Does Modularity Undermine the Pro-Emotion Consensus?

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ABSTRACT: There is a growing consensus that emotions contribute positively to human practical rationality. While arguments that defend this position often appeal to the modularity of emotion-generation mechanisms, these arguments are also susceptible to the criticism, e.g. by Jones (2006), that emotional modularity supports pessimism about the prospects of emotions contributing positively to practical rationality *here* and *now*. This paper aims to respond to this criticism by demonstrating how models of emotion processing can accommodate the sorts of cognitive influence required to make the pro-emotion position plausible whilst exhibiting key elements of modularity.

KEYWORDS: modularity; information encapsulation;plasticity; emotional rationality; frame problem; search hypothesis

Emotions can be either quick or smart, but not both — or so goes the received wisdom. Emotions can be quick when they are triggered by modular emotion-generation mechanisms; roughly, mechanisms that are designed, by evolution, to respond to specific triggers, and do so whilst ignoring background information, e.g what the agent knows. Or

they can be smart, when emotion-generation mechanisms "learn" to respond to environment-specific cues that are beneficial to the agent in their present ecological niche. But it is alleged that they cannot be both. In particular, any learning that results in response to environment specific problems, it is thought, comes at the expense of speed which is purchased through modular emotion-generating mechanisms. Likewise, it is assumed that modular mechanisms, by definition, cannot allow for the sorts of cognitive influence required to make emotions respond smartly, i.e. to the ecologically-specific problems in which agents can find themselves.

This tension in how emotions can be both quick and smart is wielded as an objection against the pro-emotion thesis, which presupposes that emotions are both modular and play a role in aiding reasoning.[1] It is argued, e.g. by Jones (2006), that emotional modularity supports pessimism about the prospects of emotions contributing positively to practical rationality *here* and *now*. This paper aims to meet this criticism by demonstrating how models of emotion processing can accommodate the sorts of cognitive influence required to make the pro-emotions position plausible whilst exhibiting certain hallmarks of modularity. In effect, I shall be arguing that emotions, contrary to current wisdom, can be both quick and smart.

In what follows, I explain two possible roles modularity can play in an argument for the pro-emotion position (§1), identify and provide an exposition of the objection at the

1 Advocates of this position include de Sousa (1987), Tooby and Cosmides (1990), Cosmides and Tooby (2000), and Prinz (2004). Note, de Sousa doesn't commit to emotional modality wholesale, but as I shall explain in (§1), he relies on one of its key features, i.e. information encapsulation.

very heart of various worries about how modularity may pose a threat to the pro-emotion position (§2), and then respond to the objection by exposing some misconceptions which give rise to it. In particular, I argue it results from misconceptions about the commitments incurred by committing to emotional modularity itself, as well as how characteristics of modularity are utilised by the pro-emotion camp (§3).

1. The Pro-Emotion Consensus

The pro-emotion consensus derives from a series of distinct views, from philosophy, psychology and neuroscience, which forgo the view attributed to the Early Moderns, *viz.* that emotions hinder reasoning, for a rival thesis: emotions can, and often do, help with reasoning. What emotions exactly are, as well as the precise role emotions play in aiding reasoning, differ based on the particular theory. Contemporary definitions of emotions differ on whether emotions, in essence, are feelings, judgements, quasi-perceptual states, certain physiological responses, a mixture of these elements etc.[2] Definitions of emotion on offer by the pro-emotion camp prove no exception. Nevertheless, pro-emotion theorists share the assumption that emotions, whatever they are, are the kinds of things which aid reasoning. Some even go so far as to define emotions in terms of their capacity to do so, which explains why Jones characterises their view of emotions as "evolved capacities that are integral to our practical rationality" (pg. 3). For present purposes, we needn't settle the thorny issue of what emotions really are. Instead, it will suffice to take "emotions" as a placeholder for the kinds of things which are assumed to aid reasoning by those in the

[2] See Deonna and Teroni (2012) for an overview.

pro-emotion camp. In this way, The actual extension of the term will vary depending on the particular theory in question.

Pro-emotion theorists also share the assumption that emotions play a role which reason cannot. But by the same token, they all tend to agree that emotions play a modest role, i.e. they do not solve problems that we cannot solve simply by reasoning. Rather, they help us solve these problems when supplemented by reasoning. A view like this is found both in the work of de Sousa (1987) and Damasio (1994). These proponents differ on how they characterise emotions. Both grant that emotions are evaluative in nature. But for de Sousa, emotions are evaluative perceptions or quasi-perceptions, e.g. to be afraid involves the perception of danger, whereas for Damasio, emotions are a combination of "mental evaluative processes" and dispositional responses to these processes; dispositions directed at both the body and the brain (pg. 139). However, the role emotions are said to play in their respective theories are remarkably similar. On both views, emotions aid the selection of response-options by highlighting some options as relevant whilst eliminating others from consideration. *Pace* Damasio, emotions act as a "biasing device" (pg. 174), which biases in favour of some response-options. Emotions, then, don't tell us the exact response-option we should choose. Instead, they narrow down the search space when choosing the

relevant course of action — thus giving these theories the name, "the search hypothesis of emotion" (Evans 2002).[3]

As Evans points out, the search hypothesis is best seen not as a definition of emotion, but rather an account of what emotions do. Moreover, the hypothesis can only be evaluated in the context of a specific theory of what emotions are. Since Damasio and de Sousa give differing accounts of what emotions are, a proper assessment of each account must, therefore, be done independently. Subsequent assessments have tended to focus on Damasio's version of the hypothesis, exposing ambiguities in how it is to be understood, as well as targeting various stages where emotions might be said to affect decision-making.[4] But there is a further complication. Even if we ignore the relevant detail, and speak very broadly about the search hypothesis by way of exposition, why emotions emotions are required for the of selection response-options is not entirely clear, at least in the works of the original proponents of the view. For both Damasio and de Sousa, one of

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[3] While there is *prima facie* reason to think that the search hypothesis relates to the empirical literature on how emotions might modulate attention, an examination of the connection between the two has not been taken up, except by Faucher and Tappolet (2002). Even here, the evidence points towards emotional effects on the attention of environmental stimuli, leaving the precise connection between selecting response-options and the phenomenon of attention in need of further investigation. See Wu (2014), as well as Mole, Smithies and Wu (2011), for an overview of empirical and philosophical notions of attention.

