**Chapter 9 Supplementary material**

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**9.1 Types of modules**

The concept of a “module” also has a wider set of meanings and is used in several different senses in the literature on brain and behaviour, ranging from describing a part of the brain that does something and receives information to functional units selected to promote fitness enhancing behaviour. A useful way of distinguishing between these usages and types is provide by Geary and Huffman (1992). Figure 9.1 provides a diagrammatic summary of their ideas.

|  |  |
| --- | --- |
| Functional module | To solve a problem and then enact the solution requires an affective and motivational system to integrate information from neural, perceptual and cognitive modules and so direct behaviour towards ends that promote survival and reproduction. This is what functional modules do. Aiming and throwing an object accurately at a desirable prey species would be directed by a functional module |
| Cognitive Module | Forming an impression of the outside world from perceptual does not in itself enable problems to be solved and decisions to be made. This is where cognitive modules come into play. In the example of object grasping, a cognitive module might allow a mental representation of the object without the object being present, allowing it to be rotated in space (in the mind) and its usefulness as a tool, for example, judged. |
| Perceptual module | These are modules that receive and integrate information from a series of individual neural modules to form a more abstract representation of the external world. So processing and co-ordinating information from each digit on the hand or pad on a paw, for example, gives rise to the felt perception of the object being grasped. |
| Neural Module | This is the lowest level of organisation and describes, for example, the system that connects sensory regions of the brain with parts of the body. The paw pad on the foot of an animal and the supporting regions of the somatosensory cortex are an example of a neural module |

Sensations from the external world

**9.2 Other heuristics**

Some examples of potential heuristics that humans may be inherently disposed to employ are:

* **Stop searching** when a reason for favouring an alternative is found.
* **Sample selection**: estimate the average and take the next on offer that exceeds the average.
* **Fall in love**. The heuristic need not necessarily be cognitive as this conjecture indicates. The emotion of falling and being in love with someone may serve to bind two individuals together and prevent further searching. Alternatively it may serve to break apart existing relationships even when a level headed assessment of costs and benefits would tend to preserve it.
* **The recognition heuristic**. In conditions of uncertainty the fact that an organism recognises something may yield useful information. For example, rats are known to initially avoid foods they do not recognise; in this respect they exhibit neophobia. They prefer food they have tasted before or can smell in the breath of older rats. The adaptive value of this tactic is obvious. It could also be that making a decision based on something as simple as recognition is also an effective problem-solving strategy for humans. Consider the question “Which has the higher value A or B?”, where value could be anything from monetary value, physical size, number and so on A recognition heuristic might be “the one you recognise has a higher value”. Goldstein and Gigerenzer (1999) asked students at the University of Chicago and the University of Munich the following question: “Which US city has more inhabitants; San Diego or San Antonio?”. The correct answer (San Diego) was given by 62% of the US students but 100% of the German students. The reason is that all the German students had heard of San Diego but few had heard of San Antonio. All the US students had heard of both. The latter then brought additional information to bear that proved less reliable than the simple recognition heuristic “ if you’ve heard of it, it is larger”. Goldstein called this heuristic “ignorance -based decision making”. It could be of value in contexts where recognition is the only cue and further information is unavailable. In this respect it is hardly surprising that the advertising industry is paid huge sums by companies to promote brand recognition. Advertisements often contain little real information about the product, yet are deemed to be successful if they ensure that a name or logo sticks in the memory of a potential purchaser. When shoppers then have to make a decision between two brand A and B and no other information on quality is available they often choose the one they have heard of before.

**9.3 Other biases relevant to EMT**

**Biases in interpersonal perception: the fundamental attribution error (FAE)**

The FAE is also sometime called the correspondence bias. It is a phrase coined by Lee Ross (1977) in his interpretation of a classic experiment by Jones and Harris (1967). It describes the tendency to attribute behaviours to an underlying personality type rather than external influences to a greater extent than is warranted. Imagine a driver suddenly cutting (recklessly?) in front of your car. Your reaction might be “What an idiot/jerk/something ruder”. In other words we are quick to interpret behaviour in terms of some underlying stable personality trait (idiocy) rather than in terms of external factors. We do not tend to say “There goes a fundamentally decent person obviously acting out of character due to some externally imposed constraint or stress”. The initial response might seem more understandable (certainly it is shorter) but experimentation under more controlled conditions often shows that we infer dispositional (that is, character-based) causality more than is warranted (Andrews, 2001). Perhaps there is a tendency to see bad actions in terms of an underlying personality type. This is illustrated by the fact that subjects often are asymmetrical in awarding praise and blame. Reeder and spores (1983) found that subjects were more likely to attribute stealing to an underlying moral tendency (irrespective of the situation and external demands) than giving money to charity. In terms of EMT, such scepticism and willingness to pin down a personality type might reflect the fact that untrustworthy or selfish other impacted considerably on our fitness in the past. If we take the hypothesis “One bad action does indicate an underlying unpleasant personality”, the FN risk (rejecting this hypothesis when it is correct) would be associating with an individual who would later inflict considerable harm through cheating or deception; the FP risk (accepting this hypothesis when it is false) means missing out on friendship or a useful contact. If the FN costs (integrated over evolutionary time) have proved higher than FP costs then we might expect such a bias in our judgements. Similar reasoning might be applied to why humans seem especially skilful at detecting cheats (see later in this Chapter).

