Parallels between the Evolution and Development of Higher-Cognitive Emotions

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Overview

Five major themes:

The evolution of higher-cognitive emotions

The development of higher-cognitive emotions

The evolutionary persistence problem

The developmental persistence problem

Serial homology as a solution to the persistence problems

Phylogenetic relations between basic and higher-cognitive emotions.

There is a long-standing tradition of drawing a sharp division between 'basic emotions' (BEs) and 'higher-cognitive emotions' (HCEs), an umbrella term to cover what have been variously called:

- Social emotions
- Self-conscious emotions
- Secondary emotions
- Higher-order emotions
- Moral emotions
- Intellectual emotions
- Aesthetic emotions
- Etc.

Basic Emotions:

Affect Programs: fear, anger, joy, disgust, etc.

- evolutionarily old
- shared with nonhuman mammals
- stereotyped physiological responses
- stereotyped behavioral responses
- rooted in dedicated neural circuits
- have a genetic basis that has evolved in response to recurrent evolutionary challenges,
- capable of being activated by unconditioned stimuli
- lead to unconditioned, involuntary responses of brief durations
- modular--neither the unconditioned stimuli that evoke them, nor the resulting responses are susceptible to the influence of more newly evolved higher cognitive processes
- appear early in development

Higher-cognitive Emotions

- evolutionarily recent
- uniquely human
- lack stereotyped physiological responses
- involve flexible behavioral responses
- rely on distributed patterns of more ‘general purpose’ neural activity
- lack a genetic basis
- culturally variable
- lack simple elicitors
- require higher cognitive capacities to elicit them
- potentially of long durations
- both the stimuli that evoke them, and the resulting responses are susceptible to the influence of more newly evolved higher socio-cognitive processes
- appear late in development

Phylogenetic relations between basic and higher-cognitive emotions.

Types of higher cognition:

Causal reasoning
Logical reasoning
Means-end reasoning
Language
Imitation

Given that emotions like shame and pride are "self-conscious emotions", there is a special emphasis on various forms of social cognition, such as

Self-reflection
Internalization of norms
Cooperation
Theory of Mind

Phylogenetic relations between basic and higher-cognitive emotions.

However, at least as far back as Darwin there is a tradition of trying to situate these emotions within an evolutionary context, and this tradition has been revived in recent years with the rise of evolutionary psychology, anthropology, etc.

> Of all the…complex emotions, pride, perhaps, is the most plainly expressed…A proud man exhibits his superiority over others by holding his head and body erect. He…makes himself appear as large as possible; so that metaphorically he is said to be swollen or puffed up with pride. (Darwin 1872: 263)

While I agree that there are indeed higher-cognitive forms of the emotions under consideration I, and a number of other authors have argued that many higher-cognitive emotions have evolutionarily ancient 'basic forms' that possess the features characteristic of basic emotions, and that their 'higher-cognitive forms' (despite undergoing significant transformations) are homologous to these basic forms, and retain many of their features.

Phylogenetic relations between basic and higher-cognitive emotions.

In other words, basic forms of these emotions:

- May be evoked by ***cognitively simple elicitors.***
- Have ***characteristic expressive and behavioral features*** across both species and cultures.
- Have ***characteristic physiological responses.***
- Have ***distinctive affective and cognitive sequalae.***
- Have ***distinctive phenomenological qualities.***
- Have ***characteristic patterns of neural activity.***

All of these features are often denied to HCEs

Phylogenetic relations between basic and higher-cognitive emotions.

Disgust: Initially a basic emotion calibrated to avoid ingestion or contact with toxins and parasites, was co-opted (via natural or cultural selection) to play other functions.

Sexual disgust: functions to avoid mating with incompatible, infected, or low-fitness partners; fluctuates according to reproductive status in females.

Moral disgust: functions to stigmatize and exclude norm violators, especially with respect to disgust-relevant violations (sexual acts, bloody violence, exploitation and social parasitism…).

Intergroup disgust: functions to solidify in-group relations and avoid, denigrate (or, alas, exterminate) outgroup members posing a perceived threat.

Phylogenetic relations between basic and higher-cognitive emotions.

Again, the different forms of disgust have retained the features of primary disgust:

expression
behavior
physiology
neural basis
and so on…

This presents a strong case for homology between these forms.

