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The Evolution of the Social Mind: Implications for Psychopathology Research

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Abstract

A central question for understanding human cognitive evolution and cognition in general is just why our Hominid ancestors developed such a large brain. Different theories have been advanced to explain this fact but increasing acceptance is given to the important role of social factors. In particular, the idea that increased social complexity, as a result of living in increasingly larger groups, led to a "mental arms race" is gaining acceptance. We consider some of the evidence that social factors were a major influence upon the increasing size and complex organisation of the Hominid brain. From this we argue that to understand the architecture and functioning of the modern mind we must begin with the premise that it is in many ways a "social mind". In addition, we argue that psychopathology which studies mental disorder lacks any model of the mind. We argue that a knowledge of the mind's last six million years of evolutionary history strongly suggests that any such model of the mind should, in large part, be that of a social mind. We draw upon Gigerenzer's notion of modularised social intelligence and Bugental's theory of domains of social life to construct a possible architecture for a social mind. The potential application of such a model is demonstrated using schizophrenia research as one example. However, we consider that the idea of a social brain has major implications for the study of most mental disorders.

The Evolution of the Social Mind: Implications for Psychopathology Research

There are a number of different strategies that we can employ in studying the causes of mental disorders. For example, the traditional biomedical approach identifies clusters of signs and symptoms that reliably co-occur and then organises these syndromes or disorders according to a taxonomy or system of classification (e.g., the DSM-IV; APA, 1994). This taxonomy is then used to guide research into the aetiology, course and prognosis of the various disorders identified. Through the reliable classification of different disorders it is hoped to better understand their respective aetiologies and thus develop effective therapies. Certainly, this has been the dominant approach to the scientific study of mental disorder, although other strategies do exist. For example, Clark, Watson and Reynolds (1995) have argued that a dimensional approach to classification might more accurately reflect the nature of psychiatric disorder. Others have recommended a focus on the specific symptoms of concern, given that the same symptoms can occur across different disorders. Hence Bentall, Jackson and Pilgrim (1988) suggest researchers could more profitably study delusions or auditory hallucinations, rather than study schizophrenia per se.

The purpose of the present article is not to add to this lively debate on the best approach to researching the phenomenon of mental disorder, but rather to argue that what is frequently missing from this debate is a clear notion of just what sort of mind is being studied. Further, it will be argued that a clearer conception of the nature of that mind, based upon a consideration of its evolutionary past, could greatly

facilitate research on mental disorders. The notion of a "mental disorder" without a mind in which that disorder is instantiated, seems slightly absurd (except perhaps to radical behaviourists). Of course, one simplistic solution to this problem is to refer instead to "brain disorders" rather than mental disorders. However, this semantic sleight-of-hand ignores the fact that many mental disorders have no clear-cut lesions despite decades of searching for them. Moreover, it also reveals an ignorance of the recent work, which has considerably enriched and sharpened our notions of the architecture of the human mind and how this architecture is an inevitable product of our evolutionary history (e.g., Donald, 1991; Mithen, 1996). Which brings us to the purpose of the present article. This article aims to review some recent ideas concerning the evolution of the mind, and in particular, to outline the evidence for a specifically socially adapted mind. Then we consider how this notion might relate to current theories of modularity and domain-specific cognition. Finally, we speculate on the implications of a social mind for research on mental disorders, using schizophrenia as an example. We begin by outlining some of the evidence that the process of hominid evolution resulted in a uniquely "social brain".

Brain Size, Intelligence and Human Evolution

One characteristic of *Homo sapiens* that distinguishes it from the other primates is its large brain (Wolpoff, 1999). Dunbar (1996, p.3) comments that "Our brain is nine times larger than you would expect for a mammal of our body size". A puzzle for evolutionary biologists and physical anthropologists has been quite why this massive expansion in brain size occurred, especially since a larger brain entails costs as well as benefits in survival terms. There are several theories to explain this increase but, before considering these, first we need to briefly summarise some of the known facts about changes in brain size in hominid evolution.

Mithen (1996) notes that there have been two "major spurts of brain enlargement" in our ancestral history and that these two periods were separated by over a million years. The first period of rapid brain enlargement occurred around two million years BP (before the present). According to Mithen archaeologists "tentatively" link this first period of brain enlargement with the development of tool making. However, he notes that there is little unequivocal archaeological evidence to explain the second period of rapid brain enlargement, which occurred some 500,000 - 200,000 years ago.[1]

One of the most intriguing aspects of this two-stage leap in Hominid brain size is that it greatly precedes the explosive cultural developments that we associate with modern Homo sapiens. For example, a "cultural explosion" is known to have occurred some 60 - 30,000 years ago during which the first art, sophisticated technology, and religion arose (Mithen, 1996). Farming only commenced some 10,000 years ago (Mithen, 1996) and the written word about 5,300 years ago (Lecours, 1995). What is so puzzling about this sequence of events is that the huge cortical development in *Homo sapiens* came well before the great technological and cultural achievements that required it. This all gives rise to the question, "Why did our ancestors require such enormous brains?"

This question is a deeply puzzling one but its answer may lend insights into the very structure of the modern mind. In modern technological and information driven societies, the question - what use is increased "brain power"? - seems almost fatuous. However, our ancestors lived for about six million years as hunter-gatherers, in small nomadic groups of a few dozen or so individuals. They gathered fruits and vegetables, scavenged for the remains after other hunting animals had eaten, and hunted. This ancestral environment is called the environment of evolutionary adaptedness (EEA). The evolutionary psychologists Cosmides and Tooby (2000, p.13, web primer), put it this way: "Each of our ancestors was, in effect, on a camping trip that lasted an entire lifetime, and this way of life endured for most of the last 10 million years". The important point here is that they did so for several million years, and quite successfully given their numbers and their spread into other parts of the globe, without the greatly enlarged brain. So why did it develop? Moreover, the extraordinary cultural developments that we consider uniquely human achievements came long after the increase in brain size. So what drove this brain enlargement?

The Costs of Increased Brain Size

It is not enough to answer this question with vague generalities about increased brain size equating with increased intelligence and assuming that increased intelligence is necessarily of adaptive or survival value. In fact an increase in brain size has costs as well as benefits for an organism. In the case of humans, brain size has increased to a point where it makes birth a difficult and dangerous process for both baby and mother, since the baby's skull size has now increased to a point where it is almost too large for the birth canal (Morgan, 1995; Wolpoff, 1999). Moreover, enlarged brain size in modern humans has meant both that pregnancy is prolonged, and that newborns are then dependent upon their mothers for a greatly extended period (Jolly, 1999). This long period of

dependence upon the mother has arisen because, given the limitations upon brain size dictated by the birth process, any further increase in brain size must occur by neural development which happens after the birth itself. Dunbar (1995, p.128) notes that "A baby human is born when its brain is less than one-third of its final size. The rest of its brain development continues over the first year of life". In effect, humans are all born premature in the cause of increased brain size.

Clearly, in the EEA this prolonged dependency must represent a considerable disadvantage, for both child and mother, in survival terms. However, there is another disadvantage to increased brain size. The brain is a demanding organ that consumes a disproportionate amount of energy and nutrients for its mass relative to the rest of the body. Dunbar (1995) states that the human brain accounts for only 2% of total body weight yet it consumes 20% of total caloric energy.

In summary, the substantially enlarged brain typical of modern humans and their Hominid ancestors brings with it some major costs. It makes birth a dangerous process, it makes infants dependent on their mothers for a prolonged period, and it consumes much more than its fair share of the available energy. It must have then also conferred some even more substantial benefits in terms of reproductive fitness. The question that needs to be answered then, is just what were these benefits? Why did our hunter-gatherer ancestors on the African savannah landscape need such a large brain? It is a central theme of the present article that this larger brain evolved to cope with an increasingly complex social environment. However, before expanding upon that theory we need to acknowledge some other important rival hypotheses.

Alternative Explanations for Increased Intelligence

The notion that the social world has been the "principal challenge shaping primate intelligence" is both a recent idea and radical one (Byrne, 1995, p.194). Byrne (1995) reviews a number of competing explanations that emphasise: the problem of finding food and the development of "cognitive maps; the rise of hunting and possible use of planning, cooperation, and weapons; tool making and use; and extractive foraging and complex food processing. It is not the purpose of the present article to review all major theories concerning the increase in primate brain size and intelligence. This is well beyond the scope of our discussion. However, it is important to acknowledge here that alternative accounts have their supporters and their supporting evidence. Furthermore, these theories are not necessarily mutually exclusive. It may be that the extensive intellectual capacities of Homo sapiens are best explained by a number of different factors operating throughout our evolutionary past. Certainly, the fact that the mind evolved a specifically social intelligence does not preclude the evolution of other "faculties", such as a technical intelligence or natural history intelligence. However, this goes well beyond the scope of the present article and the interested reader is referred to Mithen (1996) for a comprehensive account. For the purposes of the present article it is sufficient to establish that there is mounting evidence for the social or Machiavellian intelligence hypothesis.

Does Size Matter? - The Bigger Brain and Social Intelligence

It is easy to speculate as to how a larger brain might have been of adaptive benefit to our hominid ancestors. Several plausible explanations can easily be entertained. Perhaps a larger brain allowed for increased cerebral differentiation and lateralisation that facilitated the development of language, which was useful for organising hunting trips. Perhaps brain size was related to cognitive processes involved in tool use and the resultant tools made for more efficient consumption of fruit and scavenging of carcasses. Perhaps it related to enhanced visual-spatial abilities and memory, which would have been useful for finding food and shelter on the savannas. Each of these scenarios offers a plausible explanation as to why a hominid with a larger brain could have been better equipped to survive and hence replicate more frequently. But each of these scenarios contains an implicit assumption that increased brain size equates with more intelligence and more intelligence necessarily equates with increased biological fitness. This "common sense" assumption was challenged in a now famous paper by Nicholas Humphrey (1976) entitled "The social function of intellect".

Humphrey (1976) observed in that article that primates seem to have far more intelligence than they actually need. He noted that the cognitive abilities that monkeys and apes can display in laboratory tasks far exceed the intellectual demands of their natural environment. Humphrey (1976, p.16) suggests that most of the problems faced by primates in the wild can be readily dealt with by trial-and-error learning involving associative and/or operant conditioning - there seems little need to posit any more complex cognitive processes. Similarly, he argues that studies of living hunter-gatherer groups suggest that "the life of hunting and gathering, typical of early man, was probably a remarkably easy one." (p.17). Humphrey was certainly not arguing that intelligence is a disadvantage to organisms preoccupied with survival

and reproduction in a sometimes hostile environment. He simply pointed out that evolution rarely produces a surplus of a specific adaptive feature. Animals typically evolve to be as tall, small, strong, fast, colourful, or venomous, as they need to be to successfully survive and reproduce, and no more. Consequently he asked "Why then do the higher primates need to be as clever as they are, and in particular, that much cleverer than other species?" (p.17).

