PSYCHOLOGY MISCELLANY

No. 68 - February 2015

Evolution and Evolutionary Psychology: Five Essays

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ISSN: 1754-2200

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1. WHY HOMO SAPIENS?

1.1. INTRODUCTION

The complexity of the evolutionary pathway from a common ancestor with chimpanzees seven million years ago (MYA) through hominins (eg: Australopithecus africanus; Homo erectus) to Homo sapiens has become more evident with recent archaeological findings [1]. In the 1990s, the common view was that hominins appeared in East Africa 4.4 MYA, and the genus Homo about two MYA. By 30 000 years ago (YA), Homo sapiens had outcompeted all other Homo (eg: Neandertal [2]). Simplistically, Australopithecus led to Homo erectus, which led to Neandertals, and on to Homo sapiens. This view is now challenged by recent findings, and, in particular, the cognitive gap between Neandertals and Homo sapiens (Wong 2014). Most importantly, several different hominin species existed at the same time (Wood 2014).

Whatever the complexity of the picture, Homo sapiens exist today and other hominin species do not, and there is a large gap between chimpanzees and humans. What factors are involved in the "triumph" of humans? Here are four possibilities - climate change, gene-culture co-evolution, social networks, and social cognition.

1.2. CLIMATE CHANGE

For example, major shifts in African climate change can be linked to two major changes in hominins. Between 2.9 - 2.4 MYA Australopithecus afarensis disappeared and the larger-brained Homo genus appeared as dry grasslands expanded while wetter woodlands shrank, and between 1.9 - 1.6 MYA Homo erectus emerged as grasslands further expanded. During these two periods, climate alternated between dry and wet periods, which put pressure on a

[1] The theories about the origins of humans involved speculation and theory despite a small amount of fossil evidence, and this is even more so with the evolution of primates (appendix 1A).
[2] Homo neanderthalensis.

species to be flexible to survive (de Menocal 2014). For example, a species with teeth and jaws for nuts (eg: Paranthropus boisei [3]) would struggle if this food was in short supply, whereas omnivore species (that can eat a variety of different type of food) (as in Homo) would do better. Differences in diet have been studied through analysis of the different types of carbon in fossils (eg: Cerling et al 2013).

A different emphasis for climate change involves the amount of heat generated by the energy consumption of larger brains. It has been calculated that a reduction in air temperature of 1.5 °C was needed to avoid overheating with the brain size development from Homo habilus to Homo erectus (table 1.1). This coincided with the Quaternary ice age (that started about 2.5 MYA) (Holmes 2009).

David Geary argued that the cooling of the climate "would have lifted the brakes on expansion" of the brain, but "there has to be something driving the increase" (Holmes 2009).

Hominid	Brain volume	Time period
Australopithecus africanus	460	up to 2.5 MYA
Homo habilus	600	2.5 - 1.5 MYA
Homo erectus	1000	1.5 - 0.5 MYA
Homo sapiens	1500	since 0.5 MYA

(Source: Holmes 2009)

Table 1.1 - Brain volume (cm^3) and different hominids.

1.3. GENE-CULTURE CO-EVOLUTION

Species that could respond to climate change with material culture (eg: stone tools, clothing) would do better in surviving. "It seems likely that tools and other technologies allowed early hominins to launch themselves into new environments, although when conditions periodically deteriorated, those aids could no longer guarantee survival. As a result, many populations splintered, allowing genetic and cultural novelties to take root much faster than could have happened in larger groups, leading to rapid evolution" (Tattersall 2014 p40) (known as gene-culture co-evolution).

Primitive stone tools have been found in Africa dating to 2.6 MYA, and marks on animal bones suggest even

[3] "Nutcracker man" (de Menocal 2014).

earlier use. These early implements related to butchering meat, which implies a wider diet than vegetation. This richer diet is key to the expansion of brain size (Tattersall 2014).

But technological developments were not gradual, rather they appeared sporadically (probably in response to climate changes). These developments were accompanied by a "unique mode of symbolic thought" that allowed planning, for example (Tattersall 2014) [4].

1.4. SOCIAL NETWORKS

Complex human social networks are founded on monogamy (Chapais 2013), whereas monogamy is the minority among primates generally. Lovejoy (2009) argued that Ardipithecus ramidus (4 - 5 MYA) showed monogamy, along with concealing external signals of female ovulation, and carrying food in arms as walked upright. With pair bonding, male energy was spent on finding food for the partner rather than fighting other males for mating rights. Females, thus, preferred good providers and not aggressive males (appendix 1B).

Others suggest that monogamy appeared later (eg: 2 - 1.5 MYA) (Edgar 2014).

Three main hypotheses exist to explain the evolution of monogamy generally (Edgar 2014):

a) Female-spacing hypothesis - Females have larger territories to gain from limited food resources, which makes it difficult for males to keep multiple mates.

b) Infanticide avoidance - Where an incoming male kills the young offspring of the former dominant male in order to start the mothers ovulating again, there is an incentive for a female to find a male who will defend her and her babies.

c) Male parental care - Species with a large brain have babies that require a lot of energy, and more food than one parent can provide. Thus the need for a male to aid in food provision.

