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Abstract: Is there a notion of domain specificity which affords genuine insight in the context of the highly modular mind, i.e. a mind which has not only input modules, but also central 'conceptual' modules? Our answer to this question is no. The main argument is simple enough: we lay out some constraints that a theoretically useful notion of domain specificity, in the context of the highly modular mind, would need to meet. We then survey a host of accounts of what domain specificity is, based on the intuitive idea that a domain specific mechanism is restricted in the kind of information that it processes, and show that each fails at least one of those constraints.

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Abstract

Is there a notion of domain specificity which affords genuine insight in the context of the highly modular mind, i.e. a mind which has not only input modules, but also central 'conceptual' modules? Our answer to this question is no. The main argument is simple enough: we lay out some constraints that a theoretically useful notion of domain specificity, in the context of the highly modular mind, would need to meet. We then survey a host of accounts of what domain specificity is, based on the intuitive idea that a domain specific mechanism is restricted in the kind of information that it processes, and show that each fails at least one of those constraints.

Keywords:

Domain-specificity; cognitive modularity; central systems; information restrictions.

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1. Introduction

Our question in this note is *whether there is a notion of domain specificity which affords genuine insight in the context of the highly modular mind* – where by the latter we mean, roughly, a mind which has not only input-output modules but also central system, i.e., "conceptual", modules.

Our game plan in addressing this question – call it Q – is as follows. We begin by saying more about what we mean by two key terms, namely 'highly modular mind' and 'genuine insight'. This will clarify what exactly we intend by the question. (We do not explore the third key term, 'domain specificity', at this stage because the bulk of the paper will be about what it amounts to.) Next, on the basis of this explication, we formulate constraints on what would count as a notion of domain specificity which affords genuine insight in the context of the highly modular mind. Finally, we survey a host of proposals about how to understand domain specificity, and argue that none meets all of these constraints. Hence our (tentative) answer to Q is 'no'.

Before proceeding, two caveats are in order. First, our conclusion will not be that the very idea of domain specificity should be scrapped: for all we say here, it may well play an important role if the mind is not highly modular. On a related note, though our arguments tend to the theoretical/philosophical, our plaint is not that the very notion of domain specificity is incoherent in the context of the highly modular mind. Rather, our negative answer is an empirical one.

2. The Two Key Terms and The Resulting Constraints

What do we mean by 'affords genuine insight'? As philosophers of science know, giving an analysis of 'insight' as applied to scientific theories is more than challenging. Thus we won't attempt anything like that. For our purposes, we require only two things:

1) The fact that the notion applies to X tells us something we wouldn't otherwise know about X;

2) Labeling a mechanism 'domain specific' not only tell us something novel, but something *empirically plausible* about X.

In short, genuine insights are original, and they are (likely) correct.

And what do we mean by 'the highly modular mind'? This term requires rather more explanation. Since most readers will be familiar with the general idea of a module, we may be fairly brief. Modules are characterized by four key elements. First, like posits of Faculty Psychology in general, they are *mental* and they are *mechanisms*. For example transducers, construed as merely physical processors, are not modules. And, because a module must be a causally efficacious mechanism, there is not a module for every "ability": humans are able to play baseball, but there is no baseball module; humans can make coffee, but there is no coffee making module, etc. Second, each module has a *specialized function* is *informationally encapsulated* and *domain specific*. As a result, faculties of judgment or perception, if such exist, are not modules. Nor would general-purpose reasoning or memory be modules.

Any discussion of modules must reference Fodor's ground-breaking work (1983). On Fodor's original proposal, a module was not just any functionally dissociable psychological mechanism (as it is currently understood by, for example, Barrett & Kurzban, 2006). It also exhibited, to an interesting extent, the four criteria described immediately above. Yet these conditions are far from sufficient, i.e. they should not be taken as a sort of diagnostic checklist

for modularity (Barrett and Kurzban, 2006; Fodor, 2000). Still, Fodor maintains that modules have further properties. Thus he took modules: to be fast and mandatory; to provide simple outputs; to exhibit a species-specific ontogeny; and to have discrete neural correlates. Most importantly for present purposes, Fodor's modules are all input-output systems.

In the last decade or so, numerous authors (Barrett, 2005; Pinker, 1997, 2005; Sperber 1996, 2005; Cosmides & Tooby, 1992; Carruthers, 2005; Samuels, 2006) have proposed so-called *central* modules which are rather unlike those of Fodor's original conception. These modules retain the four core properties rehearsed above. However, unlike Fodor's favored examples, these new-fangled modules do not interface directly with the world beyond the mind. Instead, they take inputs from other mental mechanisms, and output them to other mental mechanisms.