Humphrey answered this question by suggesting that perhaps the major purpose of increased primate intellectual ability was to assist the individual to survive and reproduce within increasingly larger (and so more complex) social groups. He proposed "that the chief role of creative intellect is to hold society together" (p.18). Humphrey suggested that the increasing size of primate social groups, in combination with the prolonged dependency characteristic of humans, necessarily means the group politics become much more complex. This is the notion that the primary force driving increased brain size was the increasing quantity and complexity of social information, which our early ancestors had to process as the size of their social groups increased. Consequently, he argued, if increased intelligence means increased social success, and if social success means increased biological fitness, then any heritable trait that facilitates intelligence will spread through the gene pool quickly. This influential paper led to an explosion of interest in so-called Machiavellian Intelligence (Byrne & Whiten, 1988) and the role of social factors in human cognitive evolution in general. Below we will consider some of the evidence that the evolution of human intelligence was, in many ways, the evolution of a "social intelligence". First we will consider the evidence for this hypothesis that comes from the study of our closest primate relatives.

Evidence for the Evolution of a Social Brain

Machiavellian vs. Social Intelligence

This term draws its name from the author of the classic 16th century text The Prince, a treatise on the exercise of political power through deception, tact, scheming, charm, in general, the manipulation of others. Such strategies (at least in a rudimentary fashion) are thought to have evolved in large primate groups as an alternative to the simple application of force, which can be damaging to both winner and loser. Byrne and Whiten (1997, p.2) comment that this "sets up an environment favouring the use of social manipulation to achieve individual benefits at the expense of other group members. This social manipulation can involve either deception, in which the other animal is unaware of its disadvantage or loss, and cooperation, when there is mutual gain. The Machiavellian intelligence hypothesis posits that intelligence then becomes selected for as a trait, resulting in a selective pressure that applies to all group members. The effect of this is like a "mental arms race" which is thought to result in spiralling intelligence (Byrne & Whiten, 1997).

Typically, the term Machiavellian intelligence is reserved for the use of deception. However, this may be an unfortunate choice of name given its connotations of cunning, duplicity, and the ruthless application of power for personal gain. Strum, Forster and Hutchins (1996) based upon their own research on social behaviour among baboons, have cautioned that reliance upon the term "Machiavellian intelligence", may limit the scope of our inquiry. They suggest the term is a misnomer that places undue emphasis upon the exploitation, domination, and deception of others. Rather they note that "primate social complexity seems an intricate tapestry of competition and co-operation, of aggression and reconciliation, of non-aggressive social alternatives, and of behaviours and relationships that cannot be so easily dichotomised" (p.74). Consequently, while acknowledging the significant theoretical advances brought about the study of Machiavellian intelligence since the publication of the first volume with that name in 1988 (Byrne & Whiten, 1988), we prefer to use the more general term "social intelligence" for the remainder of our discussion (except where deception is the focus).

Chimpanzee Politics and Social Intelligence

One important clue to what our early ancestors' minds might have "looked like", comes from studying primate social behaviour, and in particular chimpanzees. About five to six million years ago chimpanzees and humans shared a common ancestor (the so-called "missing link"). At that point the evolutionary family tree branched. Today this is reflected in the fact that more than 99% of our nuclear DNA is identical to that of the chimpanzee (Holloway, 1995). However, unlike humans, chimpanzee brain size has remained fairly constant since then and so it is assumed their brains represent a fairly good approximation to our earliest ancestors. Consequently, the social behaviour of chimps, and what it implies about their cognitive abilities, has been enormously influential upon current conceptions of early cognitive architecture (e.g. Mithen, 1996; Tanner, 1987). So what do we know about chimpanzee social behaviour and what can we infer from it concerning their cognitive abilities? Perhaps the first point we might make about the social lives of chimpanzees is that they

have all the elements of a good television soap opera. They form political alliances, compete for dominance, are often aggressive, sometimes promiscuous, and they also practice deception (De Waal, 1987; Jolly, 1999). It is this latter characteristic, the ability to conceal their own intentions while simultaneously manipulating the behaviour of other individuals, which led to the coining of the term "Machiavellian intelligence" (Byrne & Whiten, 1988; Whiten & Byrne, 1997). Chimpanzee Politics. Some fascinating examples of the intricacies of chimpanzee relationships and their capacity for social manipulation have been given by De Waal (1982), describing a colony at the Burgers' zoo in Arnhem. He describes one example of a chimp called Yeroen who limps after hurting his hand in a fight with another chimp named Nikkie. An astute student reports that this limp only seems to occur in the presence on Nikkie. Initially, De Waal is sceptical but after systematic observation confirms this picture of "malingering" which continues for almost a week. De Waal suggests that this exaggeration of symptoms may be an attempt to avoid further harsh treatment.

Some more common examples of deception practiced by chimpanzees occur when low ranking males attempt to have sexual intercourse with females. De Waal notes that higher ranking males, especially the alpha male, do not tolerate such behaviour and their "dates" must of necessity be clandestine. In the first example, a male chimp called Dandy was surreptitiously courting a female, a process which involves the male displaying his erect penis to the female. At just this moment Dandy was surprised by an older males unexpectedly arriving. De Waal observed Dandy to drop both hands over his penis and conceal it from view until the higher ranked male had passed by. Females are equally adept at this kind of trickery. A female chimp will typically emit a special, high pitched scream at the climax of mating. De Waal observed some female chimps learn to suppress such screams (but not the associated facial expression) when copulating with lower ranked males out of sight of the alpha - while continuing to emit this scream when copulating with the alpha male. De Waal also describes a two-month power struggle between the two oldest males, involving shifting strategic alliances and tactics of social control suggestive of considerable social and Machiavellian intelligence.

In summary, there is considerable evidence from observations of chimpanzees that their social cognitive abilities are quite sophisticated. In particular, they demonstrate an awareness of other chimpanzees' behaviour and also some skills at manipulating the behaviour of others. This kind of intelligence has been labelled Machiavellian involving as it does deception. Moreover, it is not confined to chimps. Byrne and Whiten (1990,1997) have concluded that there is substantial evidence for tactical deception among Old World Monkeys and the great apes (but not among prosimians). The following section will examine the idea that brain size in primates increased in proportion to increased social group size.

Grooming, Gossip and the Evolution of Language

The title of this section is borrowed from Dunbar's (1996) book, which attempted to specify how increased brain size might have arisen as a consequence of larger social groups and the selection of social intelligence as an adaptive trait. Here we enter a branch of paleoanthropology known as allometry. Allometry is the study of changes in body proportions with changes in overall body size (Wolpoff, 1999). To a certain degree brain size is simply a reflection of total body size. To some extent the more muscles, organs, nerves and metabolic processes occurring in a mammal, the more brain tissue is required to coordinate everything. Hence the important variable we need to consider is relative brain size. Allometry uses mathematical scaling to evaluate these relative changes in body proportions.

Dunbar observed in the 1990's that previous analyses of brain size had all made the mistake of examining total brain size. This ignores the fact that the growth in size of the primate brain involved certain structures growing disproportionately more than others. It is the massive increase in the relative size of the neocortex that is the most striking feature of the evolution of the primate brain. Consequently, Dunbar examined the correlations between neocortical size in various primates and a range of variables, which had been hypothesised to account for the increase in brain size. In the late 1980s and early 1990s, the major alternative theory to explain primate brain size, concerned the problems of surviving in an uncertain environment, in particular the problems fruit-eaters would have encountered finding food. So in addition to social group size, Dunbar also looked for correlations with a number of ecological variables such as amount of fruit in diet, size of territory, daily foraging distances, and so on. Dunbar used group size as a measure of social complexity for two reasons: (a) because it was a relatively objective measure and (b) because, he argued, social complexity increases exponentially as group number increases linearly. In short, Dunbar was able to establish that among primates the neocortex increases in size with increasing group size. Subsequent work has found a similar relationship with other non-primate species including carnivores and bats (Barton & Dunbar, 1997).

Dunbar concluded from his empirical work that "The evolutionary pressure selecting for large brain size and super-intelligence in primates did seem to have something to do with the need to weld large groups together" (1996, p.64). It is Dunbar's hypothesis that in primates such as monkeys, grooming is the social glue that binds the group together, and that with the arrival of Homo erectus about two million years ago, "vocal grooming" or gossip, supplanted physical grooming. Monkeys and apes spend long periods of time mutually grooming each other, touching, removing insects, leaves, mud, and other debris from each others tangled fur. This process has obvious hygiene value but the time typically spent in grooming seems to greatly outweigh the health benefits alone. Different species of monkeys may spend between 10 - 20% of each day in grooming (Dunbar, 1996). This is all time that could have been spent on finding food. Rather, its significance seems to be undeniably social. The time spent grooming solidifies relationships among kin and allies.

As the size of the group grows, grooming becomes a less efficient means of forming and maintaining the alliances within the group. Grooming is essentially a one-on-one activity. It is physically difficult to groom more than one individual at a time, and attempts to do so may sacrifice the very intimacy that makes this activity so potent for forming friendships, strengthening existing bonds, and repairing old alliances when rifts have occurred. Grooming may also be difficult or impossible in the dark. However, as the size of the group grows, maintaining those alliances within the larger group becomes ever more important for status, reproduction, and day-to-day survival. It is Dunbar's thesis that the primary function that language may have served for early Hominids was to allow "social grooming" to supplant physical grooming. Speech allows for the possibility that two, three, four, or more individuals can participate in the interaction simultaneously, merely by hearing what is said. Further, talk can still occur while our legs are engaged in walking or our hands are busy preparing food or physically grooming a baby. In Dunbar's view, gossip replaced grooming as the glue that binds Hominid social groups together. Thus, the development of larger groups, increasing neocortex size, and the evolution of language are intimately and intricately connected.

