

Kognitionspsychologie II: Session 7

Motivation

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Learning Objectives

- Be able to distinguish different theories of motivation
- Discuss the **adaptive significance** of motivation in past and today's environments
- Learn about **comparative approaches** to motivation
- Learn about life span **developmental theories** of goal pursuit and disengagement
- Learn about **cognitive** and **neural model(s)** of motivation

Motivation

- : the act or process of giving someone a reason for doing something; the act or process of motivating someone
- : the condition of being eager to act or work; the condition of being motivated
- : a force or influence that causes someone to do something

<http://www.merriam-webster.com/dictionary/motivation>

Motivation: Different theories

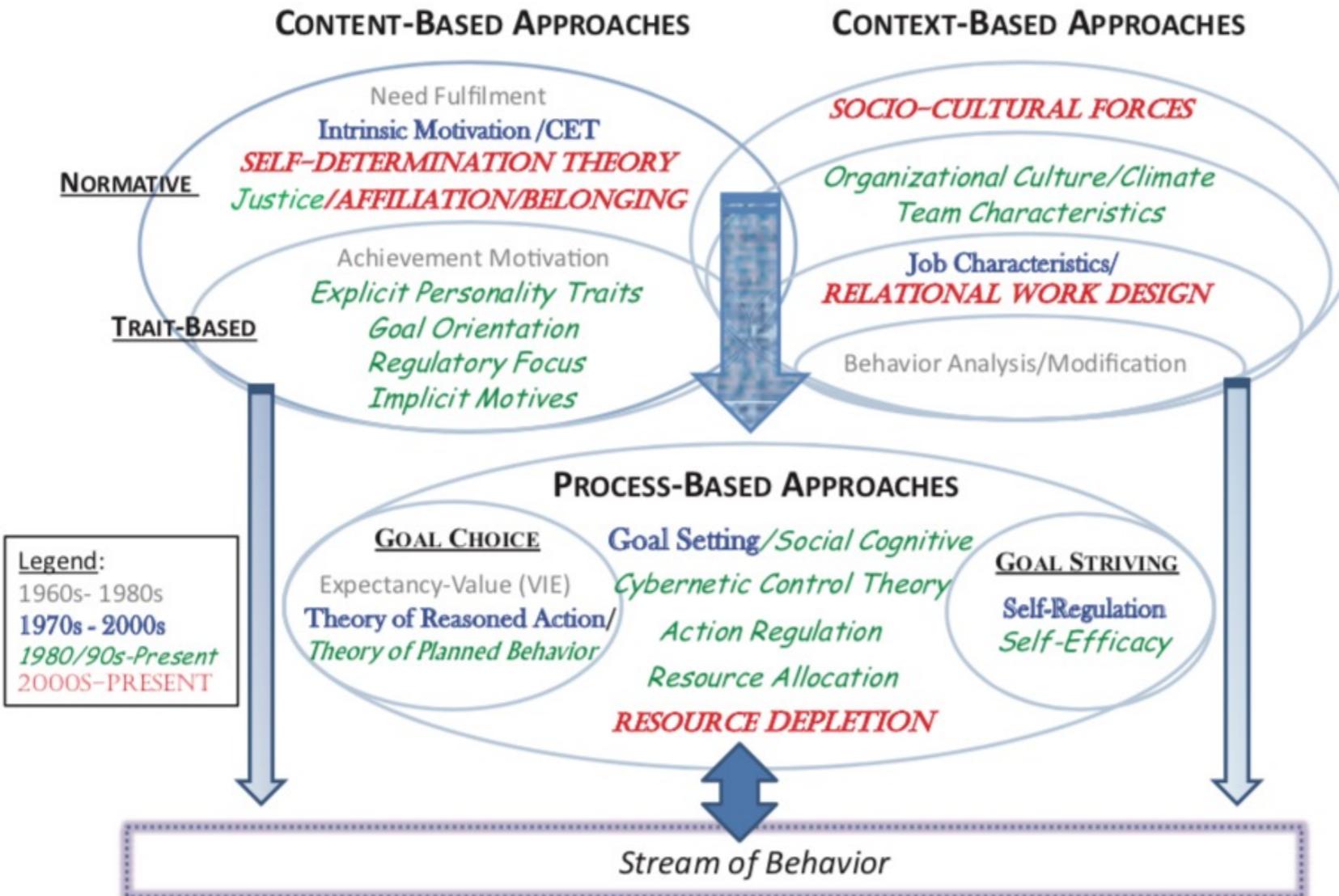
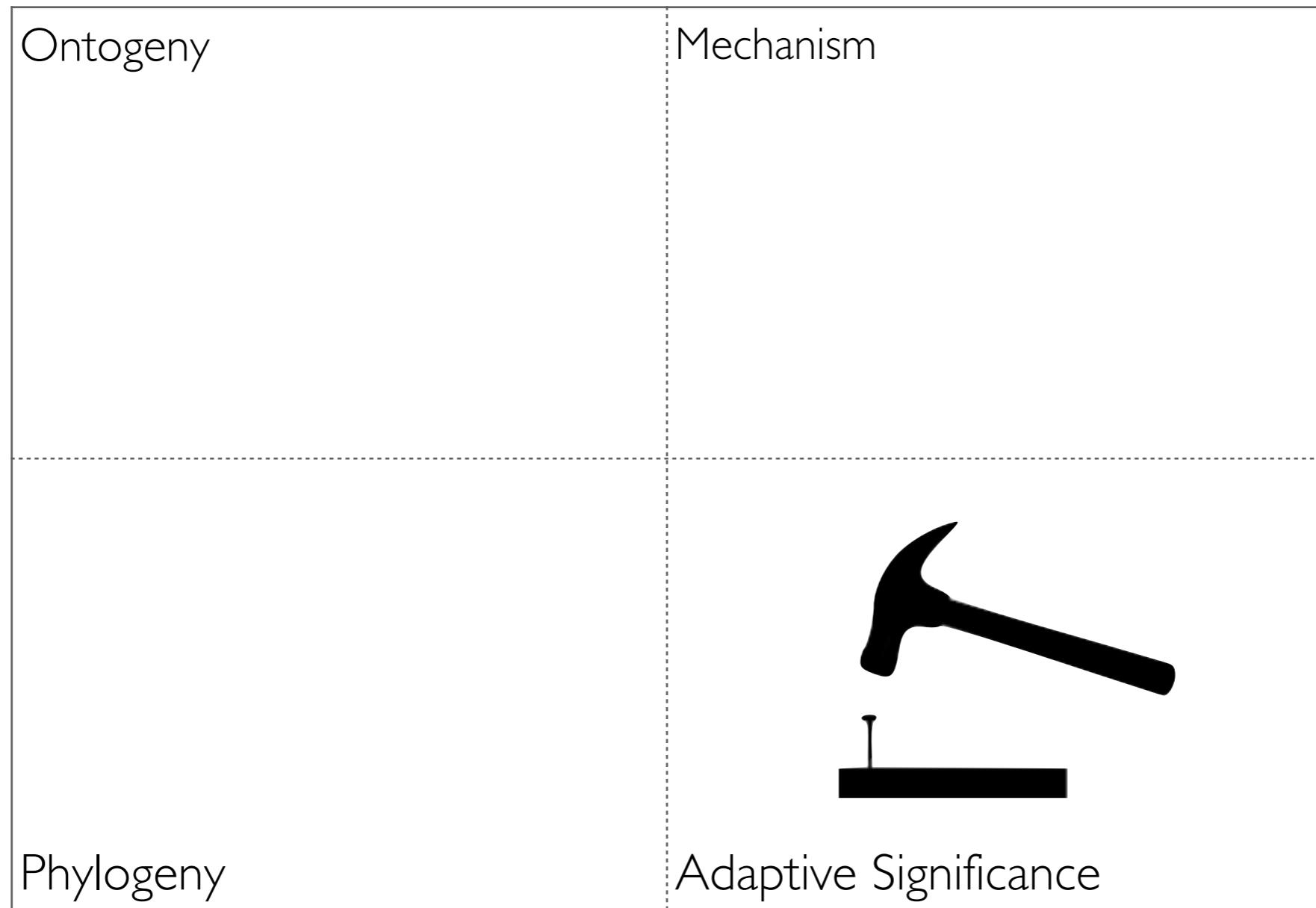


Figure 2. A heuristic meta-framework of work motivation construct networks and representative theories.

