A tale of two histories

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Title: A tale of two histories: Dual-system architectures in modular perspective

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Abstract

I draw parallels and contrasts between dual-system and modular approaches to cognition, the latter standing to inherit the same problems De Neys identifies regarding the former. Despite these two literatures rarely coming into contact, I provide one example of how he might gain theoretical leverage on the details of his "non-exclusivity" claim by paying closer attention to the modularity debate.

Main text

The cleavage between thinking that's fast, intuitive, and stereotyped and thinking that's slow, effortful, and fluid is a defining feature of contemporary dual-system accounts. However, a parallel and largely independent tradition in cognitive science posits domain-specific cognitive systems or "modules" (Mountcastle 1957; 1978; Marr 1976; Chomsky 1980; Fodor 1983). In the canonical formulation, the existence of modules is thought to hinge on the difference between "central" and "peripheral" operations, where only the latter qualify as modular (Fodor 1983; cf. Sperber 1994; 2002; Carruthers 2006; Chomsky 2018). Peripheral systems encompass both sensory (input) and motor (output) systems, including those storing procedural knowledge and skill routines. They are characterised by a similar roster of diagnostic features as those commonly ascribed to the fast and intuitive "System 1" within dual-system accounts—in particular, a degree of informational encapsulation, automaticity, and introspective opacity. The main difference is that, with modules being domain-specific, one doesn't encounter an all-purpose "Peripheral Module," akin to System 1, that's set against the central system/"System 2." Instead, there are at least as many modules as there are input and output systems, and potentially separate modules for acquired skills (Karmiloff-Smith 1992). Furthermore, being peripheral, the operations of modules map imperfectly onto System 1 functions, with some possible overlap for skills. But even then, in dual-system accounts, the skills in question are more likely to be cognitive biases and rational heuristics—something more like intellectual habits—than perceptuo-motor and procedural skills. Perhaps ironically, the dual-system view has more in common with theories of "massive modularity," in that both view central operations as carved into stereotyped modes of functioning dependent on context (Barrett

& Kurzban 2006). Both dual-system and modular theories are, in turn, distant cousins of the much older physiological division of the nervous system into the central ("voluntary") and peripheral ("autonomic"/"involuntary") nervous systems. According to the physiological classification, brain and spinal cord constitute the central nervous system, meaning that, counterintuitively, modular (peripheral) operations, being largely cortically controlled, fall under the the central nervous system, not the peripheral one.

Some philosophers have thought that if peripheral operations are "fast, cheap, and out of control" they will be less vulnerable to epistemically corrosive top-down/doxastic influences (Zeimbekis & Raftopoulos 2015; Machery 2015). Indeed, epistemic worries lay partly behind the traditional effort among modularists to show that perception isn't cognitively penetrable—that a visual module, for example, cannot access central information, such as an agent's beliefs and desires, and so operates without interference from what the agent believes or wants the world to be like (Fodor 1983; 1984). This form of informational encapsulation amounts to a more pronounced form of the System 1/System 2 distinction, albeit pitting perceptuo-motor tasks against System 2. De Neys' non-exclusivity model, for its part, predicts that System 2 responses are available to System 1, itself a highly suggestive claim that runs counter to the modularist's contention about the cognitive impenetrability of perception. For instance, De Neys speculates that "intuitive logical reasoning [c]ould serve to calculate a proxy of logical reasoning, but not actual logical reasoning." One compelling explanation for this feat is that the brain is able to execute quick, largely involuntary, and *reliable* routines by exploiting some of the same

hardware—and information—that runs the slower (more deliberate) routines. If that's true, and generalises to perceptual systems, the epistemic worry would either dissolve (optimistically) or diminish (more likely), since perceptual systems would then still be fast, cheap, and out of control, and hence less vulnerable to interference from central information, despite having access to that information (i.e. being cognitively penetrable). But more importantly for De Neys (and whether or not the idea generalises to perceptual systems), it would offer De Neys a promising source of corroborating detail for his non-exclusivity framework: System 1 might generate System 2 responses efficiently and reliably because it has *access* to System 2 information! As it happens, a proposal along these lines finds support in some of the (anti)modularity literature, which suggests that perceptual systems do have access to central information.

For example, evidence of widespread neural "reuse" or "recycling" demonstrates that the neural communities subserving even our most evolutionally ancient transduction systems also subserve central systems; and it's also likely that transduction dynamics can sometimes be activated by the same domain-general nodes yielding central system dynamics (Anderson 2010; 2014; Dehaene 2005). Both findings are significant, because overlapping neural systems are likely to share information (Pessoa 2016). Further evidence that fast routines can indeed be gotten out of the elements of slower ones comes from research showing that visual processing integrates memories and prior expectations—which feature in slower, classically central, operations—implying that some perceptual

processes have access to central information, despite being fast, automatic, and reflex-like (Chanes & Barrett 2016; Munton 2021). Take a simple example (based on true events):

> *Maple Syrup*: A bottle of "Hamptons Maple Syrup" on my kitchen benchtop struck me as "Hampton's Maple Syrup" for quite some time until one day I realised there was no apostrophe. In fact, for some of the time there *was* an apostophe, but it had been expertly occluded by my partner, an amateur lithographer, who gets a kick out of altering labels on household food items when he's bored.

Maple Syrup seems as good an example as any of the cognitive penetration of perceptual experience, and it's the cumulative force of multiple bouts of misremembering what I had previously seen, on top of heavily weighted priors, that plausibly accounts for it. The penetration is fast, automatic, and not readily susceptible to central revision. Crucially, it illustrates that fast and frugal dynamics can sometimes underwrite perceptual fidelity without the added requirement that perception be cognitively impenetrable—after all, there really *is* an apostrophe on bottles of Hampton's maple syrup!

Obviously De Neys can afford to be agnostic on the epistemic issues surrounding perception. But a fallout from this debate may offer just the lead he needs in gaining a tighter understanding of how his non-exclusivity proposal might work.

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