In our discussion so far we have considered some of the evidence that chimpanzees display a high level of what we might call social intelligence. If we accept that the chimp mind is a reasonable approximation to the mind of our ancestors of some six million years ago, then it suggests that this type of social intelligence was selected as an adaptive mechanism quite early in our ancestral past. The evidence advanced by Dunbar suggests that the growth in brain size in primate evolution was closely related to living in larger and more socially complex groups. From this it seems reasonable to conclude that the expansion of the human neocortex, and the increased intelligence that resulted, in large part reflected the evolution of an intelligent social mind. In the next section we will consider one possible architecture for this social mind.

Speculation on The Architecture of the Social Mind and the Domains of Social Life

In the introduction we suggested that one must possess a mind to have a "mental" disorder. Having argued that the human mind evolved to have a specifically social intelligence, it behoves us now to specify what this social mind might look like. That is, to outline a probable architecture for the social mind. Then we suggest what the important domains of social life might be. In doing so we draw heavily upon both the work of Gigerenzer (1997), on the modularity of social intelligence, and also Bugental's (2000) paper on a domain-based approach to the algorithms of social life.

The Architecture of the Social Mind

A powerful influence upon contemporary concepts of mental structure has been the notion of modularity (e.g., Fodor, 1983; Tooby & Cosmides, 1992; Sperber, 1994). Essentially, this is the idea that the mind is not simply an undifferentiated, general purpose problem-solving or information processing device - rather, it evolved over millions of years to solve specific problems in adaptation to the EEA. As a consequence the mind is built from various modules that act separately, and in parallel, to perform content-specific tasks. The evolutionary psychologists Tooby and Cosmides argue that the human mind "consists of a set of evolved information-processing mechanisms instantiated in the human nervous system" which are "richly structured in a content specific way" (p.24). Tooby and Cosmides posit modules for mate selection, language acquisition, family relationships, and co-operation, as well as "a belief-desire folk psychology - a so-called 'theory of mind' " (p.90).

Tooby and Cosmides might be described as proponents of a "hard" version of the modularity hypothesis. They regard individual modules as independent and self-contained information-processors that function quickly and automatically (and mostly outside of conscious awareness). They propound a great number and diverse array of such modules. Other proponents of modularity are prepared to accept a "soft

modularity" hypothesis. The softer version suggests that while some content-specific mental mechanisms do exist, there is also a degree of what we might loosely refer to here as "general intelligence". For example, Fodor (1983), who popularised the concept in recent years, only propounded modules for perceptual processes. In summary, modular concepts have heavily influenced contemporary models of mental functioning, although the extent of modularity is still a subject of controversy.

The Modularity of Social Intelligence. Gigerenzer (1997) in discussing the Machiavellian intelligence hypothesis makes the point that the mechanisms of social intelligence have not yet been spelt out. Gigerenzer argues for a modular organisation of social intelligence, or rather, "social intelligences". This modularity is thought to be an inevitable outcome of the process of natural selection. Gigerenzer observes that while there is no overall plan to natural selection, it typically results in highly specific adaptations, which have developed over generations in response to specific environmental challenges. Moreover, an evolutionary history, which resulted in a brain that embodied only a general information-processing capacity, would have been a short cut to extinction. According to Gigerenzer, such a mind would have quickly been overwhelmed with information, in his words "paralysed by data analysis" (p.273). In artificial intelligence, notes Gigerenzer, this is known technically as the "problem of combinatorial explosion", and is avoided by building semantic constraints into an intelligent system. In intelligent biological systems it can be avoided by evolved modules which function to "solve specific problems of adaptive significance, and to do this quickly" (p.274). Gigerenzer argues for a hard version of the modularity hypothesis in which modules combine both peripheral (i.e. perceptual) processes and central processes (such as reasoning). So for example, a face recognition module might involve an input system that perceives the structural features of any face, and also a central system that can match those particular features with previously encountered faces and their identities. According to Gigerenzer the modules of social intelligence are most likely organised hierarchically and connected by triggering algorithms as in a sequential decision tree.

To illustrate how this might work he asks us to imagine a scenario in which he is walking through a forest in darkness. Suddenly in the distance he sees a large, dark object that appears to move slowly. Is it a beast, another human, or just a large branch moving in the breeze? The first point to be made here is that in such a situation whatever decisions have to be made - have to be made quickly. So Gigerenzer suggests that a triggering algorithm will quickly make a decision according to whether or not the object is self-propelled (i.e., animal or human) or not (i.e. plant) based upon its movement pattern. Because the modular organisation is hierarchical, if the decision is made that it was a tree branch moving in the wind, the search for more information stops there. However, if the pattern of motion appears self-propelled, the triggering algorithm will activate a second algorithm to determine whether the moving creature is animal or human. It will also engender a state of cognitive and physiological arousal and initiate certain behavioural routines such as stopping still and readying for fight or flight. If, in the example described, the animal is human, an algorithm for facial recognition will be activated and one for social encounters, and so on. The hierarchical structure of this system conveys speed and efficiency.

One important aspect of this proposed model of social intelligence for the study of psychopathology, is the notion that "in each module, various cognitive, emotional, behavioural and motivational processes are wired together" (p.280). Thus the model promises to integrate cognition with motivation and emotion as adaptive functions rather than to treat them as separate processes. In outlining how such a modular view of social intelligence might integrate these cognitive, motivational, and emotional processes, Gigerenzer gives the example of a social contract module. Such a module is likely to involve the following separate components: a perceptual mechanism for face perception, memory of past social exchanges, some knowledge of the potential costs and benefits involved in contracts, a mechanism for detecting deception, and emotional responsivity (e.g. anger if cheated). Gigerenzer notes that such a module will have a proper domain and an actual domain. The proper domain refers to the original evolved purpose of that module in the environment of evolutionary adaptedness (EEA). The actual domain refers to the functions it serves in the present environment, known as exaptations. For example, a social contract module might have evolved in relation to the sharing of food on the African savannah, but now it is used for trading stocks.

In summary, we have described one proposed model of how a mind that evolved to cope with an increasingly complex social environment, might be structured. This highly speculative account posits a modular, hierarchical architecture with both peripheral and central mechanisms. Next we consider how such a mind might interact with its environment. In particular, we speculate as to what are the important domains of social life that this modularised social mind has evolved to deal with?

The Domains of Social Life. Just as the concept of modularity has influenced current perspectives on

human cognition, there has been increasing interest among cognitive anthropologists in the notion of domain specificity across cultures (e.g., Sperber, 1994; D'Andrade, 1995). Hirschfeld and Gelman (1994) comment that the traditional social science approach to the mind assumes that humans have a "general set of reasoning abilities that they bring to bear on any cognitive task, whatever its specific content" (p.3), whereas a domain-specific approach holds that "the structure of knowledge is different in important ways across distinct content areas" (p.xiii). Domain specificity then assumes that certain adaptive problems have been constant features of our evolutionary history and that this will be reflected in the structure of our knowledge about the world. Hirschfeld and Gelman list the following as candidates for specific domains: "Physical entities and processes, substances, living kinds, numbers, artefacts, mental states, social types, and supernatural phenomena" (p.21). However, they also note that it is difficult to offer a definitive definition of cognitive domains because the multi-disciplinary nature of this emerging field means that different, if overlapping, meanings abound. Bugental (2000, p.187) offers the following definition of domains based upon Hirschfeld and Gelman's list of domain characteristics: "By domains, I am referring to the bodies of knowledge that act as guides to partitioning the world and that facilitate the solving of recurring problems faced by organisms within that world". Broadly speaking then, domains are the subject matter in our external environment which cognitive modules process information concerning. However, in actuality things are probably somewhat more complicated. Sperber (1996) comments that we should distinguish between actual and proper domains of knowledge. Sperber defines a proper domain as "all the information that it is the module's biological function to process" (p.136), noting that modules function to process specific kinds of information in a specific way. An actual domain is broader and includes all the environmental information that can satisfy a modules input requirements. The important point to note here is that modules may process a broader range of information than solely that information which they were selected for in the EEA.

The central issue concerning domain specificity for the present discussion is what are the important domains of social life that an evolutionary perspective suggests should be universal? In other words, what were the recurrent problems of social life in the EEA? Bugental (2000) examined perspectives from social cognition, biopsychology and developmental psychology, and concluded that there is enough consistency across these divergent fields to identify the principle domains of social life and also the mechanisms that have evolved to manage them. She suggests that these domains will differ according to the following features: (a) the social problem to be solved (e.g., mate selection, care of young), (b) the timing features or developmental course, (c) the computational processes involved (i.e. the nature of the social information processed), (d) neurohormonal regulating systems implicated, and (e) the social and emotional response patterns (Bugental, 2000). It is Bugental's contention that specific algorithms have evolved which are available for managing each of these social domains. What then are these domains of social life?

Bugental proposes five principle domains of social life, namely Mating, Attachment, Hierarchical Power, Coalitional Groups and Reciprocity. These can be grouped into those that are primarily concerned with bonding processes (i.e. mating, attachment, and coalitions) and those which are concerned with negotiation processes (i.e. hierarchical power, reciprocity). It is Bugental's thesis that each domain is organised around a specific problem of social life which was a constant feature of the EEA, and hence a universal adaptation problem. For example, the attachment domain is an evolved system that functions primarily to ensure the safety of the newborn. As another example, the coalitional group system is primarily concerned with mutual defence against external threats and the acquisition, protection, and sharing of acquired resources.

Bugental marshals a broad range of theoretical ideas and empirical data to support the plausibility of her domain-based approach to the acquisition of the algorithms of social life. Certainly, our brief summary cannot do justice to her sophisticated and complex model. At the same time, it remains a new, rather speculative, and mostly untested conceptualisation of how an evolutionary perspective might structure our understanding of social behaviour. Moreover, other such taxonomies of social life already exist and must also be considered. For example, Fiske's work is particularly noteworthy on the question of the "grammar of social relationships" (Haslam, 1997; Fiske, 1991). Notwithstanding these caveats, we believe Bugental's taxonomy of social life is a superb example of how an evolutionary perspective can greatly facilitate theory development. In particular, the domain specific approach offers a theoretical bridge between the social mind and the social environment. In explicitly formulating the adaptive problem that each domain is organised around, such an approach promises to generate specific hypotheses concerning the nature of the psychological mechanisms that have evolved to deal with these recurrent problems. It also provides a clearly developed framework that might help to guide a research agenda. In the next section we will consider how the ideas of Gigerenzer and

Bugental might be integrated for a more comprehensive model of how a social mind might work.