[4] E.g. see Dunn *et al*. (2006), Gerrans (2007), Colombetti (2008), Linquist and Bartol (2013), and Bartol and Linquist (2015).

the central roles of emotion is to help select the response-options in a quick manner.[5] But speed for speed's sake doesn't suffice to explain the central role emotions play in decision making. This has to do with the particular ecological problems in which we find ourselves. Some problems have significant time constraints. Being faced with a mugger, in all likelihood, requires you to decide pretty quickly whether you should run, handover your wallet, display aggression etc.

Solutions to other ecological problems might not be as urgent, but still require that we solve them in a timely manner, especially if such decision-making problems are legion. Damasio provides the example of his patient 'Eliot' who has prefrontal damage after undergoing surgery, and spends an inordinate amount of time even on making mundane decisions, e.g. he laboriously weighs the pros and cons of deciding when to make their next appointment. Since such response-option selections are a crucial feature of our present ecological setting, a lack of emotion-driven reasoning is said to impact our ability to make decisions in an efficient manner. But given that most, if not a lot of, decision-making procedures will be affected by an absence of emotional aids, this will, quite

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[5] As Linquist and Bartol (2013) point out, Damasio's body of work doesn't lend itself to a coherent position. For instance, in contrast to Damasio (1994), Damasio (1996) stresses the importance of emotion for both the speed and the accuracy of making decisions, whereas in Bechara and Damasio (2005), speed is omitted, while a discussion of accuracy takes centre stage. By contrast, though speed is a constant factor in decision-making for de Sousa, elsewhere (AUTHOR: forthcoming) I stress the importance of de Sousa's encapsulated emotion-generating systems in also ensuring that our emotion-driven choice-selections are not overridden by what the agent knows.

plausibly, have an impact on our qualify of life. Eliot, for instance, was unable to gain regular employment because he had significant time-management difficulties at work. Timely decision making on this account, then, is required not only to solve particular ecological problems, but the cumulative problem we face when we are confronted with such particular problems on a regular basis. This additional feature, though not explicit, is implied by Damasio's discussion.

A distinct, though related, account of why emotion-driven reasoning is required is fleshed out by de Sousa. For him, emotions help solve a version of the frame problem:

> Assume all the powers already listed — logic, induction, and more-than-encyclopaedic knowledge: the *philosophers' frame problem*, roughly, is how we make use of just what we need from this vast store, how not to retrieve what we don't need. (de Sousa 1987: 193)

On this account, the kinds of information that could bear on a particular response-option selection is so vast that it would be practically impossible to solve the problem simply by laboriously considering each piece of information as to whether it is relevant, and then additionally reasoning about which pieces of the relevant information are more relevant to the particular problem. Emotions, on this version of the problem, "spare us the paralysis potentially induced by this predicament" (de Sousa, pg. 172). This differs from the previous account because not only are emotions required for solving urgent ecological problems, and the cumulative problem brought on by less urgent ones. Rather, for any given decision-making procedure, there is too much potentially relevant information, and lets not forget potentially relevant inferences to draw, such that it would be practically

impossible for the agent to solve this problem without an efficient means to narrow the search space.

The original frame problem, of course, is an altogether different problem in artificial intelligence, but the philosophers' frame problem bears a loose resemblance. Both problems are problems about how to restrict the amount of information to be computed. In the latter case, it is the problem of how to restrict information, including the inferences to be drawn, in order to select an appropriate response-option. If the information we have indeed is vast, and the inferences we can draw near infinite, solving the frame problem would be practically impossible. We do, however, solve the frame problem. Emotions are utilised as an explanation of how we do so. Emotions, *pace* de Sousa, determine the "salience" of features of reasoning, by circumscribing our practical and cognitive options.

In other words, emotions pre-select certain pieces of information as relevant, and thereby narrow our search space.[6]

Though de Sousa's version of the search hypothesis is often run together with Damasio's, the problems they discuss are importantly different. The problems discussed by Damasio remain unresolved in a timely and efficient manner except via emotional aids, whereas de Sousa's problems are computationally intractable without emotions coming to the rescue. That said, in both cases, time constraints feature in an explanation as to why the problems are practically impossible to solve. Moreover, crucially, in both cases, speed is purchased in virtue of how emotions aid reasoning. Elements of modularity feature precisely in an explanation of how emotions perform this function.

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[6] As in Damasio's hypothesis, the exact stage(s) of decision-making which de Sousa thinks is influenced by emotion remains somewhat opaque. At an initial glance, for both de Sousa and Damasio, emotions affect what Linquist and Bartol (2013) identify as "core" stages of decision-making, *viz.* "option generation", where a subject considers a range of response-options, and "deliberation", where they consider the consequences of these options. Linquist and Bartol draw on empirical evidence to challenge this picture. But on a positive note, they also show that the evidence helps explain how emotions might play a role in "peripheral" stages of decision-making. In particular, in "decision-point recognition", where a subject diverts activity away from other activities to decision-making, and "execution", where a subject follows through with their decision. These might prove relevant to how emotions help solve some present-day ecological problems. The growing empirical literature on how emotions modulate attention, as discussed by Faucher and Tappolet (2002), is likewise suggestive.