Nevertheless, by all appearances, and on most accounts, ***simpler forms of disgust continue to exist and function relatively independently alongside the other forms***.

Phylogenetic relations between basic and higher-cognitive emotions.

Shame:

shrinking posture
gaze aversion
face cover
flight
bent kneed gait
avoiding social contact
hiding

Phylogenetic relations between basic and higher-cognitive emotions.

Pride:

expansive posture
head held high
small smile
chest out
shoulders back and squared
arms raised in fists (crossed, on hips)

Phylogenetic relations between basic and higher-cognitive emotions.

No Shame

Phylogenetic relations between basic and higher-cognitive emotions.

These expressive and behavioral features are morphologically similar to the responses seen in other animals in situations involving dominance and submission, and function in similar ways in dominance-based social dynamics to express appeasement or superiority.

In virtue of possessing such basic elicitors, behavioral responses and social functions (as well as physiological, neural, etc. features) these forms of shame and pride meet the criteria for consideration as basic emotions in other animals.

Furthermore, the robust similarities between humans and animals in these respects makes it highly likely that these responses in humans are homologous to those of simpler organisms, and bear clear marks of this history.

Phylogenetic relations between basic and higher-cognitive emotions.

Human social dynamics continue to involve (relatively) simple dominance-based hierarchies, and ***the forms and functions of basic forms of shame and pride persist in these contexts***.

For example, humans continue to show prototypical shame responses simply as a result of being in the presence of a higher-ranking individual, and to show pride responses as a result of attaining physical dominance.

Phylogenetic relations between basic and higher-cognitive emotions.

However, in humans the functional breadth of shame and pride have expanded in a number of ways in response to uniquely human cognitive capacities and social dynamics:

For example, the basis for ranking within a hierarchy has expanded and shifted from dominance (coercive power) to ***prestige competitions*** (involving the attraction of positive social attention, and the possession of socially valued traits or materials) and shame and pride have come to be associated with losing or winning in such prestige competitions.

Phylogenetic relations between basic and higher-cognitive emotions.

Prestige (Henrich and Gil-White, 2001):

A form of status resulting from freely conferred deference, which evolved in order to facilitate the transmission of information by cultural exchange. Prestige involves 'nonagonistic exchange between individuals with differing assets, skills or resources' in which social learners show deference towards successful individuals in order to gain proximity and the opportunity to emulate and acquire information relevant to their success.

Full blown prestige dynamics require capacities for:

skill-ranking of conspecifics

discriminatory deference

info-copying (minimally, true imitation)

Phylogenetic relations between basic and higher-cognitive emotions.

Although shame and pride have become more complex, and expanded their functional roles as a result of social and cognitive changes, their physiological, expressive, and behavioral effects have been largely conserved in these more complex forms.

Individuals involved in shame- or pride-relevant situations involving prestige competitions still show the behavioral, physiological, etc. responses associated with basic shame and pride, (even when this is maladaptive or nonadaptive—a crucial factor for recognizing homologies).

Thus, some central elements of basic shame and pride are conserved in their higher-cognitive forms, and appear to also play an adaptive role in the newly emerging prestige contexts.

Phylogenetic relations between basic and higher-cognitive emotions.

Recalling Remane's criteria for recognizing homologies, a strong case for homologizing basic shame with higher-cognitive shame emerges. The characteristic features of basic shame (including the physiological, behavioral, expressive, psychological and social features found in basic shame) are conserved in higher-cognitive shame.

—

Phylogenetic relations between basic and higher-cognitive emotions.

These features are complex, as well as distinct and specialized to pride and shame; i.e., they possess ***special qualities***.

They play similar functional roles in higher-cognitive shame at each of their respective organizational levels, and in relation to one another, supporting a claim of ***"positional" or functional similarity***. While the functional roles of higher-cognitive pride and shame are broader than those of basic pride and shame, these functions remain centered around the same general themes, and have altered to the extent and in the direction that these themes have developed in humans.

Furthermore, the integration of more basic pride and shame with newly evolved cognitive abilities appears not to have happened all at once in humans, but rather to the degree that a given species possesses these capacities. Higher primates, e.g., possess more sophisticated cognitive abilities than rats (including at least a rudimentary TOM), and these abilities are reflected in the increased range and complexity of their affective responses, pointing to an ***evolutionary continuity*** between basic and higher-cognitive pride and shame.