Towards a Model of the Social Mind

In this section we attempt to draw together some of the major ideas from Bugental and Gigerenzer to gain a clearer picture of how the architecture of a social mind might look. These ideas are intended to help develop a framework for research in this area and are necessarily tentative and incomplete. However, before attempting an integration of Bugental and Gigerenzer's work we first need to clarify the difference between ultimate and proximate explanations.

Ultimate and Proximate Explanations of Behaviour

There are two major forms of evolutionary explanations of human traits, ultimate and proximate. Ultimate explanations attempt to identify the function of a given trait or mechanism by determining its role in solving a particular adaptive problem while a proximate explanation focuses on the nature of the causal mechanisms that underpin its functional role (Buss, 1999). In the language of EP ultimate means all the evolutionary factors that contribute to the development of a psychological mechanism or pattern of behaviour. By contrast proximal refers to the more recent factors involved. Thus ultimate causes will include such things as the ancestral environment, sexual selection, and natural selection. Proximal causes will include such variables as the person's genes, their developmental history, learning, and environmental stimuli.

An Integrated Model of the Social Mind

The process of evolution has resulted in a mind that is specifically designed to process information that is social in nature (Dunbar, 1996; Whiten & Byrne, 1998). Gigerenzer argues that this is achieved through the existence of peripheral and central modules that are content specific. That is, they process only social information. Such social intelligence modules are believed to be organised hierarchically as in a sequential decision tree. Opinions as to the extent of modularisation vary from 'hard' (e.g. Gigerenzer, 1996; Tooby & Cosmides, 1992) to 'soft' (e.g. Mithen, 1999). The major difference between these two extremes is that softer versions of the modularity hypothesis typically allow for a greater degree of communication between modules, and also generally accept the need for some amount of general or non-modular intelligence.

We believe the jury is still out on the extent to which modularity is hard or soft, and prefer to sit on the fence until more evidence accumulates either way. However, we accept the general principle of modularity and consider it is an important characteristic of mental structure. We should stress here that while some modules will be concerned only with social information not all modules will. Examples of social intelligence modules might be modules concerned with facial perception, detection of deception, mate selection, language acquisition, emotion recognition, and social reasoning (from Tooby & Cosmides, 1992). Given its content specificity we expect that each module will operate on specific domains of information in the environment. Bugental suggests there are five important domains of social life, namely Mating, Attachment, Hierarchical Power, Coalitional Groups and Reciprocity. Each domain has been determined by the original problem in the EEA for which the particular module evolved (an ultimate cause). Each domain also differs according to its timing or developmental onset, its computations, the neurohormonal systems involved, and the social and emotional responses associated with it. It is our contention that specific modules will interact with (one or more) specific domains. The general extent to which one particular module typically interacts with any particular domain will be, in large part, determined by ultimate causes. However, the activation of a specific module at any moment will be determined by proximal causes (i.e. a combination of the person's genes, their developmental history, learning, and environmental stimuli). Moreover, the activation of a specific module will be integrated with and initiate relevant physiological, motivational, emotional and behavioural response systems.

Certainly, different modules will be able to interact with the same domain, working simultaneously, in parallel, and under some form of hierarchical coordination. Consider, for example, the domain Bugental calls Reciprocity. According to Bugental the central problem to be solved within the reciprocity domain is achieving approximately equivalent benefits in shared action processes among equal individuals. In the EEA this probably centred on achieving a fair distribution of food and other resources in relation to both effort and individual need (the actual domain). Today, it might centre on a group of friends who share the use of a jointly owned holiday home (the proper domain). There are several modules that could be activated in relation to this domain. Examples might include modules for facial perception, deception detectors, emotional recognition, and social reasoning. In addition to multiple modules interacting with a single domain, it also seems likely that a single module may be interacting with more than one domain

simultaneously. Hence in family settings both the mating and the attachment domains might activate an emotion recognition module. Similarly, at political meetings, both the coalitional group and the hierarchical power domains may activate a social reasoning module.

In summary, we have proposed a possible architecture for a social mind in which peripheral and central modules operate in parallel within a hierarchical and sequential organisation. Such modules can activate relevant physiological, motivational, and emotional systems. These modules interact with specific domains of social life based upon the central evolutionary problem within that (actual) domain. The activation of a particular module in the present day environment (the proper domain) will be determined by proximal causes. A single module can interact with multiple domains simultaneously and different domains can draw upon the same module.

Psychopathology and the Social Mind: Schizophrenia

Schizophrenia is a major mental disorder, which is characterised by a range of signs, and symptoms that can include auditory hallucinations, paranoid delusions, flattened affect, catatonia, thought disorder, apathy and social withdrawal (APA, 1994). It is typically a severe disorder, which if not carefully managed, can cause major impairment in many aspects of daily living. It is also frequently distressing and frightening for both the person with schizophrenia and their family.

Schizophrenia is a disorder that occurs all around the world and has a consistent prevalence rate of around 0.5 - 1%. There is robust evidence for a biological basis for schizophrenia that includes a genetic predisposition (Gottesman & Shields, 1972), neurotransmitter abnormalities (Davis, Kahn, Ko, & Davidson, 1991) and structural brain abnormalities (Harrison, 1999). The discovery of the anti-psychotic action of chlorpromazine in the 1950's began a revolution in the treatment of this disorder and greatly facilitated the deinstitutionalisation movement (Davison & Neale, 1998).

However, even with the growing arsenal of anti-psychotic drugs currently available, medications effectively treat mainly the positive symptoms of schizophrenia, and are far from being a cure. The negative symptoms of apathy, withdrawal, and social dysfunction, which are often the best predictors of long term outcome, are less amenable to drug therapy. While the discovery of effective antipsychotics was undoubtedly a breakthrough in the treatment of this disorder, it has resulted in an unfortunate decline in research on the interpersonal aspects of this disorder.[2]

It was apparently enough to know that certain neurotransmitters, such as dopamine, were implicated, and that the antipsychotics produced dramatic improvement in positive symptoms. However, a comprehensive understanding of such a complex disorder must involve explaining it at several different levels of analysis including the biochemical (i.e. neurotransmitters), the neuropsychological (i.e. the brain structures and neural systems), the cognitive (both social and non-social cognition), and the social (e.g., social skills, family relationships, and support networks). It is the contention of the present article that social cognition is particularly important for a meaningful understanding of schizophrenia.

Penn, Corrigan, Bentall, Racenstein, and Newman (1997) have commented that there is a substantial body of research on cognition in schizophrenia but that it is mostly concerned with "non-social cognition" (i.e. attention, memory, executive functioning). Such research is often used in diathesis-stress models of schizophrenia to account for symptoms. However, Penn et al. argue that "schizophrenia is inherently an interpersonal disorder", so understanding the development and maintenance of social impairment in schizophrenia, must involve understanding social cognition in this disorder. In addition, they cite studies that show that non-social cognitive impairment typically accounts for less than 25% of the variance in the measured social functioning of people with schizophrenia. Consequently, they argue that the study of social cognition in schizophrenia should offer important insights into the disorder. This argument is also supported by the notion that our minds have evolved as uniquely efficient processors of social information.

To summarise, schizophrenia is a brain disorder that is best treated with anti-psychotic drugs. However, it is also a disorder that is characterised by chronic interpersonal problems and social impairment. Consequently a full explanation of the disorder demands an explanation at the level of social cognition. In the next section we consider how the concept of an evolved social mind might influence research on social cognition in schizophrenia.

The Social Mind and Social Cognition in Schizophrenia Research

If we accept the model outlined earlier as describing a plausible architecture for a social mind, then we can begin to speculate as to how it could provide a framework for research on social cognition in schizophrenia. Perhaps the major implication is that researchers must attempt to specify whether their research is concerned with a particular module or

social domain (or combinations thereof). This is no easy task as there is to date, no agreement, even among proponents of modularity, as to the likely number and nature of modules. Also, as mentioned previously, opinions vary as to whether a 'soft' or 'hard' form of the modularity hypothesis best fits the data. Fortunately, there is a greater degree of consensus as to the important domains of social life (Bugental, 2000).A Brief Digression on the Subject of Modularity. To avoid the proliferation of modules for everything we need to establish some criteria for a plausible putative module. We suggest the following as the minimum criteria for positing the existence of a module: (1) It should be a psychological mechanism that would have enabled ancestral Hominids to solve fundamental problems of living in the EEA and thus have conferred a reproductive advantage upon the individuals concerned; (2) Its functioning be consistent with evidence from cognitive and developmental psychology; (3) Supportive evidence should also come from neuropsychology, especially cases displaying double dissociations. It is argued that the accumulation of convergent evidence from all these avenues provides reasonable insurance against a proliferation of hypothetical modules. It is important to note however, that in arguing for modularity, we are not arguing for specific devices localised in one brain region. The construct of a "module" represents a functionally specialised system at the cognitive level of explanation. Such a specialised system may well involve different brain regions or separate neural networks operating in concert. For example, a face recognition module will almost certainly involve brain regions concerned with perceptual (i.e. occipital lobe) and semantic memory (i.e. temporal lobe) functions.

Modules, Domains, and Schizophrenia

The Mind-Reading Module. One example of a module, with direct relevance for schizophrenia research, is the concept of a "theory of mind" (TOM) (Baron-Cohen, 1995). This is the idea that humans have evolved a mechanism for forming a mental representation of another's thoughts, intentions, emotional states, beliefs, desires, wishes, and goals. The evidence for such a "mind-reading" ability comes from evolutionary theory (Baron-Cohen, 1997), developmental psychology (Gopnik & Wellman, 1994) and cognitive anthropology (Lillard, 1998). The notion of a TOM module is closely related to the concept of a social intelligence and, in particular, the Machiavellian intelligence hypothesis. Presumably, in large primate groups with complex social relationships it is a useful skill to form accurate appraisals of the intentions and motives of another.

Not surprisingly, given the nature of schizophrenic symptoms (i.e., paranoid delusions, hearing voices) the TOM theory has recently attracted the attention of schizophrenia researchers (e.g., Frith & Corcoran, 1996). Frith (1992) has advanced the hypothesis that some of the symptoms characteristic of schizophrenia may be explicable in terms of a "mind-reading" deficit among persons with schizophrenia. For example, Frith suggests that patients with certain kinds of delusions may have lost the ability to "read the intentions and beliefs of others" (p.153). He suggests that some of the negative symptoms such as social withdrawal and avolition could result from a weakened ability to represent one's own goals. In 1992 Frith commented that there were no published studies of theory of mind in schizophrenia. Since then studies on this topic have flourished and it has become an important focus for research on social cognition in schizophrenia (e.g., Doody, Goetz, Johnstone, Frith & Cunningham-Owens, 1998; Drury, Robinson, & Birchwood, 1998; Frith & Corcoran, 1996; Sarfati & Hardy-Bayle, 1999). To date, TOM research probably reflects the best example of a specific application of the social module hypothesis to research on schizophrenia. Where such research is lacking, is in its failure to specify the relevant domains of social life that a TOM module will interact with and to incorporate this specificity within the research design. We shall consider this issue in the next section on domain specificity and schizophrenia research.

