

Stefan Linquist
Biohumanities Project
Department of History, Philosophy, Religion and Classics
University of Queensland, Australia

Prospects for a dual inheritance model of emotional evolution

Abstract: Dual inheritance (DI) models of cultural evolution have been criticized for likening cultural transmission to genetic (lateral) transmission. I argue that although these objections might pertain to the cognitively sophisticated traits that DI theorists typically focus on (e.g. tool making and natural history knowledge), they do not undermine DI models of *emotional* evolution. Cultural traditions influence emotional development primarily during the early stages of life, before the onset of complex cognition and when children are exposed almost exclusively to their parents. Consequently, many emotional dispositions are transmitted laterally as DI models assume.

1) Introduction

The complexity and apparent adaptive utility of many human emotions have inspired numerous evolutionary hypotheses about their possible origins and functions. A major stumbling block for these proposals however is the hard-to-deny fact that emotions are significantly influenced by culture. How could a trait be both culturally determined and an adaptation at the same time? Recent developments in evolutionary theory shed light on this question. In particular, dual inheritance models of evolution seem well suited to explaining how human emotions might evolve. In what follows I first outline a basic sketch of dual inheritance systems, and identify three criticisms that have been

raised against the attempts to explain other (non-emotional) human traits in these terms. Second, I defend the claim that human emotions satisfy the requirements for a dual inheritance system by considering two case studies of emotional development. In the final section I defend this dual inheritance model against the three aforementioned criticisms.

2. Problems and promise of dual inheritance models

Dual inheritance models of evolution have enjoyed a surge in popularity over recent years (Avital & Jablonka, 1999; Sterelny, 2003; Boyd & Richerson, 2004). Part of the attraction is their apparent ability to account for the evolution of such complex human skills as cooperative hunting, tool making, natural history knowledge, and farming. As Boyd and Richerson argue (2004), many of these skills are not only highly adaptive, they are too complex to have been invented *de novo* or re-invented time and again each generation. A more likely scenario is that these abilities evolved by a process of gradual modification and selection. Dual inheritance models offer a potential explanation for how such skills might evolve without presupposing that they are somehow genetically encoded. The key idea is that complex psychological traits are transmitted from parent to offspring via two parallel channels. The computational “hardware” required for social learning is transmitted genetically and the specialized psychological “software” that supports a given technology or skill is transmitted culturally. Both modes of inheritance are assumed to be relatively high fidelity but also capable of slight modification over successive generations, as is required for any cumulative process of evolution. Importantly however, the fitness values of these traits are calculated in terms of the *reproductive* costs or benefits they bestow on their bearers. A new hunting strategy

evolves in a population because it enables the individuals who acquire it to obtain more calories and thereby have more (or healthier) offspring to whom they can pass that strategy on. This feature distinguishes dual inheritance models from memetic accounts of cultural evolution. According to memetic models, the fitness of a psychological trait is determined largely by its tendency to spread horizontally (like a virus) from individual to individual regardless of its impact on his or her biological fitness.

While dual inheritance models have been invoked to explain the accumulation of adaptive skills and other forms of “cognitive capital”, relatively little has been written on their prospects for explaining the evolution of human *emotions*. However, many of the “complex” or “higher cognitive” emotions (e.g. guilt, jealousy, shame, pride, embarrassment and moral disgust) lend themselves to just this sort of framework. As I shall illustrate below, these emotions develop out of “innate” reactive dispositions that emerge early in life, but which become increasingly cognitively elaborated over the course of an individual’s emotional development. This developmental process is governed by social practices (e.g. parenting strategies, childhood myths, and rituals) which are culturally transmitted and have apparently evolved for this purpose. The idea that human emotions have been shaped by natural selection is a popular theme in the writings of many psychologists and biologists, beginning with Darwin. These proposals often emphasize the (apparent) adaptive utility of many human emotions. For example, fear seems well designed for mobilizing a fight or flight response. Guilt and shame have been proposed as internal enforcement mechanisms for motivating adherence to cooperative alliances. Similarly, embarrassment has been suggested as a social signal of one’s adherence to cooperative norms. Somewhat more controversially, romantic

jealousy has been proposed as a mechanism for monitoring the status of a sexual pair bond and for motivating defensive behaviours when it becomes threatened. Despite their appeal as viable hypotheses, these proposals have run into a theoretical stumbling block. Most if not all of the emotions just mentioned are under the influence of culture – they are not “innate” in the traditional sense of having a strong genetic influence. This has led several thinkers to reject evolutionary hypotheses from the outset (e.g. Prinz, 2004). Since complex human emotions are not innate, it is argued, they are just not the right sorts of candidates for an evolutionary explanation. But for reasons that I discuss below, this argument fails. Dual inheritance models can potentially accommodate the fact that emotions are cultural influenced while at the same time explaining how they might have been shaped by natural selection.