Conceptions of modularity diverge on what is essential for an information processing system to be modular. Fodor (1983), who de Sousa draws on, takes the "essence" of modularity to be constituted by the property of a processing system being informationally encapsulated. Very roughly, a system is informationally encapsulated when the function it computes is insensitive to information stored outside the module. de Sousa does not commit to emotional modularity wholesale. However, he takes information encapsulation to be a necessary feature of how emotions help solve the philosophers' frame problem. More accurately, he proposes that "the role of emotions is to supply the insufficiency of reason by imitating the encapsulation of perceptual modes" (1987: 195). Exactly how information encapsulation helps here needs some unpacking.

According to Fodor, frame problems don't arise for informationally encapsulated systems because there is only a small amount of information over which to compute. de Sousa's proposed solution operates under this principle. The vast store of information with which we are possessed creates a frame problem when we attempt to select an appropriate response-option. Emotional processing, when encapsulated or "imitating" encapsulation, occurs without considering this vast store of information. Such processing, consequently, is quick, but more importantly, it manages to highlight certain response-options as relevant for consideration whilst eliminating others. Thus such processing, in

effect, limits the range of response-options we need to consider, and thereby makes selecting a response-option a practically tractable problem.[7]

While de Sousa and Damasio's pro-emotion theses are run together, an essential property of modulatory features in the former's proposal, whereas no such property features in the latter. However, information encapsulation also bears on Damasio's problems. Some ecological problems we face come with significant time constraints, and the speed which is purchased by encapsulated processing systems ensures that we can emotionally respond to such situations in a quick and efficient manner. The fear responses triggered when faced with a mugger biases in favour of certain response-options (e.g. submission) over others (e.g. aggression). Likewise, the cumulative problem is minimised so long as some particular decision-making problems are resolved as a product of encapsulated emotion-generation systems.

The difference in the proposed contribution made by information encapsulation to the pro-emotion hypotheses is whether encapsulated emotional processing is practically useful or necessary to solve the problems we face. As I read Damasio, encapsulation is

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[7] See Ransom (2016) for a critique. Note, a central worry here is that emotions can't help solve the frame problem because "rigid, reflex-like" mechanisms would fail to manifest the kinds of intelligence required to identify content-sensitive factors embedded in real-life frame problems. Part of addressing this worry, I take it, involves explaining how automatic, reflex-like emotion-generating mechanisms can accommodate the kinds of cognitive influence required to account for context. This is taken up in section 3.

necessary to solve some particular ecological problems, though not all.[8] (Nevertheless, there is a case to be made that encapsulation is required to minimise the cumulative problem). In contrast, for de Sousa, encapsulation is necessary to solve all instances of the philosophers' frame problem. This is because for any given instance of the problem, there is simply too much information we possess which might be relevant; and too many inferences we can draw from them.

The overall point to draw from this discussion is this: the role attributed to modular emotion generating mechanisms by the pro-emotion camp depends on precisely how they understand the relevant decision-making problems. According to some conceptions of the problems, it plays an indispensable role, while on others, it plays inessential, though incredibly useful, role. How much modularity could undermine the pro-emotion consensus will, then, depend on which particular pro-emotion position we take as a target. However, if modularity does prove to be a legitimate threat, there is enough of a link between conceptions of modularity and pro-emotion hypotheses to make it a serious cause for concern for advocates of the pro-emotion camp.

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[8] Again, as Linquist and Bartol (2013) point out, the need for emotions — encapsulated or otherwise — is not consistent through out Damasio's work. Damasio (1994: 193), as well as Bechara and Damasio (2005: 339), take emotions to be necessary for decision-making, whereas Damasio (1994: chapter 3; 1996) suggests otherwise.

2. The Objection

Modularity, as we saw, can feature in an explanation of how emotions aid reasoning. In this regard, it remains a tool in the pro-emotion theorist's toolkit. Modularity, however, has also been employed to explain how emotions can be irrational. Griffiths (1997) employs modular emotion-generation mechanisms, which are quick and automatic, to explain how emotions can occur without the process of belief-fixation which gives rise to judgement. This is supposed to explain irrational emotional episodes where we get the relevant emotions *sans* the relevant beliefs, e.g. fearing flying without judging it to be unsafe. Moreover, modularity not only helps explain irrational emotions, but it has also been argued more recently, e.g. by Jones, that it undermines the pro-emotion position. The crux of Jone's criticism is that modularity, if anything, supports pessimism about the prospects of emotions contributing positively to practical rationality *here* and *now*.

The threat posed by modularity for our current ability to reason has been outlined in different ways, though I shall now argue they point to the same underlying worry. Those who argue for emotional modularity suppose that emotions are adaptations, which enable us to respond quickly to practical problems posed by our natural and social environments. For example, emotions are designed, by evolution, to respond to a certain class of stimuli. However, as Deonna and Teroni note, "the very existence of classes of stimuli for any given type of emotion is in itself questionable. Trotting out shopworn examples of snakes and spiders to delineate the class of stimuli relevant in the case of the fear affect program is often the best we can do in employing this strategy" (2012: 26). There are at least two worries here, only of which is really relevant to the threat. First, the set of

examples those in the modularity camp offer as examples of quick fitness-enhancing emotional responses are limited. This, primarily, is a threat to the view that emotions are modular more generally, as opposed to a threat posed by modularity to the pro-emotion thesis. It makes us doubt that there are such responses designed by evolution, especially for each emotion type. Behind this worry, however, lies a second worry more germane for our purpose. That is, given the nature of the examples trotted, not just their sheer scarcity, it remains doubtful that modular emotional responses, even if they exist, are relevant for practical rationality in our present environment. Put in another way, why suppose that adaptations to the Pleistocene environment of our ancestors have any fitness-enhancing value for 21st Century dwellers like us? If they are such useful adaptions, e.g. an "innate" fear of snakes, they seem to be limited, and certainly cannot do the work posed by pro-emotion theorists, like Damasio and de Sousa, in terms of aiding decision-making.

