The "Puzzle" of Emotional Plasticity

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ABSTRACT: The "puzzle" of emotional plasticity concerns making sense of two conflicting bodies of evidence: evidence that emotions often appear modular in key respects, and evidence that our emotions also often appear to transcend this modularity. In this paper, I argue a developmentalist approach to emotion, which builds on Karmiloff-Smith's (1986, 1992, 1994, 2015) work on cognitive development, can help us dissolve this puzzle.

KEYWORDS: emotional plasticity; modularity; representation redescription; Karmiloff-Smith; recalcitrant emotions

1. Introduction

Most philosophers of emotion accept that our emotional responses are, more or less, plastic. That is, they can, to an extent, be shaped and reshaped by us and by our socio-cultural environments. But this runs counter to many empirically-driven theories of emotion which suppose that at least some of our emotional responses are the products of special emotion-generating systems in the brain or 'modules'. The problem, in brief, is that traditional ways of understanding modularity threaten to make emotional plasticity into a philosophical puzzle because modules, by definition, are thought to be incapable of undergoing learning. In this paper, I draw on recent insights from developmental psychology, especially Karmiloff-Smith's (1986, 1992, 1994, 2015) work on cognitive development, to dissolve this puzzle. I argue both the appearance of emotional modularity, as well as our ability to transcend

this modularity (i.e. exhibit emotional plasticity), can be explained by two distinct, yet complementary, developmental factors, *viz.* developmental modularity and cognitive flexibility.

The paper is structured as follows. First, I give a brief overview of the "puzzle" of emotional plasticity (Section 2). I then appeal to the notion of developmental modules to explain why emotions look modular (Section 3) and the notion of cognitive flexibility to explain why they can transcend this modularity (Section 4).

2. Background

'Emotional plasticity' is a term of art, a recent one at that.[1] The term may be new, but the idea certainly isn't it. The term, I take it, is a nod to both neural plasticity and phenotype plasticity; the former being the ability of our brains to form new neural connections throughout our lives, and the latter capturing the ability of an organism to alter its phenotype in response to its environment. Emotional plasticity is similar, but also more familiar. In the broadest sense of the term, emotional plasticity is the capacity of our emotions to undergo change, say in response to our socio-cultural setting. For example, Tappolet observes, "Quite generally, emotional systems manifest an important degree of plasticity, in the sense that they are largely shaped, and can also be reshaped, by their socio-cultural environments" (2016, p. 37). Likewise, our emotions can also be changed, to an extent, by us, e.g. a phobic might eliminate, if not minimize, their fear by undergoing therapy.

This broad characterization of emotional plasticity subsumes several related, though importantly distinct, phenomena. For instance, it captures both phylogenetic and ontogenetic changes: respectively, the evolutionary history of emotions in our species, and developmental

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[1] See Schafe and LeDoux (2002), Faucher and Tappolet (2008a), Saarni (2010), Kotsou et. al. (2011), and Tappolet (2016).

changes in an individual's emotional responses during their lifespan. Within the domain of ontogeny, it captures both intrapersonal and interpersonal emotional changes, i.e. changes in an individual's emotional development vs. differences in development across individuals. Moreover, honing in on intrapersonal plasticity, it captures both the ability of an individual to regulate their occurrent emotions (i.e. the emotions they experience at a given occasion), as well their ability to influence their emotional dispositions over time. It is this latter ability, i.e. our ability to change our emotional dispositions, which has received most attention in the philosophy of emotion, and thus forms the topic of this paper.

There are at least two reasons which explain this focus. The first concerns its relevance for moral philosophy. There are several different ways issues about emotional plasticity intersect with moral theorizing, perhaps the simplest being that plasticity has implications for how we evaluate agents. It is worth pointing out that both forms of intrapersonal emotional plasticity play a role here. Consider someone with an angry temperament who is disposed towards acts of aggression when their anger gets too intense. For any specific act of aggression brought on by an episode of anger, the agent can only be deemed morally blameworthy if they can exert some control over this episode of anger. So the plasticity of occurrent emotions is relevant for how we evaluate the culpability of agents with respect to individual acts. But there is a larger issue at hand. If the agent is able to regulate the intensity of their anger on one occasion, this doesn't mean that they have successfully changed their temperament. For lasting change, we want them to change not just a few specific instances of anger, but their long-term dispositions for anger as well. Moreover, we can judge the agent to be morally praiseworthy if they undergo such change and blameworthy if they don't. Both moral praise and moral blame is predicated, then, on our being able to change not just our occurrent emotions, but also

our emotional dispositions. Moreover, when it comes to our emotions, arguably, it is change in our emotional dispositions which is really the all-important end goal for us as moral agents.[2]

Second, there is a widely held assumption in the philosophy of emotion that emotional dispositions are actually easier to change than certain kinds of occurrent emotional episodes. This feature of emotional plasticity is best exemplified by recalcitrant emotions. Recalcitrant emotions are emotions that are in tension with your considered judgments. For example, you fear Fido, your neighbor's docile dog which you judge to be harmless.[3] Recalcitrant emotions are supposed to be a common feature of our emotional lives. You are jealous when you partner talks to an attractive friend even when you know their interactions are perfectly harmless. You feel anxious and a bit fearful when you have to meet your dean, even when you know this meeting isn't about them chastising you for anything. Recalcitrant emotions are said to be irrational, and explaining why this is so is taken to be a challenge for a theory of emotion.[4] Tappolet (2012, 2016) assumes an 'ought implies can' principle when it comes to our emotions, and argues that recalcitrant emotions are irrational because something can be done about them, i.e. we may seek to revise our emotional responses. How? The recalcitrant, mulish, nature of recalcitrant emotions speaks to the difficulty in controlling them. Nevertheless, Tappolet thinks we can exert some level of control over even these sorts of emotions over time. That is, we can hope to change our emotional dispositions. For example, someone with serious issues about jealousy in their romantic relationships might seek therapy to minimize such boughts of jealousy.

