Motivation, Emotion, and Personality: Steps to an Evolutionary Synthesis

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Abstract

In this chapter, I present an emerging evolutionary framework for motivation, emotion, and personality. The framework is composed of three "layers", each building on the previous ones: (1) a theory of *motivational systems*; (2) an *extended coordination approach* to emotion, which describes a hierarchy of coordination mechanisms, from emotions to motivational systems to moods; and (3) the *General Architecture of Motivation* (GAM)—an abstract model of the mechanisms that underlie motivation and their functional relations, designed to serve as a conceptual foundation for models of human and animal personality. As I describe the main features and assumptions of the framework, I compare and contrast it with Carol Dweck's alternative proposal for unification, which is similar in scope and direction but based on partially different premises. A coherent, realistic model of motivation is an invaluable asset, not only in basic research but also in clinical psychology and psychotherapy. I believe that an evolutionary synthesis is within reach, and hope that the approach presented in this chapter will foster integration across disciplines and research traditions.

Motivation is one of the deepest unifying concepts in psychology—the burning center where cognition, development, and behavior get their purpose and direction. Without motivation, models of the mind devolve into sterile abstractions, and making sense of mental suffering becomes an impossible task. This is why I am excited to see that different strands of psychology and neuroscience are increasingly converging on motivation as a key organizing construct. In affective science, *motivational theories* that frame emotions in terms of goals and action tendencies are becoming increasingly prominent (Scarantino, in press). In the field of personality, researchers are striving to move beyond structural trait models (such as the *Five-Factor Model*, often referred to as the "Big Five"; McCrae & Costa, 2003) and toward a functional understanding of the processes that give rise to stable individual differences in cognition, emotion, and behavior (see Baumert et al., 2017; Rauthmann, 2021). In doing so, they are rediscovering the central role of motivational mechanisms, in line with modern neurobiology (e.g., Corr, 2008; Davis & Panksepp, 2018; Gray & McNaughton, 2000; McNaughton et al., 2016) but also in the spirit of classical personality theory (e.g., Cattell, 1957; Murray, 1938).

This shifting *zeitgeist* is inspiring bold attempts at synthesis that center around motivational concepts (e.g., Goel, 2022). One particularly interesting example is Carol Dweck's proposal for a unified theory of motivation, personality, and development (Dweck, 2017). In her paper, Dweck laid out a taxonomy of innate psychological needs, and argued that needs are turned into active goals via representations that connect goal-relevant beliefs, emotions, and action tendencies (BEATs). She further proposed that individual differences in key BEATs are the functional basis of Big Five personality traits (Agreeableness, Conscientiousness, Neuroticism, Extraversion, and Openness to experience). As needs fluctuate and combine throughout development according to a biological maturation schedule, BEATs are formed in response to the person's experiences, which in turn can be modulated by genetic predispositions that affect the strength and salience of particular needs.

Dweck's 2017 paper is noteworthy because it asks four crucial questions that, I believe, are exactly on target: (a) what are our evolved biological motivations, and how can we identify them? (b) How do evolved motivations connect to the specific, represented goals that guide a person's actions? (c) What is the role of emotions in this process? And (d) how can we use the resulting theory of motivation to rebuild personality theory on functional grounds? These questions point in the right direction, and the paper makes many insightful points along the way; but the answers remain unsatisfactory, and the theory lacks specificity at key junctures. It is probably not a coincidence that, despite receiving a lot of attention in the literature,[1] Dweck's proposal has yet to spark an actual research program. I see two main reasons for the theory's weaknesses. First, the treatment of innate needs is overly abstract, and based on simplistic assumptions about the evolution of psychological mechanisms. These limitations are not unique to Dweck's proposal—they are shared by other prominent accounts of motivation in psychology, such as *Self-Determination Theory* (SDT; Ryan & Deci, 2017). Second, the theory is insufficiently mechanistic; it fails to specify the functional relations between the various components of motivation in any detail, and ends up relying on complex representations (the BEATs) that do most of the interesting work. This bias toward representations also explains why the theory lacks an account of motivation as a control system—a critical lacuna, because the

[1] Google Scholar (https://scholar.google.com) returned 490 citations on April 10, 2023.

pursuit of needs and goals is essentially a problem of behavioral control (e.g., Carver & Scheier, 2013, 2014; DeYoung, 2015; Revelle & Condon, 2015).[2]

In the remainder of this chapter, I present an alternative evolutionary framework for motivation, emotion, and personality that is partly based on my recent work in this area (Del Giudice, 2018, 2023a, 2023b, 2023c). To understand the framework, it can be useful to think of it as consisting of three "layers" of theory, each building on the previous ones. The first is the theory of *motivational systems* that originated in early 20th century instinct psychology (e.g., McDougall, 1908), bloomed within ethology (Tinbergen 1951; McFarland, 1974; Toates & Archer, 1978), was brought back into psychology with the work of Bowlby (1982), Gilbert (1989), and others, and is currently being extended and refined by evolutionary psychologists (Del Giudice, 2018, 2023a; Kenrick et al., 2010; Schaller et al., 2017). The second is a theory of emotion and mood that extends the *coordination approach* laid out by Tooby and Cosmides (1990, 2008; see Al-Shawaf et al., 2016) with the inclusion of motivational systems (Del Giudice, 2023a). The third layer is the *General Architecture of Motivation* (GAM), an abstract model of the mechanisms that underlie motivation and their functional relations, specifically designed to serve as a foundation for models of human and animal personality (Del Giudice, 2023b). The GAM builds on the extended coordination approach by adding a general-purpose system for the pursuit of specific, moment-to moment goals (called "instrumental goals" to distinguish them from the innate goals of motivational systems), as well as downstream behavioral mechanisms that regulate broad tendencies toward approach and avoidance. Throughout the paper, I use Dweck's theory as a foil, noting the main points of convergence and divergence as a way to highlight the unique features of the framework.

Motivational Systems: Multiple, Interacting Sources of Biological Value

The Nature of Motivational Systems

As I mentioned in the introduction, the theory of motivational systems has a long history between psychology and biology (see Del Giudice, 2023a). Ethologists made key contributions by redescribing classical "instincts" such as feeding and mating as hierarchically organized structures of behavior (Tinbergen, 1951), and later conceptualizing them as hierarchies of control systems regulated by feedback processes (e.g., McFarland, 1974; Toates & Archer, 1978). In this perspective, motivational systems are equipped with specific goals and sub-goals, and control the sequencing of behavior through complex loops of activation and inhibition. Scott (1980) and Bowlby (1982) revised the concept from a psychological standpoint, by explicitly connecting the functioning of motivational systems to the experience of emotions. In Bowlby's formulation, the activation of a motivational system, the progress of current behavior in relation to the system's "set goal", and the eventual consequences of behavior (success vs. failure to achieve the set goal) all give rise to subjectively experienced feelings. For example, the *attachment system* in infants

[2] Note that Dweck has also coauthored some work in which motivation is explicitly analyzed from a control systems perspective (Uusberg et al., 2019). However, this more recent approach does not address the role of emotions in any detail, does not elaborate on the concept of BEATs, and has not been used to explain development or personality differences. Thus, I regard it more as an interesting but separate effort rather than a continuation or extension of the 2017 proposal.

and children has the set goal of maintaining the proximity and/or availability of the caregiver. The system is activated by perceived dangers or separations (with feelings of anxiety, fear, distress, loneliness), and successfully deactivated by the attainment of proximity and protection (with feelings of relief, comfort, and "felt security"). Lack of progress in reaching proximity can elicit anger and protest behaviors (e.g., crying, yelling), whereas protracted failure of the system leads to sadness, despair, and emotional detachment.