**9.4 Case Study: The Wason selection task: cognitive adaptations for social exchange**

**9.4.1 Logical reasoning and the social contract**

This quotation reminds us that our ancestors had to cope with a difficult physical environment and a social world that contained difficult unreciprocating people. We have in-built mechanisms to cope with the cold: we shiver, reduce our exposed surface area and raise hairs from ‘goose bumps’ to improve insulation. So do we have in-built mechanisms to cope with cheaters? Tooby and Cosmides suggest that we do and that this is reflected in our powers of reasoning. They contend that since hominins have engaged in social interactions over a few hundred thousand years, our brains should have evolved a constellation of cognitive adaptations to social life. If interactions with other humans in our EEA involved exchanges of help and favours (reciprocating altruism), our cognitive algorithms (sequence of thought processes) should be adapted to possess the following abilities:

1. To estimate the costs and benefits of various actions to oneself and to others

2. To store information about the history of past exchanges with other individuals

3. To detect cheaters and be motivated to punish them.

To investigate human cognition, Tooby and Cosmides used a technique called the Wason selection task (Wason, 1966). Wason was interested in Popper’s view of science that identified the hallmark of scientific reasoning to be the hypothetico-deductive method. In particular, scientists should test hypotheses by looking for the evidence that would falsify them. Box 9.3 shows the structure of a typical Wason selection task.

……….BOX 9.1 ……………

Basic form of Wason’s selection task

Context: Part of your new clerical job in the Registry of your university is to check that student documents have been processed properly by your previous colleague. The document files of each student have a letter code on the front and a numerical code on the back. One basic and important rule for you to check is:

Rule: If a person has a D code on the front, the numerical code on the back must be a ‘3’.

You suspect that the person you have replaced did not label the files accurately. Examine the four documents below (some showing the front of the file and some the back).

Which document(s) would you turn over to test whether any file violates

the rule?

…………………………………end of box…………….

The logical structure to problem in Box 9.1 can be written as:

D F 3 7

P not P Q not Q

The rule takes the form: ‘If P then Q’ (if a D on the front of the file, then a 3 on the back). The rule is violated if there is a D on the front but not a 3 on the back, or ‘If P and not Q’. Thus we need only examine files D and 7. Cosmides then applied the problem to a context that involved social exchange and hence the recognition of benefits and the payment of costs. In such situations, the potential for cheating is exposed. Box 9.2 shows the logical structure of this new setting.

…………………..BOX 9.2 ……………….

Wason’s selection task in a social exchange context

Context: You are a bouncer in a Boston bar. You will lose your job unless you enforce the following rule:

Rule: If a person is drinking beer, he/she must be over 20 years old.

Information: The cards below represent the details of four people in the bar. One side indicates what they are drinking, the other side their age.

Instruction: Indicate only the card(s) you would definitely turn over to see whether any of the people is breaking the law.

16

25

Coke

Beer

…………..end of box…………

In this new context, the proportion who chose ‘Beer’ and ‘16’ (the correct answers) rose to 75 per cent. Tooby and Cosmides explain this improvement in performance by suggesting that the social context evokes a ‘search for cheats procedure’ in the human mind.

A rival explanation might be that people are simply better at reasoning in a non-abstract context of which they have some experience. Most of us are familiar with the illegality of under-age drinking but not with strange rules about student files. To test this Tooby and Cosmides varied the reasoning tasks as follows:

1. A task that has the same formal structure as the drinking problem but in a totally alien cultural setting

2. A task in which a concern to detect cheating would in fact lead to logical errors.

With regard to the second task, Tooby and Cosmides found that people were actually led into errors of reasoning by their propensity to look for cheats. With regard to the first challenge, they found that, even if it were couched in unfamiliar cultural terms (Box 9.3), the Wason problem was solved better when the problem entailed costs and benefits. Despite the unfamiliarity of the context, over 70 per cent of subjects were still able to reason correctly and choose ‘P’ and ‘not Q’ (Figure 9.2).