Domain Specificity and Schizophrenia Research. If we accept that human knowledge is organised at a cognitive level in terms of specific domains of social life, which each reflect fundamental and recurrent problems of existence in the EEA, then this should be reflected in our research agenda. We cannot assume a priori that the modules of interest are "domain neutral", and in fact, this seems unlikely in light of our previous discussion of the domain specificity of social life. The performance of a certain module may well vary widely depending upon which specific social domain it interacts with. Moreover, because domains have different timing features, developmental differences will be observed. So, for example, in a young infant the TOM module may best be studied in relation to the Attachment domain, but in adolescence it may become more active in the domain of Coalitional Groups. In early adulthood the TOM module may become especially active in the Mating domain, and so on. However, most research on social cognition in schizophrenia has tended to ignore this issue and employed domain-neutral stimuli. For example, research on theory of mind in schizophrenia has typically used stimuli such as cartoon stories. The subject is shown a "theory of mind comic strip" and asked to make inferences about the thoughts or intentions of the characters in the cartoon (e.g., Sarfati,

& Hardy-Bayle, 1999). This is reminiscent of some traditional memory research in which participants are required to memorise lists of nonsense syllables. It lacks a context, particularly a social context. To take another example, Sullivan and Allen (1999) have investigated social deficits in schizophrenia in terms of "Machiavellian social dexterity". While we applaud their general approach, the use of a pencil-and-paper questionnaire as the dependent measure, divorced from any specific social domain, may be limit the extent to which important differences can be observed.

Penn et al. note that stimuli in social cognition differ from those employed in studying non-social cognition in two important ways. First, they are personally relevant and can change over time (unlike the numbers, words and objects favoured in non-social cognition studies). Second, the relationship with the stimuli is interactive. The stimuli (e.g. another person) can act upon the subject of the research. The example Penn et al. give, is that in social cognitive research the "stimulus" could conceivably disparage the "subject". Thus we are dealing with stimuli that are rarely affectively neutral and which exist in a dynamic relationship with the subject of the experiment. We doubt that this is true of the vignettes, cartoons and pencil-and-paper measures typically employed in examining TOM in schizophrenia. They are generally fairly abstract, affectively neutral tests of social reasoning that have little direct connection with any of the five important social domains. Hence any differences observed between schizophrenic participants and controls, may well underestimate actual differences in mind-reading abilities, or only reflect differences in non-social cognitive reasoning abilities.

Consequently, if we wish to understand social cognition in schizophrenia, then we need to not only specify the kind of mental module that is most relevant for the specific research issue of concern, but also the specific social domain(s) that it will be most active within. Ideally, the two variables would be studied together. This all sounds rather vague so let us consider an example of how this might work in practice.

For argument's sake let's assume we are interested in the phenomenon of delusions as they occur in people diagnosed with paranoid schizophrenia. Say we believe that a module exists concerned with detecting deception in social exchanges (Hauser, 1996; Cosmides & Tooby, 1989, 1992). Our hypothesis is that in people with paranoid delusions this mechanism is calibrated so that deception is detected too readily - on the basis of little evidence. Consequently, imagine we design a laboratory task, some kind of card game perhaps, in which detecting deception is embedded. It is our contention that this research paradigm is not complete until we can specify which social domain is most salient for our participants and the task. The experimental task should then be framed in terms which domain (or domains) is of most relevance. In cases where it is unclear which social domain is the most salient, then social domain should be manipulated as an independent variable, and their relative importance determined empirically. A major issue to take account of here will be the developmental stage of research participants. Bugental says one characteristic of social domains is their timing or developmental course. For example, the mating domain may be most salient during the reproductive years. Initially however, the question of which domain is most salient might have to be determined empirically, by trial-and-error, given the newness of theory and lack of data in this area. So in our hypothetical research study, we would need to examine the "deception detector" in relation to the mating domain, the hierarchical dominance domain, the coalitional group domain, etc...

In summary, we have proposed a social mind that comprises specific social intelligence modules acting in parallel under an hierarchical organisation. These modules will interact or be activated by specific domains of social life. Broadly speaking, we regard the modules as cognitive mechanisms and the domains as categories of knowledge of the external environment. Thus a meaningful programme of research on mental disorder (and cognition in general) must reflect these two important constructs, by specifying which are germane to a research question, and also investigating their interplay. This may demand a move away from reliance upon rather abstract pencil-and-paper measures, towards greater ecological validity through the study of social cognition in more dynamic life-like settings.

Summary and Conclusions

In the present paper we began by asking why Homo sapiens has evolved such a large brain and then reviewed evidence supporting the theory that it was primarily social factors that drove this increase. Acceptance of this theory leads to the inevitable conclusion that a major component in the evolution of human cognition has been the evolution of social intelligence. However, this is not reflected in most of the research on cognition in schizophrenia, which is dominated by non-social cognition. We presented a model of how such a "social mind" might work, based upon the concepts of modularity and domain specificity in cognition. We then argued that research on psychopathology, using schizophrenia as our example, should begin to focus on the adapted social

nature of the mind. In particular, such research should specify which social intelligence modules and which social domains are of special interest, and how they might interact.

References

American Psychiatric Association (1994). Diagnostic and statistical manual of mental disorders (4th ed.). Washington, DC: Author.

Barton, R. A. & Dunbar, R. I. M. (1997). Evolution of the social brain. In A. Whiten & R. W. Byrne (Eds.), *Machiavellian intelligence II: Extensions and evaluations* (pp.240 - 263). Cambridge: Cambridge University Press.

Baron - Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind.* London: MIT Press.

Baron - Cohen, S. (Ed.) (1997). *The maladapted mind: Classic readings in evolutionary psychopathology.* East Sussex, U K: Psychology Press.

Bellack, A. S., Hersen, M., & Turner, S. M. (1976). Generalization effects of social skills training in chronic schizophrenics: An experimental analysis. *Behavior Research and Therapy*, *14*, 391 - 398.

Bentall, R. P., Jackson, H. F. & Pilgrim, D. (1988). Abandoning the concept of 'schizophrenia'; Some implications of validity arguments for psychological research into psychotic phenomena. *British Journal of Clinical Psychology*, *27*, 156 - 169

Bugental, D. B. (2000). Acquisition of the algorithms of social life: A domain-based approach. *Psychological Bulletin*, *126*, 187 - 219.

Byrne, R. (1995). *The thinking ape: Evolutionary origins of intelligence.* Oxford: Oxford University Press.

Byrne, R., & Whiten, A. (Eds.). (1988) *Machiavellian intelligence: Social expertise and the evolution of intellect in monkeys, apes, and humans.* Oxford: Oxford University Press.

Chua, S. E., & McKenna, P. J. (1995). Schizophrenia - a brain disease: A critical review of structural and functional cerebral abnormality in the disorder. *British Journal of Psychiatry*, *166*, 563 - 582.

Clark, L. A., Watson, D., & Reynolds, S. (1995). Diagnosis and classification in psychopathology: Challenges to the current system and future directions. *Annual Review of Psychology*, *46*, 121 - 153.

Cosmides, L. & Tooby, J. (1989). Evolutionary psychology and the generation of culture, Part II. Case study: A computational theory of social exchange. *Ethology and Sociobiology*, *10*, 51-97.

Cosmides, L., & Tooby, J. (1992). Cognitive adaptations for social exchange. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture.* (pp.19 - 136). New York: Oxford

University Press. Cosmides, L. & Tooby, J. (2000). *Evolutionary psychology: A primer.* http://cogweb.english.ucsb.edu/EP/EP-primer.html

Davis, K. L., Kahn, R. S., Ko, G., & Davidson. (1991). Dopamine and schizophrenia: A review and reconceptualization. *American Journal of Psychiatry*, *148*, 1474 - 1486.

Davison, G. C., & Neale, J. M. (1998). *Abnormal Psychology. (7th Ed.)*. New York: John Wiley & Sons, Inc.

De Waal, F. (1988). Chimpanzee politics. Reprinted in R. Byrne & A. Whiten (Eds.). *Machiavellian intelligence: Social expertise and the evolution of intellect in monkeys, apes, and humans.* Oxford: Oxford University Press.

Donald, M. (1991). *Origins of the modern mind.* Cambridge, MA: Harvard University Press.

Doody, G. A., Goetz, M., Johnstone, E. C., Frith, C. D., & Cunningham-Owens, D. G. (1998). Theory of mind and psychoses. *Psychological medicine*, *28*, 397 - 405.

Drury, V. M., Robinson, E. J., & Birchwood, M.(1998). 'Theory of mind' skills during an acute episode of psychosis and following recovery. *Psychological Medicine*, *28*, 1101 - 1112.

Dunbar, R. (1996). *Gossip, grooming and the evolution of language.* London: Faber and Faber Ltd.

Fiske, A. P. (1992). The four elementary forms of sociality: Framework for a unified theory of social relations. *Psychological Review*, *99*, 689 - 723.

Fodor, J. A. (1983). *The modularity of mind.* Cambridge, MA: MIT Press.

Frith, C. D. (1992). *The cognitive neuropsychology of schizophrenia*. London: Lawrence Erlbaum.

Frith, C. D. & Corcoran, R. (1996). Exploring 'theory of mind' in people with schizophrenia. *Psychological Medicine*, *26*, 521 - 530.

Gigerenzer, G. (1997). The modularity of social intelligence. In A. Whiten & R. W. Byrne (Eds.), *Machiavellian intelligence II:*

Extensions and evaluations (pp.264 - 288). Cambridge: Cambridge University Press.

Gopnik, A., & Wellman, H. M. (1994). The theory theory. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture.* Cambridge, UK: Cambridge University Press.

Gottesman, I., & Shields, J. (1972). *Schizophrenia and genetics: A twin study vantage point.* New York: Academic Press.