Bowlby's seminal model of motivation (which also included caregiving and exploration) was extended by Gilbert (1989, 1995, 2005) and others to include additional systems such as *social ranking*, *affiliation*, and *mating/sexuality*. It is important to stress that a given motivational system can embody a set of thematically related goals, rather than a single overarching goal. For instance, the goals of a system that regulates status/dominance relations include improving, maintaining, and displaying one's status, as well as deferring or submitting to higher-status individuals (e.g., Gilbert, 2005). The purposeful, goal-directed nature of motivational systems is what distinguishes them from generic "motives" or "needs" (e.g., Dweck, 2017). Crucially, the goals of motivational systems do not need to involve explicit cognitive representations of the desired outcomes; instead, they can emerge from the evolved operating rules of the system itself. For this reason, these goals may be described more precisely as "pseudo-goals" (Miceli & Castelfranchi, 2015) or "free-floating rationales" (Dennett, 2009) that are not explicitly represented anywhere in the system.

Motivational systems can embody fairly sophisticated and context-sensitive operation rules, that respond flexibly to the state of the environment and draw on internal representations and "working models" of the world (e.g., inferences about the caregiver's intentions, expectations about the caregiver's likely response, representations of the child's value to the caregiver). The representations that regulate the functioning of motivational systems are constructed from repeated interactions with motivationally relevant situations, and typically operate at an implicit level, in line with the concept of *internal regulatory variables* invoked by evolutionary theories of motivation (Tooby et al., 2008). Different systems can share certain regulatory variables (e.g., estimates of the safety and predictability of one's environment), and can reciprocally potentiate and inhibit each other's activity; for example, when the attachment system is activated it quickly suppresses play and curiosity-driven exploration (Bowlby, 1982). Finally, note that a given motivational system is not tied to a single emotion, but to a *set* of characteristic emotions (both "positive" and "negative"). Different emotions are activated depending on contextual factors, internal representations, and the consequences of the individual's actions. Moreover, the same emotion—or specialized variants of the same emotion—can be activated by more than one system with somewhat different functions; for example, one can experience anger in the context of attachment, but also in that of status competition, pair bonding (in tandem with jealousy), and a number of other domains.

These one-to-many relations between motivations and emotions differentiate the framework I am presenting from a related approach, namely, Panksepp's theory of "basic emotional systems" (Panksepp, 1998, 2005, 2011; Davis & Panksepp, 2018). Panksepp postulated the existence of specialized affective/motivational mechanisms such as RAGE, CARE, and PLAY, but linked each system to one and only one "primary emotion" or "core emotional feeling" (e.g., anger for RAGE, joy for PLAY). This narrow focus on single emotions precludes the strategic flexibility and computational richness of multi-emotion motivational systems. Another limitation of Panksepp's theory is the insistence that, to be truly "basic", emotional systems must be shared across all mammalian species. But every species faces somewhat distinctive adaptive problems, and humans have evolved complex forms of social interaction that make them unique among mammals and primates. Thus, we can be expected to possess species-specific motivational systems and emotions, as well as many specialized variations on the basic themes of mammalian motivation (Al-Shawaf et al., 2016; Aunger & Curtis, 2013).

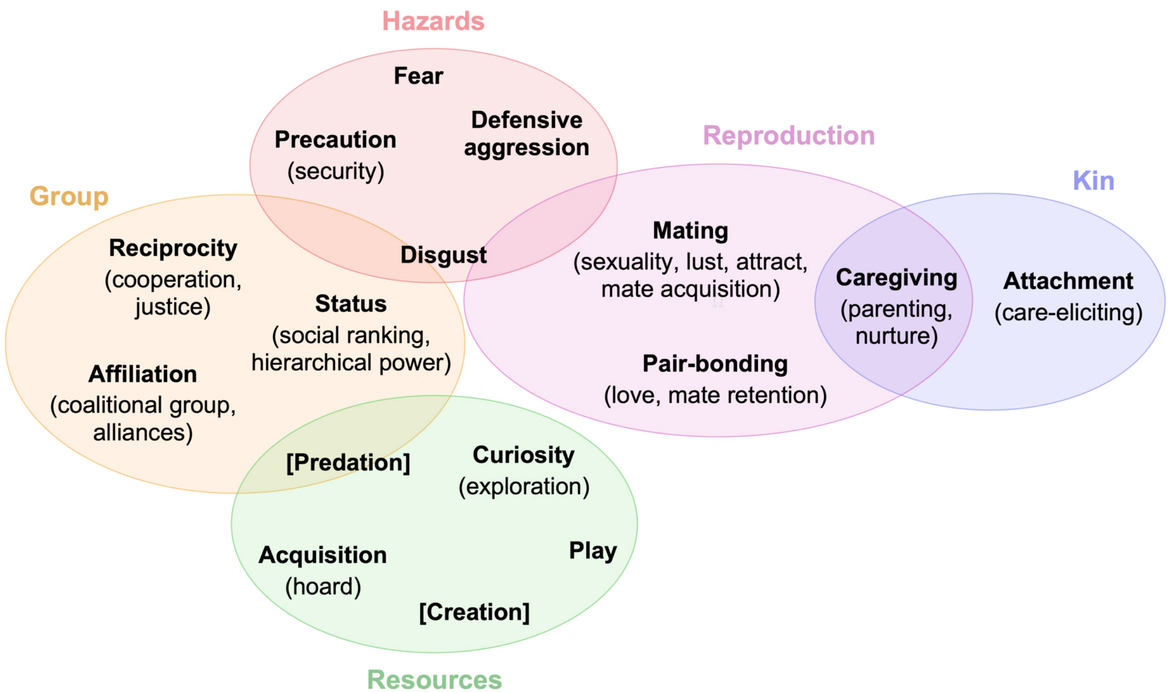

Figure 1. A partial map of human motivational systems. Some alternative labels used in the literature are shown in parentheses. The systems in square brackets are still mostly hypothetical and in need of further investigation. Note that the map does not include basic physiological needs such as hunger/thirst, evacuation, or thermoregulation. Reproduced with permission from Del Giudice (2023b).

Recent Developments of the Theory

Motivational systems have attracted quite a bit of attention in the recent evolutionary literature. Kenrick and colleagues have developed a model based on seven fundamental motives—*immediate physiological needs*, *self-protection*, *affiliation*, *status/esteem*, *mate acquisition*, *mate retention*, and *parental/kin care*, with *disease avoidance* as an additional specification of self-protection (Kenrick et al., 2010; Kenrick & Lundberg-Kenrick, 2022; Schaller et al., 2017). Other important contributions have addressed individual systems including caregiving (Brown et al., 2012; Schaller, 2018), pair-bonding (Fletcher et al., 2015), dominance and status (Anderson et al., 2015; Johnson et al., 2012), and play (Pellis et al., 2019). The work of Boyer and Liénard (2006) and Woody and Szechtman (2011) has singled out the *precaution* *system* (or *security system*), a motivational system specialized to prevent rare, potential threats and associated with anxiety and apprehension (in contrast with the fear triggered by imminent threats).