Monogamy is not enough by itself to explain the developments in Homo, there needs to be a wider community

[4] There is a mismatch between the modern world and the environment in which humans evolved. The reason, Sapolsky (2012) argued, is "our impulse to push beyond the limitations evolution imposed on us by developing tools to make use faster, smarter, long-lived. Science is one such tool - an invention that requires us to break out of our Stone Age seeing-is-believing mindset so that we can clear the next hurdle we encounter, be it a pandemic flu or climate change. You could call it the ultimate expression of humanity's singular drive to aspire to be better than we are" (p26).

co-operating as well (Edgar 2014). de Waal (2014) emphasised co-operation beyond kin. He stated: "Without denying our violent potential, I am convinced that it is these co-operative tendencies that have brought us as far as we have come. Building on tendencies that evolved in non-human primates, we have been able to shape our societies into complex networks of individuals who co-operate with one another in all kinds of ways" (p55).

1.5. SOCIAL COGNITION

Chimpanzees can perform as well as young children on general reasoning tasks, but they are poorer on social cognition tasks (eg: theory of mind - understanding what another person thinks). This limits their ability to work with others on a shared goal (Stix 2014).

For example, Herrmann et al (2007) compared over 100 chimpanzees and 100 two and a half year olds on various tests including general intelligence (eg: comparing quantities of objects) and social intelligence (eg: learning from others). The median of both groups were similar for the former tasks, but the children scored double on the latter type.

Bailey and Geary (2009) argued that the development of the brain to "outsmart neighbours" was supported by the relationship between larger population size and brain expansion based on 175 fossil hominid skulls from 1.9 MYA to 10 000 YA.

1.6. APPENDIX 1A - EVOLUTION OF PRIMATES

Primates are a group of mammals that includes lemurs, apes, and humans. The ancestor of all primates appeared around 60 MYA when a small, nocturnal mammal took to the trees (Pilcher 2013).

Primates have grasping hands (instead of claws), and forward-facing eyes for judging distance. But why did these two features evolve in the primate ancestors?

Cartmill (eg: 1974) argued that it was to catch insects while living in the trees (insect-hunting hypothesis). Hands to grasp branches and forward-facing eyes to judge short distances to prey (ie: at arm's length or not).

Sussman and Raven (eg: 1978) preferred the angiosperm evolution hypothesis, which saw primates evolving in tandem with angiosperms (flowering plants). By the time of the primate ancestors the angiosperms had evolved into trees, and this offered a new feeding niche. Hands were needed to move around the branches to find fruit.

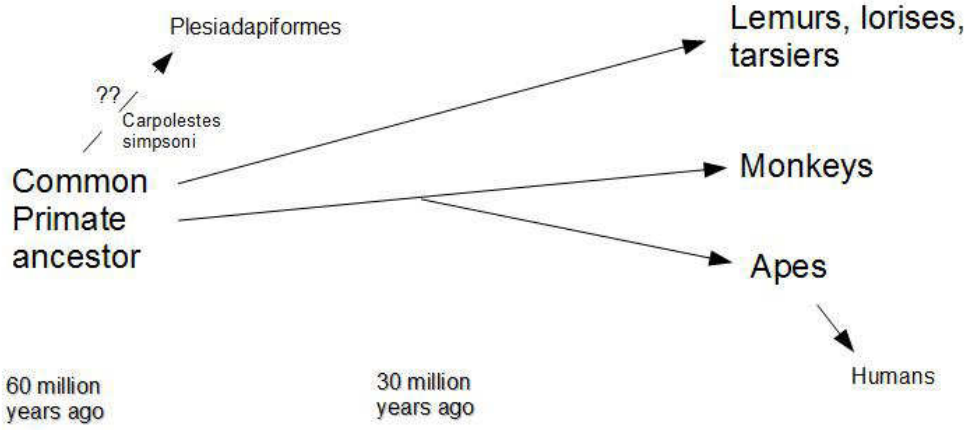
Rasmussen (eg: 1990) proposed a combination of these

ideas. Early primate ancestors needed grasping hands for climbing to find fruit, and catch insects, but the eyes evolved later to enhance insect catching.

Alternatively, Changizi and Shimojo (2008) suggested that the evolution of forward-facing eyes was to see better through (and around) branches and leaves.

These different ideas are fought out in theories, but also over the interpretation of fossil finds like Carpolestes simpsoni (Sargis 2002). From around 56 MYA this creature was rat-sized, living in trees, with grasping hands and sideways facing eyes. This seems to challenge the insect-hunting hypothesis.

But some primatologists have argued that Carpolestes simpsoni was not a primate ancestor, but belonged to Plesiadapiformes (which were similar yet different to early primates) (Pilcher 2013) (figure 1.1).



(Based on Pilcher 2013 figure p45)

Figure 1.1 - Basic primate family tree.

1.7. APPENDIX 1A - HUNTING AND THE "HANDICAP PRINCIPLE"

Individuals, particularly males, seek to communicate the good quality of their genes to potential mates. The "handicap principle" (Zahavi 1975) (or "show-off hypothesis) suggests that wasteful displays and altruistic behaviours are specific examples of this. It is like saying. "look, my genes are so good that I am able to do this behaviour". For instance, among the Meriam Islanders of the Torres Strait, male spearfishers find prey that is of limited nutritional value, but is particularly difficult to capture (Bliege Bird et al 2001).

Interestingly, males of other primate species that humans do not provide much food for females and juveniles, whereas hunting is traditionally the male behaviour in subsistence human societies. Hawkes and

Bliege Bird (2002) argued that the hunting of large animals is an example of the "handicap principle" at work: "When hunters target large prey, and when others can learn about and compare their successes, hunting reputation becomes a prominent determinant of how desirable a neighbour and ally, and how a dangerous a rival, a man might be" (p59). Key is the ability to communicate the hunting prowess with stories told "around the campfire". An ability that other primates do not have.