There is an even more forceful objection in the vicinity, which is owing to Jones. That is, *pace* Sterelny (2003), modular mechanisms would be unlikely to provide veridical solutions to problems that require complex situation specific cues for their solution To elaborate, many problems we face in our present environment are "open problems" that require a nuanced understanding of the particular environments in which they occur for us to solve them in an adequate manner. So what is required is for there to be a cognitively modifiable range of triggering properties. That is, we need our emotional responses to be triggered not just by properties that proved relevant for our Pleistocene ancestors. We need quick and automatic responses to properties that prove relevant in our present environment, including our social niches.

Problem-solving within a social setting is especially pertinent when it comes to explaining the need for *cognitive* modifications. We may learn from past experiences "off-line" without recourse to anything like cognitive input. In such cases, emotional processing systems benefit from a modified set of trigging properties, though not ones that are modified in any way that resembles high-level cognition. Sterelny, however, assumes that our social environments are inherently dynamic, which in turn means that simple stimulus-response mechanisms will prove ineffective when it comes to solving problems that arise in such environments. Judgements of infidelity, for example, only prove effective when implemented as cognitive tasks. Running with this example, Jones notes that jealousy is triggered not just by the mere smell of perfume or an awareness that one's partner is again late from work, but once these factors are "seen as" evidence of possible infidelity (pg. 21).

The need for a cognitively modifiable range of triggering properties is certainly not neglected by the pro-emotion camp. For de Sousa, the objects that can trigger emotional responses are learnt during "paradigm scenarios" drawn from early life as children but reinforced by culture. Likewise, according to Damasio, the mental images that can trigger our emotional responses can be acquired as opposed to being innate.[9] The problem, however, is that such cognitive modifications appear to be in tension with emotional modularity. One of the hallmarks of modularity is information encapsulation. If modular emotion generating mechanisms are thus encapsulated, it seems by definition, they will

[9] Note, these images needn't be visual, they can be auditory, olfactory etc. (see pgs. 84-89).

turn out to be insensitive to the kinds of cognitive modifications that may be learnt through the developmental stages of an agent's lifespan.

There are, then, two objections. First, insofar as emotions help with decision making, they can do so only in a limited range of situations; situations that call for quick solutions to "closed problems", which don't require additional input during the lifespan of the organism for their solution. Second, emotions can't help with decision-making problems which are open problems; problems that require additional input, e.g. cognitively modifiable triggering properties, for their solution. These objections are not only compatible but can be viewed as differing viewpoints on the same underlying scepticism about the prospects of modular emotion-generating mechanisms being useful for decision-making problems we presently face. Moreover, they result from the same source, *viz.* a tension between emotional modularity and the kinds of cognitive influence required to resolve our present decision-making problems. The overall objection is summed up by Jones:

> Far from grounding an easy inference to a pro-emotion position, positing emotions as evolved modules designed to help constrained and ecologically situated agents respond quickly and reliably to their environment tends to support pessimism about their prospects for contributing positively to practical rationality here and now. (Jones 2006: 25)

This objection helps us re-articulate our starting dilemma. Some problems require fast decision-making solutions, and a possible way this is achieved is if emotions both help with response-option selections and do so in a quick manner. A possible explanation for why they can be quick is that they are brought on by modular emotion-generation

mechanisms; or at least mechanisms that are informationally encapsulated. However, for emotions to prove useful to decision making in our present environment, i.e. for them to legitimately count as smart, they need to allow for the sorts of cognitive influence ruled out by emotion-generating mechanisms being informationally encapsulated. It would, then, appear that emotions can be quick or smart, but not both.

The threat this dilemma actually poses to the pro-emotion position depends on the specific roles modularity plays in the pro-emotion views. Previously we looked at two examples; examples which by no means exhaust the kinds of pro-emotion views in the literature. For de Sousa, a key feature of modularity, *viz.* information encapsulation, helps prevent real-life decision making problems from being frame problems. Decision-making is not only quick but practically possible only because emotional processing is informationally encapsulated. Subsequently, insofar as real-life decision making problems require cognitive modifications for their adequate solution, encapsulated emotion-generation mechanisms would fail to solve them. But by the same token, if such mechanisms are un-encapsulated, de Sousa's theory predicts that the decision-making problems will become computationally intractable frame problems which are unsolvable. So the tension between modularity and how emotions can solve open decision-making problems, unless resolved, would undermine de Sousa's position. This is because the tension predicts that on either option, emotions can't help solve practical decision-making problems which arise in our present ecological niche.

The situation is not as dire for Damasio. As discussed, Damasio doesn't appeal to modularity to argue for his pro-emotion position. Nevertheless, as we also saw,

modularity bolsters this position by providing an explanation of how emotional processing can deliver quick response-option selections, which are required to solve at least some decision-making problems, and moreover help minimise the cumulative problem posed by having to solve less urgent, but still time-constrained, decision-making problems on a regular basis. Given that modularity is not essential to decision-making on this picture, the role that emotions can play in aiding reasoning is not entirely undermined by the aforementioned tension. Nevertheless, it is limited in crucial respects.