Based on this and other work (notably Aunger & Curtis, 2013), I proposed a somewhat more detailed (but still provisional) taxonomy of motivational systems, summarized in Figure 1 (Del Giudice, 2023a, 2023b). Setting aside basic physiological needs like hunger, thirst, and thermoregulation, human motivations can be parsed into five broad categories of adaptive problems: (a) prevention and avoidance of physical hazards; (b) acquisition and enhancement of resources (including "embodied" resources such as knowledge and skills); (c) mating and reproduction; (d) relations with kin; and (e) relations within and between groups. Each of these categories comprises multiple narrower problems, which in turn give rise to the biological goals pursued by specific motivational systems: *aggression*, *fear*, *precaution*, *disgust*, *status*, *affiliation*, *reciprocity*, *mating*, *pair bonding*, *attachment*, *caregiving*, *acquisition*, *curiosity* (including exploration), *play*, and—more provisionally—*predation* and *creation*. While some of these systems are associated with a single emotion (as in the case of disgust), others control a variety of positive and negative emotions (for example, status competition can evoke pride, confidence, shame, anger, etc.). For a more detailed description of these systems and the associated goals and emotions, see Del Giudice (2023a).

How Many Systems? Evolutionary Considerations

Questions about the "right" number of constructs (instincts, needs, motivational systems…) are as old as the psychology of motivation. To deal effectively with this problem, it is vital to realize that the evolution of complex biological mechanisms—including the brain—proceeds by extensive reuse, co-option, duplication, divergence, and gradual accrual of function (see e.g., Anderson, 2010 and commentaries; Barrett, 2012, 2015; McLennan, 2008; West-Eberhard, 2003). This process of "descent with modification" does not deliver neatly packaged mechanisms with simple, well-specified functions—instead, it produces overlapping mechanisms with somewhat indistinct boundaries, multiple functions, and a great deal of redundancy (Nesse, 2020). Moreover, most psychological mechanisms are composed of simpler components or sub-processes, some of which may be shared with other mechanisms. For example, pair-bonding in adults seems to recruit some of the same processes of infant and child attachment; in turn, attachment in mammals may have originally evolved out of mating-related mechanisms designed to promote the search for proximity and physical contact (Crespi, 2016; Fletcher et al., 2015; Panksepp, 1998). Figure 2 visually illustrates the contrast between a naïve, "tidy" model of how mechanisms evolve and the intricate, "messy" quality of real-world evolutionary processes.

One important implication of the above is that it may not be possible to converge on a single, unambiguous taxonomy of motivational systems; there will always be multiple defensible ways to draw boundaries between related systems, and multiple levels of resolution to describe the same processes. For example, on can legitimately describe a unitary *mating/sexuality* system (Gilbert, 2005), or distinguish between a *mate acquisition* system for sexual desire and attraction and a *mate retention* system that includes pair-bonding (Kenrick et al., 2010); this ambiguity is a predictable consequence of the organic, evolved complexity of motivational mechanisms (Nesse, 2020; see Del Giudice, 2023a).

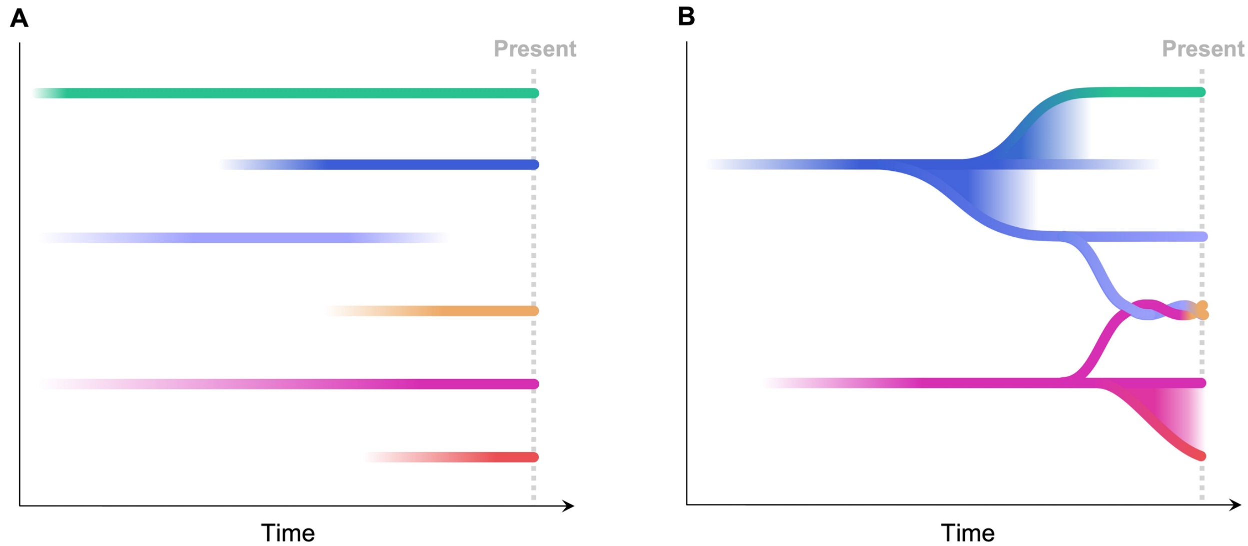

Figure 2. The contrast between (A) a naïve, "tidy" model of the evolutionary process, in which each mechanism evolves from scratch following a separate trajectory; and (B) a more realistic, "messy" model in which mechanisms evolve by extensive reuse, duplication, and divergence. In this abstract diagram, each color represents an identifiable mechanism; different vertical positions indicate different functions. Shaded areas in panel B represent periods of ongoing (incomplete) functional divergence. The twisted lines illustrate the notion that an existing mechanism can be repurposed to serve additional functions without losing the previous ones, and may combine with other mechanisms into novel, more complex functional units.

A realistic understanding of how biological mechanisms evolve suggests that the criteria used by Dweck (2017) to identify the "basic" human motives of *predictability*, *competence*, and *acceptance* are inadequate and potentially misleading. In Dweck's taxonomy, a need can be regarded as basic only if (a) it is not derivative of other motives, and (b) it is present from very early in life. But motivational systems can easily evolve through duplications, modifications and reuse of other systems, which does not mean they should be regarded as "derivative" or less fundamental. Likewise, motivations that emerge later in development (e.g., status, mating/sexuality) can be just as fundamental as those that are apparent from birth; breasts and beards are not present in infancy, but this does not make them any less biological than eyes or hair. Status and mating motivations may become more salient in middle childhood owing to specific maturation events (with a likely role for adrenal androgens; see Del Giudice, 2014)—not because they require more complex cognitive skills than, say, attachment or exploration. Also, the idea that "basic" motives combine two by two to yield "compound" motives for status, trust, and control is reminiscent of the biologically implausible distinction between "basic" and "non-basic" emotions (for critiques see Al-Shawaf et al., 2016; Del Giudice, 2023c).

In sum, Dweck's criteria can appear logical and compelling, but on closer analysis they lack biological grounding and yield an abstract, hyper-simplified model of human motivation. A better way to proceed is to start with the analysis of specific adaptive problems (Al-Shawaf et al., 2016; Lewis et al., 2017), combined with convergent evidence from behavioral, neurobiological, and comparative/phylogenetic research (Del Giudice, 2023a). That said, it is important to recognize that the domain-specific theory of motivational systems presented in this section is ill-equipped to explain the existence of general needs for competence, predictability, and control, which—as correctly noted by Dweck (2017)—are present from early in life and arise across disparate behavioral domains. As I discuss in a later section, this problem can be solved by complementing motivational systems with additional specialized mechanisms dedicated to the pursuit of instrumental goals.