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2. EVOLUTIONARY PSYCHOLOGY

Evolutionary Psychology (EP) is a metatheory (ie: a theory that can be applied to any area of the discipline). It "is the integrative study of behaviour and its underlying psychological mechanisms, including their development, activation, and expression, guided by insights provided by modern evolutionary theory" (Buss and Reeve 2003 p848).

Buss and Reeve (2003) listed over fifty findings in different areas of psychology based on EP, including:

- Differences between men and women in characteristics preferred for long-term mates (eg: women seek men with greater resources) [5].

- Cheater detection in social interactions (eg: better recall of faces of past cheaters in a game).

- Waist-to-hip ratio and female attractiveness.

Within EP, though, there are competing theories of specific behaviours (eg: male sexual jealousy as an adaptation or by-product of other emotions) (Buss and Reeve 2003).

Also: "Some evolutionary psychologists contend that modern environments have altered selection pressures sufficiently so as to make some evolved adaptations no longer 'adaptive', whereas others emphasise the continuity of human adaptive problems and their evolved solutions from the deep past through modern times" (Buss and Reeve 2003 p849). Some evolutionary psychologists play down the environment and emphasise behaviour as "the product of its genes" (Lickliter and Honeycutt 2003a), whereas Buss and Reeve (2003) argued that "evolutionary psychologists do not partition genes and environment into primary and secondary roles" [6].

Furthermore, "evolutionary psychologists argue for complex and specialised forms of interactionism in which environments at many levels of analysis play a causal role at every step in the causal chain, including the selective environment of evolutionary history, the ontogenetic environment of the developing organism, the immediate inputs into evolved psychological mechanisms, and many aspects of the internal environment such as influences from other psychological mechanisms" (Buss and

[5] But there is little data "to show whether mating with a wealthier man actually leads to more viable or 'fitter' offspring in modern contexts or in the contexts of our distant relatives" (Lickliter and Honeycutt 2003b p870).

[6] The debate tends to be theoretical rather than seeking actual genes to explain the behaviour (appendix 2A).

Reeve 2003 p851).

Lickliter and Honeycutt (2003b) felt that EP had "no coherent framework for how to integrate genetic and experiental factors into a theory of the phenotype... resulting in an almost exclusive focus of adaptationist accounts of evolution by natural selection, rather than a more broad-based focus on the process and products of evolution by developmental mechanisms" (p866).

This links to a debate about genetic determinism, or "genetic predeterminism" (Lickliter and Honeycutt 2003a). Dawkins (1982) was adamant: "The belief that genes are somehow super-deterministic, in comparison with environmental causes, is a myth of extraordinary tenacity" (quoted in Buss and Reeve 2003).

Buss and Reeve (2003) suggested that such disagreements are a healthy part of science.

Lickliter and Honeycutt (2003b) presented three key challenges to EP:

i) Methodological - Many studies use interviews or questionnaires, and there is always an issue of what people say and what they do.

ii) Counterfactual evidence - Researchers who make predictions based on EP are faced with contradictory as well as supporting evidence. For example, it was predicted that men would infanticide offspring of their mate which were not biologically their own. The upshot is a prediction of abuse of stepchildren by the stepfather. Yet the majority of stepfathers do not abuse their stepchildren, and levels of abuse are lower in step than biological families (Lickliter and Honeycutt 2003b).

iii) Domain-specific cognitive modules - It is argued by some evolutionary psychologists that specific cognitive modules evolved in the brain (eg: cheater-detection module). "Given the complexity (and oftentimes ambiguity) of real-world encounters and contexts, no doubt multiple modules will often be activated... But which modules will dominate others to gain control over behavioural strategies and responses? For example, if a man is bargaining for or purchasing a food item from a woman, will his cheater-detection module, food preference module, or any of the other modules involved in decision making or sexual behaviours take control of behaviour? How is one to choose whether behaviour is guided by a single module or an aggregate of modules...?" (Lickliter and Honeycutt 2003b p870).

APPENDIX 2A - FINDING THE ACTUAL GENES

Establishing the actual genes involved in

characteristics or conditions with high heritability has not proved easy. Maher (2008) used the example of height in a population. If the range of height from the tallest 5% and the lowest 5% of the population is 29 cm, a 80-90% heritability would mean that 27 cm of the difference was down to genetics and 2 cm to environment. But the actual genes found account for 6 cm. It could be that heritability was overestimated and the role of the environment underestimated.

Maher (2008) stated:

> There is a nagging worry as researchers hunt for heritability: that common diseases might not, in fact, be common. Medicine tries hard to lump together a complex collection of symptoms and call it a disease. But if thousands of rare genetic variants contribute to a single disease, and the genetic underpinnings can vary radically for different people, how common is it? Are these, in fact, different diseases?... researchers are seeking shared susceptibility genes in a group of people who may share few, if any (p21).

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3. EVOLUTION AND HUMAN MATING STRATEGIES

3.1. INTRODUCTION

"Modern humans have inherited the mating strategies that led to the success of their ancestors" (Buss 2006). Successful mating strategies have to deal with the issues of finding a fertile mate, out-competing same-sex rivals in attracting that mate, defending against "poachers" (eg: males who would take the mate away), preventing the mate from leaving, and other behaviours related to successful conception (Buss 2006).