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[2] A more detailed description of the various connections between emotional plasticity and moral philosophy can be found in Faucher and Tappolet (2008a).

[3] See Greenspan (1981), D'Arms and Jacobson (2003), Benbaji (2013) and Grzankowski (2016).

[4] E.g. see Greenspan (1988), Helm (2001), Brady (2009) and Majeed (2020).

Tappolet's explanation of the irrationality shrouding recalcitrant emotions has proved controversial, but what hasn't is her claim that we can change our emotional dispositions over time.[5]

This sense of the ways we can and can't change our emotions speaks to the very heart of what's supposed to be puzzling about emotional plasticity. On the one hand, emotions often don't seem to be the kinds of things we can influence. For example, you are devastated after a breakup, and it would be quite handy if you could stop feeling so incredibly sad, but you just can't help it. The occurrence of recalcitrant emotions is another way of bringing out this point. But there is a crucial difference. Recalcitrant emotions are witness to the fact that, sometimes, emotions don't just appear out of our control, they don't seem to succumb to reason at all; they don't seem to be influenced by your thoughts, judgments, etc. This feature of our recalcitrant emotions is evidence for the modularity of emotion.[6] That is, recalcitrant emotions manifest several traits which characterize Fodor's (1983) conception of modularity. They are quick and automatic. Sometimes they appear domain-specific, i.e. they are triggered by certain stimuli but not others. (Recall fearing Fido). But most crucially, recalcitrant emotions manifest what Fodor took be the essence of modularity, *viz.* information encapsulation. A cognitive system is informationally encapsulated, roughly, if the functions it computes are insensitive to what is going on elsewhere in the mind. Recalcitrant emotions appear informationally encapsulated in the sense that they are insensitive to what is going on in higher cognitive systems, e.g. those to do with judgment.

To recap, recalcitrant emotions give us reason to think that (some) emotions are modular in key respects. However, on the other hand, such emotions also appear to break free from the constrains of typical modular systems in that, as we have seen, we seem to be able to change them over time.

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[5] See Döring (2014) and Majeed (2020).

[6] Frijda (1986), Griffiths (1990, 1997), Charland (1995), Goldie (2000), Prinz (2004, 2008), Faucher and Tappolet (2008b), Jones (2008), and Tappolet (2016).

Perceptual modalities, which were Fodor's prime examples of modular systems, don't act in this way.[7] Optical illusions, for instance, continue to persist no matter how much, and for how long, we tell ourselves that what we are seeing is untrue. Emotions don't seem to be modular in this sense. We can gradually change our emotional dispositions, at least some of the time. The "puzzle" of emotional plasticity is how we are to account for these two conflicting bodies of evidence: evidence that our emotions often appear modular in key respects, and evidence that our emotions also often appear to transcend this modularity.[8]

It is plausible that some of the "puzzle" stems from a lack of terminological precision. In particular, they arise on account of the different ways the term 'emotion' is employed in various sub-areas that discuss emotional modularity and emotional plasticity. For example, recalcitrant emotions typically refer to emotions triggered in response to specific situations, when dogs are near, when you see your partner flirting with someone etc., whereas discussions around changing your temperament in ethics focus on emotion types, e.g. fear, jealously, and so on. Some of the tension between the modular appearance of the former and the plastic nature of the latter could, therefore, be resolved by being clearer on what we mean by 'emotion'. For instance, it might be that you never get rid of your fear of dogs, but you might, over time, become a less fearful person.

Terminological precision, however, won't dissolve the puzzle completely. In fact, it arguably won't speak to the most puzzling aspect of our puzzle, i.e. why the very same kinds of emotional responses can appear both modular and plastic. As far as I can tell, it is this puzzle that is found in

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[7] The plasticity of perception is actually somewhat contentious, but there tends to be acknowledgment within the philosophy of emotion that perception is a lot less plastic than emotion, e.g. see Tappolet (2012, p. 221) and Döring (2014, p. 127).

[8] Note: the tension here is sometimes described as a paradox, which is not, technically speaking, correct. So here I use the weaker notion of a puzzle.

the literature on recalcitrant emotions. Consider someone who has an irrational fear of dogs. Such a person might genuinely believe that their neighbor's toothless dog is harmless and yet still have a fear response when it comes near. If Tappolet is right, we judge that person as being irrational because something can be done about their fear. In particular, while they might not be able to influence the fear they experience at that very moment, they might, over time, learn to eliminate, if not minimize, their disposition to fear dogs, including the one owned by their neighbor. The very same kind of emotional response, i.e. being afraid of your neighbor's dog, then, can on the one hand appear modular and on the other appear plastic.