The Extended Coordination Approach: A Hierarchy of Coordination Mechanisms

Emotions as Coordination Programs

Evolutionary research on emotion is converging on the notion that emotions can be understood as organismic modes of operation (or "programs") that evolved to solve the *coordination problem*—the adaptive problem of how to orchestrate suites of cognitive, physiological, and behavioral mechanisms so as to produce efficient but flexible responses to recurrent fitness-relevant situations (Al-Shawaf et al., 2016; Nesse, 1990; Tooby & Cosmides, 1990, 2008). To fulfill their organism-wide coordination function, emotion mechanisms modulate a wide range of downstream processes that include perception, attention, memory, reasoning and inference, categorization, and learning; they also generate affective displays, physiological reactions, action tendencies, as well as goals and priorities (more on this later; see Tooby & Cosmides, 1990, 2008).

Note that when emotions are conceptualized in this way, they include states and feelings that are not usually labeled as such, as for example hunger and sexual arousal. Crucially, evolved emotion mechanisms need not correspond in a one-to-one fashion to folk categories such as "anxiety" (Al-Shawaf et al., 2016; Scarantino, 2012; Sznycer et al., 2017); in some cases, people may be using the same word to refer to the outputs of different mechanisms (e.g., the precautionary anxiety caused by potential threats vs. the anxiety elicited by separation from an attachment figure).

Motivational Systems as Second-Order Coordination Mechanisms

In the standard coordination approach, emotion mechanisms include *situation-detecting algorithms* in addition to coordination programs; each emotion works as a self-contained "module" that appraises the state of the world, and deploys the appropriate response when internal and/or external cues indicate the presence of a triggering situation. But the existence of a large number of specialized emotions gives rise to a *second-order* coordination problem (how to coordinate the coordinators); moreover, the meaning of a situation at a given point in time often depends critically on the preceding sequence of situations (consider for example revenge, betrayal, or reconciliation), raising additional difficulties for the appraisal process (I call this the *sequence integration problem*).

As a solution to these problems, I proposed to extend the coordination approach with a layer of motivational systems that effectively work as second-order coordination mechanisms (Del Giudice, 2023a). Motivational systems perform most of the appraisal tasks that are usually attributed to emotions: they contain situation-detecting algorithms that control the system's activation, as well as *goal pursuit/evaluation algorithms* that monitor the progress of current behavior in relation to their biological goals (regardless of whether these goals are explicitly represented or not), evaluate situations in terms of success vs. failure, and deploy the appropriate emotions. This is exactly how motivational systems have been conceptualized by Bowlby, Gilbert, and other theorists in the same tradition. For historical reasons, the evolutionary study of emotions has remained almost completely disconnected from the parallel work on motivation (for a rare exception see Beall & Tracy, 2017). The extended coordination approach aims to merge these two strands of research into a coherent whole. But to achieve this goal, there is one more important issue to consider—namely, the function of moods and their place in the broader control hierarchy.

Moods as Third-Order Coordination Mechanisms

Any given situation or event can be relevant to more than one biological goal at once, prompting the question of how multiple motivational systems can achieve coordination and resolve conflicts between competing motivations. A first important answer is that motivational systems directly modulate each other's activity, resulting in patterns of reciprocal potentiation and inhibition (see above). But while cross-modulation can confer self-organization qualities on the architecture, it is probably insufficient to ensure smooth coordination and conflict resolution when there are more than a handful of motivational systems. The result is a *third-order* coordination problem that could be addressed by an additional, superordinate layer of control mechanisms. The extended coordination approach is unique in that it includes *mood mechanisms* that play precisely this role (Del Giudice, 2023a).

In the psychology of emotion, the distinction between emotions and moods has always been somewhat puzzling and conceptually imprecise. As affective states, moods are long-lasting and diffuse; despite their powerful impact on motivation, they usually lack well-defined triggering stimuli, and do not entail specific action tendencies like emotions do (Beedie et al., 2005; Gendolla, 2000). Mood states seem to reflect integrative estimates about the organism and its environment—which have been variously described as the probability of encountering threats vs. opportunities, the rate of progress (or lack thereof) toward the individual's goals, the momentum of recent outcomes (i.e., their improving or declining trend), or the expected success of future actions (e.g., Eldar et al., 2016; Nesse, 2004; Nettle & Bateson, 2012). From the standpoint of the extended coordination approach, moods can be understood as the product of third-order coordination mechanisms that (a) receive information from motivational systems about success and failure in the pursuit of domain-specific goals (together with other inputs that encode the state of the organism, for example its immunological condition, energy balance, and level of fatigue); (b) compute integrative estimates of the present/future state of the organism in relation to its environment; and (c) strategically modulate the functioning of multiple motivational systems—not just by generically "activating" or "inhibiting" them, but also by selectively influencing their sensitivity to threats vs. opportunities. In other words, mood mechanisms affect cognition, behavior and physiology on a broad scale; but, for the most part, they do so *indirectly* through the action of motivational systems and the corresponding emotions.

Thus, the extended coordination approach accommodates previous insights about moods and accounts for key aspects of their phenomenology, including the combination of high motivational potency and low motivational specificity. It also provides a simple, principled answer to the long-standing question of what is the difference between emotions and moods. Both are coordination adaptations; but emotions are first-order coordination mechanisms activated by motivational systems, whereas moods are third-order coordination mechanisms whose primary function is to modulate the activity of motivational systems. The same approach suggests that many key issues in the study of emotion regulation—from the effectiveness of different regulation strategies, to the reasons why people prefer to "feel bad" in certain situations—can be reconsidered from the perspective of "motivation regulation" and yield fresh, clinically useful insights (see Del Giudice, 2023a).