They also have shared developmental mechanisms which I address below.

The Persistence Problem

One fact that is especially relevant for present purposes is the fact that *the basic forms of these emotions appear to persist independently to some degree, alongside their higher cognitive forms, and function largely as they originally did*!

For example, Fessler notes that adult humans still show shame responses simply by being in the presence of a higher ranking individual.

Furthermore, some of the responses involved in such emotions are divergent or even opposing.

I have called this the ‘persistence problem’.

The Persistence Problem

This problem is well illustrated by the evolutionary account of pride offered by Shariff, Tracy, Henrich and Cheng (2010).

Tracy, et al. argue that pride in humans is homologous with a more basic emotion in apes.

On this view, humans possess two 'types' of pride:

Hubristic Pride (HP): associated with dominance-based status.

Authentic Pride (AP): associated with prestige-based status.

The Persistence Problem

According to Tracy et al. HP and AP are not distinct emotions, but rather two 'facets' of

a single emotion, sharing a common, indistinguishable expression, and overlapping in other respects e.g., in lexical classification and appraisal structure.

Despite these similarities, HP and AP diverge significantly with respect to:

personality correlates

behavioral and social dynamics

finer grained appraisal structure

finer grained lexical associations

physiological variables

phenomenology

The Persistence Problem

These two distinct forms of status are attained through divergent behavioral patterns, and claim that HP and AP were selected for in response to distinct evolutionary pressures to attain distinct forms of high status:

HP evolved to motivate the attainment of dominance.

AP evolved to motivate the attainment of prestige.

The Persistence Problem

This suggests the possibility that:

HP evolved first within the primate lineage as a means of navigating dominance-based status hierarchies.

With the rise of prestige hierarchies and uniquely human cognitive capacities, HP was modified to facilitate and communicate prestige-based status, resulting in AP.

However, given that dominance hierarchies continue to play an important role in human societies, the forms and functions of HP are retained in humans.

So what is the phylogenetic relationship between AP and HP?

The Persistence Problem

Transformational homology (Single-trait Homology, Refinement): An ancestral trait is transformed into a derived trait via a continuous series of modifications. The ancestral and derived traits are still the "same trait", but the original trait no longer exists in its ancestral form.

The standard solution in emotion research: Ancestral traits do not continue to persist independently. Instead, what we have is a single-trait with an expanded set of elicitors and behavioral responses.

The Serial Homology Solution

This is a potentially viable solution.

However, to the extent that these forms require the mobilization of different, even conflicting resources, and result in different, often opposing consequences, the standard solution seems problematic.

An interpretation of the relationships between such forms in terms of serial homology avoids this problem:

The ancestral emotions are duplicated and the duplicates are allowed to vary in response to new contexts and selective pressures.

Serial Homology: Duplication and Variation

"I wrote a screen play, but the editor said

I had to rewrite it.

Serial Homology: Duplication and Variation

"I wrote a screen play, but the editor said

I had to rewrite it.

I said f--- that, I'll just make a copy"

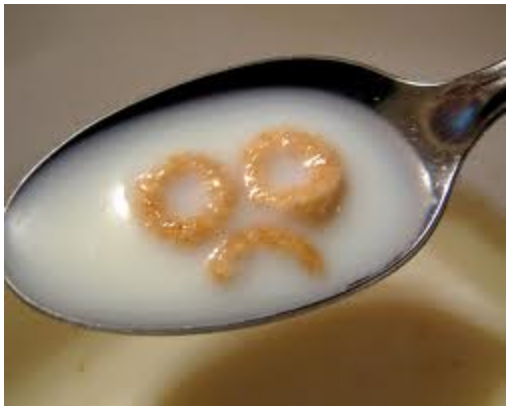
Serial Homology

In serial homology, a trait is duplicated within a single organism; e.g., the vertebrae of the spine are serial homologues of one another. The ancestral trait intitially remains present in its original form and function.

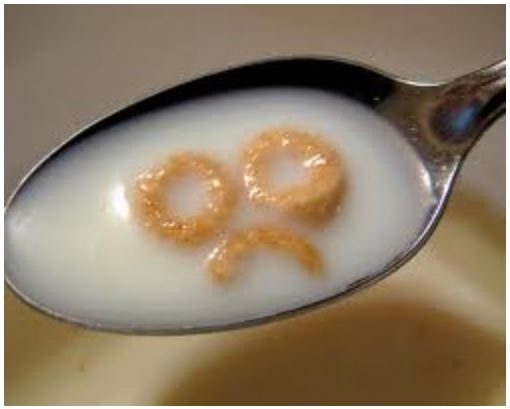
The duplicated trait can either augment the function of the original, or else may diverge from the original at multiple levels as a result of differences from the original trait in its spatial, temporal, functional, etc. contexts.