I should be clear from the onset that I don't think this is a genuine puzzle. For there to be a genuine puzzle, it needs to be the case that the very same emotional phenomenon, e.g. the very same occurrence of fearing Fido, appears both modular and plastic. This is clearly not the case. Nevertheless, there is something puzzling about the way certain occurrent emotional responses can appear modular whilst our dispositions to have them can appear plastic. At a first pass, this "puzzle" stems from supposing that at least some emotions are the outcomes of Fodorian modules. An obvious response, then, is to eschew all talk of modularity. However, simply forgoing all talk of modularity isn't the quick fix it promises to be either, as we need to explain the appearance of modularity, i.e. why emotions look like they are sometimes triggered by modular systems.[9] One option is to rethink

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[9] It is for this reason that constructionist accounts of emotion, e.g. Russell (1991, 2003) and Barrett (2013, 2017), don't (presently) solve our puzzle. While they reject emotional modularity and allow for emotional plasticity, they don't offer an explanation for why some emotions look modular. The same worry applies to other psychological theories of emotion development which eschew any talk of modularity, e.g. see Pérez-Edgar et al. (2019) for a review. As I see things, my solution to the puzzle should be congenial to such accounts. Barrett (2017), for instance, could incorporate

the traditional notion of modularity. There are already ways of rethinking emotional modularity that sets us on the right track. But so far, such moves have been preliminary. Moreover, I don't think rethinking the notion of modularity alone suffices to resolve the appearance of a puzzle.

Consider the following by way of example. As we have seen, an important way a system can be modular on the Fodorian conception is if it is informationally encapsulated. Informationally encapsulated systems, however, are thought to be incapable of undergoing any learning.[10] This in turn makes emotional plasticity, i.e. how emotions can be shaped and reshaped by us and by our socio-cultural environments, puzzling. But we can observe that there are really two ways a system can be informationally encapsulated. It can be encapsulated synchronically or diachronically (Majeed 2019).[11] A system which is encapsulated diachronically is neither influenced by what is currently going on elsewhere in the mind nor by what goes on elsewhere at any stage of development. By contrast, a system that is (just) synchronically encapsulated is insensitive to what is currently going on elsewhere in the mind, but it may be subject to diachronic updating, i.e. its functions might be influenced by what is going on in other systems, gradually, over the course of development. Crucially, this rethinking of modularity paves the way for a modular system which can be shaped and reshaped by us and by cultural and social factors.

For instance, consider how this plays out with regards to emotion. You might, say, have an irrational fear of Fido, but such irrational phobias are the sorts of things which people do sometimes overcome overtime. That emotions are plastic in this sense has been commented on by several

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developmental modules into her predictive processing version of constructionism by way of explaining the appearance of modularity.

[10] E.g. see Karmiloff-Smith (1994), Jones (2008) and Tomasello (2019).

[11] Segal (1996) makes an analogous distinction with regards to modularity in general.

philosophers of emotion[12], but what is missing is an actual explanation of how they can be thus so. That is, how can emotions be synchronically encapsulated whilst simultaneously being open to various kinds of diachronic updating? The overall aim of this paper is to dissolve our puzzle. But one way to do so is to actually answer this question. It is to this task that I turn in the rest of the paper.

The picture I provide of emotional plasticity will draw on developmental psychology, especially Karmiloff-Smith's work on cognitive development, which is summed up in *Beyond Modularity: A Developmental Perspective on Cognitive Science*. As will become evident, there are some non-trivial obstacles that need to be addressed if we are to apply her model of cognitive development to explain emotional plasticity. Nevertheless, as I hope to show, these obstacles aren't insurmountable, and her overall developmentalist framework will prove to be a useful tool in fleshing out one way we can dissolve our "puzzle".[13]

3. Developmental Modules

The question we are concerned with is how emotions can be synchronically encapsulated whilst being open to various kinds of diachronic updating. At present, there are some gestures towards an answer. For instance, Faucher and Tappolet (2008a) explain why a developmentalist model of emotion is a promising framework to utilize if we are to explain emotional plasticity. However, they stop short of

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[12] E.g. see Faucher and Tappolet (2008a), Tappolet (2016), and Majeed (2019).

[13] Note: there are other psychological explanations of cognitive development that might also help dissolve our puzzle. For example, both Tomasello (2019) and Dehaene (2020) offer biologically-constrained accounts of social learning, which *prima facie* could also be put to the task of explaining why (some) emotions look both modular and plastic. By using Karmiloff-Smith's framework, I don't mean to rule out such explanations, however, I shall leave the task of exploring them for another time.

offering such a model themselves. Likewise, I made some suggestions earlier about possible ways emotions might be modular (i.e. synchronically encapsulated) but still subject to cognitive influence over time, which draws on context-sensitive modular frameworks from cognitive science (Majeed 2019).[14] Nevertheless, these, I noted, were speculative and underdeveloped. What remains missing, then, is a fully worked-out story about precisely how emotions are supposed to be plastic in the relevant sense. The present paper aims to make up for this gap in the literature, and does so by picking up exactly where Faucher and Tappolet left off. I think a plausible, but by no means only, explanation of the relevant features of emotional plasticity can be given by drawing from developmental psychology in the way Faucher and Tappolet anticipate.

Faucher and Tappolet argue that emotional plasticity is plausibly accommodated by a framework based on the Developmental Systems Theory (DST), as championed by Griffiths and Gray (1994). On this view, the emotional phenotype is not preprogrammed into our genes, but depends on inputs from physiological factors (e.g. locomotion), social factors (e.g. parent reactions), and cultural factors (e.g. emotion concepts), as well as inputs from our genes. Moreover, constraints on development channel development not in a direction necessarily programmed into the genotype.[15] The DST affords the opportunity for emotional plasticity not present in frameworks that posit innately-specified modules, e.g. as made popular by Cosmides and Tooby (2000). However, the DST is really a view about biology and it remains unclear, at least from Faucher and Tappolet's discussion, how it is supposed to be adopted in the emotional context to explain both the modular (i.e.

