject-matter, transcending an observer's perspective. In physics, for instance, metasubjective is a perspective that investigates the cosmos' own internal organization as a dynamic totality, from within.

[2] Difficulties in grasping these interesting data is in part due to some clerical errors — e.g., relation between speed and Gf in Study 2, reported to be −.19 in Table 1, appears in the text (p.42) and attributed to the relation between speed and working memory.