The evolution of characteristics and behaviours related to mating rather than survival is known as sexual selection (Darwin 1871). This involves intrasexual competition and intersexual selection. Intrasexual competition occurs between members of the same sex to gain a mate (eg: males of the species fighting). The winner of the fight or competition gets to mate while the loser does not [7]. Intersexual selection is the preference of one sex for members of the opposite sex with certain characteristics (eg: female preference for large tails in male peacocks).

Buss (2006) highlighted a number of strategies that have evolved in humans through sexual selection related to long-term mating, short-term mating, extra-pair mating, mate poaching, and mate guarding.

3.2. LONG-TERM MATING

Choosiness is important when deciding who to take as a long-term mate, particularly for women who have the greater obligatory parental investment (ie: pregnancy). Thus the desire for males who have resources to invest in her and her child(ren), and the ability to protect them. Buss et al (1990) found support for this in a study of thirty-seven cultures. Over 10 000 men and women were asked about thirty-two characteristics in an opposite-sex long-term mate. Women significantly more often chose "good financial prospect" than men along with other

[7] There are concerns about the consequences about "shortages" of women (appendix 3A).

characteristics linked to resources and resource acquisition (eg: social status, ambition). On the other hand, men preferred women who were "physically attractive" (which is taken as a cue of health, fertility, and reproductive ability).

The male preference for fertile females is seen in men marrying women younger than themselves. Buss (1989) confirmed this observation with data on age of partners at marriage in twenty-nine cultures. Kenrick et al (1996) also found support for this idea from a different angle - teenage males preference for slightly older females. "The findings of the Kenrick et al (1996) studies confirmed this counterintuitive prediction. Although teenage males were willing to accept dates with women who were slightly younger, they found women a few years older to be the 'most attractive'. Interestingly, this finding occurs despite the fact that these older women express no interest at all in dating younger men. Taken together, the cumulative findings suggest that men's age preferences exist, at least in large measure, because of the historically recurring link between a woman's age and her fertility" (Buss 2006 p246).

Studies analysing dating ads show the difference between the sexes in females offering signs of fertility while seeking resources, and men the opposite. For example, men who mentioned good financial resources in their self-description got a higher response from women than men who did not (Baize and Schroeder 1995).

3.3. SHORT-TERM AND EXTRA-PAIR MATING

Because males have little obligatory parental investment (ie: only sperm), they can "afford" multiple short-term mating (ie: casual sex). For example, a man who has short-term sex with many women in a year increases his reproductive success greatly, whereas a woman with the same behaviour is limited to one pregnancy.

Buss and Schmidt (1993) asked participants how many sex partners they would ideally like in their lifetime, and the average for men was eighteen compared to 4.5 for women.

Other sex differences that have evolved related to short-term mating include men's desire to have sex sooner after meeting a woman. Clarke and Hatfield (1989), for instance, had experimenters approach strangers of the opposite sex on a university campus and say "Hi, I've been noticing you around campus, and I find you very attractive". Then to ask one of three questions - "Would you go out on a date with me?", "Would you go back to my apartment with me?", or "Would you have sex with me?". Men were much more likely to say "yes" to the last question (figure 3.1).

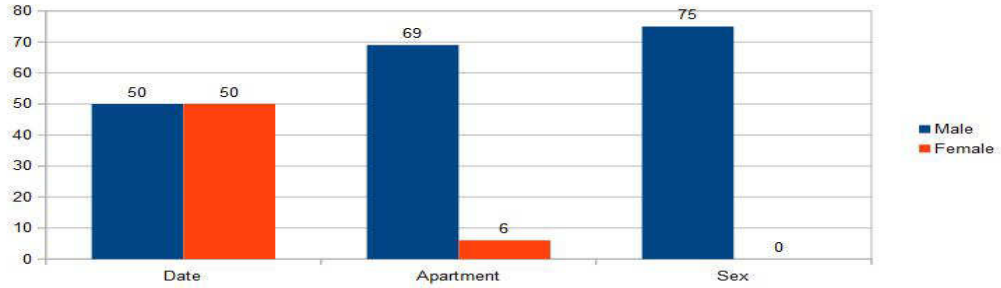


Figure 3.1 - Percentage of respondents answering "yes".

Buss (2006) stated:

> ... men have evolved psychological mechanisms dedicated to solving the complex problems posed by success at short-term mating. These include a desire for sexual variety, the tendency to let little time elapse before seeking sexual intercourse, and the behavioural willingness to consent to sex with strangers. In addition, men appear to lower their standards dramatically in the context of short-term mating...; show a marked decrease in attraction to a sex partner immediately following sexual intercourse, perhaps to facilitate a hasty post-copulation departure...; report exaggerating the depth of their feelings to gain sexual access...; and report that they would have an extramarital affair if they knew that no one would find out... (pp250-251).

If men are interested in many sexual partners, then there must be women who are willing to participate. But "short-term mating often carries substantial costs for women. Women, more than men, risk damage to their reputations, a lowering of perceptions of their mate value, and if mated, the possibility of violence at the hands of a jealous boyfriend or husband. Given these costs, it is unlikely that selection would have forged a female short-term mating psychology in the absence of substantial benefits that outweigh those costs" (Buss 2006).