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[14] I drew on the work of Sperber (2005) and Carruthers (2006), which emphases competition amongst modules to explain the context-sensitivity of modular systems. A drawback of this model is that it explains cognitive flexibility at the expense of positing more and more modules.

[15] For more on the DST, see Griffiths and Stotz (2000), Griffiths and Gray (2004, 2005), Griffiths (2011), and Griffiths and Hochman (2015).

synchronically encapsulated) nature of (some) emotions and our ability to diachronically influence these emotions over the course of development.[16]

An answer can, nevertheless, be found in the DST. In particular, it can be found in Griffiths and Stotz's (2000) exposition of how the DST can explain an analogous puzzle concerning cognitive flexibility:

> Taking a developmental perspective on evolved cognitive traits allows us to do justice to both bodies of evidence: evidence of the apparent modular nature of cognition and evidence of our ability to transcend modularity. The solution of this paradox is to understand modularisation as a product of development. (Griffiths & Stotz, 2000, p. 42)

Here Griffiths and Stotz are actually appealing to Karmiloff-Smith's (1992) idea that if the mind has any modular structure at all, it is the outcome of development.[17] This picture contrasts dramatically

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[16] Views similar to the DST that Faucher and Tappolet mention in the emotional context tend to be constructionist positions which don't explain (or explain away) the evidence for the modular nature of emotion, e.g. see Russell (2003), or just assume the very thing that needs explaining here (i.e. the seemingly synchronically encapsulated nature of emotion juxtaposed with their diachronic plasticity), e.g. see de Sousa (1987).

[17] They also appeal to Mithen (1996), who likewise advocates developmental modules. (In fact, the idea of a developmental "paradox" comes from Mithen, p. 52). Mithen's work is instructive but I will largely sidestep it on grounds that he's interested in explaining phylogenic changes in cognitive development, as opposed to ontogenic changes, and draws heavily from Karmiloff-Smith herself to justify his claims.

with the orthodox picture of modules, i.e. innately-specified systems which are incapable of undergoing any learning. It is my view that Karmiloff-Smith's notion of developmental modules helps us with our question in two respects. It enables us to explain why emotions can have the appearance of being modular, for she can grant that emotional systems can be synchronically encapsulated. Moreover, it does so whilst simultaneously offering us a model of modularity that doesn't rule out diachronic updating. What it doesn't do, however, is provide an explanation of the diachronic updating itself. In other words, the notion of developmental modules helps explain part of our puzzle, i.e. the appearance of emotional modularity, but it doesn't explain the other part, namely our ability to transcend this modularity.

Karmiloff-Smith's overall goal in *Beyond Modularity* was to reconcile Fodorian nativism with Piaget's constructivism. In concession to nativists, she grants that the human infant is born not with a blank slate but with certain domain-specific dispositions, e.g. dispositions to acquire grammar, dispositions to acquire certain kinds of mathematical knowledge, knowledge of physics, and so on.[18] However, in line with constructivists, she also accepts that we are not born with pre-specified modules, rather, to the extent that the human mind possess modules, these are acquired through a process of modularization.[19]

To clarify, first consider her distinction between domains and modules. A domain is the set of representations which sustain a specific area of knowledge, e.g. language, maths etc. A module,

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[18] In later work, she replaces the notion of domain-specificity with domain-relevance: biases relevant, but not specified, to process certain kinds of inputs. E.g. see Karmiloff-Smith (2015).

[19] This theme is developed in subsequent work under the 'neuroconstructivist' banner, which emphasizes environmental and neurobiological features, as well as genes and cognition, and the interaction between these features. E.g. see Karmiloff-Smith (2009), and Karmiloff-Smith et al. (2018).

by contrast, is an information-processing system which encapsulates that knowledge and performs computations on it. In this way, the domain specificity of a system doesn't entail its modularity. On her account, we are not born with an innate knowledge of certain domains, e.g. grammar. But we do have an innate propensity to acquire knowledge of certain domains, like grammar. Significantly, this doesn't entail the existence of a grammar module. Modules, when they develop (i.e. if they do so at all), are the products of a gradual process of "proceduralization" or "modularization", where behavioral responses are rendered more automatic and less accessible. Why believe this? One reason is evidence from neural plasticity: "knowing what we do about the brain's plasticity, progressive modularization, rather than prespecified modularity, is more plausible. By definition, precoded encapsulated modules could not reconfigure themselves. By contrast, modularization is a function of multiple levels of environment/organism interactions" (Karmiloff-Smith, 1994, p. 733). If modules do form, developmental modules better explain the different ways they can do so through dynamic interactions between the agent and their socio-cultural environment.

This might not completely convince the nativist, but note that Karmiloff-Smith's picture also heralds a departure from Piaget's framework in two further respects. First, she rejects his picture of early infancy. Not only are we born with certain kinds of domain-specific dispositions, crucially, these act as a constraint on development. For her these constraints "potentiate" learning by limiting the hypothesis space the child entertains. This has implications for modularity as well. Insofar as our minds have modules, the development of our modules is also constrained in this manner. That is, a limited set of domain-specific predispositions constrain the classes of inputs the infant mind computes, which can gradually lead to the development of brain circuits progressively selected for certain domain-specific computations. In some cases, this can result in the formation of (relatively)

encapsulated modules.[20] Second, she rejects Piaget's notion of developmental stages and replaces it with developmental phases: recurrent cycles of processes that occur again and again during the course of development (Karmiloff-Smith, 1987). This enables the developmental of modules even in adulthood, which we need if we are to explain automated emotional responses acquired late in life, e.g. a fear of dogs developed during middle-age. For Karmiloff-Smith, the central feature of Piaget's framework worth keeping isn't any specific detail concerning child development, but rather his epistemology: the idea that there is more to cognitive development than a genetically-specified program.