If most decision making problems are open, solving them would require un-encapsulated emotion generating mechanisms, which in effect would fail to solve the really urgent decision-making problems, like what to do when faced with a mugger. The decision-making problems that Damasio discusses, e.g. those that confront Eliot, however, are less urgent, so it doesn't seem like the problems targeted by emotion-driven reasoning on this picture would be affected by a failure of emotional modularity. That said, there remains the issue of the cumulative problem. If less urgent decision-making problems are solved by taking the maximal amount of time required to solve them, e.g. as in the case of Eliot, this would prove incredibly ineffective, and have significant ramifications for the agent's quality of life. Thus forgoing modular emotion-generation mechanisms still come with significant costs; costs that don't really work as a knockdown objection to Damasio's pro-emotion view, but prove significant enough to considerably limit its scope.

The pro-emotion position is, thereby, found to stand on shaky ground. But it is important to be clear on which point of the explanation is threatened by a commitment to modularity. The search hypothesis of emotion is a view which, in essence, stands

independent of any claims about emotional modularity. It's key claim is that emotions assist reasoning by highlighting some response-options whilst eliminating others from consideration. This is achieved not by emotions being in any way modular, but rather by their affective components. In brief, emotions have valences: they feel good or bad; they are positive or negative. In virtue of this, they are capable of representing what they are responses to as also being positive or negative.[10] This allows response-options which provoke a positive or negative emotional response to be highlighted. Moreover, they enable us to eliminate the options that elicit negative responses while shoeing in on the ones that elicit positive responses.[11]

Modularity enters the picture in terms of how this is executed. More precisely, the mechanisms which elicit emotion responses being modular enables these responses to be quick; it allows for response-options to be selected in a quick and efficient manner. What is threatened by the tension between modularity and the cognitive influence required for practical rationality is not any key claims of the search hypothesis *per se*. Rather, modularity threatens its execution. The tension tells us that the architecture of the human mind is such that we don't have the mechanisms that enable the search hypothesis to be

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[10] To paraphrase Colombetti (2005), this is to suppose that 'object valence' (the positive or negative charge of objects in the environment) is parasitic on 'affective valence' (how good or bad an emotion feels). For Damasio (2003), affective valences, in turn, are dependent on whether our organismic processes are optimal and non-obstructed (positive) or impeded (negative). See Colombetti for an exposition of this and rival accounts of valence.

[11] This is explicit in Damasio (1994). See Author (forthcoming) for an exposition of precisely how affective components and information encapsulation feature in de Sousa's proposal.

implemented. Those in the pro-emotion camp owe us a plausible story about how the search hypothesis works in practice. As it stands, the tension tells against any such account being forthcoming.

3. Modularity and Cognitive Influence

The pro-emotion position is threatened because emotional modularity, which pro-emotion theorists utilise to explain how emotions contribute to decision-making, appears incompatible with the sorts of cognitive influence required to explain how we resolve real-life decision making problems. There are two possible courses of response: reject that cognitive modifications are required to solve problems we face in our present ecological niche, or explain how the perceived incompatibility is just that; perceived as opposed to actual.

While the first of these responses isn't a non-starter, it would be ill-advised to take it for a plethora of different reasons. First, *prima face*, it is plausible that we emotionally respond to stimuli which we aren't designed to by evolution. There are countless examples: responding anxiously to the sound of your ringtone when you hear it late at night, fearing people of particular skin colours, e.g. the tendency of some Americans to fear blacks but not other ethnic minorities, and so on. Second, neural plasticity suggests that our brains not only develop new neural pathways during our lifetime, but that our neural circuits can "learn" to be activated by various stimuli.[12] Neural architecture, of

[12] See Stiles, Reilly, Levine *et al.* (2012) for an overview.

course, can come part from cognitive architecture. However, insofar as cognitive models of the mind track our neural ones, this suggests that the cognitive architecture is not rigid, at least not in terms of content. This is borne out in the neurobiology emotion generation. There is good empirical evidence to suggest that affect-programs, i.e. the coordinated set of physiological changes which feature in an emotional response, e.g. autonomic nervous system, musculoskeletal and expressive facial changes, can be triggered by content which is learnt.[13] Third, rejecting cognitive influence is a straw-man since even proponents of emotional modularity are explicit that modular emotion generating mechanisms can acquire the content to which they respond. For example, Griffiths, one of the champions of emotional modularity, notes that "While the structure of the adaptive responses is innate, the contents of the system which triggers them are largely learnt" (1990: 175). Finally, as critics, e.g. Jones, argue, such cognitive modifications are indeed useful, if not essential, for real-life decision making. We can't, for instance, fully utilise the benefits of quick fear responses if they can't be directed at things like oncoming cars, stock market numbers, sirens etc.

These points carry in favour of an altogether different response, i.e. explain how emotional modularity is compatible with the sorts of cognitive influence required for practical rationality. But before we proceed, note the puzzle that now appears in the dialectic. Thus far, the pro-emotion camp has been criticised for assuming modularity, which is said to be incompatible with the forms of cognitive influence required for

[13] E.g see LeDoux (1996) and Ekman (2003).

practical rationality. But as we just saw, proponents of emotional modularity appear to grant precisely these forms of cognitive influence. So what is going on?

The worry of a tension is most explicit in Jones. According to her, "a pro-emotion position presupposes that emotions are capable of coming to be directed towards new objects in virtue of a cognitively modifiable range of triggering properties", but this "is a substantive and controversial assumption, which is in prima facie tension with the claim that emotions are modular" (2006: 4). There are two possible sources for this tension, one made clear by Jones, the other we have hinted at earlier. Both of these can be defused. Let us begin with the second.