There are many different types of theories of motivation in psychology; the figure above depicts 3 main classes (content-, context-, and process-based) that have been applied to work psychology (but are representative of psychological theorising in general).

Motivation



Does motivation matter for academic performance?



Your turn!

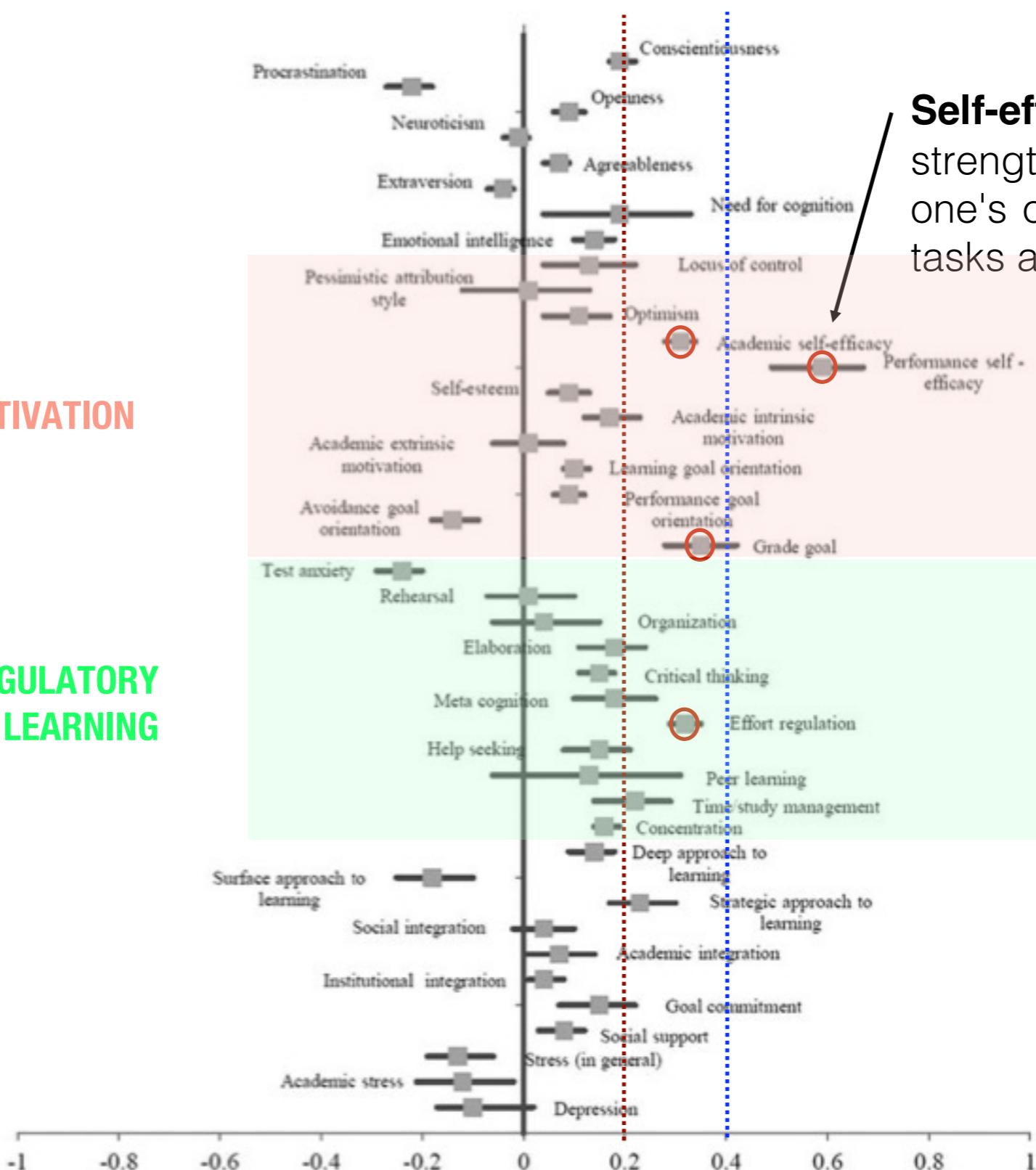
Does motivation
matter?