The notion of developmental modules enables us to explain why emotions can have the appearance of being modular. Emotions appear modular because sometimes they are modular. Emotional modules may form in the course of development, via certain dynamic interactions between agents and their environment, which is constrained, but not determined, by their genes. Developmental modules also give us a way of explaining interpersonal emotional plasticity. Differences in the emotional dispositions across individuals, even concerning their quick and automatic emotional responses, can be explained by differences in their developmental setting. The development of emotional modules, though constrained by our biology, can be shaped, and reshaped, by us and by socio-cultural factors. What remains less clear is if it also explains intrapersonal emotional plasticity. Once modules are formed, how do they explain our ability to transcend this modularity? The short answer is that they don't. While the process of modularization explains how we can form certain kinds of emotional dispositions, the account is at the same time limited in that it doesn't actually offer an explanation of how we are able to influence and reshape our emotional dispositions once we acquire them. For Karmiloff-Smith, such cognitive flexibility is explained by a

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[20] For more detail, see Karmiloff-Smith (1992, pp. 4-5). A similar account of both ontogenetic and phylogenetic development is discussed by Greenfield (1991) and Mithen (1996).

distinct, yet complementary process, which she calls "Representation Redescription" (RR): very roughly, the process where information stored in a domain gets accessed as manipulable data, which enables the application of existing skills to new purposes.

4. Cognitive Flexibility

The central idea driving Karmiloff-Smith's explanation of cognitive flexibility is that such flexibility is a product of development. This is manifest in how RR contributes to cognitive flexibility:

> The RR model attempts to account for the way in which children's representations become progressively more manipulable and flexible, for the emergence of conscious access to knowledge, and for children's theory building. It involves a cyclical process by which information already present in the organism's independently functioning, special-purpose representations, is made progressively available, via redescriptive processes, to other parts of the cognitive system. In other words, representation redescription is a process by which implicit information *in* the mind subsequently becomes explicit knowledge *to* the mind, first within a domain and then sometimes across domains. (Karmiloff-Smith, 1992, pp. 17-18)

RR is a process where information stored in a domain is redescribed in a way that makes it accessible to other domains. This cross-mapping of information across domains enables information previously stored in certain domains to be accessed as manipulable data. That is, we not only have explicit knowledge of information previously stored in an inaccessible way within a certain domain, but we are able to apply this information to solve issues that arise in other domains. Crucially, this provides

us with an account of cognitive flexibility because for Karmiloff-Smith, such flexibility, at least in one of its iterations, is nothing more than the application of existing skills to new purposes.[21]

Karmiloff-Smith is careful to make a distinction between this *model* of RR and the *process* by which she thinks RR occurs. The process explains a possible implementation of the model, which can be rejected without rejecting the model itself. The more controversial aspects of Karmiloff-Smith's notion of RR, arguably, concern the process of RR. On her account, RR is brought about not through instability but via behavioral mastery: when there is consistently successful performance in a given micro-domain. Such mastery enables a certain kind of meta-cognition, where implicit knowledge *in* the system is made explicit *to* that system. Meta-cognition in this context becomes possible (partly) because the redescribed representations lose a lot of the detail of the original representations, which in turn makes them less domain-specific and more easily accessible to other domains.[22] For example, a redescription of the perceptual information about a zebra into a "striped animal" (be it linguistic or image-like) sacrifices a lot of perceptual detail, which makes it less specific to the domain of visual perception. But this loss of detail also enables a new form of cognitive flexibility, e.g. it allows a human to understand the analogy between an actual zebra and a road sign for zebra crossings.

The actual process of RR Karmiloff-Smith outlines is more complicated. It involves several steps of RR, where each step involves recoding information which is stored in one representational code into a different one. For example, a proprioceptive representation can be coded into a spatial

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[21] Similar assumptions about cognitive flexibility are made by Gardner (1983) and Boden (1990).

[22] How meta-cognition itself is possible is a separate issue, one which Karmiloff-Smith (2015), following Dehaene et al. (2014), speculates has to do with a "global workspace": roughly a temporary conscious memory, which maintains relevant information for brief periods and relays it to various modules.

representation, which in turn can be coded into a linguistic representation, and so on. Each step of redescription is an abstraction from the prior representations, which sacrifices specificity for access. On her framework, the initial representations involved in behavioral mastery are encoded in procedural form, sequentially specified, and encapsulated, i.e. these representations are implicit. At the first level of RR, (E1), the representations lose many of the procedurally encoded information, are simpler, and less domain-specific. Here information previously embedded in the procedures are explicitly defined, including the relationships between their component parts. For Karmiloff-Smith, these representations are explicit in the sense that they are now available *to* the system, though they aren't necessarily available to conscious access or verbal report. At the next level of RR, (E2), we get representations which are available to conscious access, but these representations are in a similar representational code to the E1 representations, and thereby aren't available for verbal report. (For example, we often have access to spatial information, which we can convey by drawing but can't verbalize). At the final level, (E3), representations a recoded into a "cross-system code", which is close enough to natural language, and thereby can easily be translated into communicable forms such as verbal report.