………………………..Box 9.3 .……………

Wason’s selection task in unfamiliar context of social exchange

Context and Rule: You are part of a tribe where a fundamental rule is that only married men are allowed to eat the aphrodisiac cassava root. Married men are always given a tattoo. All men (married or not) may eat molo nuts – a foodstuff less desirable than cassava root both in terms of taste and effects.

Instruction: Which cards would you turn over to test whether the rule has been violated?

No tattoo

Has tattoo

Eats molo nuts

Eats cassava

The formal expression of this is:

P = Benefit Not P = Benefit not drawn Q = Has paid cost Not Q = Not paid cost

|  |  |
| --- | --- |
| **Context** | **% Correct responses – i.e choose “P” and “not Q”** |
| Social contract formulation, unfamiliar setting, involves cheating | 75 |
| Unfamiliar setting, no cheating connotations | 21 |
| Abstract logical task (If P then Q…) | 22 |
| Familiar context but no cheating connotations | 46 |
|  |  |

Table 9.1 **Percentage of correct responses in Wason’s selection task according to context.**

Source: After Tooby, J. and Cosmides, L. (1992) The psychological foundations of culture, in J. H. Barkow, L. Cosmides and J. Tooby (eds) *The Adapted Mind*. Oxford, Oxford University Press.

If the general thrust of Tooby and Cosmides’ work is supported, the implications may be profound. Instead of thinking of the human mind as containing a single ‘reasoning faculty’, it may indeed be better to think of it as a cluster of mechanisms designed to cope with problems that we commonly encountered in the Pleistocene period of our biological evolution. One of these problems was how to reason accurately enough to detect cheating. The critical response to this work has been mixed. For methodological criticisms that still support the social contract hypothesis see Gigerenzer and Hug (1992). For a more severe criticism of this view, see Davies et al. (1995). The hypothesis that the detection of cheaters in social exchange contexts is part of the cognitive architecture of humans is supported by findings showing this facility to be present in young children (Harris et al, 2001) and in every culture so far tested ranging from Westernised industrial societies to the Shiwiar hunter-gatherer horticulturalists of the Ecuadorian Amazon (Sugiyama et al, 2002)

If the detection of cheating were so important in the social environment of our evolution, we might expect that other components of our mental apparatus would be finely tuned to detect cheating. Mealey et al. (1996) investigated whether our memory of faces is enhanced by a knowledge that the face belongs to a cheater. They presented a sample of 124 college students with facial photographs of 36 Caucasian males. Each photograph was supplied with a brief (fictitious) description of the individual, giving details of status and a past history of trustworthy or cheating behaviour. Students were allowed about 10 seconds to inspect each face. Of the 36 pictures seen, 12 were described in the category of trustworthy, 12 as neutral and 12 as threatening or likely to cheat. One week later, the subjects were shown the pictures again (together with new ones) and asked whether they remembered the faces.

The overall finding was that both male and females were more likely to remember a cheating rather than a trustworthy face. The effect was significant for males and females but stronger for males (p = 0.0261). This work supports the general notion that our perceptual apparatus is adapted to be efficient at recognising cheaters. Puzzling features, however, remain. In the same study, the authors found that if pictures of high-status males were used, the enhanced recognition of cheaters disappeared for males and was even reversed for female subjects, in that they were now able to recollect trustworthy faces more reliably.

**9.4.2 The Wason task and the pay off to the participant**

In the tests administered by Cosmides and Tooby described earlier the selections that correspond to benefits taken ( for example, Drinking beer or eating cassava) and costs not paid ( for example, under age and having no tattoo) also correspond directly to the “P” and “not Q” of formal logic. The whole point of this being that the correct selection of P and not Q cards is greatly facilitated by this social context. A common misunderstanding of the work on Tooby and Cosmides on social exchange reasoning, however, is the idea that cheater detection somehow enhances formal logical reasoning. This would seem unlikely since it would require a formal reasoning cognitive facility plus a cheater detection module or circuitry plus some sort of connection between them. Instead they argue that social exchange scenarios have their own non-standard rules of inference not necessarily congruent with formal logic. It is true, of course, that in many Wason-style formulation of rule-based problems the cheater-detector answer is also the logically correct one. But it is possible to create social exchange problems where cards representing those who have taken the benefit and not met the requirement (that is, cheaters) corresponds to the logically incorrect answer. Yet in these situations subjects still tend to choose the social exchange answer and not the logically correct one. Gigerenzer and Hug (1992) investigated this very point: whether cheating simply stimulated a formal prepositional logic reasoning device somewhere in the brain or whether reasoning itself was in some way dependant on the perspective of the participant and in particular the cost benefit payoff to the reasoner. Box 9.4 shows the reformulation of the test:

……….Box 9.2 …………………

Wason’s task: social contract and perspective change

The day off rule:

If an employee works on the weekend, then that person gets a day off during the week.