However dual inheritance models raise their own set of challenges. Three criticisms are particularly salient. First, as Kim Sterelny has recently argued (2003, 2004) the same cognitive abilities that are required for the acquisition of cultural information are likely to degrade the fidelity of its transmission. Sterelny points out that imitation learning (a sophisticated capacity) is required for an individual to acquire a skill by observing its execution. But the greater an individual’s capacity for imitation learning, the more prone they will be to draw on individual experience to modify a task. Moreover, a mimic will often have only limited exposure to a model, so some inferential reconstruction of the task will be required [e.g. I know that bow-making had something to do with heating the branch before bending it, but how much heat? For how long?]. Thus Sterelny argues that:

these very abilities undermine the intergenerational flow of information. For they increase the extent to which an individual's beliefs and behaviour are sensitive to his own experience, and they decrease the extent to which these beliefs and behaviours are the result of blindly copying those of previous generations (2004, p. 8).

Let us call this the cognitive degradation problem.

Boyd and Richerson attempt to solve this problem by appealing to the fact that cultural transmission is often not vertical. Some cultural information also flows horizontally (person to person within a generation) and obliquely (from individuals in the N generation to non-kin in the N+1 generation). Boyd and Richerson argue that horizontal and oblique transmission can compensate for a loss of fidelity, provided that the right sorts of cognitive biases are in place. *Conformist biases* involve the tendency to adopt the most commonly practiced behaviour. Thus, an individual of the N generation might sample from multiple "cultural parents" and choose whichever practice is most common. This effectively adds redundancy to a signal thereby making low fidelity traits more likely to be passed on over successive generations. *Content biases* motivate an individual to choose whichever practice is most successful or the one that they find particularly appealing. This form of bias effectively enhances transmission rate by soliciting a high number of mimics. Boyd and Richerson demonstrate mathematically that such biases in the transmission of cultural information can lead to the accumulation of cognitive capital *at the population level* over successive generations. However, horizontal transmission can also lead to the rapid transmission of maladaptive tendencies. It is psychologically unrealistic to suppose that content biases will always lead an

individual to choose the most adaptive behaviour from a range of alternatives. Some traits will be psychologically appealing but biologically maladaptive – think of heroine use, or abstinence. Thus, dual inheritance systems that are capable of horizontal and oblique transmission are less likely to support individually adaptive traits than systems that are exclusively linear and high fidelity. Call this the maladaptive meme problem.

A further objection to biased transmission models is that they fail to take into account the costs that information transfer impose on the *model*. As Sterelny points out, sharing valuable information with non-kin of the N+1 generation can be costly to a model if those skills are used to compete against his or her own offspring. Sterelny argues that unless group-level selection is acting on a population, it will be disadvantageous for models to openly share their precious skills with non-relatives. Call this the costly information problem.

My aim in what follows shall be to defend a dual inheritance model of human emotions against the three criticisms just described. My strategy shall be to first consider two case studies of emotional development. These examples provide a vivid picture of the ways that biological and cultural factors act in concert in the production of an emotional phenotype. The examples also highlight some important differences between the acquisition of emotional traits and the transmission of the sorts of complex skills with which dual inheritance theorists are usually concerned. In particular, I argue that emotional traits are (1) acquired early in life, prior to the acquisition of sophisticated cognition, (2) influenced primarily by one's parents and are therefore transmitted linearly, (3) are scaffolded by cultural practices that are unlikely to be modified in light of

individual experience. Thus, complex human emotions are especially good candidates for dual inheritance models of evolution.

3. Guilt and *metagu*: Two case studies in emotional development

From an early age children exhibit a range of emotional reactions that have been posited as the developmental precursors to guilt, shame, embarrassment and other complex emotions that develop later in life (Hoffman, 1970). By age two the perception of anxiety or distress in others generates a similar state in the observer, which in turn gives rise to a range of “prosocial” behaviours (e.g. hugs, pats, kisses) in an apparent attempt to alleviate their shared anxiety. Interestingly, Zahn Waxler et al (1992) report that a toddler’s own state of anxiety as well as his level of pro-sociality is significantly higher when he perceives himself to be the *cause* of another person’s distress as opposed to when their distress is merely incidental. The fact that even such young toddlers appear to have a rudimentary sense of responsibility associated with their own bad feelings and conciliatory gestures makes this affect program a good candidate for the developmental origin of guilt. Of course, such responses do not qualify as full blown guilt. Mascolo and Fischer (1995) note that not until ages 3 to 4 are children able to verbally articulate the link between harmful actions and bad feelings. Without such foresight, it is unlikely that guilt could play a role in deterring a person from engaging in future harmful behaviors. Toddlers also lack an understanding of the norms specifying the conditions under which one ought to feel guilty. Bretherton et al (1986) note that it is not until at least age five that children fuse their understanding of emotional agency with an appreciation for social norms and conventions. And only some time later that they become sufficiently self