Here is an intuitive way of introducing central system modules. According to a very old philosophical idea, the human mind has specific mechanisms for pre-conceptual sensation, plus a general mechanism for conceptual reasoning (Locke, 1975). These are taken to be exclusive and exhaustive. In contrast to this old idea, a central module has features of each kind: it is special purpose, like sensation; but it is also conceptually rich, like reasoning (Collins, 2005). Examples of proposed conceptual modules include folk biology (Atran, 1999, 2001; Keil, 1994) folk physics (Carey & Spelke 1994; Carey & Xu 2001), face recognition (Kanwisher, N. & Moscovitch, M., 2000) cheater detection, mate selection, (Cosmides & Tooby, 1992) and so forth (Roberts, 2007; Santos et al., 2002; Hirschfield et al., 1994). It is in this context that our term of art, the 'highly modular mind', plays its part. By 'highly modular' we mean a mental architecture that has numerous input-output modules, but also numerous central system modules.

(What has been termed the 'massively modular mind' – that is, one that has only modules, and no general-purpose central system at all – is thus a sub-case of the highly modular mind.)

Recall, by way of summary, our central question:

Q: Is there a notion of domain specificity which affords genuine insight in the context of the highly modular mind?

In light of our terminological discussion of 'insight' and the 'highly modular mind', Q amounts to this: Is there a notion of domain specificity which (a) tells us something novel and empirically plausible with respect to (b) a mind which not only has numerous input-output, pre-conceptual modules, but also has numerous central system, richly conceptual modules?[1] The question is pressing because the original notion of domain specificity was elaborated in the context of input-output modules, and Fodor-modules in particular. Thus, even if it affords insight into the mind so construed, it may not retain its novelty and correctness when central system modules are thrown into the mix.[2]

Having clarified our question, we may now derive constraints on a notion of domain specificity which affords genuine insight in the context of the highly modular mind. To provide insight, in the sense highlighted above, the notion must do some novel work. That is, it should

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[1] One might be tempted to cheat here by having a disjunctive notion – with one disjunct applying to input-output modules and the other applying to Central System ones. Arguably, this would run afoul of the requirement of providing genuine insight, by rendering the notion largely vacuous. Regardless, let us agree that disjunctive notions are not allowed.

[2] A similar conclusion on completely different grounds has been put forward by Peter Carruthers (2006, p. 6).

reveal facts that would not be captured in any case by means of some other, independently motivated, psychological posit. Specifically, then, an acceptable notion of domain specificity must rule things in or out that are not otherwise included/excluded on independent grounds. That is the first constraint. In addition, the notion must be empirically adequate: it should categorize things in a way that fits current evidence. In particular, it should be neither too loose nor too restrictive – e.g., it ought not treat as 'domain specific' mechanisms which are paradigms of the domain general, like Fodor's central system. Finally, given that the heart of our question is whether domain specificity continues to afford insight in the context of the highly modular mind, it is crucial that the requisite notion be applicable to both varieties of modules, both input/output and central/conceptual.

It remains to urge that, whatever value it may have had in the older framework, no notion of domain specificity meets all three constraints. Thus the probable answer to our question is 'no'.

3. Eight Candidate 'Notions'

The intuitive idea of domain specificity is this: that the causal mechanism is *restricted* in terms of the *kind of information* that it processes. This intuitive idea certainly does seem to characterize modules. But closer scrutiny is called for. In particular, we need to ask what this intuitive idea amounts to, so that we can then consider seriously what genuine insight it might afford.

We may begin to spell out the intuitive idea by noting multiple readings of 'restricted' in 'restricted to information of a certain kind':

P: Provides only information of a certain kind

T: Triggered only by information of a certain kind

D: Draws upon information of only a certain kind

O: Operates on only information of a certain kind

Being an empirical inquiry, proof is not in order. Thus it would demand too much to require a demonstration that these four exhaust the possibilities. Nonetheless, there is good reason to believe that they do so. The reason is that a module can only be characterized in terms of its inputs, its outputs, or the kind of processing internal to it. And this four-fold taxonomy covers all three bases, in all the obvious ways. P pertains to a restriction in outputs – specifically, it is about what kind of questions the module answers. T pertains to a restriction in inputs – specifically, it is about what kinds of information cause it to perform its function. Finally, as will be explained in more detail below, D and O have to do with the kind of representations that the modules operate on.