Harrison, P. J. (1999). The neuropathology of schizophrenia: A critical review of the data and their interpretation. *Brain*, *122*, 593 - 624.

Haslam, N. (1997). Four grammars for primate social relations. In J. A. Simpson & D. T. Kenrick (Eds.), *Evolutionary social psychology.* New Jersey: Lawrence Erlbaum Associates.

Hauser, M. D. (1997). Minding the behaviour of deception. (pp. 112 - 143), In A. Whiten & R. W. Byrne (Eds.), *Machiavellian intelligence II: Extensions and evaluations* (pp.50 - 85). Cambridge: Cambridge University Press.

Holloway, R. H. (1995). Toward a synthetic theory of human brain evolution. (pp.42 - 54). J. P. Changeux & J. Chavaillon (Eds.), *Origins of the human brain.* Oxford, U.K.: Oxford University Press.

Humphrey, N. (1976). The social function of intellect. Reprinted in R. Byrne & A. Whiten (Eds.). *Machiavellian intelligence: Social expertise and the evolution of intellect in monkeys, apes, and humans*. Oxford: Oxford University Press.

Jolly, A. (1999). *Lucy's legacy: Sex and intelligence in human evolution*. Cambridge, MA: Harvard University Press.

Lecours, A. R. (1995). The origins and evolution of writing. (pp. 213 - 234) In J. P. Changeux & J. Chavaillon (Eds.), *Origins of the human brain.* Oxford: Clarendon Press.

Leff, J. (1976). Schizophrenia and sensitivity to the family environment. *Schizophrenia Bulletin*, *2*, 566 - 574.

Lillard, A. (1998). Ethnopsychologies: Cultural variations in theories of mind. *Psychological Bulletin*, *123*, 3 - 32.

Mithen, S. (1996). *The prehistory of the mind: A search for the origins of art, religion and science.* London: Thames & Hudson, Ltd.

Morgan, E. (1995). *The descent of the child: Human evolution from a new perspective.* Oxford University Press.

Penn, D. L., Corrigan, P. W., Bentall, R. P., Racenstein, J. M., & Newman, L. (1997). Social cognition in schizophrenia. *Psychological Bulletin*, *121*, 114 - 132.

Sarfati, Y. & Hardy-Bayle, M. C. (1999). How do people with schizophrenia explain the behaviour of others? A study of theory of mind and its relationship with thought and speech disorganization in schizophrenia. *Psychological Medicine*, *29*, 613 - 620.

Sperber, D. (1994). The modularity of thought and the epidemiology of representations. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture.* Cambridge University Press.

Strum, S. C., Forster, D., & Hutchins, E. (1997). Why Machiavellian intelligence might not be Machiavellian. In A. Whiten & R. W. Byrne (Eds.), *Machiavellian intelligence II: Extensions and evaluations* (pp.50 - 85). Cambridge: Cambridge University Press.

Tanner, N. M. (1987). Gathering by females: The chimpanzee model revisited and the gathering hypothesis. (pp. 3 - 27) In W. G. Kinzey (Ed.). *The evolution of human behaviour: Primate models*. Albany, N. Y.: State University of New York Press.

Tooby, J. & Cosmides, L. (1992) The psychological foundations of culture. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture.* (pp.19 - 136). New York: Oxford University Press.

Whiten, A. & Byrne, R. W. (1997). *Machiavellian intelligence II: Extensions and evaluations.* Cambridge: Cambridge University Press.

Wolpoff, M. H. (1999). *Paleoanthropology. 2nd Edition.* Boston, MA: McGraw-Hill.

[1] A slightly different account of brain size changes in the evolution of the Hominid brain is given by Holloway (1995). Holloway's account seems more gradual, involving a larger number of smaller or modest increases in brain size. It also emphasises the reorganisation of the brain in terms of changes in the relative size of different parts of the brain, rather than just an increase in overall size. However, this probably reflects a difference in emphasis or simply detail, rather than any fundamental difference in the interpretation of the facts. Holloway is a paleoneurologist, Mithen an archaeologist. Holloway's account still paints most of the increase in brain size as complete by 100,000 years ago, well before the 'cultural explosion'. In fact, he argues for a small decrease in brain size among modern H. sapiens. Most importantly, we note his argument "that the human brain evolved under strong natural selection for

enhanced social behaviour emphasising communication" (p.49).

[2] Two notable and impressive exceptions being research on expressed emotion or EE among families of people with schizophrenia (e.g., Leff, 1976), and social skills training with schizophrenic patients (e.g, Bellack, Hersen, & Turner, 1976).

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Commentary on: The evolution of the Social Mind: Implications for Psychopathology research by Richard Siegert and Tony Ward

The emotional brain drives the social mind

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Abstract

According to Siegert and Ward, the fact that the evolved human mind is profoundly social has implications for the way we understand and treat psychopathologies such as schizophrenia. While we agree with the overall thrust of Siegert and Ward's position, we also believe that, just as social cognition has been criticized for its relative neglect of the role of emotion in human information processing, so too does an exclusively cognitive account of the origins and workings of the social mind run the risk of telling only a small part of the story. After a brief review of the evolutionary origins and functions of emotions, we discuss the implications of taking an emotion-focused approach for understanding various psychopathological disorders. We conclude that an explicit consideration of the social functions of emotions has the potential to enrich our understanding of the social mind and its disorders.

Introduction

Siegert and Ward's interesting and thought-provoking paper presents evidence in support of the theory that social factors have been a major influence upon the evolution of the Hominid brain, and that the human mind is, in consequence, profoundly social. Further, the authors discuss the implications of this understanding of the evolved human (social) mind for the ways in which we study and treat mental disorders such as schizophrenia. As social psychologists, we are highly sympathetic to the broad thrust of this paper. We are also encouraged to see clinical psychologists drawing upon the rich store of knowledge that has been accumulating over recent years in the domain of social and evolutionary psychological theorizing and experimentation. However, while we are in general agreement with the overall perspective of the paper, we also believe that the heavy emphasis throughout on explicitly cognitive information processing mechanisms unnecessarily restricts the scope of enquiry. This is particularly evident in the psychopathological implications section, where the arguments are provocative, but rather under-developed.

Our contention is that, along with the explicitly social-cognitive approaches to understanding the social mind and its disorders described by Siegert and Ward, there is another, complementary route to understanding the social mind and its vicissitudes that deserves serious consideration. Specifically, and in line with Wright's (1994) colourful description of emotions as evolution's executioners, we propose that the emotional brain drives the social mind, and that a consideration of the social functions of emotions has the capacity to enrich our understanding of various psychopathological phenomena, including schizophrenia.

Emotions and the social mind

Emotions are ancient evolutionary mechanisms that play profoundly important roles in the initiation, maintenance, breakdown, and repair of interpersonal and social relationships (Clark, Fitness, & Brissette, 2001; Planalp & Fitness, 1999; Plutchik, 1994). Darwin himself recognized the importance of emotions in the social lives of humans (and other animals) (e.g., Darwin 1872/1965), but it was not until the 1960s that the putative evolutionary, biological, and social functions of various discrete emotions were articulated

in the psychological literature. Tomkins (1962, 1963), for example, argued for the existence of eight (later nine), biologically hard-wired affects, each distinguished by its own qualia, or felt experience, and each capable of being activated, both innately and via learning, by perceptual, visceral, and motoric processes as well as by cognition (including memory). Crucially, each affect was held to motivate particular kinds of behaviors in the service of survival. Thus, enjoyment-joy is a rewarding affect that motivates social responsiveness and serves a critical function for social animals who cannot survive without the care of others. In contrast, distress/anguish is a punishing affect evoked by aversive stimuli such as being alone and in need of care. Moreover, the cry of distress motivates others to attend to the sufferer's needs (see Fitness, in press, for a discussion of Tomkins' theory).

A growing body of scientific evidence supports Tomkins' speculations that a currently unspecified number of evolved, hard-wired affect systems exist in the brain (e.g., see Panksepp, 2000), and that these affects can be activated without recourse to higher-order cognitive processes. Cosmides and Tooby (2000), for example, argue that emotions are superordinate programs that detect events that have recurred repeatedly over hominid evolution (e.g., the presence of a potential mate, or rival; loss of status; discovery of betrayal; abandonment, etc). Once triggered, each functionally distinct emotion state sets in train a specific set of perceptual, motivational, cognitive and behavioral subprograms that have been selected over time as the most adaptive in dealing with the triggering event. In this sense, emotions really do, as James (1890) suggested, transform the world, so that the woman in love perceives her beloved through rose-colored glasses, is motivated to stay close to him, attributes the causes of relationship conflicts to forgivable lapses (such as forgetfulness) and devotes her time and energy to making him happy. In contrast, the cuckolded husband perceives his unfaithful partner through the blood-shot lens of anger, is motivated to punish her (and her lover), attributes the cause of her betrayal to her inherent bad character, and devotes his time and energy to wreaking revenge on his partner and his rival. Of course, vengeful behaviors may not be adaptive in the current context. However, emotionally-driven motivations to protect his resources (e.g., reputation and paternity certainty), and to punish those who thwart his goals, do make evolutionary sense.

From this perspective, social cognitive models that conceive of emotion and 'reason' as two, discrete modes of information processing may be highly misleading. Rather, the evidence suggests that the two modes are inextricably intertwined, with perception and cognition evoking emotion, and emotion driving perception and cognition (e.g., see Hanoch, 2002; Planalp & Fitness, 1999). There is even speculation that the emotion system may be primary, and that much of our reasoning and decision-making actually involves post-hoc rationalizations of what our 'gut feelings' have already persuaded us to do, particularly in relation to moral behavior (with all its attendant social implications) (Damasio, 1994; Haidt, 2001). While we do not intend to revisit the Zajonc/Lazarus debate of the 1980s with respect to the primacy of cognition versus emotion, we do believe there is sufficient empirical evidence to assert that feelings and emotions play an integral role in social cognition, motivation, and behavior (Planalp & Fitness, 1999). What, then, are the implications for psychopathology?