aware to anticipate which behaviors are likely to cause bad feelings in themselves so that they can be avoided. Thus, guilt appears to follow a multi stage developmental process that starts out with an “innate” sensitivity to the distress of others and which becomes increasingly cognitively elaborated as the child matures.

Kochanska (1991) has conducted an elegant study illustrating how different parenting styles influence this developmental process. Toddlers (1.5 – 3 years) were first rated for their individual anxiety levels. In general, some children are born more anxious than others – they will be more reluctant to approach a novel toy or unfamiliar adult, they are more easily distressed by a loud noise, etc. Kochanska then observed toddlers interacting with their parents in a naturalistic setting and took note of two different strategies for dealing with misbehavior. Authoritarian parents tend to issue commands or criticisms without providing rationalizations - e.g. “put that toy back where you found it!” or “don’t be so naughty?” Perspective-taking parents encourage the child to consider how their actions impact others - e.g. “how do you think that made Johnny feel?” or “what if that was your toy?” Kochanska also surveyed parents on the parenting norms they endorse and found that the authoritarian style is often justified by the idea that one must be tough with children (e.g. “you’ve got to teach them manners early on”). Whereas the perspective-taking style is often justified in terms of instilling empathy in one’s offspring. Finally, Kochanska surveyed the same population of children five years later for their tendency to experience guilt. Interestingly, she discovered an interaction effect between early anxiety levels and parenting styles. Low anxiety children displayed an average level of guilt-proneness regardless of which parenting style they encountered. However, high-anxiety children who encountered the authoritarian style exhibited higher

than average levels of guilt proneness. Whereas high anxiety kids who encountered the perspective taking style exhibited lower than average levels of guilt. One thing that this study makes clear is that the development of guilt involves more than just the internalization of norms once one has reached a certain level of cognitive sophistication. The development of guilt involves both a biological and a cultural contribution, and appears to begin even before children acquire an explicit sense of agency or can draw a conscious link between their actions and their future feelings.

Turning to our second example: In her influential ethnography of the Ifaluk of Micronesia, the anthropologist Catherine Lutz describes an emotion – metagu– quite similar to what we in the West would identify as shame. Lutz describes metagu as “the primary inhibitor of misbehavior in children and adults”. A well socialized member of Ifaluk society is expected to experience this emotion in the presence of a respected elder, or in response to another person’s “justifiable anger”. Lutz explains that, “Good people on Ifaluk are those who anticipate ‘justifiable anger’ of others (especially elders), are metagu of their own wrongdoing, and hence behave in a calm, nonaggressive manner” (1983, p. 253-4). To fail to exhibit this emotion under the appropriate circumstances would be unthinkable in Ifaluk society, thus there is strong social pressure on a parent to instill this emotion from an early age. Interestingly, Lutz notes that the Ifaluk themselves view metagu as something that emerges naturally in children, but which requires careful cultivation through the enforcement of norms and, periodically, through explicit rituals. From the first year of life children are expected to exhibit metagu in the presence of an adult visitor to the home. For example, when a visitor enters the house children are expected to adopt a subordinate posture and to avoid direct contact. Lutz explains that,

“children who do not appear metagu have their attention drawn to the stranger in an attempt to elicit this emotion” (1983, p. 254). If this strategy proves unsuccessful or if children fail to exhibit metagu in other social settings, parents will resort to the following ritual:

The most striking way in which metagu is socialized is through the use of a special type of ghost (tarita) which is said to kidnap and eat children. This ghost is impersonated by one of the women of the child’s household, who covers and disguises herself with cloths. The ghost, which normally resides within the wooded interior of the island, is called by parents to come and take the child if she or he misbehaves. The ghost is most frequently called if the child has aggressed against a peer, or if the child begins to wander away from the house. Appearing menacingly at the edge of the house compound, the ghost causes young children to leap into the arms of any nearby adult. The label metagu is used in profusion to describe the child’s reaction, and the ghost is then told by one of the adults present that “the child will no longer misbehave” and that it should therefore go away” (1983, p. 255).