This is a feature referred to as 'heterotropy' or 'heterochrony'—the insertion of a trait
into a spatial, temporal or functional context different from its original context.

Cereal Homology:
Augmentation of Function



Cereal Homology:
Augmentation of Function



Cereal Homology:
Duplication and Variation

Serial Homology:
Duplication and Variation

Serial Homology

These differences in context can result in divergent developmental and evolutionary paths for the original trait and the duplicate as a result of differences in context or selective pressures.

Thus, serial homology can act as a mechanism of evolutionary novelty since the duplicated trait can vary its function within the new context, without disturbing the function of the original trait, thus avoiding some of the theoretical problems associated with ‘repairing the boat at sea’, or ‘jumping between local fitness peaks’ associated with the modification of a single, existing functional trait.

Serial Homology: Problems, Solutions and Possibilities

This could result in duplication and transformations of the emotion in numerous ways at numerous levels:

expressive displays
behavioral responses
physiological responses
neural connectivity and function
cognitive features
phenomenology
personality correlates

At one extreme—single features (e.g., expression) alone are duplicated.

At the other extreme—the entire emotion is duplicated.

(And every piecemeal, decompositional possibility in between…)

Serial Homology: Problems, Solutions and Possibilities

An intriguing experiment by Stammbach (1988):

> Specially trained low-ranking macaques were the only members of the group capable of manipulating a machine to attain food. In virtue of such skills even higher-ranked members began to show them deferential access to resources, and displayed increased affiliative behaviors towards them, such as proximity maintenance and grooming. *The dominance-based rank of the subordinate did not change as a result*.
>
> (This illustrates the previous point that many nonhumans possess two specific precursors for prestige processes: (1) skill ranking of conspecifics, and (2) discriminatory deference.)

Serial Homology: Problems, Solutions and Possibilities

However, deference and affiliation are two key ways in which prestige-based status differs from dominance, and the increase in such behaviors toward the individual suggest that they possessed a precursor form of prestige-based status.

Importantly:

> This early form of prestige existed side-by-side with dominance-based status. It is easy to imagine that here or at some nearby point in evolution, individuals began experiencing and expressing an existing dominance-related emotion in response to nondominance-based forms of status.

Serial Homology: Problems, Solutions and Possibilities

Here, the originally dominance-related emotion might begin to be expressed in proto-prestige contexts. With increasing reliance on prestige-based status dynamics, the emotion may then be transformed in response to its new context(s), under the influence of distinct selective pressures. But the original dominance-related responses remain in place and function largely as before in its original context.

The lack of need to dominate others to attain status, and the more affiliative social consequences of such achievements may eliminate the need for aggressive components of the dominance response.

Serial Homology: Problems, Solutions and Possibilities

This is a highly speculative just-so story, and the example is here meant to be primarily suggestive!

However, there may be ways to begin to test it by replicating Stammbach's experiment:

(i) with an increased reliance of the group on skilled individuals.

(ii) over a longer time period.

(iii) with chimps or bonobos (who do possess imitation abilities).

Ontogenetic relations between basic and higher-cognitive emotions

Given the phylogenetic arguments, we can turn towards developmental theories of emotions to see whether they can be used to support a strong BE/HCE distinction, or whether the evidence supports a the claims of homology advanced in the phylogenetic argument ,and vice versa.

The usual argument for a sharp distinction based on developmental evidence has at least three main claims:

(1) HCEs develop later than BEs

(2) HCEs appear only after the emergence of higher cognition

(3) HCEs differ from BEs in that they are primarily constituted by higher cognition, without many of the other features of BEs (e.g., physiological responses).

Ontogenetic relations between basic and higher-cognitive emotions

If these claims are true, that would seem to support the sharp distinction, since it indicates a dependence relation between HCEs and higher cognition, suggesting that HCEs also could not emerge in phylogeny prior to the evolution of these capacities.

In contrast, what would we expect to see if the HCEs in question have more basic forms?