Does it matter
independently of IQ or
previous performance?

Image generated using AI (Bing), January 31, 2024

Motivation matters... Intelligence GPA (high-school)

MOTIVATION
SELF-REGULATORY LEARNING

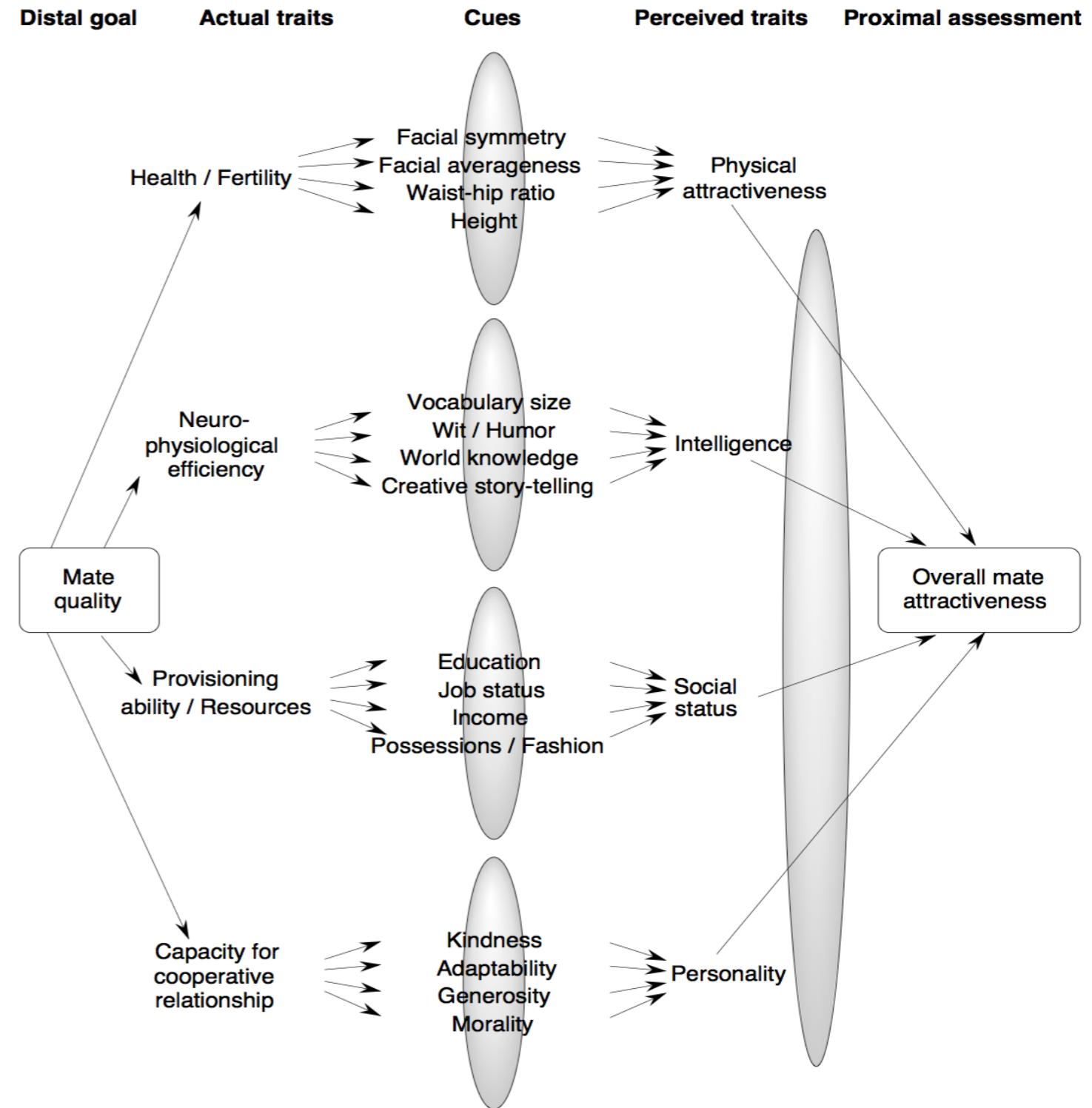


Self-efficacy is the extent or strength of one's belief in one's own ability to complete tasks and reach goals.