The exact details of how RR occurs will turn out to be important if we are to use Karmiloff-Smith's framework to explain emotional plasticity. But for the present, let us ignore some of the detail in order to get a general sense for how the model explains cognitive flexibility. This is best brought out by considering one of her examples. When you learn to play a musical instrument, say the piano, you first learn a sequence of notes (or chords), which you practice laboriously. In the beginning, you are only able to make small changes, e.g. play the piece faster or slower, louder or quieter; there is little flexibility. Once this process of playing the sequence of notes becomes proceduralized, and you are able to play them without much effort, this kickstarts a process of representation redescription where the knowledge of the notes gets accessed as manipulable data. When this starts to happen, you are able to do more, e.g. start playing the sequence from the middle, alter the arrangement by adding

or subtracting notes, and so on. Gradually, after more practice, and more representation redescription, instead of just being able to run off the sequence of notes, you are able to alter things like the arrangement, introduce new variations on the theme, add bits from other pieces etc., all of which enable a new skill, namely improvisation.[23]

One aspect of this picture that has created confusion is whether RR involves a process of demodularization. According to Karmiloff-Smith, the process of modularization is conservative. When modules are formed, they remain intact and continue to operate as modules even after RR takes place. As she notes, "RR is a process of redescription, not replacement" (1994, p. 733). More specifically, RR operates on the outputs of modules instead of their internal functions. (Of course, they also operate on the outputs of non-modular parts of the mind). This keeps good on her promise that RR is a distinct, yet complementary, process to modularization. In fact, a developmentalist picture of human cognition is in need of both processes. We need modules to explain proceduralized processes which occur quickly and automatically, processes that occur even in adulthood. Moreover, we need RR to explain how it is that proceduralization of certain processes, e.g. playing a certain piece of music, lends itself to greater flexibility, say being able to compose a new song using some of the skills learnt to play the initial piece.

In summary, in this section we've seen how a developmentalist framework can be utilized to explain cognitive flexibility, and in a way that is compatible with the mind being modular in key respects. Some of the details concerning how RR actually works, I suspect, need augmenting[24], but

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[23] For an extended discussion of Karmiloff-Smith's account of cognitive flexibility, see Mithen (1996, Chapter 3). Here Mithen draws parallels between RR and Carey and Spelke's (1994) notion of "mapping across domains".

[24] For instance, many, I suspect, will reject some of Karmiloff-Smith's levels of redescription, e.g. the level where there is conscious access *sans* the ability to make verbal reports.

the general framework gives us a way of understanding our capacity for cognitive flexibility from the perspective of developmental psychology, as Karmiloff-Smith intends. What remains unclear is how to use this framework to explain emotional plasticity itself. In the next section, I turn to this task.

5. Emotional Plasticity as Cognitive Flexibility

Cognitive flexibility, the way Karmiloff-Smith (1992) understands it, is a relatively domain general phenomenon, which she demonstrates via its application to specific domains such as language acquisition, numerical cognition, musical performance and theory of mind. In this section, I want to apply the idea to the domain of emotion. More specifically, my plan is to treat emotional plasticity as a type of cognitive flexibility and thereby explain emotional plasticity as we do other forms of cognitive flexibility, i.e. via the notion of representation redescription (RR). So how does RR work in the context of emotional plasticity?

In order to apply the RR model to emotional plasticity, we first need to figure out what should count as behavioral mastery in the domain of emotion, for it is behavioral mastery in a domain that triggers the process of RR. One obvious suggestion is that we should consider emotion regulation:

> [T]he processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions. Emotion regulatory processes may be automatic or controlled, conscious or unconscious, and may have their effects at one or more points in the emotion generative process. (Gross, 1998, p. 275)[25]

To elaborate, we regulate our emotions either consciously or unconsciously, and we do so via a whole host of strategies. These strategies are heterogenous, but they tend to fall into two camps: "antecedent-focused" approaches that occur before the occurrence of full-blown emotional responses (e.g.

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[25] Also see Rottenberg and Gross (2007), Gross (2008, 2014), and Zarolia et al. (2015).

situation selection and cognitive reappraisal) and "response-focused" approaches that occur after those responses are generated (e.g. suppression, breathing and mindfulness) (Gross, 2008, p. 501). Emotion regulation is the phenomenon by which we apply such approaches to influence some aspect(s) of our emotion. For our purposes, we can understand behavioral mastery as a degree of success, or 'mastery', in emotion regulation. In practical terms, this amounts to the use of an emotion-regulation strategy, or strategies, to successfully influence some aspect(s) of our emotion.

It is worth bearing in mind that "emotion regulation" refers to both short-term and long-term regulatory processes. In philosophical speak, this means emotion regulation can involve how we employ emotion regulation strategies to influence our occurrent emotions, as well as how we employ them to influence our emotional dispositions. Both forms of emotion regulation fall under the rubric of 'intrapersonal emotional plasticity'.[26] However, while most work in psychology has focused on how we regulate our occurrent emotions, what has attracted the most attention in philosophy is how we regulate our emotional dispositions.[27] In what follows, I suggest that we regulate our emotional dispositions by first learning various emotion regulation strategies to regulate our occurrent emotions. I don't think this idea in itself is very controversial. The real question is about how this works. How does regulating particular emotional episodes ultimately lead to the regulation of our emotional dispositions?

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[26] See Section 2.