These accounts of the tactics parents employ to regulate the development of metagu betray a complex interaction between biological and cultural factors. It is well established that children possess an “innate” aversion to strangers and that, as toddlers, they will look to their parents as a “social reference” to determine whether they should approach or avoid an unfamiliar person. The Ifaluk have apparently adopted cultural practices that harness this aversive tendency in the development of metagu. As Lutz explains, the child who does not immediately display an aversive response when a

stranger enters the house has their attention drawn to the visitor in an attempt to elicit this response. If that doesn't work, parent's stage a frightening ritual that effectively enhances the threatening stimulus thereby ensuring that the appropriate affect program is engaged. It is also significant that parents proceed to use the word "metagu" profusely while the child is recoiling in fear. This practice presumably establishes a direct association in the child's mind between this term and the appropriate aversive response. Once this association has been established it could facilitate the further cognitive elaboration of metagu. On future occasions when a child encounters this term (e.g. while being instructed on how the metagu individual ought to behave) the mere mention of metagu might trigger a "somatic marker" (a low-level physiological response) in the subject which leads her to associate norm violations with a strong, negative emotional episode (Damasio, 1994). Interestingly, Lutz herself offers a similar interpretation of the socialization of metagu: "As has already been seen, Ifaluk parents encourage the prewalking child's natural aversion to strangers and, additionally, they call forward ghosts in a generally successful attempt to keep toddlers close to themselves and away from danger. Adults link the child's early developmental avoidance reaction to strangers to other dangerous situations (such as straying from the household) which the child does not yet perceive as such" (Lutz, 1983, p. 257). However, Lutz goes on to emphasize only the cultural aspects of this socialization process. A more accurate model of metagu's development ought to recognize the interaction between biological and cultural factors. Both the innate aversive response to strangers and the social norms and rituals that exploit this disposition contribute to the development of metagu.

From these two examples – guilt and metagu – we get a vivid depiction of how emotions might evolve in accordance with the predictions of a dual inheritance model. Kochanska’s study illustrates that individual genetic differences in anxiety levels of toddlers impact their susceptibility to different parenting styles. Assuming that parenting styles are transmitted socially from parent to offspring, it is easy to imagine how modifications to either the genetically or the culturally transmitted component of this phenotype might impact an individual’s fitness. In a socio-ecological context that places a premium on cooperation, say, guilt-prone individuals might enjoy a fitness advantage. This situation would select either for some combination of genetically induced anxiety and an “authoritarian” parenting style. Similarly, in Ifaluk society we can imagine that an individual who fails to develop metagu would incur the costs associated with social ostracism, for example, by encountering difficulties finding a mate or failing to receive cooperative social benefits. Thus, modifications to either an individual’s genetically induced stranger-anxiety or to the social norms and rituals that scaffold the development of metagu would have consequences on his or her fitness. With these proposals in mind, let us turn to the three objections (mentioned earlier) to dual inheritance models.

4. How emotional traits differ from complex skills

Recall that the cognitive degradation problem arose out of a sort of catch 22: The same cognitive prerequisites required for imitative learning are likely to degrade the fidelity with which a trait is culturally transmitted. This occurs, according to Sterelny, because sophisticated social learners can be expected to modify previously acquired skills in light of their individual experiences. Notice that this argument assumes that the

acquisition of the phenotype in question – a valuable skill – involves a sophisticated copying process. But in this respect emotional development differs from skill acquisition. Emotional development involves no such imitation process. Rather, these emotions are “scaffolded” by parenting norms and rituals that exert their influence long before the child has acquired the ability to reflect on her own experiences. And by the time that they reach an age of self reflection it will be too late to undo those influences without considerable effort. Therefore, cognitive degradation does not threaten the transmission of emotional phenotypes.

But perhaps this argument is a little too quick. What happens when the child matures and it becomes time for her to guide the emotional development of her own children? Dual inheritance models require that the adult reproduces the same cultural practices that were influential on her own development – people exposed to authoritarian parenting must treat their own children in a similar fashion. However, by this time the individual will possess the cognitive resources to reflect on his or her actions and to modify the relevant parenting techniques accordingly. Won't fidelity be lost?