Motivation

Content Theories

Evolutionary theories focus on the adaptive significance of particular traits to propose why certain cues are attractive and thus motivate organisms to pursue specific goals or objects (e.g., mates)

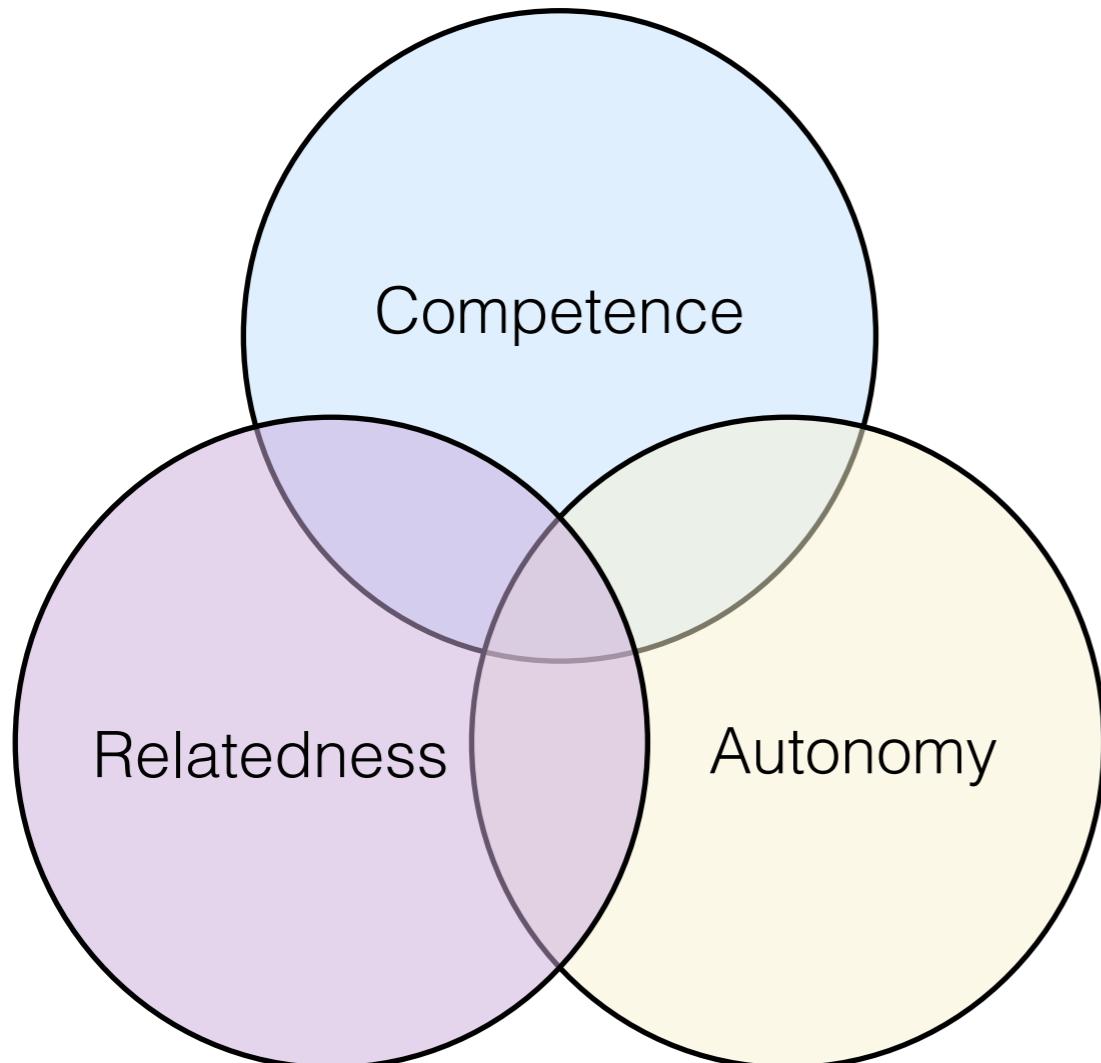


A lens model for assessing distal mate quality (simultaneous integration)

Motivation

Content Theories: Self-determination Theory

"The findings have led to the postulate of three innate psychological needs--competence, autonomy, and relatedness--which when satisfied yield enhanced self-motivation and mental health and when thwarted lead to diminished motivation and well-being."