As discussed earlier, it is assumed that modular mechanisms, by definition, cannot allow for cognitive influence. In particular, insofar as information encapsulation marks the essence of modularity, modularity rules out cognitive influence for to be informationally encapsulated, by definition, is to be insensitive to information stored outside the modules, including cognitive information. This is correct in terms of a very broad picture of modularity. But it needs some fine-tuning if we are to implement it at a lower, more detailed level. To start with, informationally encapsulated processing systems are not insensitive to all background information. They are insensitive to information not already stored within the module (Shea 2015). Informationally encapsulated processing, then, doesn't rule out cognitive influence; it just rules out cognitive influence from other modules.

The next step is to determine whether new kinds of information can actually be acquired and stored in the emotion-generating modules. Emotional plasticity suggests that

emotion processing systems do acquire new content.[14] Since this isn't ruled by a commitment to information encapsulation, *ceteris paribus*, there is no reason why emotion processing can't be both informationally encapsulated and subject to cognitive information acquired during the life-span of an agent. Sterelny (2003) provides an example of how this could be so for the content of a lexicon. He is, in particular, interested in spelling out a possible way such content can be encapsulated whilst changing over time and despite failing to be innate: "though the database is updated over time, a single time interpretation depends only on the database's current contents. That database does not have to be updated on-line, while grappling with a specific interpretation problem" (pg. 219).

Sterelny calls this "partial" encapsulation. I think it is more illuminating to make a distinction between diachronic vs. synchronic encapsulation.[15] Information processing is synchronically encapsulated, roughly, when it is insensitive to information *presently* stored outside the module, whereas it is diachronically encapsulated when it is incentive to any information stored outside the module *simpliciter*. On this way of drawing the distinction, diachronically encapsulated emotion-generation modules will be insensitive to any information acquired during the life-span of an organism, while synchronically encapsulated modules won't be insensitive in this way. As discussed, information encapsulation, as conceived in cognitive science, and to the extent to which it is assumed

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[14] For an overview on emotional plasticity, see Tappolet and Faucher (2007).

[15] Here I borrow from the analogous distinction in the cognitive penetrability of perception debate. See Stokes (2013).

in discussions of modularity in evolutionary biology[16], commit to processing systems that are only synchronically encapsulated.

The idea that there is a further commitment to diachronic encapsulation comes from misconstruing the commitments of an evolutionary developmental psychology as applied to the mechanisms of emotion processing. To suppose that emotions are, *pace* Jones, "clever design solutions", does not incur a commitment to an innate, cognitively unmodifiable range of triggering properties. As we saw, advocates of the program are explicit in granting that the properties which trigger our emotional responses are overwhelmingly learnt. Ekman, for instance, notes that, "Our affect-programs are open so that we can learn what will work in the particular environment in which we are living, and store this information in a way that will allow it to guide our behaviour automatically" (2003: 67). Likewise, for Griffiths:

> The local events which possess the properties of being dangerous, noxious or novel may be very different from one environment to the other. If affect-programs are to be of significant adaptive advantage to an organism over an evolutionarily significant time period, it would be advantageous for them to be linked to some mechanism which can interpret the broad ecological categories of danger, novelty and so forth, in the light of local conditions, and equate them with detectable features of the local environment. So it comes as no surprise that organisms have to learn which events in their particular environment should trigger the affect-programs. (1990: 184)

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[16] Contrary to notions of modularity we get from cognitive science, e.g. Fodor, domain-specificity, as opposed to information encapsulation, is regarded as the hallmark of modality for developmental biologists, e.g. Pinker (1997).

Affect-programs are typically understood as modular. They are said to be generated by mechanisms that are encapsulated. But they are also understood as being open in that they allow for information about the local environment to be acquired and stored in the emotion-generating modules. The *prima facie* tension, then, is misplaced. Information encapsulation doesn't, as a matter of definition, rule out cognitive influence. Not only that; proponents of emotional modularity seem to be overwhelmingly committed to such influence.

The second source of tension gets more traction. *Pace* Jones, here the tension is owing to it being an open question whether there are any theoretically acceptable notions of modularity which allow for the kinds of cognitive influence required to make the pro-emotion position plausible. As noted, there are theoretically acceptable notions of modularity that allow for cognitive influence. However, whether they can accommodate the kinds of influence which make a pro-emotion position plausible is an altogether different matter. This depends on the precise role modularity plays in an argument for the pro-emotion position. As we saw, a central role it plays is not in telling us which response-options to consider, but in telling us which ones to consider in a quick and efficient manner. Emotion processing systems being synchronically encapsulated suffices for this role.

On de Sousa's picture, emotions "imitate" the encapsulation of perception, and thereby solve the philosophers' frame problem: roughly the problem of figuring out which information is relevant for a particular response-option and to avoid considering irrelevant information. The claim about "imitation" is imprecise, and can be criticised for

being more conjectural than an empirically tractable hypothesis we can scrutinise. Conjecture or not, multi-pathway models of emotion-generation provide plausible ways of fleshing out de Sousa's thesis. According to Griffiths (1997), what we call "emotions" can be generated either through appraisal mechanisms that are "cognitively impenetrable" and deliver responses quickly and automatically, and are thereby more or less modular, or mechanisms that are cognitively penetrable, and generate responses in a slow and considered fashion.[17]

An implementation of this model is found in the twin-pathway neurobiological account of emotion generation for fear proposed by LeDoux (1996). On this account, two distinct "emotion circuits" are involved in fear responses: roughly, (i) a thalamus-to-amygdala circuit, which bypasses the cortex, is "quick and dirty", and occurs without the conscious experience of the stimulus, and (ii) a thalamus-to-cortex-to-amygdala circuit, which is slow, and occurs with the conscious experience of the stimulus. Circuit (i) allows for the rapid response to threatening situations, which is needed for survival, and (ii) ensures a detailed evaluation of the emotional significance of the situation such that we can respond in the most appropriate way.[18]

Applying this to de Sousa's version of the search hypothesis, emotions can be said to "imitate" the encapsulation of perception when they are generated by cognitively impenetrable emotion-generation mechanisms. The question is, are these mechanisms

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[17] In this context, cognitively penetrable emotion generating systemsare systems that fail to be informationally encapsulated.