(1) Basic forms of HCEs should emerge around the same time as other BEs.

(2) These basic forms should precede the emergence of uniquely human cognition (although this is complicated by the possibility of heterochrony).

(3) While HCEs may involve higher-cognition in a way that BEs do not, they are not primarily constituted by such higher cognition, but also involve many features of the basic forms from which they develop.

Ontogenetic relations between basic and higher-cognitive emotions

There are many other questions and potential pitfalls that arise when asking how we Should expect phylogenetic relations between traits to be reflected in development.

For example, while we expect the timing of such a progression to roughly map onto the phylogenetic progression in certain broad aspects, we should probably avoid looking for simple recapitulation of phylogeny in ontogeny.

Jonas Langer "The Heterochronic Evolution of Primate Cognitive Development"

Also, a true consideration of the implications of development for evolutionary inferences would require a comparative analysis of human and primate developmental patterns. There is very little research on primate emotional development (even BEs), and virtually none on the development of dominance and submission behaviors. Compared to cognition, there is very little research on development of HCEs.

Prior to direct experimental work, we will need try to use what is known
About cognitive development to extract some general principles that also apply to emotional development.

Jonas Langer "The Heterochronic Evolution of Primate Cognitive Development"

I hope to return to this issue briefly below, but the claims above impose only minimal constraints on the relationships between phylogeny and ontogeny.

Ontogenetic relations between basic and higher-cognitive emotions

Cognitive Developmental Theories (CDT) (Lewis, Sroufe, Stipek, et al.)

VS.

Early Emergence Theories (EET) (Trevarthen, Schore, Reddy, Draghi-Lorenz, et al.)

(1) The age at which various forms of self-cognition and social dynamics emerge.

(2) The nature of self cognition (cognitive or emotional?).

(2) The causal direction of developmental influences between emotions and cognition.

(3) The use of cognitive developmental landmarks to classify emotions, rather than vice versa.

(4) When it is appropriate to apply terms like ‘pride’ and ‘shame’ to animals, infants or toddlers.

Ontogenetic relations between basic and higher-cognitive emotions

Many of these differences are semantic, though not trivially so! For example, do we call simple forms of pride "joy in causal efficacy" or "proto-pride" or "dominance", or just "pride"?

Here I want to focus on seven points that most developmental theorists of emotions on both sides of the debate agree upon.

Ontogenetic relations between basic and higher-cognitive emotions

(1) *Adult human forms of HCEs arise from developmentally earlier and simpler precursors.*

Mascolo and Fischer offer a multi-stage account of the development of pride in terms of 'dynamic skills theory', the first four of which are important for the present debate:

P1: joy about simple action-outcome contingencies (7-8 mos.)

P2: joy about complex action-outcome contingencies including other's evaluation (11-13 mos.)

P3: joy/pride about result caused by self (18-24 mos.)

P4: pride about result caused by performing well (2-3 yrs.)

Ontogenetic relations between basic and higher-cognitive emotions

(2) *Adult human forms of HCEs retain and redeploy many features of their BE forms.*

Moral disgust involves the same facial and expressive characteristics, physiology, etc. with more basic forms of disgust.

Ontogenetic relations between basic and higher-cognitive emotions

(3) Adult human forms of HCEs are sufficiently distinct from those of children and animals that we want a means of marking this distinction.

"To accurately describe the ontogenesis of the various emotions…it is necessary to consider both continuity and discontinuity…**No emotion suddenly appears full-blown in humans…At the same time there are qualitative changes in emotion… that relect reorganizations in psychological development**. Whether on wishes to call the greeting reactions of the 10 mo. old "joy", or the aversive reactions of the 10 mo. old "fear" they are qualitatively different from earlier expressions of positive and negative affect". (Sroufe)

Ontogenetic relations between basic and higher-cognitive emotions

(4) *HCEs are highly and essentially socially scaffolded.*

Mascolo and Harkins also emphasize the role of "emotional scaffolding" in the development of pride.