[27] There is work done in psychology that might prove relevant to long-term emotion regulation, which is carried out under the general theme of 'emotional intelligence': our ability to monitor our emotions, as well as the emotions of others, and to use this information to guide our thinking and actions (Salovey & Mayer, 1990; Goleman 1995). See also the related themes of 'emotional competence', 'emotional awareness' and 'emotional differentiation'.

My proposal is that a 'mastery' of emotion regulation, *qua* the use of an emotion regulation strategy (or strategies) to successfully regulate various occurrent emotional episodes, kickstarts an internal process of RR, where certain information that facilitates the performance of this strategy become explicit to the agent. Moreover, the explication of this information enables their use as manipulable data, which in turn allows the agent to apply this information in new ways. In this case, we are able to apply the information to a whole series of emotion-eliciting situations such that the subject, in effect, ends up undergoing a change in their emotional disposition.

For example, take cognitive reappraisal, the strategy where we reevaluate our emotion-eliciting situations. Gaining competence in this emotion regulation strategy might make someone who is prone to fits of jealousy significantly less so over time. First, they might, with difficulty, learn to reappraise specific situations that trigger their jealousy. They might, for instance, reappraise instances where their partner is seen to be flirting with a colleague from being threatening to harmless. By learning to apply the reappraisal technique in response to this situation, the agent kickstarts a reiterative process of RR where the proceduralized information required for this mastery is recoded and made available as manipulable data. This allows aspects of this procedure to be applied to other situations; initially to similar situations, but then to a whole host of different situations.

For instance, after learning to reappraise the situation where their partner is seen to be flirting with their colleague, the agent might, with more ease, learn to reappraise further situations where their partner is seen to be flirting with other people. Moreover, after gaining a level of competence in this domain, the agent might learn to reappraise even further situations where their partner causes them to be jealous, e.g. when their partner is seen to be neglectful by paying more attention to their children. This might, in turn, extend to reappraising situations which don't involve their partner, e.g. when they are jealous because other people are perceived as being neglectful, and so on. In this way, we see how a mastery of regulating certain occurrent emotions can kickstart a reiterative process of RR, which culminates in the person becoming a less jealous person over time.

It is worth noting that the above picture makes no commitments as to how we are able to successfully apply certain regulatory skills to specific sets of occurrent emotions in the first place. (Presumably this comes from practice, when the application of certain regulatory skills to a set of emotion-eliciting situations itself becomes proceduralized). What it does assume is that once we attain a level of competence in regulating certain occurrent emotions in this manner, RR helps explain how we can reapply these strategies to other regulatory tasks, such that the regulation of a given emotion type, e.g. jealousy, can be reshaped over time. In other words, whilst various emotion regulation strategies explain how we can regulate occurrent emotional episodes, RR helps explain how such success in regulation can result in changes in our emotional dispositions themselves.

Let us now address some questions which will hopefully make this picture clearer.[28] First, what ensures that this entails a change in our emotional dispositions and not just in our emotion regulation strategies themselves? To elaborate, in our example, the subject learns to be less jealous by mastering certain emotion regulation strategies, e.g. by learning how to reappraise the situations that trigger their jealousy. Why should we think that this amounts to a change in our dispositions to emote as opposed to a change in our dispositions to regulate our emotions in certain ways? In particular, why not think that the change here concerns a change in the non-emotional tendency to appraise situations in a way less likely to trigger jealousy?[29]

The short answer is that the common usage of the term "emotion regulation" does not respect a sharp distinction between having an emotion and regulating that emotion. To elaborate, "emotion regulation" is a broad umbrella term that refers to the various ways we influence our emotions. As

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[28] I am grateful two anonymous referees for this journal for these questions.

[29] An analogous worry might also be raised with regards to response-focused regulation strategies. For example, why think acquiring a new disposition to regulate our emotions using a certain breathing technique is tantamount to a change in our emotional dispositions themselves?

we have seen, we can regulate our emotions using a myriad of antecedent and response focused approaches. The successful employment of any such approach to regulate an emotion is typically taken to constitute a change in that emotion itself. For instance, consider cognitive reappraisal. According to Gross, "Reappraisal" involves changing a situation's meaning in such a way that there is a change in the person's emotional response to that situation"; and changing the meaning of a situation in this way "can profoundly affect the quality (which emotion) as well as the quantity or intensity (how much emotion) of the subsequent emotional response" (2008, p. 503). This I gather holds true of how we regulate our emotional dispositions as well as our occurrent emotions. In both instances, successful emotion regulation is taken to be constitutive of changes to emotion itself.

The long answer is more complicated, for it must address why using the term "emotion regulation" in this manner is justified in the first place. This isn't something explicitly addressed in the literature, but there a few potential reasons. First, any given strategy only counts as an emotion-regulation strategy if its aim is to regulate emotion. For example, while various situations, e.g. where we go, who we see etc., can affect our emotions, "situation selection" *qua* an emotion regulation strategy "refers to the subset of these choices that are taken with a view, at least in part, to the future consequences of our actions for our emotional responses" (Gross 2008, p. 501). This gives us some conceptual grounds to forge a link between emotion regulation and changes to emotions themselves.