Competence

Seek to control the outcome and experience mastery

Autonomy

Is the universal urge to be causal agents of one's own life and act in harmony with one's self

Relatedness

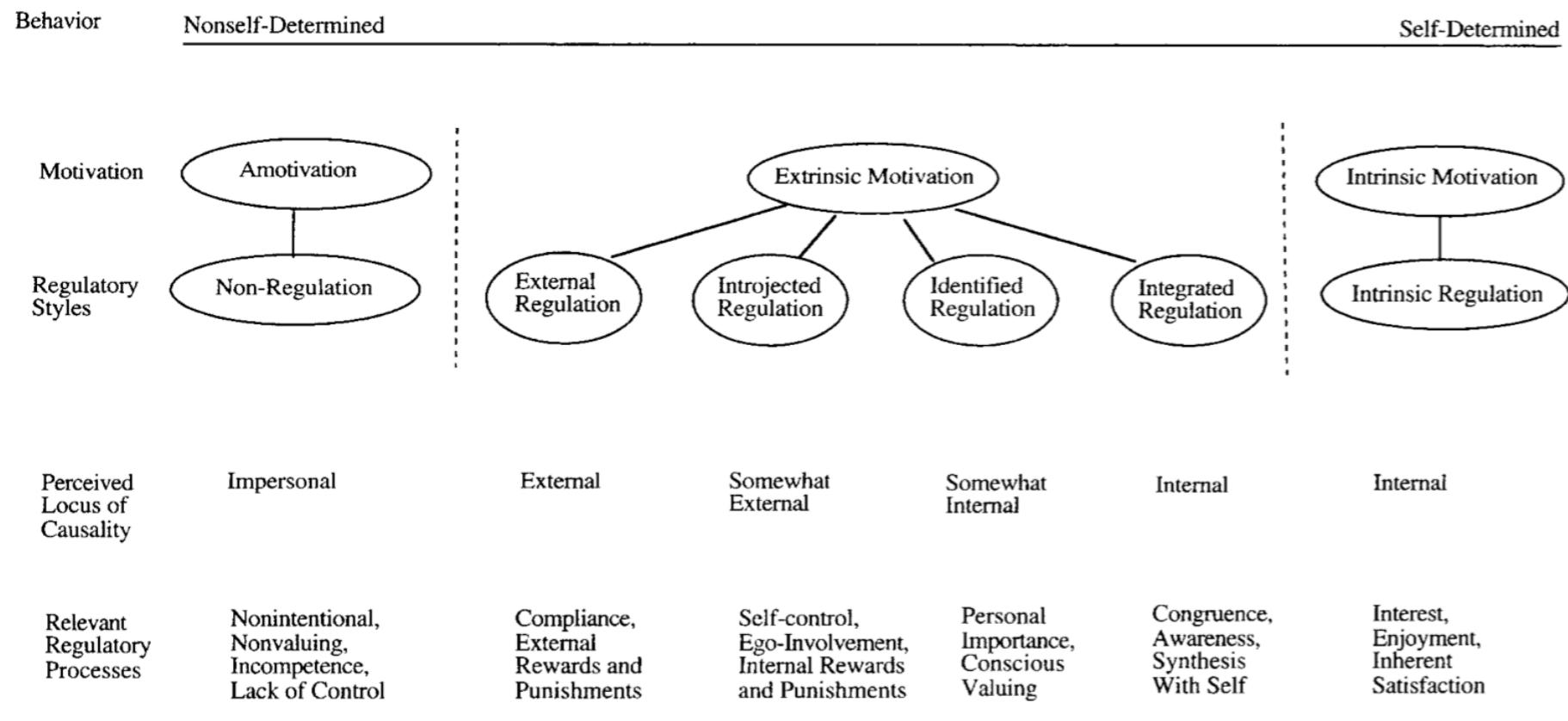
Is the universal want to interact, be connected to, and experience caring for others

Motivation

Content Theories: Self-determination Theory

Figure 1

The Self-Determination Continuum Showing Types of Motivation With Their Regulatory Styles, Loci of Causality, and Corresponding Processes



Intrinsic Motivation

“The inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn”