Greiling and Buss (2000) proposed a number of benefits to women including:

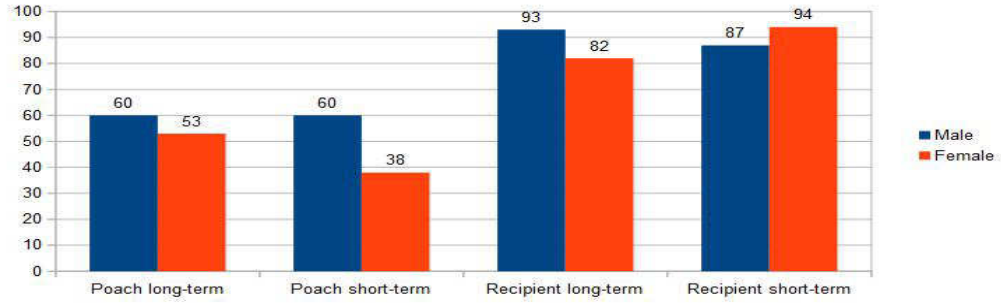
- Resource acquisition (eg: gifts during an affair).
- More genetically diverse offspring.
- Using short-term mating as a means to switch long-term mates.

3.4. MATE POACHING

This is "behaviour designed to lure someone who is

already in a romantic relationship, either temporarily for a brief sexual liaison or more permanently for a long-term mating" (Buss 2006).

Schmidt and Buss (2001) asked a sample of Americans aged 30-45 years old if they had attempted to poach or being recipients of poaching. It was quite common (figure 3.2). In terms of successful poaching, 67% of male recipients and 41% of female ones admitted being lured away from an existing long-term relationship.



(Poach = attempted to poach another's mate; recipient = was approached by "poacher"; long-term = in long-term relationship; short-term = casual sex)

Figure 3.2 - Percentage of respondents.

3.5. MATE GUARDING

Jealousy is seen as an emotion that has evolved as a strategy for mate guarding. Buss et al (1992) found that men were more likely to be jealous about female sexual infidelity (ie: fear of loss of paternity) than women (61% vs 13%), but women were jealous about male emotional infidelity (ie: fear of loss of resources) more than men (87% vs 39%).

Both sexes also make use of "mate retention tactics" (eg: calling mate at unexpected times to see who with). Men display their resources more in the presence of potential rivals, while women enhance their physical appearance (Buss 2006).

3.6. APPENDIX 3A - SEX RATIO

What happens in societies where there is a glut of men without female partners? This is because in some countries there is a male-biased sex ratio (ie: more men than women) [8]. One fear is "more men, more violence" (Schacht et al 2014a).

Schacht et al (2014b), in a review of twenty studies

[8] There are fifty-eight million more men in the world than women (Schacht et al 2014a).

on the level of violence in different societies, found contradictions. Nine studies showed more men and more violence, but nine studies found more women more violence, and the other two studies were inconclusive.

In societies where there are less women, men are actually better off (in evolutionary terms) finding a single mate to stay with. "Rather than becoming ever more violent when faced with a deficit of women, men can engage in much more positive social behaviour to attract and keep a partner" (Schacht et al 2014a p28).

Rates of men killing men and sexual assault on women are higher in female-biased sex-ratio societies as men compete against each other for multiple partners, but intimate partner violence by men is higher in male-biased societies (due to mate-guarding and sexual jealousy, evolutionists might say) (Schacht et al 2014a).

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4. CHEATER DETECTION

Buchner et al (2009) began: "Social co-operation is a universal feature of human societies and groups that may have evolved because individuals can increase their fitness by cooperating with each other... However, co-operation is also risky. Some individuals may exploit their social-exchange partners by benefiting from them, but failing to reciprocate" (p212).

Mealey et al (1996) argued that, consequently, "we have evolved highly selective attention and storage mechanisms for processing social information, and that both character (cheating potential) and status are important features in the engagement of these mechanisms" (p119). The idea is that the human brain evolved to deal with relevant stimuli, and with early humans they related to social interactions within a co-operative group [9]. In such environments it is important to remember, in particular, who can be trusted, and who is of high status. It is the specifics of the cognitive process of face recognition and recall that has evolved (ie: the relevant physiology of the brain). Cosmides and Tooby (1992) described a domain-specific cheater detection module. This would be part of the evolution of brain mechanisms to deal with environmental threats, in the same way as mechanisms evolved related to mates and food.

Mealey et al (1996) showed this evolutionary bias in an experiment on the recall of faces. Under the pretext of rating attractiveness, 124 US students were shown thirty-sex black and white photographs of White males. Attached to each photograph was a brief statement which signalled the status of the man (high or low), and their "threat potential" (history of cheating or trustworthiness, or irrelevant information). For example, "a vendor at baseball games who, after finding a wallet containing $250, located the owner using the driver's license" (low status/trustworthy), and "a bishop who was caught embezzling money from his own church" (high status/cheater). There were six different conditions with six photographs in each. The photographs from each condition were mixed together as this was a repeated measures design.

One week later, the participants were shown seventy-two photographs (without the statements), of which half were new, and asked if they recognised any of the photographs. It was predicted that faces presented as high status and/or cheaters would be remembered more.

[9] Another aspect of the evolution of means to distinguish cheaters from co-operators is the management of reputation. Individuals are aware that their reputation (eg: in being helpful) is important and behave to maintain it. It has been argued that gossip evolved in relation to this process (appendix 4A).

Overall, the average correct recognition of faces was 16.4 (out of 36). The faces presented as cheaters (low or high status) were recalled significantly better than those with irrelevant or trustworthy information (mean: 5.70 vs 5.54 vs 5.12 out of 12 respectively). But, unexpectedly, the low status faces were recalled better - low/cheater 3.06 (out of 6) vs high/cheater 2.64 (table 4.1).