In considering this objection it is important to become clear on why Sterelny thinks that cognitive sophistication will lead to degradation in a cultural tradition. Presumably, in the case of a social skill modification will be motivated by feedback: differences in the execution of a skill that have an identifiable bearing on its outcome will inspire an individual to make changes. I propose that people will be less likely to tinker with emotion-governing traditions for two reasons. Firstly, in the case of emotional development there is a significant time delay (a matter of several years) between the point where a parenting strategy begins to be employed and the time when it manifests itself in

the offspring's behaviour. Children begin to encounter a particular parenting at infancy, they do not develop full-blown guilt until after age five. With such time lag, it will be difficult for an individual to develop hypotheses about which aspects of their parenting impacted their children's emotional development in a particular fashion. The feedback process is just too slow to be amenable to trial and error. Second, connections between a parenting tactic or ritual and its impact on emotional development are often non-rational and contrary to folk-psychological expectations. Who would have expected that perspective-taking would lead to *lower* than average guilt levels in anxious children? Non-rational connections between cultural practices and their developmental outcomes make the parenting process difficult to anticipate and therefore less likely to be tinkered with. Of course, this doesn't mean that some modifications won't occur. Some people will come up with novel ideas about how their children should be raised that will impact emotional development. But these changes will be effectively random, on par with random genetic mutations.

The maladaptive meme problem also seems less likely to arise in the case of emotion-governing traditions. Recall that the threat of a maladaptive cultural tradition spreading virus-like through a population is made possible by the existence of horizontal and oblique transfer. The more horizontal transmission taking place in a system the greater the threat. When it comes to cultural traits that require sophisticated cognition for their acquisition, horizontal transmission seems likely because by the time an individual is in position to acquire them (when he or she has the requisite motivation, coordination, attention span, etc.) se will be interacting with numerous adults and peers in the community. By contrast, emotional dispositions are laid down before most children

have left the home or had much exposure to people besides their parents. Therefore, emotionally significant traditions will be more likely follow a lateral (parent to offspring) pattern of inheritance. So long as the transmission process occurs with reasonably high fidelity, emotional traits will evolve in ways that benefit individual lineages. For similar reasons the expensive information problem does not arise in the case of emotion-governing practices. If parents' influence is restricted primarily to their own children, the fitness costs associated with teaching a "good idea" to a non-kin member do not arise. Nor is it necessary to appeal to group selection to explain how adaptive emotional traditions evolve.

5. Conclusion

Emotional traits resemble complex survival skills in their complexity and in their apparent adaptive value. The practices and rituals that regulate emotional development are unlikely to have sprung de novo out of the mind of some insightful individual. It is more likely that these traits evolved over successive generations by a process of gradual selection. Dual inheritance models provide an explanation of how such culturally influenced traits might have evolved. Examples of emotional development reveal that guilt, shame, and most likely many of the other "complex" human emotions develop out of innate dispositions which are cognitively elaborated through their interaction with culturally sustained practices. Adaptive modifications to either the genetic or the culturally transmitted component of these complex traits could potentially be favored by natural selection. Emotions are unlike complex skills, however, in that their acquisition does not involve a template-copying process. Thus, complex cognitive skills like

imitation learning are not required for their acquisition. And once an emotional disposition has been acquired it will remain relatively impervious to modification. Nor will agents be motivated to tinker with the social scaffolding apparatus required for the development of an emotion, because the significant time lag between cultural cause and emotional effect plus the non-rational nature of these developmental systems make them difficult to reverse engineer. Therefore, the cultural component of an emotion should be transmitted with relatively high fidelity. The fact that these practices and rituals exert their influence on children while they are still under the primary influence of their parents ensures that cultural transmission will primarily be from parent to offspring. This is precisely what is required for a dual inheritance system to operate effectively.

Bibliography

- Avital, E. & Jablonka, E. (2000) *Animal Traditions: Behavioural Inheritance in Evolution*. Cambridge, UK: Cambridge University Press.
- Boyd, R. & Richerson, P. (2004) *Not by Genes Alone: How Culture Transformed Human Evolution*. University of Chicago Press.
- Bretherton, I., Fritz, J., Zahn-Waxler, C., & Ridgeway, D. (1986) Learning to talk about emotions: A functionalist perspective. *Child Development*, 57: 529-548.
- Damasio, A. R. (1994) *Descartes' Error: Emotion, Reason and the Human Brain*. New York: Gosset/ Putnam.
- Kochanska, G. (1991) "Socialization and temperament in the development of guilt and conscience". *Child Development*, 62: 1379-1392.
- Lutz, C. (1983) "Parental goals, ethnopsychology and the development of emotional meaning". *Ethos*, 11(4):246-262.
- Prinz, J. (2004) *Gut Reactions: A Perceptual Theory of Emotion*. New York: Oxford University Press.
- Sterelny, K (2003) *Thought in a Hostile World: The Evolution of Human Cognition*. Oxford University Press.
- Sterelny, K. (2004) "The evolution and evolvability of culture" forthcoming in Dennis Walsh (ed) *Twenty five Years of Spandrels*, Oxford University Press.
- Zahn-Waxler, C. (1992) Development of concern for others. *Developmental Psychology*, 23: 126-136.