Implications for psychopathology

Siegert and Ward note that one must have a mind in order to have a "mental" disorder. Given that the human mind is a social mind, this implies that mental disorder should manifest primarily in social spheres. Accordingly, Siegert and Ward argue that social cognition is important for a meaningful understanding of schizophrenia, because various schizophrenic symptoms suggest a deficit in the ability to read the minds and intentions of others. However, an interesting extension of this concerns the corresponding ability (or inability) to also accurately read and understand the emotions of others, particularly given that the development of Theory of Mind (TOM) occurs within the kinds of relational contexts that are steeped in emotion. For example, Brockway (in press) speculates that both language and TOM abilities may have evolved within the hominid mother-infant relationship, and that the pervasiveness of empathic mind-reading in our species (e.g., teaching, counselling, helping others when distressed, in a way that parallels a mother looking after her own infant) may be a generalization from a deeply rooted kin-selection mechanism. This hypothesis suggests a host of research questions in relation to the etiology of a number of conditions such as autism and sociopathy, as well as schizophrenia. Siegert and Ward's discussion of delusions in paranoid schizophrenia is also a provocative one. Specifically, they argue that in people suffering from paranoid delusions, the 'cheater detection' mechanism, or module, may be mis-calibrated so that deception is falsely detected on the basis of little evidence. However, we would suggest that, rather than positing a purely cognitive explanation based on a so-called "cheater-detection" mechanism, it may be more informative to look at the superordinate, emotion 'modules', or programs (Cosmides & Tooby, 2002) in relation to understanding such paranoia. For example,

paranoid delusions may arise from over-activation of both the fear system (heightening vigilance and alarm) and/or the anger system (convincing us that others are out to deliberately thwart our goals and desires – to cheat us and treat us unfairly), with such over-activation directing attention, coloring perception and cognition, and motivating behaviours such as flight, withdrawal, or hostility (see also Bailey & Gilbert, 2000). Moreover, and in line with Haidt's (2001) argument, if a paranoid individual's emotions are telling her that deception is rife and the world is a dangerous place, then asking her to account for her experiences may elicit post hoc rationalizations of overwhelming feelings that make little 'logical' sense (Panksepp, 2000). Nevertheless, it is her emotions and the information they provide with respect to her survival and social needs that provide a route into her internal world, and that may also point the way to effective interventions (such as addressing perceived safety needs, needs for inclusion, etc.).

Emotions are also intimately implicated in other forms of psychopathology. For example, Haidt (2001) cites Cleckley's (1955) case studies of people in whom reasoning has become dissociated from so-called moral emotions such as guilt, remorse, and shame. As he notes, such individuals may be intelligent and know the appropriate rules of behavior, but they do not care about the consequences of their actions on others; nor are they sensitive to others' social disapproval. Other pathologies too, including depression, anxiety/social phobia, and various personality disorders, involve problems with respect to achieving what Bailey and Gilbert (2000) refer to as biosocial goals, such as mating, managing conflicts, and acquiring and maintaining status as a valued group member. Problems in relation to the attainment of any of these goals may be associated with the experience of intense emotions such as grief, fear, anger, and shame; and each emotion, in turn, provides crucial information about how an individual currently perceives (or misperceives) the state of his social world (e.g., lonely; threatening; unimportant), and his place within it (e.g., abandoned; in danger; useless). And this information, in turn, suggests the need for innovative treatments that do not simply target 'faulty' cognitions, but that take the individual's social context and social needs into account with respect to understanding currently dysfunctional feelings, emotions, motivations and behaviours.

In conclusion, we agree with Siegert and Ward that the human mind is a social mind, and that research on mental disorders must reflect this important observation. However, we also plead for a more explicit consideration of emotions to enrich our understandings of the social mind and its disorders. As profoundly social animals, the majority of our needs and goals are bound up in our relationships with others, and emotions are the currency of those relationships. An approach to psychopathology that takes social motivations and emotions into account, along with social cognition, will provide a much richer, and more meaningful, picture of the human mind.

References

Bailey, K. G., & Gilbert, P. (2000). Evolutionary psychopathology: Where to from here? In P. Gilbert & K. G. Bailey (Eds.), *Genes on the couch* (pp. 333-348). Hove: Brunner-Routledge.

Brockway, R. (in press). Evolving to be mentalists: The 'Mind-Reading Mums' hypothesis. In K. Sterelny & J. Fitness (Eds.), *From mating to mentality: Evaluating evolutionary psychology*. New York: Psychology Press.

Clark, M., Fitness, J., & Brissette, I. (2001). Understanding people's perceptions of their relationships is crucial to understanding their emotional lives. In G. J. O. Fletcher & M. Clark (Eds.), *Handbook of social psychology. Vol 2: Interpersonal processes* (pp. 253 – 278). U.K: Blackwell Publishers.

Cosmides, L., & Tooby, J. (2000). Evolutionary psychology and the emotions. In M. Lewis & J. Haviland (Eds.), *Handbook of emotions (2nd ed.)* (pp. 91-115). New York: Guilford Press.

Damasio, A. R. (1994). *Descartes' error: Emotion, reason, and the human brain.* Great Britain: Picador.

Darwin, C. (1872/1965). *The expression of the emotions in man and animals.* Chicago: University of Chicago Press.

Fitness, J. (in press). Emotion, emotion scripts, and close relationships: The legacy of Silvan Tomkins. *Theory and Psychology*.

Haidt, J. (2001). The emotional dog and its rational tail: A social intuitionist approach to moral judgment. *Psychological Review*, *108*(4), 814-834.

Hanoch, Y. (2002). "Neither an angel nor an ant": Emotion as an aid to bounded rationality. *Journal of Economic Psychology*, *23*, 1 – 25.

James, W. (1890). *The principles of psychology.* New York: Holt.

Panksepp, J. (2000). Emotions as natural kinds withiin the mammalian brain. In M.Lewis & J. Haviland (Eds.), *Handbook of emotions (2nd ed.)* (pp. 137-156). New York: Guilford Press.

Planalp, S., & Fitness, J. (1999). Thinking/feeling about social and personal relationships. *Journal of Social and Personal Relationships*, *16*, 731–750.

Plutchik, R. (1994). *The psychology and biology of emotion.* New York: Harper Collins.

Tomkins, S. S. (1962, 1963). *Affect, imagery, and consciousness. Vols. 1–2*. New York: Springer.

Wright, R. (1994). *The moral animal*. New York: Pantheon Books.

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A non-specific non-module?

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Abstract

Siegert and Ward argue that consideration of the evolutionary past of the mind "could facilitate greatly research on mental disorders". In their paper, they present arguments concerning the evolutionary origins of the mind, and in particular the *social* mind (social cognition). Then they attempt to relate these ideas to current notions of modularity and domain specificity and finally, consider the implications of a social mind for research on mental disorders (schizophrenia).

The notion of *domain-specificity* championed in the paper actually appears to refer to a form of social cognition module (or modular system) that has remarkably *general* characteristics. For example, they agree with the ideas that a social contract module may "involve the following separate components: a perceptual mechanism for face processing, memory of past social exchanges, some knowledge of potential costs and benefits in contracts, a mechanism for detecting deception and emotional responsivity (e.g., anger if cheated)". This indicates a *module* with various subcomponents and so, leads to the question of how these components can be distinguished from modules themselves. In others words, why not just argue that we have modules for each of these things and it just happens that they function in a broadly social domain, but are responsive to their own domain-specific inputs e.g. why would memory for past social exchange be *triggered* by faces?

Additionally, the authors point out that "modules may process a broader range of information than solely that information which they were selected for in the EEA". Again, this is quite reasonable, but in conjunction with the view outlined above, it suggests that a module is: an information processing system potentially comprising a collection of *components* that respond to domains that are specific and non-specific; and will be affected also by *ultimate* and *proximal causes* (e.g. a persons genes, their developmental history, learning and environmental stimuli). It is difficult to see how this differs from a general processing system – it is certainly quite different from generally accepted notions of modular systems (Indeed, the authors say "specific modules will interact with (one or more) specific domains").

Also the reference to *components* appears to avert the necessity for fulfilling the criteria for modularity which the authors outline later in the paper. How do we decide that any module exists or that any processing is domain-specific? How are these distinguished from *components?* Theoretically Siegert and Ward align themselves with the idea that modules should: (1) be a psychological mechanism that would have enabled ancestral Hominids to solve fundamental problems if living in the EEA and thus conferred a reproductive advantage upon the individuals concerned; (2) be functionally consistent with evidence from cognitive and developmental psychology; and (3) that supportive evidence should also come from neuropsychological, especially cases displaying double dissociation. They suggest that convergent evidence from these stop the proliferation of hypothetical modules; however, they present no evidence to show that modules consist of such components rather than being separate modules.

Turning to the link with schizophrenia via Theory of Mind (ToM) research and the argument that "schizophrenia is inherently an interpersonal disorder" (Penn). What would be the grounds for accepting that schizophrenia is an interpersonal disorder anymore than Alzheimer's disease is an interpersonal disorder? What evidence marks schizophrenia out as an interpersonal disorder while Alzheimer's is not (both would presumably affect interpersonal

behaviour)? I am not denying that these disorders have interpersonal consequences, but why are they considered special in schizophrenia? How is any interpersonal disorder a fundamental part of the disorder rather than a consequence of the disorder (e.g. as perhaps in Alzheimer's disease)? And what empirical evidence supports the position?

Further their argument that "ToM research probably reflects the best example of a specific application of the social module hypothesis to research on schizophrenia" is not strictly true since a much larger literature exists for other social factors e.g. face processing. Indeed, the literature on ToM in schizophrenia is small and unconvincing as far as indicating a specific deficit associated with schizophrenia and independent of general intellectual problems in that group. First, the studies make very tenuous links with specific symptoms (often using large numbers of comparisons without adjusting for this fact); second, they do not adequately account for differences between normals and patients in terms of IQ; the controls often perform at ceiling; and finally, sex differences are not considered. Finally, it is not clear exactly the line of argument pursued by the authors. On the one hand, they want to argue schizophrenics perform worse on ToM tasks and so, this supports their position that they have an impairment of social domain processing; however, on the other hand they claim that the tests are not *specific* enough (i.e. that the test materials are *domain-neutral*). If the latter is true, then there cannot be evidence that ToM is impaired in these patients; rather some other more general factor is impaired. Indeed, I largely agree with this (see above), but you cannot hold both positions (especially since no data supports their *more specific* hypothesis).

The notion that "in cases where it is unclear which social domain is the most salient, then social domain should be manipulated as an independent variable, and their relative importance determined empirically" is not a solution. This runs counter to their proliferation of modules notion i.e. that an evolutionary justification should be given, that evidence comes from cognitive and development psychology and double dissociations shown. It seems that the authors are proposing a unique cognitive psychology which depends upon the specific experiences and life-stage of the person. This approach has been used in other areas of schizophrenia research (e.g. delusions) but the difference between *general* structure and *specific* content is important. The approach advocated by the authors is quite sensible, but does not represent a modular approach so much as a social cognition or individual differences approach.