Male participants showed a greater difference in recall between cheaters (5.46) and trustworthy individuals (4.32) than female participants (5.87 and 5.66 respectively). In the high-status conditions, female participants recalled the trustworthy faces best, and recalled all such faces more than male participants.

	Low status	High status
Cheater	3.06	2.64
Irrelevant	2.85	2.69
Trustworthy	2.37	2.75

(Data from Mealey et al 1996 figure 1 p123)

Table 4.1 - Mean number of faces recognised in each condition (out of 6).

Oda (1997) confirmed the findings in an experiment that presented faces of fictitiously labelled co-operators or defectors in a Prisoner's Dilemma Game (PDG) (table 4.2). But not all studies have done so (eg: Mehl and Buchner 2008).

- In the basic scenario, two prisoners are kept separately (without communication), and each must decide whether to confess to the police (known as defecting) or keep quiet (known as co-operating). There are different lengths of prison sentence depending on who defects or not. Usually this scenario is now played with points gained as in the payoff matrix in figure below.

	PLAYER B CO-OPERATE	DEFECT
PLAYER A		
	5	6
CO-OPERATE	5	1
	1	2
DEFECT	6	2

Figure - Payoff matrix of "prisoner's dilemma" game.

Table 4.2 - Prisoner's Dilemma Game.

Dealing with the failure to replicate Mealey et al's (1996) findings, Buchner et al (2009) argued that there is not an enhanced recognition memory for cheaters, but a better source memory for them (ie: memory for where the face encountered). Their experiments were similar to Mealey et al (1996) involving thirty-six photographs and attached information, but the researchers varied the information to be exceptional or ordinary (table 4.3). The participants were students at a German university. Recognition of cheaters, irrelevant of ordinary or exceptional, better than the other faces would support Mealey et al (1996). But the participants recalled the exceptional cheaters best, which is taken as support of a better source memory.

Buchner et al (2009) explained their findings, thus: "better recognition memory for cheaters (ie: higher familiarity of cheaters) in the absence of source information might even imply a higher risk of being exploited. In order to avoid cheaters, it is necessary to recollect the source, that is, the cheating context in which they were encountered" (p223).

- Cheater (ordinary) - "a used-car dealer. He regularly sells restored crash cars as supposedly accident-free and conceals serious defects from the customers".
- Cheater (exceptional) - "a soldier. He constantly steals munitions and other equipment from the camp and sells it to criminals".
- Irrelevant (ordinary) - "a scaffolder. Presently, he works at a building site in southern Germany where several tenements and office buildings are to be built".
- Irrelevant (exceptional) - "an assembly line worker. He is very interested in the Far East and, as a practicing Buddhist, he meditates everyday even in his lunch breaks".
- Trustworthy (ordinary) - "a cheese monger. He strongly attends to sorting out old cheese immediately and allows his customers to try all his products".
- Trustworthy (exceptional) - "a baker. He allows some homeless people from his neighbourhood to have breakfast and, in the winter, to have some hot coffee for free".

(Source: Buchner et al 2009 p215)

Table 4.3 - Examples of exceptional and ordinary descriptions for low-status jobs.

Yamagishi et al (2003) suggested that humans recall the faces of cheaters better co-operators even when not told who is which. Photographs of individuals who had co-operated or defected in a PDG were used as the stimuli. Participants were presented with the photographs of them and then a recognition test.

In the first experiment, participants correctly recognised defectors and co-operators in equal amounts, but defectors were recognised better for female photographs. Yamagishi et al (2003) concluded that

"cheaters may look different from co-operators, at least among female faces, and that humans may be able to pick up on the subtle differences to better remember cheaters' faces than co-operator's faces, but the effect was weak at best" (p293). This experiment had thirty-seven participants looking at thirty-six photographs.

In the second experiment, with fifty-five participants looking at fifty-six photographs, recognition of defectors was significantly higher than co-operators (63% vs 57% correct). The third experiment used thirty different photographs to the previous two experiments with seventy-five participants. The results of Experiment 2 were replicated.

Why the difference in findings between Experiment 1 and the other two? it may be a simple product of different samples. The experimenters do not state the country where the studies took place, but it could have been USA, Japan, or England based on the addresses of the researchers of the article. There were small methodological differences between the experiments:

1. Gender of participants - Experiment 1: 18 male/19 female; six male/49 female (Experiment 2); 48 male/twenty-seven female (Experiment 3).

2. Number of photographs used - 36 in Experiment 1, but eighteen were fillers (ie; not defectors or co-operators), and the recognition test involving nine new photographs out of eighteen. Experiment 2 used 56 photographs will no fillers and all included in a recognition test of 112 photographs. Experiment 3 had thirty photographs and a recognition test of sixty.