Second, there is empirical evidence to suggest that emotion regulation strategies involve changes to the very systems that generate our emotions. For instance, down regulation is associated with a decrease in activity in the subcortical regions involved in emotion generation.[30] Relatedly, there is also a growing view within psychology that emotion generation and emotion regulation are part and parcel of the same process, some going so far as to argue that there is no such thing as

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[30] E.g. see Levesque et al. (2003), Ochsner et al. (2002) and Ochsner et al. (2004).

unregulated emotion.[31] If the mechanisms involved in emotion generation and emotion regulation overlap in any of these ways, this gives us empirical grounds to suppose that emotion regulation can involve changes to emotions themselves. These grounds, as well as the conceptual ones, require more scrutiny. But for now, they tell us that the current practice of viewing changes to emotion regulation as changes to emotions themselves isn't without precedence.

Let us now consider an altogether difference question, namely how does our picture actually explain the plasticity of recalcitrant emotions? Episodes of emotional recalcitrance are occurrent emotions that are notoriously difficult to regulate. The strategy I have pursued this far has assumed that we change our emotional dispositions by changing our occurrent emotions. The worry is that this mightn't work when recalcitrant emotions are at play. I think there is something to this worry. Recalcitrant emotions appear modular. I argued earlier that the modular nature of emotions can be explained by developmental modules. Since the development of such modules is a conservative process, once modules form, they are difficult to expunge. This accounts for the recalcitrant nature of recalcitrant emotions. But we also noted the widely held assumption that even recalcitrant emotions are things which can be reshaped over time, at least in some cases. How does this work within a modular picture?

One suggestion is that we shape our recalcitrant emotional dispositions not by first learning to regulate the relevant occurrent recalcitrant emotions but by learning to regulate other occurrent emotions, ones that aren't recalcitrant. Say you have a recalcitrant bout of jealousy whenever your partner talks to their attractive colleague. This might not be an emotion you have had much luck regulating thus far. Now say you acquired a couple of emotion regulation strategies and learnt to apply them to other instances where you are prone to jealousy; instances that aren't recalcitrant. A

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[31] See Kappas (2008, 2011), Campos et al. (2004), and Gross and Barrett (2011).

mastery of such strategies, especially in the context of jealousy, might activate the various processes involved in RR, which in turn might gradually shape not just how you respond to these particular instances of jealousy, but to other instances as well, including ones that previously proved recalcitrant. Of course, this is not a surefire way to ensure that you will no longer feel jealous when your partner talks to their attractive colleague. The important thing, however, is that we now have a possible route by which such recalcitrant episodes might be eliminated, if not minimized, over time.

Two clarifications. First, although this is fairly speculative, it is a natural fallout of our view. Cognitive flexibility within a domain is explained by the process of RR, which is triggered via the mastery of certain techniques and results in their application to new tasks. In the case of emotion, learning to control certain instances of jealousy, using say a few distinct emotion regulation strategies, might, via RR, result in the application of these skills to new tasks, such as controlling, with a greater degree of success, the instances of jealousy that previously proved recalcitrant.

Second, in proposing this explanation, I don't take myself to be ruling out other ways of explaining our ability to exert some influence over our recalcitrant emotions. In fact, 'emotional recalcitrance', as understood in the philosophy of emotion, is not a very precise notion, and it might actually turn out that some explanations work better for some cases of emotional recalcitrance than others. For instance, say you are angry at your friend because of a joke they made at your expense despite judging that the joke was harmless and that your friend didn't intend to cause offense. In such a case, your anger, arguably, parses the mark for being a recalcitrant emotion because it is an emotion that is in tension with your considered judgment. But emotional episodes such as these, though initially recalcitrant, are fairly easy to regulate, e.g. by applying techniques such as distraction and suppression. In such cases, I don't think you necessarily need to laboriously learn how to regulate other instances of anger before you learn to regulate the instances that prove recalcitrant. You might influence them directly.

By contrast, consider the paradigm examples of emotional recalcitrance found in the literature; fearing your neighbor's dog and being romantically jealous. These are emotions that are supposed to be relatively hard to regulate. Earlier I argued that the we can explain the recalcitrant, i.e. mulish, nature of such emotions by employing the notion of developmental modules. Here I argue that we can explain our ability to exert some gradual influence over them via the notion of cognitive flexibility. In particular, learning to apply various emotion regulation strategies to successfully regulate certain non-recalcitrant emotions might kickstart various reiterative processes that represent knowledge in new ways, which in turn might, over time, enable us to use such knowledge to exert some influence over our recalcitrant emotions as well. Crucially, if these explanations are right, they also explain why certain recalcitrant emotional responses, e.g. fearing Fido or being romantically jealous, can appear modular on the one hand and plastic on the other.

7. Conclusion

The "puzzle" of emotional plasticity concerns making sense of two conflicting bodies of evidence: evidence that emotions often appear modular in key respects, and evidence that our emotions also often appear to transcend this modularity. In this paper, I have explained how a developmentalist approach to cognitive flexibility, which builds on the work of Karmiloff-Smith, can be employed to dissolve this "puzzle". I argued we can explain the modular nature of emotion via Karmiloff-Smith's notion of developmental modules, where functional specialization develops through a process of modularization, which is the product of interactions between an individual and their environment. Moreover, I also argued we can explain our ability to transcend this modularity in terms of her notion of representation redescription, where implicit, domain-specific, procedural knowledge relevant to a certain task is recoded into less domain-specific formats and made explicit as manipulable data. I don't take this response itself to have rendered complete a developmentalist picture of emotional plasticity. But in proposing this response, I take it we have pushed the philosophy of emotion in the

right direction. If we are to understand emotional plasticity, but also its implication for mainstream philosophy, e.g. its ramifications for moral theorizing, we should start by taking development seriously.

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