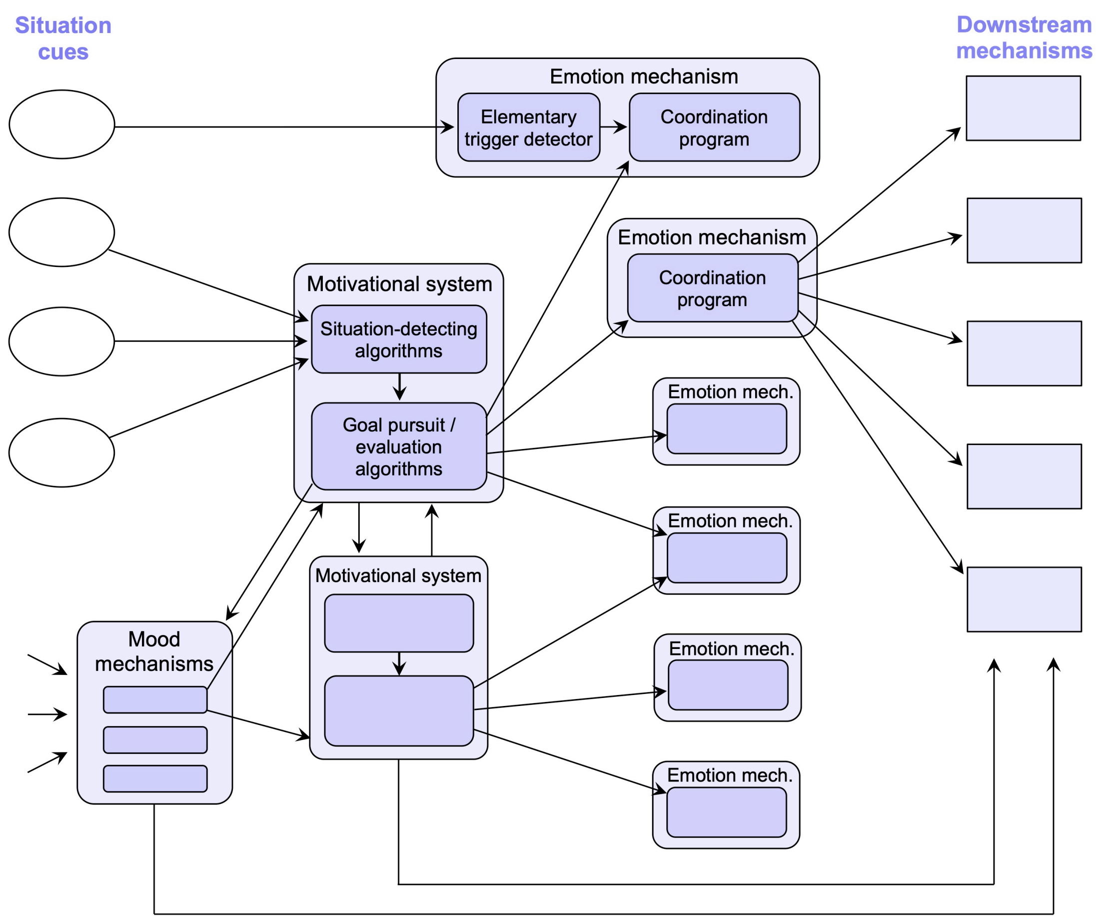

Figure 3. Schematic diagram of the extended coordination approach. Reproduced with permission from Del Giudice (2023b).

Figure 3 sketches the conceptual structure of the extended coordination approach. The figure includes some additional details, such as the existence of *elementary triggers*—simple stimuli that evoke emotional responses in an almost reflex-like fashion, for example the rapid fearful response triggered by a sudden loud noise (see Del Giudice, 2023b). Also note that both mood mechanisms and motivational systems can directly modulate certain downstream processes without the mediation of lower-level mechanisms; however, they are going to do so in ways that are more generic and less situation-specific. For example, being in an elevated vs. dejected mood is likely to have some broadband effects on attention, approach-avoidance tendencies, and so forth. For conceptual clarity, figure 3 depicts emotions and motivational systems as neatly distinct mechanisms with clear-cut boundaries; as I discussed earlier, this is a dramatic simplification of reality (the same applies to Figure 4 below).

The General Architecture of Motivation: Instrumental Goals and Approach-Avoidance

From Evolved Motivations to Instrumental Goals

The extended coordination approach explains how motivational systems equip organisms with evolved goals to strive for, and indirectly shape behavior through emotions; however, a complete account of motivation cannot stop here. Throughout their life, humans and other animals pursue all kinds of practical goals—most of which are only very indirect linked to core motivations like attachment and mating, or stem from the need to carry out routine activities, deal with unexpected events and disturbances, and coordinate with other individuals. Moreover, many of our moment-to moment goals as human beings originate outside of us—for example when we are fulfilling obligations and duties, obeying commands, or following norms and instructions.

In contrast with the evolved goals of motivational systems, these goals have an "instrumental" quality in that they are not sources of ultimate value, but more or less indirect means to other ends; they make it possible for the individual to pursue their biological interests through the complexity of the real world. Instrumental goals also involve representations of the desired outcomes, and thus qualify as "goals proper" in Miceli and Castelfranchi's (2015) nomenclature. As noted by these authors, certain kinds of goals proper (which they label "wishes" and "desires") can be actively represented and tracked without being pursued in actual behavior, either because conditions are unfavorable or because the outcomes are (currently) outside of the individual's control. In contrast with the (pseudo)goals of motivational systems, instrumental goals are cognitively penetrable and accessible to conscious awareness. Naturally, people can become *indirectly* aware of the goals of motivational systems via self-observation, reflection, or learning, even if those goals remain impenetrable. If I learn that the purpose of hunger is to control the intake of calories and other nutrients, I can form an explicit representation of this goal and even use it to regulate my feeding behavior. However, the inner workings of the feeding/hunger system remain just as encapsulated as before, and the system continues to rely on the same evolved cues (blood sugar levels, flavors correlated with the presence of different nutrients…) without regard for my new representational knowledge.

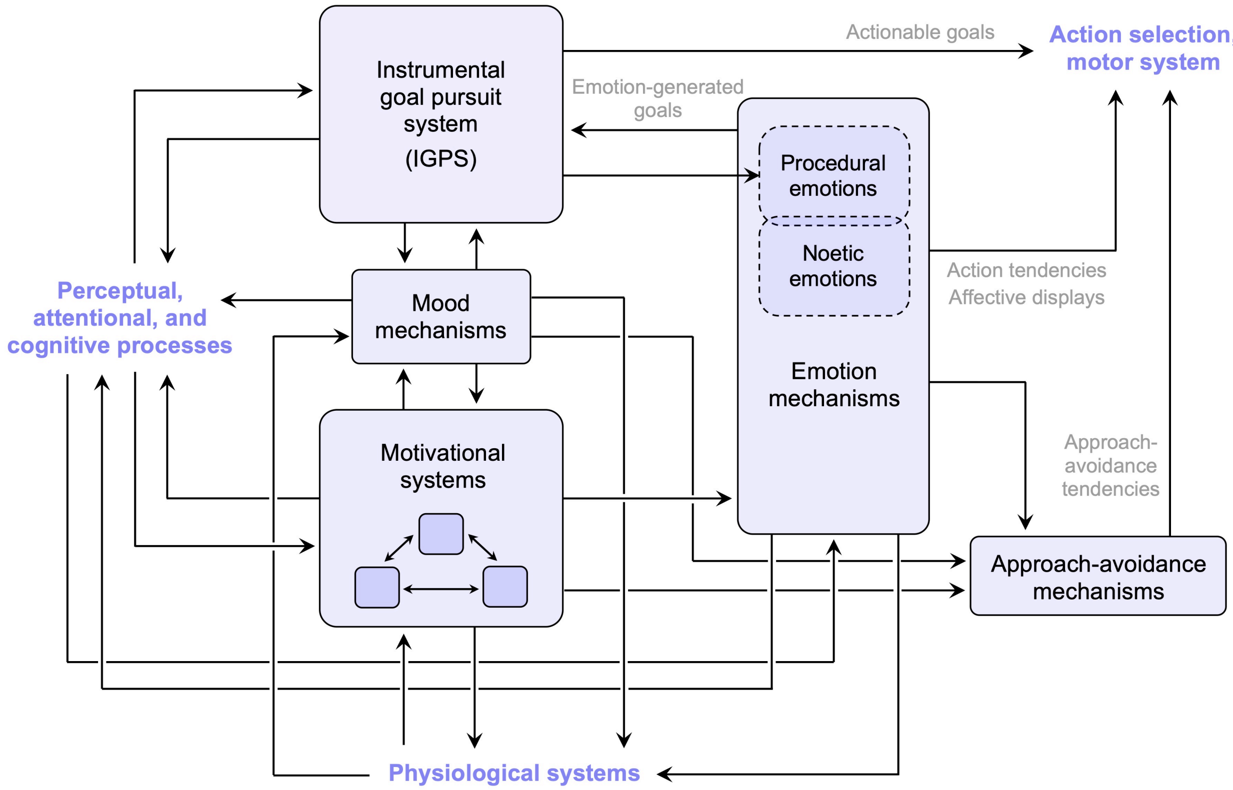

Figure 4. Schematic diagram of the General Architecture of Motivation (GAM). Reproduced with permission from Del Giudice (2023b).