There are also two salient readings of 'information' in 'restricted to information of a certain kind'. On the one hand, as tends to be emphasized with respect to the computational aspect of the computational-representational theory of mind, what makes information belong to a certain kind K may be the *form* of the vehicle which carries it. On the other hand, focusing upon the representational aspect of mental symbols, what makes the information belong to kind K may be the *content* or *topic* of the representation. Again, this appears to be exhaustive: all there is to a mental representation is its form **F** and its content **C**.

Empirically-informed conceptual analysis thus results in eight ways of understanding 'domain specificity'. Eight notions which, were they viable, would yield a positive answer to our question.

[TABLE 1 here]

4. Evaluation of Each Notion

We have explained question Q in detail, presented three constraints on a successful positive answer, and rehearsed each potential ways of explicating domain specificity. We turn, at last, to addressing Q itself. We proceed by elimination of the eight options, showing that none satisfies our constraints.

The first point to make about all eight is that they appear to make it too easy for a mental mechanism to be domain-specific. After all, it is vacuously true of any putative cognitive mechanism that it is specialized to answer whatever questions it answers (and only those), to be triggered by whatever information triggers it, to draw on whatever information it draws on, etc. In other words, any mental mechanism is specialized to do whatever it is that it does. It is restricted to process whatever information it processes. Thus, any cognitive mechanism has a specific domain in this loose sense. However, we do not want just any cognitive mechanism to be domain-specific. Hence, not any restriction in the kind of information a mechanism processes can amount to domain-specificity. There are other worries too, however, depending upon which of these is proposed, and to these we now turn.

Let us begin with the left-most cells of our taxonomy, namely **FP** and **CP (**see table 1). Patently, answering questions of a certain kind amounts to nothing more than having a specialized function.[3] Thus, understanding 'domain specific' in either way would mean that

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[3]. Talk of "function" in the modularity literature ambiguous. Sometimes, it aims to be in tune with the evolutionary biological sense of *selected* or *proper* "function" (Millikan, R.G., 1984). In evolutionary biology, an organ's proper or selected function is whatever it was naturally selected to do. "If an organ has been naturally differentially selected-for by virtue of something it does, we can say that the reason the organ is there is that it does that something." (Wright 1973, p. 46).

domain specificity would add nothing new beyond the four core properties: being (i) mental and (ii) a mechanism, having (iii) a specialized function and exhibiting (iv) informational encapsulation. Understanding 'domain specific' in this way thus violates the first constraint.

A very reasonable rebuttal here is that domain specificity does add something new. It is having a specialized function which is otiose: it is the latter which ceases to afford insight in the context of the highly modular mind. However, we take functional specialization to be indispensable in a way that domain specificity is not. First, functionally specialized sub-systems are independently warranted by biological grounding: functionally specialized mechanisms are

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Other times, cognitive talk of "function" is much looser, meaning nothing but the mechanism's typical effects (Cummins, R., 1975) . This is the sense in which F&P and C&P identify domain specificity and specialized function, and it is also the way Fodor uses the word "function" to individuate modules in (1983). Notice, however, that taking a mechanism to be domain-specific if it exhibits a proper biological function would not satisfy our constraints either. After all, evolution might still have selected an all purpose system like Fodor's putative central system. It is an empirically open question whether or not it did, but either is conceptually possible. Fodor's central system, if selected for, therefore, would have a proper function. But Fodor's central module is the paradigmatic non-domain-specific mental mechanism. Thus, it is possible for a mechanism to have a specific proper function, yet not be domain specific. This shows that having a specific proper function would fail to exclude non-domain specific mechanisms like Fodor's central processor. Therefore, to have a specific proper function cannot be what it is required for a mental mechanism to be domain specific either.

ubiquitous in nature, whereas domain-specific ones are not. Related to this, the worry that we can willy-nilly invent mechanisms with function f can be addressed by appealing to an evolutionary robust notion of "function" and empirical facts about whether a mechanism was selected for. In contrast, the worry that mechanisms with *domain f* can be invented *ad nauseam* really is problematic.

On a closely related note, consider **FD** and **CD** (see table 1). These are ruled out as providing genuine insight because they recapitulate informational encapsulation. Encapsulation is defined, for example in Fodor (1983, p. 104) as having "to do with the range of information that the device consults in deciding what answers to provide". So, if domain-specificity is to be an independent notion, it cannot be reduced to a constraint in the range of information that the mechanism uses to perform its task. And, here again, we take informational encapsulation to be an indispensable notion in faculty psychology – whereas it is controversial whether we really require the much broader notion of domain specificity. If asked to choose between "domain specificity" and "encapsulation" as terms for the same notion, "encapsulation" has the advantage of lacking the kind of ambiguity that kick started this whole discussion.