Emotional scaffolding for pride consists in such things as encouragement and emotional displays from the parent before and after a task, guiding the child's behavior and emotional reactions. They found that the pride exhibited by scaffolded children is more complex than it could be on its own, that early manifestations of pride-behavior in children were more dependent on parental scaffolding for their presence and complexity than later ones, and that parents gradually provide fewer emotional cues as children begin to exhibit pride autonomously

Ontogenetic relations between basic and higher-cognitive emotions

(5) *HCEs are not asymmetrically dependent on higher cognition. Instead the emotions and cognitive capacities associated with HCEs bootstrap and reinforce one another. Emotions serve to highlight various socio-cognitive judgments (etc.) and to subject them to further and more extensive processing than nonemotional instances of these phenomena. In this way they propel the devcelopment of such cognitive caqpacities.*

"[M]any theorists believe that shame and guilt become possible only after the child has meta-awareness of self. It is my position that shame and guilt are highly important influences on the *development* of such awareness. (Barrett)

Reddy argues that the direction of effect and chronological sequence is precisely the opposite of the typical view, claiming that "self-consciousness is, in the first instance, not an idea, but an emotion" and that such emotions provide the basis for the relevant cognitive capacities.

"…emotion gives rise to thoughts about emotions that, in turn, give rise to the objectification of the self, and to the new SC emotions." (Lewis)

Ontogenetic relations between basic and higher-cognitive emotions

(6) *HCEs emerge according to a consistent timetable. They are thus likely to rely on stable evolved genetic and developmental mechanisms.*

"Based on simple biological principles principles, there is no reason to assume that because something emerges later it is less biologically central than something that emerges later" (Lewis)

"…if shame and pride are also universal, adaptive, and accompanied by functional physiological or endocrine responses, as accumulating evidence seems to indicate, then they may also meet the criteria for good exemplars of Bes." (Lewis)

"It is difficult to imagine that we 'learn' shame. While we may learn about the elicitors of these emotions or about what responses are culturally appropriate, the emotion itself is not learned." (Lewis)

Ontogenetic relations between basic and higher-cognitive emotions

Note that the above points of agreement broadly support the phylogenetic argument and vice versa:

BE forms of HCEs arise prior to, and in tandem with the higher-cognition involved in HCE forms in development and undergo a series of transformations in which the BE forms provide the material for later forms via shared developmental mechanisms. We may thus say that they are developmental homologues, or "homologous at the developmental level".

But exactly what "kind" of homology is involved?

Serial homologies in development

(7) *Earlier, simpler emotional capacities are not lost in the process of transformation, but are retained as such alongside the later, more complex forms.*

"I should like to propose that SRGs and objective self-awareness interact with the exposed SC emotions and transform them into the evaluative SC emotions I have been discussing. This transformational process uses the exposure emotions, but in the developmental process these emotions are not destroyed. This material transformation allows for the material of early structures to be utilized but not converted in the process. in this way, *both* exposure and evaluative emotions appear at the next level…In such a transformation, embarrassment becomes the material for shame." (Lewis)

"While I present these modes [of self] as an ontogenetic sequence, it is important to remember that the end result is the existence of all modes in the adult..Thus as the child develops new and different modes of self, earlier modes continue to exist." (Lewis)

"…because these three ways of knowing the self are **nontransformable**, all three modes are avilable to adults." (Lewis)

Serial homologies in development

And here we come full circle to the persistence problem, development-style.

If the emotions at early stages of development are conserved in the adult emotional repertoire, and if the elicitors, expressions, behavioral responses, etc. are in some cases incompatible or opposing, then there is a strong pressure to consider them as separate emotions

On the other hand, given the strong similarities between the different forms, we also want to say that they are in some sense the "same" emotions.

Again, serial homology provides the basis for an account of these emotions as "the same but different".

Serial Homology: Problems, Solutions and Possibilities

Any theory of serial homologies of psychological traits must provide an account of the neural basis of such processes. How might this be done?

(1) Anatomical duplication of neural structures?

This is possible in some cases; e.g., duplication of cortical layers and spatial/motor maps in the brain. But such duplications appear to be rare, and in any case, this cannot be a general, fundamental process underlying serial homologies of psychological traits, for obvious reasons—brain size is under tight evolutionary constraints, and is already maxed out.

However, recall that homologues may coincide or diverge at multiple levels. Here this means that serially homologous psychological traits need not have the same neural (or any other) basis.

Serial Homology: Problems, Solutions and Possibilities

(2) Duplicated via functional migration (encephalization)?

Functions originally mediated by one, usually 'lower' brain structure are duplicated in other, usually 'higher' regions of the brain (frequently as stabilizing redundancy). The higher area may subsequently take over and/or modify the function of the lower regions, often resulting in rewiring of the lower area.