Clarifying the relations between evolved motives and moment-to-moment goals was one of Dweck's main objectives (Dweck, 2017). In her theory, the link is provided by mental representations called BEATs, which are stored in memory and activated during goal pursuit. I addressed the same problem when I developed the General Architecture of Motivation (GAM), schematically represented in Figure 4 (Del Giudice, 2023b). The GAM is built around the extended coordination approach I summarized in the previous section, with the addition of two critical components. The first and most important of these components is the *instrumental goal pursuit system* (IGPS)—a "programmable", general-purpose control system that manages the pursuit of specific, concrete goals in the organism's life. The second is a set of phylogenetically ancient mechanisms that control general tendencies toward approach vs. avoidance (more on this below).

Unlike motivational systems, the IGPS does not have pre-specified goals; what it does is keep and manage a list of *active goals* (i.e., the goals that may be actively pursued and tracked at the moment); determine priorities between competing goals; direct the production of appropriate actions in the service of those goals, and monitor the individual's success or failure. At any given moment, the IGPS pursues a multiplicity of goals, defined at various levels of concreteness and specificity (as in "get some food" vs. "catch a fish") and arranged in hierarchical representational structures. Typically, goals that are more abstract and/or higher in the relevant hierarchy also tend to be farther away in the future. In our species, goal hierarchies can become quite deep and layered (Schultheiss, 2021); the overarching goals at the top (e.g., "become a surgeon") may be located in the distant future, and be pursued—albeit intermittently—for years or even decades. Goal representations are value-laden, and the positive or negative value associated with each goal is used to determine that goal's priority in the control of behavior.

Goal management and scheduling systems like the IGPS are a common feature of the cognitive architectures developed in cognitive science and artificial intelligence (e.g., Sun, 2009, 2018). In the GAM, the IGPS is a stand-in for a diverse collection of cognitive processes (which may involve access to multiple valuation systems, internal simulations, working memory, etc.). These processes are packaged into a single abstract mechanism, without specifying the precise algorithms by which it performs its tasks. The purpose of the IGPS within the GAM is not to provide a mechanistically precise account of goal management, but to capture some of its essential features, in a way that can usefully inform models of motivation, emotion, and individual differences. And while the GAM does not explicitly include executive/metacognitive mechanisms, certain functions of the IGPS clearly grade into executive territory. From this perspective, goal management takes place on a continuum of automaticity: most routine decisions about the goal structure (including conflicts among competing goals) can be managed by relatively simple and automatic algorithms, but more complex scenarios—particularly those involving conflicting social goals and relationships—may require the intervention of deliberate top-down processes.

In many respects, the IGPS behaves like another motivational system within the architecture (albeit a "programmable" one); but there are also some crucial differences. Both the IGPS and motivational systems receive inputs from perception (oriented and filtered by attention) as well as from other cognitive processes in the form of memories, predictions, results of internal simulations, and so forth. They both feed information about success/failure to mood mechanisms, and are modulated by those mechanisms in return. On the output side, the IGPS coordinates the activation/deactivation of emotional mechanisms like motivational systems do; but whereas motivational systems activate a wide range of emotions (including "classic" emotions such as fear, anger, shame, etc., and their domain-specific variants), the activity of the IGPS is specifically associated with a subset of *procedural emotions* that regulate goal pursuit across domains—emotions such as frustration, satisfaction, disappointment, boredom, feelings of rightness/wrongness about the outcomes of one's actions, and anxious indecision in the presence of unresolved conflicts between goals (for more details see Del Giudice, 2023b). Most importantly, the output of the IGPS is not limited to emotions; one of its key functions is to identify specific, immediate goals with the highest priority within the current goal structure (labeled *actionable goals*) and pass them along to action selection mechanisms, which then generate behavioral sequences and motor commands (see Fig. 4).

There is one more analogy to explore between the IGPS and motivational systems—one that has notable implications for the theoretical reach of the framework. Even though the IGPS does not have a pre-specified, domain-specific goal, it does possess the overarching "meta-goal" of *fulfilling the individual's instrumental goals across domains*. Hence, the IGPS is the natural substrate of the generalized motives for competence, control, and (in part) predictability highlighted by Dweck (2017) and other scholars (see e.g., Uusberg et al., 2019). In Dweck's theory, competence motives are regarded as "basic" because they are so general and pervasive (as well as present from early in life). From the alternative perspective of the GAM, competence motives are pervasive—and early developing—because they pertain to the general-purpose control mechanism of the IGPS, *not* because they are simpler or more fundamental than the domain-specific goals embodied by motivational systems.

The Role of Emotions in the GAM

As depicted in Figure 4, actionable goals from the IGPS are the main behavioral output of the entire motivational architecture. In contrast, motivational systems do not *directly* produce actionable goals; they affect the organism's behavior only indirectly, mainly by activating emotion mechanisms (e.g., fear). Emotion mechanisms may then (a) provide the IGPS with urgent but abstract goals (e.g., protecting oneself from danger in the case of fear) that can be integrated in the current goal structure and eventually translated into actionable goals; (b) prompt the termination or suspension of currently active goals (e.g., stop protecting oneself in the case of relief); (c) trigger emotion-specific action tendencies (e.g., an impulse to run away or hide), and/or affective displays such as facial and vocal expressions; and (d) modulate the activity of *approach-avoidance mechanisms* to produce directional tendencies in relation to salient stimuli (e.g., avoidance of danger, approach to safety; see Harmon-Jones et al., 2013; McNaughton et al., 2016). Approach-avoidance tendencies are more generic that emotion-specific action tendencies: they prompt the organism to go toward or away from a stimulus, but do not prepare it for particular actions such as running away, hitting, hugging, and so forth.

The notion that emotions generate high-priority goals for the individual is a key postulate of the coordination approach (Al-Shawaf et al., 2016; Tooby & Cosmides, 1990, 2008) and the main focus of motivational theories of emotions, such as those proposed by Miceli and Castelfranchi (2105) and Scarantino (2014). The emotion-generated goals of the GAM are analogous to what other theorists have called *relational goals* (Scarantino, 2014) or *emotivational goals* (Roseman, 2011): they are defined by an abstract desired outcome (e.g., removing the offending object in the case of disgust) but do not specify the concrete sub-goals that may be used to reach it (throw it away, step away from it, wash oneself, etc.). According to the GAM, these abstract goals are evaluated by the IGPS in terms of their importance/urgency and their compatibility with the existing goal structure; as a result, the goal structure may be rearranged to include the new emotion-generated goals, derive concrete sub-goals, etc. The IGPS plausibly uses the intensity of an emotional episodes to compute the value of the corresponding emotion-generated goal, compare it with those of other active goals, and determine their relative priority. In this way, feelings help solve the problem of how to compare and rank qualitatively different kinds of costs and benefits (e.g., safety vs. status), by providing a "common currency" of value across multiple domains (see Goel, 2022 for another elaboration of this idea).