The cards below have information about four employees. Each card represents one person. One side of the card tells whether the person worked on the weekend, and the other side tells whether the person got a day off during the week. Indicate only the cards you definitely need to turn over to see if the rule has been violated

Did not work on the weekend

Worked on the weekend

Did not get a day off

Did get a day off

………..end of Box……………..

In this revised scenario the costs and benefits are unevenly distributed between employee and employer as follows:

Employee:

Would be cheated if he/she worked at weekend (P) and did not get a day off (not Q). Hence this perspective should be especially sensitive to the other side of both these cards. This perspective corresponds to prepositional logic and the formally correct answer of P and not Q.

Employer:

Here being cheated means fining an employee who “did get a day off” (Q) but “did not work on the weekend” (not P). From this perspective the other side of both these cards should be most interesting.

In the Wason task it is noticeable that responses of the sort “not P” and “Q” are rarely found. In the experiment carried out by Gigerenzer and Hug the results are interesting (Figure 9.2)

**Figure 9.2 Percentage responses to Wason’s task as revised by Gigerenzer and Hug.**

Source: Plotted from data in Gigerenzer, G. and Hug, K. (1992) ‘Domain-specific reasoning: social contracts, cheating and perspective change.’ *Cognition* 43: 127–71.



Key :

P and not Q means participant turned over “Worked on the weekend” and “Did not get a day off” cards

Not P and Q means the participant turned over Did not work on the weekend and Did get a day off cards

Commenting on these findings Gigerenzer notes:

“Our participants were not reasoning with a Kantian moral but with a Machiavellian intelligence” (Gigerenzer, 2000, p. 222). If this work is robust it shows the advantages of constructing a theory of cognition that is informed by social interaction rather than trying to fit human reasoning into abstract and logically flawless procedures and then wondering why fallacies occur.

**9.4.3 Social exchange reasoning or simply following rules?**

Not all subscribe to Tooby and Cosmides’s interpretation of the effect of cheating connotations on performance in the Wason selection task. Oakford and Chater (1994) propose an “Optimal Data Selection” theory to account for the findings. They argue that the abstract task (the Registry) and the cheating-context task (for example, the under-age drinking) belong to different domains. The abstract task is, as they say, indicative, meaning that it refers to truth and falsehood - the rule about the filing could be shown to be false. But the under-age drinking scenario is deontic (from Grk deon = duty) and is concerned with obligations. In this case finding someone under 20 drinking beer does not prove the rule false but rather that some social infringement has taken place. They advance an interesting explanation for the popularity of the “q card” choice in both such tasks. They suggest that in real life situations choosing “q” (that is, positive confirmation of a generality) may be more informative because of what they call the “rarity assumption” and the “expected information gain”. Imagine you are trying to test the validly of your conclusion that black fruits taste sweet. It is more useful to taste yet another black fruit ( q) than to establish the identity of something that tasted bitter (not q) because there are potentially hundreds of things that could taste bitter that have no bearing on your newly discovered rule. Yet it would be rare (ecologically speaking) to keep finding that black fruits are sweet if there was not some useful basis to the rule. It may be then that this bias to seek positive confirmation is a quite sensible strategy. In which case, choosing “p and q” is more “rational” in terms of expected information gain than the logically correct “p and not q”. In the fruits example we can add the observation that once a hypothesis “black fruits taste sweet” receives some support it is adaptive to keep consuming black fruits rather than run a controlled experiment to sample fruits of every possible different colour in the interests of science. Hence a confirmation bias may be adaptive. The authors themselves steer clear of applying evolutionary logic to their interpretation but we can see how easily such reasoning fits with ecological rationality. Where the idea of expected information gain does struggle, however, is explaining the biases observed by Gigerenzer above where cheater detection facilitates reasoning but altruism does not.