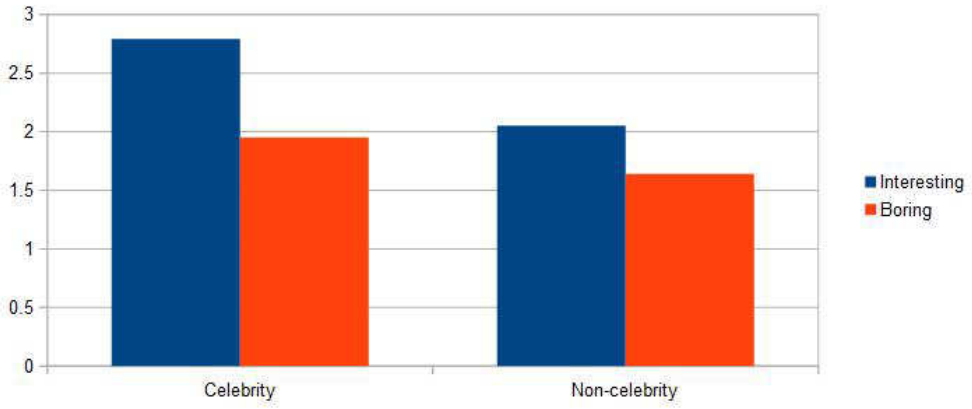
3. Presentation of faces - Altogether in grids for thirty seconds in Experiment 1, but one by one for two seconds each in the other two experiments.

Yamagishi et al's (2003) fourth experiment tested whether the participants recalled the face of defectors or thought they had seen them before when not the case. In one condition participants were shown fifty-six photographs, and then had a recognition test of 112 photographs which contained none of the originals. Participants here claimed to recognise more defectors than co-operators. The authors said: "The fact that the subjects 'recognise' defectors' faces more often than co-operators' faces either correctly or incorrectly strongly suggests that some facial features distinguish defectors from co-operators, whether we can consciously identify these features or not" (Yamagishi et al 2003 pp299-300). But the key questions are what are these features, and are they really different between cheaters and co-operators?

APPENDIX 4A - GOSSIP

Gossip is "an exchange of evaluative information about an absent third party" (Yao et al 2014). It can be used to bond members of a social group, communicate unwritten norms, and enhance the gossiper's status, as well as influencing the perception of reputation.

Yao et al (2014) explored the factors involved in gossip in two experiments. In Experiment 1 twenty "members of the University of Glasgow community" were presented with short fictional stories about a celebrity or non-celebrity (target familiarity variable) that were interesting or boring (story interest variable) [10], and asked how likely they were to pass the information to friends. Stories involving celebrities that were interesting were significantly more likely to be passed on to friends (figure 4.1). Thus, familiarity and interest are two key factors in gossiping.



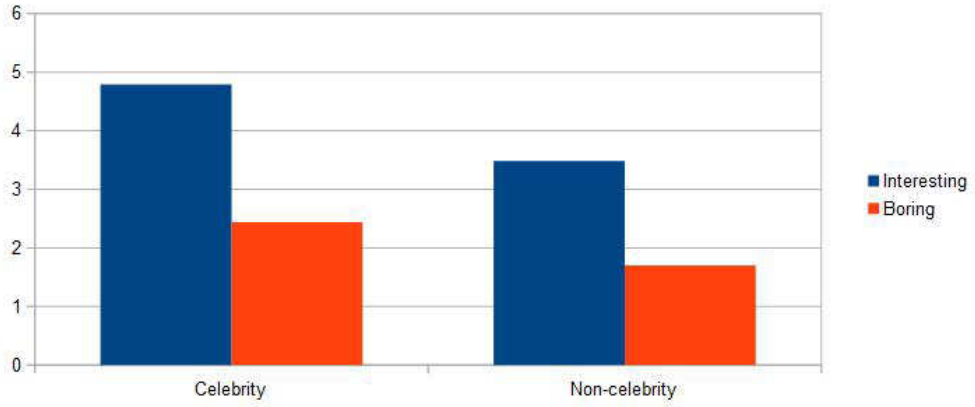
(Data from Yao et al 2014 table 2)

Figure 4.1 - Mean ratings of likelihood of passing on information to friends (out of 4) in Experiment 1.

Experiment 2 was a replication with thirty-six more of the same participants. The participants were also asked if they were aroused by the story (emotion), their expectations challenged, and the reputation of the individual in the story. The same basic finding as Experiment 1 was produced (figure 4.2). The likelihood of

[10] Celebrity/boring example - Barack and Michelle Obama visited the Bastille during a diplomatic visit to Paris. Their kids were given a personal tour and the history was explained by a local tour guide. They took a lot of photos at the Bastille and later at the Eiffel Tower. Celebrity/interesting - Barack and Michelle Obama visited the Bastille during a diplomatic visit to Paris. Afterwards, they had to take their kids to McDonald's because they refused to eat French food. The other diners were very amused by their presence in the fast-food chain (Yao et al 2014).

gossiping was influenced by surprise (expectation challenged) and reputational shift. In other words, individuals reported being more likely to gossip about an interesting story involving a celebrity if the celebrity had behaved in a surprising/unexpected way, which led to a change of opinion about them. Yao et al (2014) saw this finding as evidence of gossip playing a key role in reputation management.



(Data from Yao et al 2014 table 2)

Figure 4.2 - Mean ratings of likelihood of passing on information to friends (out of 7) in Experiment 2

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5. TRIVERS-WILLARD HYPOTHESIS AND HUMANS

The Trivers-Willard hypothesis (Trivers and Willard 1973) predicted that natural selection will favour different maternal "investment" in offspring (ie: sons and daughters) because of their varied reproductive potential. In good conditions (eg: plenty of food and mates), mothers will "invest" more in sons, but more in daughters in poor conditions. "Investment" refers to time and energy given to an offspring from conception onwards, including lactation and care after birth. In human societies, the "investment" includes behaviours like education, medical care, and financial wealth [11]. The type of social structure is also important. For example, where males with status and resources can have multiple mates (polygynous societies), higher reproductive success for the mother [12] can be obtained in good conditions through sons, but in poor conditions by daughters (who could gain a mate of higher status - known as hypergamy) (Fujita et al 2012) (figure 5.1).