Simplifying a bit, the interplay between motivational systems and the IGPS can be understood in terms of two partially nested control loops linked by emotions. Motivational systems constitute the outer loop, constantly evaluating the situation in light of the individual's biological goals and activating the relevant emotions. The emotions triggered by motivational systems provide situation-specific goals to the IGPS; the IGPS then integrates those goals in the current structure and attempts to fulfill them (by turning them into actionable goals and monitoring their success or failure), thus closing the inner loop. Note that the control loop managed by the IGPS is partly regulated by procedural emotions. Figure 5 illustrates this dynamic with a toy example involving the attachment system. By detailing the control structure of motivation, the GAM provides a more precise account of the role of emotions than those offered by alternative models. In addition to coordinating whole-organism responses (as postulated by the coordination approach), emotions function as “messengers between worlds”—they are responsible for bridging the gap between two qualitatively different kinds of goals, those embodied by motivational systems and those represented and managed by the IGPS.

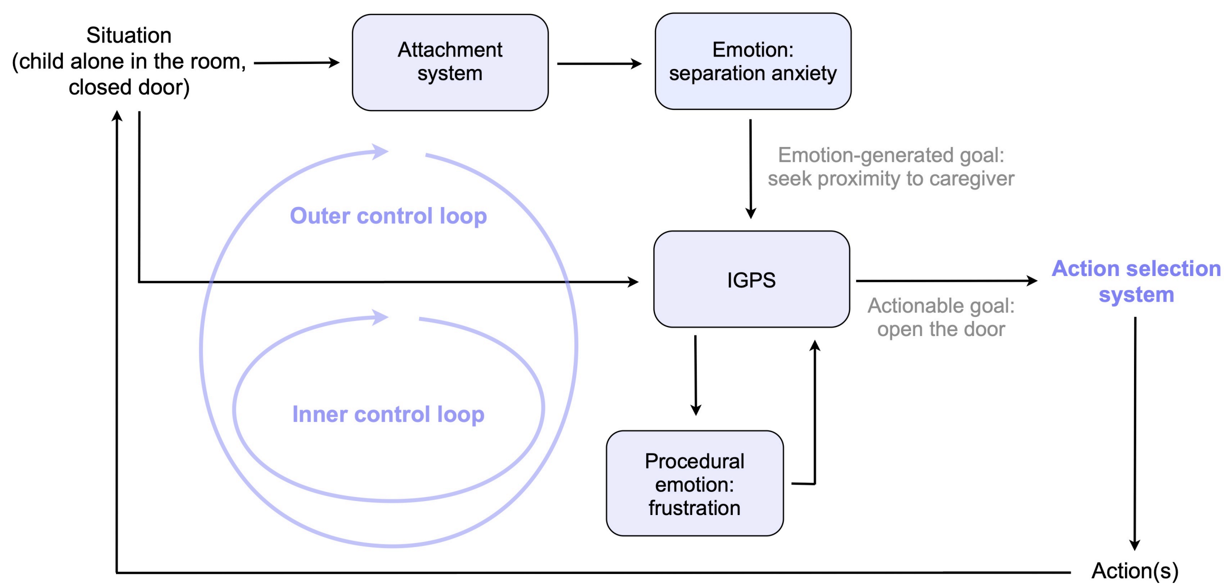

Figure 5. Schematic example of the interplay between motivational systems and the IGPS in the control of behavior. In this hypothetical vignette based on a typical separation-reunion procedure, a child is left alone in a room without the caregiver. The attachment system triggers separation anxiety, which feeds the abstract goal of seeking proximity to the caregiver to the IGPS. The IGPS integrates the goal into the current hierarchy, and generates the actionable goal of opening the door. The child tries to open the door but does not succeed, leading to frustration—a procedural emotion that feeds back to the IGPS and contributes to regulate the next step in the sequence (e.g., giving up and trying a different action). The outer control loop is managed by the attachment system: situation → attachment system → emotion → IGPS → action selection system → action(s) → situation. The inner control loop (with the current goal of opening the door) is managed by the IGPS: situation → IGPS (→ procedural emotion → IGPS) → action selection system → action(s) → situation.

Approach and Avoidance

Approach and avoidance are the simplest and most basic polarities of motivation; and indeed, the mechanisms that prompt organisms to move toward or away from certain stimuli are phylogenetically very ancient (McNaughton et al., 2016). In some models of motivation, approach-avoidance mechanisms have a central or superordinate role (e.g., Carver & Scheier, 2013). The most prominent exemplar of this kind is Reinforcement Sensitivity Theory (RST; Corr, 2008; Gray & McNaughton, 2000), a model of motivation and personality based on three neurobiological systems that regulate behavior in the context of approach (the *behavioral approach system* or BAS); avoidance (the *fight-flight-freeze system* or FFFS); and motivational conflicts, typically between approach and avoidance (the *behavioral inhibition system* or BIS).

The GAM diverges sharply from these models because, as depicted in Figure 4, it treats approach and avoidance as downstream "effectors" that can be activated by a host of other mechanisms higher in the control hierarchy—namely emotions, motivational systems, and moods. In other words, they represent a shared output pathway for domain-specific systems. In many cases, the same system can induce both approach and avoidance depending on context (approach food when hungry, avoid it when too full; avoid dominant individuals, approach subordinates; etc.). The underlying idea is that approach and avoidance have *phylogenetic* priority, but have not retained *control* priority as nervous systems have evolved and increased in complexity. Indeed, it is plausible to hypothesize that emotions may have originally evolved precisely to coordinate approach-avoidance responses with other cognitive and physiological changes. In my opinion, this unconventional placement of approach-avoidance mechanisms is the best way to resolve the inconsistencies that arise from other accounts. For example, the classical notion that positive stimuli (rewards) motivate approach while negative stimuli (threats/punishments) motivate avoidance turns out to be mistaken, because anger and other negative emotions can trigger strong approach tendencies toward negative stimuli (Harmon-Jones et al., 2013).

Of note, the main constructs of Reinforcement Sensitivity Theory can be usefully redescribed using the conceptual toolkit of the GAM. For example, I argued that the function attributed to the BIS are carried out by two distinct mechanisms, the precaution system (see above) and the IGPS. Both systems can trigger forms of "anxiety", which is the characteristic emotion of the BIS; but in one case we have precautionary anxiety in the face of potential threats, in the other we have anxious indecision elicited by unresolved conflicts between instrumental goals. For more details about approach-avoidance and how the GAM can account for the phenomenology of RST, see Del Giudice (2023b).

From Motivation to Personality

As the name implies, the GAM is a general architecture that can be adapted to the specific motivational and cognitive endowment of other animals besides humans (for example by specifying a different set of motivational systems, or detailing the species-specific capabilities and constraints of the IGPS). Once the motivational architecture of a species has been mapped (which even in humans is still a work in progress), individual differences in the parameters of the relevant mechanisms can be used to build a functional model of personality for that species, in the spirit of "ground-up adaptationism" (Lukaszewski, 2021; Lukaszewski et al., 2020). This mechanistic approach is informing recent attempts to model personality with computational methods (e.g., Brown & Revelle, 2021; Read et al., 2010, 2021; Sun & Wilson, 2014).