[18] See Teasdale (1999) for a discussion of various multi-level theories of emotion generation.

encapsulated diachronically as well as synchronically? The role emotions play in solving, or rather avoiding, real-life frame problems can be performed even if emotions turn out to be only synchronically encapsulated. At least, this is what de Sousa himself supposes since he allows for the contents which trigger emotional responses to be learnt through paradigm scenarios. There is also good reason to think that this supposition is correct. Emotions can control for the salience of features of reasoning even when which pieces of information it deems relevant at any given moment is learnt within the life-span of the agent. What is required to avoid real-life frame problems are biasing mechanisms that can highlight pieces of emotion in a timely and efficient way. This can be achieved even if some of these biases have to be acquired. As Griffiths warns, "the issue of whether affect-programs exist must not be confused with the issue of whether they are innate. In principle, an affect-program may be entirely innate, entirely learnt, or a mixture of the two. These are questions about how the circuitry gets built, not about whether it exists" (1990:180). What matters for emotions to fulfil their "biological function" of determining the salience of information on de Sousa's theory is the existence of biasing mechanisms that generate emotional responses roughly along the lines of affect-programs. Such programs, as we saw, accommodate cognitive influence.

As for the search hypothesis proposed by Damasio, emotions are required to solve decision-making problems with significant time-constraints and the cumulative problem we face when we are confronted by decision-making problems, both urgent and less urgent, on a regular basis. Modularity, as we saw, is not explicitly discussed as part of this project, but can play a role in explaining both how decision-making can be quick for the

problems that require urgent responses, and how the cumulative problem can be resolved, if not minimised, when we have emotion processing systems that deliver response-options quickly and automatically. Again, these roles can be occupied even if our emotion generating systems are only synchronically encapsulated. Take Eliot. Synchronically encapsulated emotion generation mechanisms would suffice for Eliot to make decisions, like when to book his next appointment, in an effective and timely fashion so as not to jeopardise his plans for the day.

Synchronically encapsulated systems do have limitations. We addressed the worry earlier, owing to Sterelny, that modular mechanisms would be unlikely to provide veridical solutions to problems that require complex situation specific cues for their solution. But there is an ambiguity here in how we are to understand such cues. On one reading, namely the earlier one, the cues we need to take to into account are those that can be acquired within the lifespan of the agent. Perhaps they are acquired during key stages of development, e.g. in something akin to paradigm scenarios. But they needn't be. They may be acquired at any given stage provided they are prior to the decision-making problem in question, and are acquired early on and frequently enough for a sensitivity to these cues to be stored in one or more of the emotion processing modules. So long as situation specific cues are ones to which we can be thus sensitive, modular, i.e. synchronically encapsulated, emotion-generation mechanisms may suffice to solve the relevant decision problems.

On a different reading, situation specific cues are cues indexed to the specific decision-making problem we face. Put another way, the problem is novel with regards to

at least some of the information required to solve it. On this reading, given the very nature of the problem, background information already stored within the module won't suffice to deliver a vertical solution. The situation specific cues need to be taken into account, stored, and thought over alongside whatever else the agent knows, for us to solve such problems. Synchronically encapsulated information processing systems, subsequently, won't solve them. What we require are non-modular emotion generation mechanisms which fully take into account all of the cues specific to that particular problem. In this case speed will be sacrificed for the deliberation required to solve it.

This is a limitation of modular emotion-generation mechanisms. They cannot assist solve open problems that are genuinely novel. However, it is a limitation that those in the pro-emotion camp should, and appear to, accept. The fact that we have two or more emotion-generating systems speaks to the need to solve both kinds of problems. Theories of emotional modularity accommodate this because they tend to be dual or multi-pathway models of emotion generation. Since those in the pro-emotion camp draw on these theories, we need a more careful reading of the kinds of decision-making problems they think are solved with the assistance of emotion-driven reasoning. Emotions are helpful biasing devices that bias us in favour of some response-options and against others. Biases, however, have limitations. They error precisely when they are exceptions to the rule; when we are exposed to genuine novelty. But such novelty, though pervasive, is by no means the norm. The ecological problems we face are often novel, but they also often fail to be so.

An inability to deliver veridical solutions to such problems, then, in no way undermines the work emotions can do in helping solve both open and closed problems — where there is at least some prior precedent set for the kinds of information required to solve them.