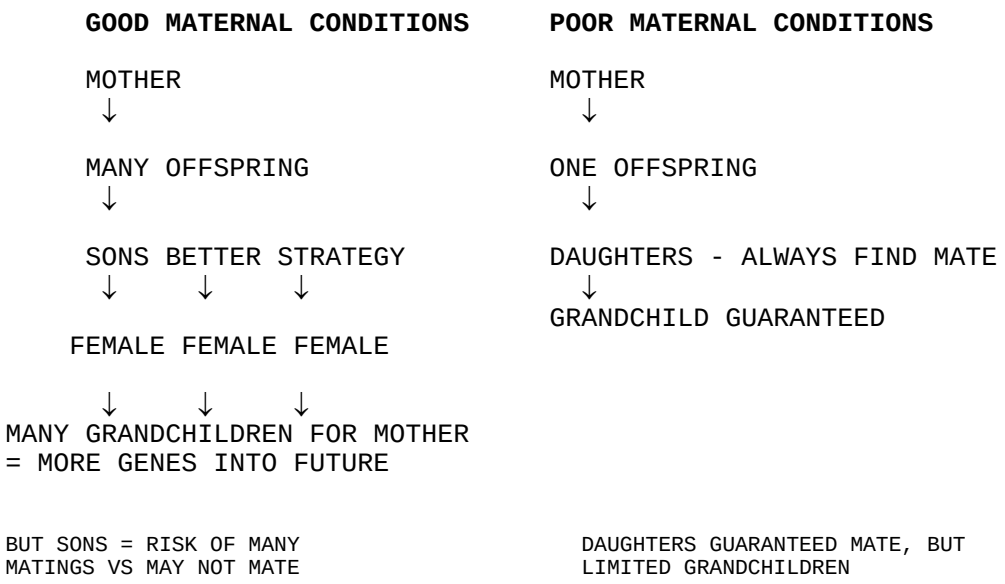

Figure 5.1 - Different strategies for offspring in different maternal conditions.

Fujita et al (2012) provided "tentative support" for the Trivers-Willard hypothesis among humans in a study of

[11] There are mixed results for the Trivers-Willard hypothesis in studies of these areas (Fujita et al 2012).

[12] Where resources are plentiful, then the maximum genes can be passed into future generations by male offspring based on grandchildren. Daughters will always find a mate even if this limits the number of grandchildren. The production of daughters is a better strategy where resources are limited.

breastfeeding frequencies and breastmilk fat [13] among the Ariaal people in Marsabit district, Northern Kenya. The economic sufficiency of the mother (ie: wealth) was used as the indicator of conditions.

Two hypotheses were proposed related to:

a) Breastfeeding frequency - wealthy mothers will breastfeed sons more often than daughters, and the opposite for poor mothers.

b) Fat concentration of milk - wealthy mothers will produce breastmilk with higher fat concentration for sons than daughters, and the opposite for poor mothers.

Ariaal society is polygynous, and wealth is transferred down a male line (patrilineal inheritance). However, women can generate personal income from selling surplus milk and vegetables from farms/gardens.

Eighty-three breastfeeding mothers were the focus of the study. Breastfeeding frequency was self-reported for a typical 24-hour period, and milk fat concentrations were made from a sample of breastmilk. Wealth of the other was category as poor/not poor based on variables like size of land owned (less or more than two acres) and livestock (more or less than a camel, a cattle, and a goat/sheep).

The first hypothesis was not supported. There was no difference in breastfeeding frequency [14] of sons and daughters based on wealth of mother. The second hypothesis was supported. "Not poor" mothers produced milk with greater fat content for sons than daughters (2.8 vs 0.6 gm/dl [15]) [16], while "poor" mothers produced richer milk for daughters than sons (2.6 vs 2.3 gm/dl) [17].

The study by Fujita et al (2012) has five main limitations which meant the study was only "tentative support" for the Trivers-Willard hypothesis:

i) Breastfeeding frequency was based on maternal recall with no independent verification.

ii) No information about milk volume consumed by infants.

iii) The milk fat concentrations were taken from

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[13] Milk fat is the main source of calories, fat soluble vitamins, and fatty acids for babies, which are key to growth, but it is energetically costly for the mother (Fujita et al 2012).

[14] Overall average was 9.7 times in 24 hours.

[15] gm/dl = grams per decilitre.

[16] This compares to a study of relatively well-off mothers in Massachusetts, USA, where breastmilk had 25% greater energy content for male than female babies (Powe et al 2010).

[17] Median human milk fat concentrations in developed countries vary from 2 - 6 gm/dl (Fujita et al 2012).

breastmilk collected in the morning, and so did not account for normal daily variations. Thus, the study did not measure total milk or milk fat per day. Fujita et al (2012) noted: "For example, if boys tend to nurse longer each time than girls, sons would be able to tap in to more of the richer hindmilk in each nursing episode than daughters. This could potentially offset the sex bias in milk fat concentration, or perhaps contribute to the sex-biased total milk transfer despite the equivalent feeding frequencies for sons and daughters" (p57).

iv) No data about growth of infants.

v) The mechanism by which fat content is varied in breastmilk is not clear, though maternal nutrition state important generally (ie: well- or under-nourished mother).

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