An in-depth discussion of how the GAM can serve as a foundation for personality models is beyond the scope of this chapter; I direct interested readers to Del Giudice (2023b). Here I wish to briefly highlight a few relevant issues. The first concerns the nature of individual differences in the GAM. At the level of motivational systems, the most economical way to describe them is in terms of *activation sensitivity:* a system is more sensitive if it becomes activated more quickly and intensely by the same situational cues. This is a common approach in the literature; for example, in Davis and Panksepp's (2018) affective neuroscience model, personality arises from differences in the responsiveness of emotional systems such as CARE and RAGE (see also Read et al., 2010; Revelle & Condon, 2015; Sun & Wilson, 2014). This approach can be refined in three ways: (a) by describing separate parameters for sensitivity to threats vs. sensitivity to opportunities (e.g., the status system can be activated by opportunities to rise in social hierarchies *and* by challenges to one's current rank); (b) by distinguishing between activation and *de*activation sensitivity, to model individual differences in the sensitivity to cues that tend to disengage the system (e.g., cues of safety and absence of danger in the case of fear; proximity to a caregiver in the case of attachment); and (c) by considering how sensitivity parameters may be correlated and functionally patterned across systems, for example because two or more systems rely on shared internal variables, or are affected by the same genetic and environmental inputs. This would make it possible to identify higher-order dimensions of variation that summarize broad patterns of functioning across motivational domains, as for example the generalized sensitivity to threats that underlies trait Neuroticism in the Big Five.

From a complementary perspective, individual differences in the functioning of a motivational system can be described in terms of the working models and internal regulatory variables that inform that system. This duality is well exemplified by the literature on attachment styles: individual differences in attachment fall along two dimensions of *anxiety* (or *preoccupation*) and *avoidance*, which can be linked to different patterns of (largely implicit) beliefs and expectations about the person's own vulnerability and lovability and the availability and sensitivity of attachment figures (see Bretherton & Munholland, 2016; Fraley & Spieker, 2003; Fraley et al., 2015). At the same time, anxiety can be framed as a "hyperactivating" strategy (quick, intense activation in response to perceived threats coupled with slow deactivation) and avoidance as a "deactivating" strategy (characterized by low activation sensitivity); by comparison, attachment security is characterized by quick activation of the system, followed by similarly rapid deactivation upon reassurance (Mikulincer & Shaver, 2016). With due distinctions, one can apply the same basic approach to other motivational systems besides attachment (e.g., Mikulincer & Shaver, 2020; see my discussion in Del Giudice, 2023b).

In the GAM, the IGPS is a different kind of mechanism with its own function and logic. Individual "styles" of goal pursuit can be described by parameters such as the depth of goal hierarchies (which corresponds to the time horizon of active goals), the rigidity vs. flexibility of goal priorities, the persistence of goal striving in the face of failure, and the stringency of the criteria for determining success. Differences in these functioning parameters—which are likely to show meaningful patterns of reciprocal correlations—can have substantial effects on individual patterns of behavior and emotion; they are reflected in personality traits such as conscientiousness, impulsivity, constraint, and perfectionism. The corresponding internal regulatory variables may include expectations about the predictability/controllability of future outcomes, and self-perceptions competence and success (see also Dweck, 2017). The lack of a conceptual equivalent of the IGPS has hindered previous attempt to reconstruct personality from motivational processes. For example, the Affective Neuroscience Personality Scales (ANPS) based on Davis and Panksepp's affective neuroscience model show sizable unique correlations with most of the Big Five, but not with Conscientiousness (Davis & Panksepp, 2018).

In comparison with Dweck's proposal, this approach to personality is more explicit about the role of different motivational mechanisms, and less focused on representations such as BEATs and the beliefs they are based on. But there are also points of contact, because (a) core beliefs about the world (e.g., its goodness and safety) and oneself (e.g., being in control) can be included in the GAM in the guise of internal working models or regulatory variables; and (b) while Dweck (2017) mostly focused on BEATs, she also noted that individual differences in the value and urgency of various needs—which can be recast as motivational sensitivities—can contribute to personality in ways that do not involve representations. A notable difference is that Dweck takes the Big Five at face value, whereas the primary goal of the GAM approach is to identify and describe narrower "functional traits" that are directly linked to specific mechanisms. These functional traits should not be expected to behave like the familiar "structural traits" derived by factor analysis and other correlational methods. In functional models, biological meaningfulness and mechanistic accuracy take precedence over parsimony and descriptive simplicity; thus, one can expect functional traits to show a lot of redundancy and intricate patterns of covariation (see Del Giudice, 2023b). I surmise that, in addition to being more biologically meaningful, a functional model of personality rooted in motivation would also prove more clinically useful and informative (again, attachment styles offer a glimpse of the heuristic power of such a model). Naturally, there are also going to be areas of overlap; as I noted earlier, a higher-order dimension of sensitivity to threats would strongly resemble the trait of Neuroticism. More broadly, any realistic model of personality should be able to reproduce the structure of the Big Five on demand, by applying standard correlational methods to the model's functional traits.

Conclusion

In this chapter, I drew on my recent work to outline an evolutionary framework for motivation, emotion, and (ultimately) personality. I compared and contrasted this approach with Carol Dweck's unification proposal, which is similar in scope and direction but based on partially different premises. As I hope to have shown in the chapter, the evolutionary framework embodied in the GAM has some key advantages over the alternatives, including Davis and Panksepp's attempt to renew personality theory with the tools of affective neuroscience.

Needless to say, the framework I presented is still provisional and speculative in many respects. There is much to be done, and many important questions remain open. One that I think is especially urgent concerns the nature of "higher" needs for self-coherence, identity, and meaning. In line with other approaches, Dweck (2017) placed them at the apex of human motivation, and suggested that self-coherence serves as a "master sensor" to monitor the joint fulfillment of all the other needs. In the GAM, mood mechanisms serve a similar kind of integrative function; incidentally, this may be relevant to the fact that positive mood is one of the strongest predictors of perceived self-coherence and meaning in life (King & Hicks, 2021; King et al., 2016). At present, it is not clear if meaning and self-coherence are best understood as bona fide motives analogous to feeding and mating, or rather as emergent outcomes of other motivational and cognitive processes (see Baumeister & von Hippel, 2020 and commentaries; King & Hicks, 2021); regardless, we still lack a mechanistic understanding of how they work, and they remain poorly integrated within current evolutionary models of motivation (e.g., Kenrick et al., 2010).

It is fitting to conclude this chapter on a note of enthusiasm. There can be no doubt that a coherent, realistic model of motivation is an invaluable asset, not only in basic research but also in clinical psychology and psychotherapy.[3] I believe that an evolutionary synthesis is within reach, and that such a synthesis is not merely desirable but necessary: it is impossible to fully understand motivation without emotion, emotion without motivation, and personality without both of them. I am confident that evolutionary scholars working in these areas will keep working toward convergence, and hope that the framework I presented will facilitate this process of dialogue and integration.

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[3] Some classic examples from clinical psychology are Lichtenberg et al. (1992) and Gilbert (1989, 1995, 2005). In my recent book on evolutionary psychopathology (Del Giudice, 2018), I discussed the motivational profiles associated with common mental disorders. Within Italian cognitive-behavioral therapy, there is a distinctive clinical tradition informed by evolutionary models of motivation, based on the work of the late Giovanni Liotti and his collaborators (Liotti, 2001; Liotti et al., 2017; see Farina et al., 2020). Some of the key texts have been only published in Italian, but see for example: Farina et al. (2017); Fassone et al. (2012); Liotti & Gilbert (2011); Monticelli & Liotti (2021); Monticelli et al. (2022).

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