Here we would be remise not to mention recent work by Sterelny (2012), which helps illuminate the present dialectic. In a chapter entitled "The Challenge of Novelty", Sterelny critiques modular accounts of the mind more broadly, and does so on the basis of the increasing complexities of our social world. Moreover, his subsequent aim is to explain the role of cultural learning in human evolution, including how such learning solves problems which are (allegedly) too difficult for modular systems. This project, despite appearances, is compatible with the picture presented above. The issue hangs as much on what he means by novelty, as on the target of his critique. In footnote 4, he makes the following clarification: "By novel, I mean "evolutionarily novel"; I do not mean an individual's first experience of a particular challenge. Obviously, prior experience leading to learning is often essential to adaptive response" (2012: 199). Sterelny, then, readily accepts that mechanisms can have adaptive responses that are learnt within the lifespan of an organism. Subsequently, the target of his critique is not really synchronic modules but diachronic ones; modules which are pre-programmed to trigger in response to special innately-specified triggering properties. Diachronically flexible modules, as we saw, will still prove ineffective in response to situations which are genuinely novel to the agent in question. But crucially, this is not the challenge of novelty which Sterelny poses for an account of innate modularity. Much more, granted, needs to be said by way of explaining precisely how diachronically flexible modules, made use of by the pro-emotion camp, can

feature in a Sterelny-style story, which stresses the significance of socio-cultural learning in hominin evolution. Nevertheless, as things stand, we find no real tension between the two programs.

In this paper, my strategy has been to diffuse the objection to the pro-emotion consensus by showing that models of modularity *can* accommodate cognitive influence of the sort often required for practical rationality. Nevertheless, if we are to defend the pro-emotion program in this way, its future success will, in part, depend on our ability to flesh this out. The challenge posed by the dynamic nature of our social environments, in particular, puts pressure on providing an explanation of precisely how synchronic encapsulation can give way to diachronic flexibility, i.e. of the sort required to solve decision-making problems in such environments. This is a substantial task, one best left for another day. But let me end by making some very tentative preliminary remarks about how such an explanation might go at the computational level.

The task of explaining flexibility to context is a broader problem for any account of modularity; not just for ones to do with emotion-processing. This problem has proved especially cumbersome for accounts of massive modularity, which hold that the mind consists of many modules which exist and operate, more or less, independently of one another. One possible explanation of how such an account can accommodate context-flexibility has to do with competition amongst the modules. Drawing on the work of Sperber (2005), Carruthers (2006) suggests the following picture:

> Different modules are cued by different features of the environment — social, physical, animal, vegetable etc. — and at various levels of abstractness (e.g. suddenly moving stimuli and loud

> noises verses cheater detection). All, when activated, compete with one another for resources, and to get outputs entry into downstream inferential and decision-making systems. But how this competition pans out in a given case might often be highly be sensitive to the details of the context (both environmental and cognitive), and also to the learning history of the person in question. (Carruthers 2006: 219)

Carruthers here is operating on a much less restrictive account of modularity than the one proposed in this paper. However, we needn't commit to it, nor the massive modularity hypothesis, to make use of the basic idea.

Suppose that even within the scope of a twin or multi-pathway model of emotion-generation, each "module" that makes up a given emotion-processing pathway comprises of two or more separate modules. Say this holds for the "quick and dirty" emotion-generating pathways, as well as the ones that are slower and involve conscious deliberation. Out of the modules that comprise the quick emotion-generation pathways, some of them may encode (cognitive) information specific to certain contexts, while others might fail to do so. Crucially, none of the modules that feature in this quick pathway will be sensitive to information stored outside any of the modules associated with it, which means the synchronically encapsulated nature of the overall pathway will be preserved. Nevertheless, synchronic encapsulation can give rise to diachronic flexibility when the activation of the pathway involves the activation of one of the modules which happens to store information relevant to the particular context.

I can only speculate as to how this is implemented at the neural-level. But let me do so, regardless, as it helps make the point clearer. According to LeDoux, the "quick and

dirty" emotion circuit for fear is a thalamus-to-amygdala circuit, which bypasses the cortex, and occurs without the conscious experience of the stimulus. Recent work by LeDoux (2016) suggests, however, that at a more fine-grained level, this pathway might actually comprise of several distinct emotion circuits, some of which activate the hippocampus; the region of the emotional brain that encodes context-sensitive information. On such a picture, how synchronically encapsulated modules give way to diachronic flexibility can be explained, roughly, as follows. A quick and dirty emotion-processing circuit is diachronically flexible when it features modules that incorporate the hippocampus, and thereby take certain context-sensitive cues into account, whereas it fails to be thus flexible when it only features modules that bypass the hippocampus. Nowhere in this picture is there a guarantee of diachronic flexibility being manifest in every instance. But *pace* Sperber and Carruthers, it is plausible that competition amongst the modules is often won by modules that encode information relevant to the contexts in question.

Sperber himself grants the speculative nature of his proposal, and concedes that it "calls for both greater empirical anchoring and for formal modeling" (pg. 68). I end by making the very same concession here regarding the details of diachronically flexible emotion-generating modules.

4. Conclusion

In conclusion, the scope of this paper is modest. It does not seek to establish that emotions actually aid reasoning. Rather, it argues that widespread assumptions about the incompatibility of modularity and emotion-driven reasoning are misplaced and rest on misconceptions about the commitments incurred by committing to emotional modularity, as well as how characteristics of modularity are utilised by the pro-emotion camp. As we saw, pro-emotion theorists can accommodate cognitive modifications to emotion processing of the sort required to solve certain ecologically specific problems whilst still allowing this processing to be modular in key respects. An integral part of this is the recognition that pro-emotion theorists are, and need be, only committed to modules which are synchronically encapsulated: modules that are insensitive to information *presently* stored outside the module, but which allow for various kinds of diachronic updating. I don't think the fault here lies squarely with the opponent. To the extent to which pro-emotion theorists employ notions like 'modularity', the precise sense in which these notions are employed, as well as the exact work they are put towards, are often obscured. In this paper, I have aimed to clarify these issues and thereby remedy the present confusion. Doing so helps us see more clearly why modularity doesn't undermine the pro-emotion consensus. But this paper is also telling of a more general lesson, namely we need to be much clearer when we employ concepts of cognitive science to inform a philosophy of emotion.

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