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Psychopathology and the Evolved Social Mind: Responses to Commentaries

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Introduction

We are delighted to have the opportunity to respond to the commentaries by Julie Fitness, Trevor Case, and Keith Laws on our paper exploring the relationship between evolutionary theory, the social mind, and psychopathology. In our view there is real value in building on the conceptual and empirical research in the domains of biology and psychology in order to clarify the mechanisms generating serious mental disorders such as schizophrenia.. It is necessary to value ideas, but not to be captured by them. We show our colleagues enormous respect by taking their theories and research seriously enough to criticise them, and also by then attempting to extend their work in new directions. It is in this spirit that we would like to thank those authors who took the time to critically examine our paper on the evolution of the social mind and psychopathology. We will now address the major points outlined in each of the commentaries.

Response to Julie Fitness and Trevor I. Case

Fitness and Case note that they are "in general agreement with the overall perspective" of our paper, but consider that we have over-emphasized cognitive information processing and underestimated the importance of affective or emotional factors. In this regard, they argue that a focus on social cognition that treats "emotion and reason" as two separate or parallel processes, will be unproductive, if not downright "misleading". They also argue that a large body of evidence suggests that emotion and cognition are closely inter-related and that psychological therapies must address emotional issues as much as cognitive distortions.

There is little here that we can disagree with and it was not our intention to minimise the importance of emotional factors in psychopathology. Rather, we intended the contrary, although this may not have been made very clear in our paper through the frequent use of the term "social cognition". While not wanting to get into any tangential debates about the difference between "hot and "cold" cognition - we see emotion as one very important component of the social mind and intimately linked with social cognitive processes. In fact, the major point we wanted to make in our article, was that research on schizophrenia needs to focus less on how well people with this disorder can do the Wisconsin Card Sorting Test, and more on how they function in relationships. By functioning in relationships we mean how they behave, think and feel. However, we accept that as it stands, the paper may well seem somewhat unbalanced in favour of reason over emotion. Finally, their suggestion of extending Theory of Mind studies to include studying the ability to read and understand the emotions of others is an exciting idea.

As an aside, Paul Griffiths recent book on the nature of emotions from an evolutionary perspective casts doubt about the way emotions are currently conceptualised in our every day folk understandings (Griffiths, 1997). He states that “the general concept of emotion is unlikely to be a useful concept in psychological theory” (p14). Instead he argues that there are affect programs which are ancient “reflex like responses” (p16) that appear to be uninfluenced

by cultural factors, and higher level cognitively laden emotional responses that are culturally derived. Each type is characterised by distinct features and has its own relationship to the processes of natural selection. Furthermore, Griffiths proposes that the emotion category can be fractured into three more fundamental categories that cross cuts our current crop of emotional types in interesting ways. These categories are affect program responses, higher cognitive states, and socially sustained pretences. The implication of this fracturing is that some emotions that we see as one type, for example, anger, may in fact contain distinct and different states that have little in common other than our everyday tendency to label them in the same way. The implication for psychopathology is that the different (fractured) categories of emotions will have unique relationships to the social mind. This exiting idea will no doubt be the focus on ongoing evolutionary inspired research into emotional states and psychopathology

Response to Keith R. Laws

Laws makes several cogent points regarding our paper that include:

(1) the claim that the notion of modules with sub-components seems tenuous and our modular architecture ends up looking quite like "a general processing system".

(2) asks how is schizophrenia anymore an "interpersonal disorder" than say Alzheimer's disease?.

(3) And states that "the literature on ToM in schizophrenia is small and unconvincing as far as indicating a specific deficit …… independent of general intellectual problems…..".

He concludes by commenting that our general approach to understanding schizophrenia is sensible but does not represent a modular approach so much as a social cognition or individual differences approach. We will address each of these major concerns in turn.

(1) The notion of modules with sub-components seems tenuous and our modular architecture ends up looking more like "a general processing system".

The literature on modularity and modular approaches to cognition is burgeoning and it is difficult to make broad statements about "modules" unless one qualifies precisely what that term means. In this regard we may be guilty of using the term somewhat loosely on occasion. However, we make a number of points in our defence.

First, we began the article by commenting that the domain of psychopathology (as evidenced in the DSM-IV) is lacking a clear model of the mind in its construction of mental disorders. A major purpose of our paper was to stimulate discussion and debate as to how we might develop a model of the mind most relevant for studying mental pathology. We consider that any such model must be broadly consistent with the known facts of human evolutionary history. In this regard, we view debate centring on the putative modularity of the mind to be valuable in heuristic terms alone.

Second, while supporting the general notion of a modular architecture, we do not accept that all modules necessarily display all eight of Fodor's characteristic properties of a module (fast, automatic, encapsulated, etc..). Fodor was explicit that these were the characteristic properties of perceptual input systems only. Indeed, we believe that the actual nature and properties of any cognitive module is something to be demonstrated empirically rather than determined conceptually on *a priori* grounds. Consequently, we must protest at the repeated attempts by critics of modularity to portray all modules in the strictest of Fodorian terms. Leading proponents of a modular architecture have never argued for such a rigid model. Anderson et al. (2002) have recently noted in this regard that "It is frequently believed that there is a contradiction between modular conception of cognition and general architectures for cognition … this is not the case". In a similar vein, evolutionary psychologist Leda Cosmides in a recent interview commented that:

> "… some people misunderstand the Swiss Army knife metaphor – they think the claim is that these programs do not share information or work together. All these functionally specialised, domain-specific programs are designed to work together to produce behaviour. They share information, pass it back and forth, and so on." (p?)

Explicitly addressing the claim that all modules must be completely encapsulated, Cosmides utilises the metaphor of the body's organs, to argue that just because an organ such as the heart is functionally specialised for pumping blood, does not rule out interactions with other organ systems such the lungs, the muscles, or the brain.

A further comment is that we know the world in terms of our theories and their associated classification systems. The categories we use to carve nature at its joints reflect our best theories and ultimately are defensible by further evidence and analysis. The point is that the construction of theories and models for knowing the world is an essential process in everyday life as well as in science; we have no choice but to become theoreticians as well as experimentalist in our day to day activities. The attribution of mental states to other people, the explanation of salient social events, and our inferences concerning the causes of our own behaviour all rely heavily on scientific and folk psychological theories. A theoretical term such as "module" represents a powerful way to explain certain capacities of human beings and other organisms. Exactly what the properties of a module are and whether they are all share the same features is something we find out through empirical research and conceptual analysis. In other words, categories may evolve, disappear, be subdivided, or redrawn over time depending on the findings of science. Our knowledge is imperfect and fallible, our concepts flexible and responsive to changing circumstances and new evidence.

(2) How is schizophrenia anymore an "interpersonal disorder" than say Alzheimer's disease? …What empirical evidence supports the position?

The description of schizophrenia as "inherently an interpersonal disorder" is not ours, but as noted a quote from Penn et al.'s (1997, p.114) Psychological Bulletin review of social cognition in schizophrenia. The empirical evidence for this assertion is already summarised in that article. We are simply suggesting that, in the same way that cognitive neuropsychology has studied patients with Alzheimer's to shed light on working memory, semantic memory and object recognition (for example) - schizophrenia might offer similar insights into the grammar of social relationships.

In fact, it is mystifying to us as clinicians why the mountain of research on attention, memory and executive functioning in schizophrenia is not matched by a comparable body of research on social and emotional cognition in schizophrenia. We have yet to meet a parent who complains that their child with schizophrenia is hell to live with because of their poor working memory or divided attention.

(3) "the literature on ToM in schizophrenia is small and unconvincing as far as indicating a specific deficit …… independent of general intellectual problems…..".

Even if this was true, the ToM approach has stimulated a large amount of research on representational thinking in people with schizophrenia. Our first point here is that the theory has already shown considerable heuristic value and only time will tell regarding its empirical foundations.

However, we believe that this criticism is mistaken and is inconsistent with the actual findings of research on ToM. That is, our reading of the ToM and schizophrenia literature has led us to arrive at a quite different conclusion. We are currently in the midst of writing a review article on schizophrenia and theory of mind. Twenty-four of the 26 studies reviewed compared their schizophrenia sample

with a control group and found that the schizophrenia sample performed significantly more poorly on at least one of the ToM tasks employed. Of these studies, all but two included tests to estimate general intellectual ability, memory, or executive functioning and found that ToM deficits were frequently independent of performance on these tests. Furthermore, 13 studies used psychiatric comparison groups in order to determine whether the ToM deficit could be accounted for by more general psychopathology. Twelve of these groups included participants with anxiety, affective, learning, and personality disorders, and one (Pilowsky et al., 2000) used a comparison group with (high functioning) Autism. Although Pilowsky et al. found that the Autistic group performed slightly more poorly on ToM than the childhood onset schizophrenia sample, in all of the remaining 12 studies the schizophrenia groups scored significantly lower than psychiatric controls. The evidence therefore is strongly in support of there being a ToM deficit associated with schizophrenia that cannot be better accounted for by either executive functioning or more general intellectual impairments, or by the mere presence of psychopathology.

Concluding Comments

Both commentaries have highlighted that the model we have proposed remains fairly speculative and in need of further theoretical and empirical development. We accept this. However, our fundamental argument was that the study of psychopathology needs a model of mind - and that such a model must be consistent with our evolutionary history. In the same way that the shift from a rat model to a computer model revolutionised Psychology in the 1970s, we believe that greater integration of Psychology with the principles of evolutionary biology, will prove an equally important paradigm shift in the 21st century.

References

Anderson, J. R., Bothell, D., Byrne, M. D. & Lebiere (2002) An integrated theory of the mind. Submitted to Psychological Review. Available at: http://actr.psy.cmu.edu/papers/403/IntegratedTheory.pdf

Leda Cosmides interview for the Chilean newspaper *El Mercurio* published there on October 28, 2001 can be found at: http://www.psych.ucsb.edu/research/cep/ledainterview.htm

Griffiths, P. E. (1997). *What emotions really are.* Chicago, ILL: The University of Chicago Press.

Pilowsky, T., Yirmiya, N., Arbelle, S., & Mozes, T. (2000). Theory of mind abilities of children with schizophrenia, children with autism, and normally developing children. *Schizophrenia Research*, *42* (2), 145 - 155.