This is also a possibility; e.g., the relationships between the amygdala and other subcortical emotional structures and orbitofrontal cortex. However, again, this may be relatively uncommon.

Serial Homology: Problems, Solutions and Possibilities

(3) Neural re-use (exploitation, recycling, redeployment, sharing, etc.):

Brain regions can continue to acquire new uses after an initial or original function is established. The acquisition of new uses need not involve much local change to circuit structure (e.g., it might involve only the establishment of functional connections to new neural partners), although such changes are possible.

Neural re-use that preserves a region's original anatomy or function is essentially a form of serial homology.

THIS IS WHERE IT'S AT!

Another problem specific to the serial homology claims being made here for emotions is how to differentiate cases of serial homology from expansion views using transformational homology.

Consider the case of fear.

Fear (like the forms of shame, pride and disgust reviewed above) can result in radically different, even opposing behaviors depending on features of the elicitor and the context.

Freezing, fleeing, and fighting are responses that are incompatible with one another. They also differ with respect to their physiological concomitants: e.g., freezing is accompanied by bradycardia, whereas fleeing and fighting are associated with tachycardia.

Given that fear is typically considered to be a single emotion, why should we take multifunctionality as a reason for postulating two serially homologous traits?

There are several possible responses to this challenge:

(1) There is nothing in the serial homology view that rules out the possibility of a single emotion with multifunctionality. The fact that an emotion exhibits such opposing features is taken as one piece of evidence for a serial homology view, but is not by itself conclusive.

(2) Perhaps fear should be split into distinct subtypes. It is unlikely that any of our vernacular emotion categories will pick out a simple unified emotion. The final analysis for most emotions will probably resemble the sort of splitting that has occurred relative to the concept of "aggression", which has fractured into a number of sub-types with different mechanisms and task demands; e.g., predatory aggression, maternal aggression, defensive aggression, etc. As discussed above, disgust is another example of an emotion that is increasingly seen as having a number of distinct forms. The result of such a splitting might result in a number of single emotions, each with more restricted features, in which case the example of fear as a single multifunctional emotion would no longer apply.

(3) The different features of fear do not appear to be evolutionarily layered in the way that the features of shame, pride and disgust are layered; i.e., all of the fear elicitors and responses above seem to be situated at the same level of phylogeny.

Relatedly, the multifunctionality of fear does not appear to have resulted from the integration of simpler responses with newly emerging behavioral, psychological or social capacities. The multiple elicitors of fear as well as the responses to them do not require any new capacities—animals presumably had the capacity to judge the distance of a threat and the possibilities for escape, as well as the behavioral capacities to monitor, freeze, flee or fight, from a very early stage of evolution.

While it is possible (indeed likely) that there are 'higher-cognitive forms' of fear that do involve such integration with novel capacities, I know of no evidence to suggest that the capacities associated with the basic forms of fear under consideration emerged at different stages of evolution, with later forms co-opting the features of earlier forms.

(4) The different aspeects of basic fear under consideration show neither a developmental progression, nor the developmental persistence of early emotions alongside the later emerging forms. As in the evolutionary responses above, the development of basic fear does not appear to involve integration with later-emerging psychological or social capacities.

Homology

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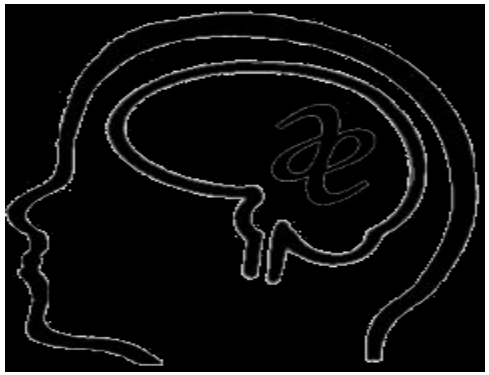

Jonas Langer “The Heterochronic Evolution of Primate Cognitive Development”

Logicomathematical cognition: knowledge about necessary qualitative (e.g., class) and quantitative (e.g., numeric) relations.

Physical cognition: knowledge about contingent causal, object, spatial, and temporal relations.

Diverging ontogenetic onset and offset ages, developmental velocity, discontinuous developmental extent, stage sequencing, and structural organization.