Four candidate notions remain: **CT**, **FT**, **CO** and **FO** (see table 1). Consider **CO** and **CT**. Understanding 'domain specificity' in terms of the content of the representation that the module operates upon, or is triggered by, violates our third basic constraint, namely that any viable notion must apply to both input-output and central modules. In particular, either way of cashing out the notion fits ill with perceptual and motor modules, because many of them are not individuated semantically. For instance, the visual domain is not individuated in terms of the topic of the representations that it responds to or manipulates internally. One can see things and

facts of many, many kinds. What sets vision apart as a distinct domain is the *format* of its signals.

One might respond to this worry by insisting that there is not one domain here, vision, and one corresponding module, the visual system, but rather many of each: a module specific to colour (which arguably is a topic), a module specific to edges (which arguably is a topic), a module specific to spatial orientation (which arguably is a topic), and so forth. This is a perfectly coherent proposal. But, given current understanding of mental architecture, it is not empirically plausible that for every kind of content that can be input into the mind, there is a corresponding module. Similarly for every kind of output, i.e., motor routine. And that is what would be required, for domains to be individuated in terms of the content of the representations that trigger it, or that it operates over internally.

What about **FO**? The idea here is that to be domain specific is to operate internally only upon signals of a certain form. This fits input systems well. But when we consider conceptual modules, a complex dilemma arises. Either central system modules operate on representations in multiple formats, or each operates on representations in a single format. But, by hypothesis, to be domain specific is to operate only upon signals of a certain form. Thus the former disjunct can be immediately ruled out. It would entail that no central system mechanism is domain specific – which violates our third constraint that any acceptable notion of 'domain specificity' must be applicable to both alleged kinds of modules.

So, under **FO**, central system modules must operate on representations in only one format. But endorsing this disjunction leads to more complex problems. Another dilemma, in fact. Either the single format is the Language of Thought or it is proprietary to the module in question. On the first disjunct, even the Central System is domain specific. That is because the

Central System operates exclusively over representations in the Language of Thought. The proposal therefore violates the second constraint of empirical plausibility: it rules in something that clearly should be excluded. Also, endorsing this disjunct would mean that domain specificity plays no role in individuating conceptual modules, since all of them will have the very same domain.

The only remaining option, then, if we are to understand domain specificity as involving operations only over representations of a certain form, is that the single format is not the Language of Thought, but is rather specific to each module. However, the whole point of a central module is to integrate information of different kinds, from a variety of sources. In which case, central system modules, being domain specific in sense **FO**, must be able to take inputs of various non-LOT formats, output by its sister modules; and, to be of use to other central system modules, they must output representations in various formats. But without being able internally to operate on representations of multiple formats. This is conceivable. Central system modularity does not require, as a matter of conceptual necessity, a *lingua franca*; each might be fed inputs from various sources, pre-digested into the specific format that it can operate upon. This would be possible if there existed ever-so-many translation modules which mediate between central system processors. For instance, there would be a translation module whose task is to convert, say, face recognition's proprietary representations into formats usable by each of cheater detection, mate selection and theory of mind modules. But, apart from preserving domain specificity as a stand-alone notion, there is no reason to believe that the human mind is actually this complex.

The final option is **FT**. That is, what characterizes a module as domain specific is that the format of the representations which cause it to operate are idiosyncratic. (To be clear, this is to

be distinguished from the idea that the format of 'machine language' of the module is specific to it: that would be **FO** again.) Again, this notion seems quite appropriate for input-output modules. But, like **FO**, the idea falls afoul of our third constraint: it does not apply to central system modules.

5. Conclusion

The upshot of our discussion, then, is this. Though the intuitive notion of 'domain specific' seems to apply very naturally, careful scrutiny reveals that, in all likelihood, there is no notion of domain specificity which affords genuine insight in the context of the highly modular mind. After considering all possible meanings this notion may have, we have found none of them to satisfy the requirements set forth by the discussion itself.

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Table 1
Eight Candidate Notions of Domain Specificity

	P: Provides about	**T**: Triggered by	**D**: Draws upon	**O**: Operates on
F: Form of Vehicle	**FP**	**FT**	**FD**	**FO**
C: Content	**CP**	**CT**	**CD**	**CO**