The influence of deontic reasoning rules can be tested. In a social exchange scenario the good reciprocator loses out if the social contract (You can have x if you perform y) is broken. This could occur through the non-reciprocator making an error or because he or she is an habitual cheater. In a single encounter, whatever the cause, the loss to one part is the same. Now from an economic, deontic or utility viewpoint there is not much difference between an accidental violation of an implicit rule of social exchange and a violation through cheating: both involve a loss to the trustworthy reciprocator. However, from an evolutionary point of view cheating is a more serious cause since the reciprocator needs to identify cheats and avoid them in future exchanges. Moreover, treating accidental violators and cheaters equally imposes the potential future cost of missing out on worthwhile future exchanges with non-cheaters who made an uncharacteristic mistake. This line of reasoning leads to a rather dramatic prediction: reasoning will be more efficient in detecting violations of social exchange rules in relation to the intentional violation of rules (that is, cheating) compared to unintentional and accidental violations. Social contract theory also predicts that as soon as problems arise involving rules based around benefits and obligations then this should activate social exchange type reasoning.

To test the first prediction about intentions and mistakes Cosmides et al (2010) devised a scenario where a rule (which was associated with a considerable benefit) could be broken intentionally or by accident. As predicted there were more correct answers (that is, P and not-Q) in the intentional setting (68%) compared to the setting of accidental violation (27%). To test the prediction about the importance of costs and benefits the group devised a scenario, based on the idea of anthropologists studying a tribe on the Kalaman Islands, with three variations. Subjects were told that members of this tribe always wear a small piece of volcanic rock tide to their ankle. The colour of the rock must conform to rules set up by the elders. Two of the three rules tested were (italics added):

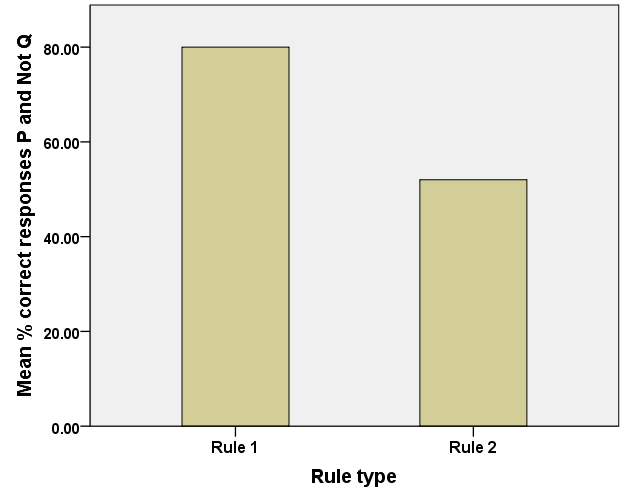
1. If one is *going out at night*, then one must tie a small piece of red volcanic rock around one’s ankle
2. If one is *staying in at night* , then one must tie a small piece of red volcanic rock around one’s ankle

The subjects of this test were undergraduates and so notice that in rule 1 there was a benefit to be had (going out is viewed favourably) and an obligation to be violated. In rule 2 there is no real benefit Table 9.3) The students were told that cards represented what a person did on one side and one they wore on the other. Again they were asked to choose card(s) to test if the rule had been upheld.

Table 9.2 Logic of two rules in a revised test of social contract theory

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Card: | WENT OUT | STAYED AT HOME | WORE RED ROCK | WORE BLUE ROCK |
| Logic of Rule 1 | P | Not P | Q | Not Q |
| Logic of Rule 2 | Not P | P | Q | Not Q |

Although the sample size was small the comparison between responses to the two problems was supportive of cheater-detection social exchange reasoning (Figure 9.3). Remarkably this change was noted even though the difference between the two rules was just a two word change: going out (at night) to staying home (at night)



**Figure 9.3 Correct answers in a revised Wason selection task scenario**. Subjects performed better when a rule involved benefits to be had in a social exchange scenario. Data from Cosmides, L., Barrett, H. C., & Tooby, J. (2010). Adaptive specializations, social exchange, and the evolution of human intelligence. *Proceedings of the National Academy of Sciences*, *107*(Supplement 2), 9007-9014.

These recent experiments are important since they are difficult for rival theories of human reasoning in these situations to explain. What is also remarkable is the narrow specialisation of the system. As Cosmides et al note:

*“…this system has the computational power to detect social contract violations – it must, to detect cheaters. Yet it is regulated so that violation detection is deployed only in the service of cheater detection. It is difficult to think of a more powerful signal of the system’s functional specificity than that”* (Cosmides et al, 2010, p. 9012)

The task now for advocates of domain specific reasoning is to identify the level of abstraction of the mechanisms involved in such reasoning. On the one hand the results repudiate the idea of a perfectly abstract logical reasoning device. On the other hand the opposite level of virtually no abstraction with problems solved using memory and familiarity seems ruled out by the fact that problems can be solved in unfamiliar contexts. Somewhere along this continuum lies the domain specific level of abstraction where some content is stripped away but the context (cheating and the perspective of the reasoning) is retained.

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