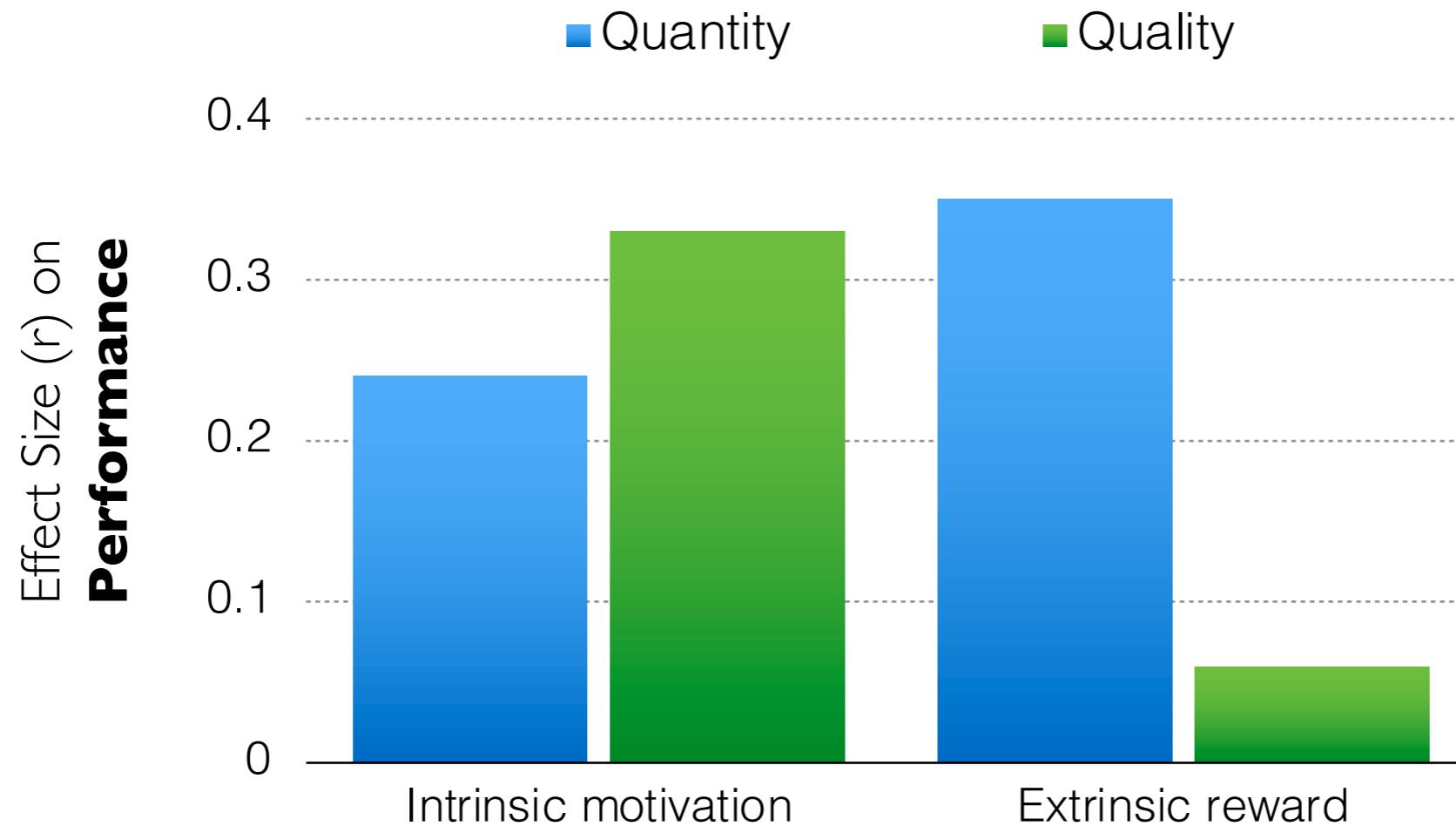
Extrinsic Motivation

“(...) refers to the performance of an activity in order to attain some separable outcome and, thus, contrasts with intrinsic motivation, which refers to doing an activity for the inherent satisfaction of the activity itself.”

Deci & Ryan (1985):
Organismic integration theory

Motivation

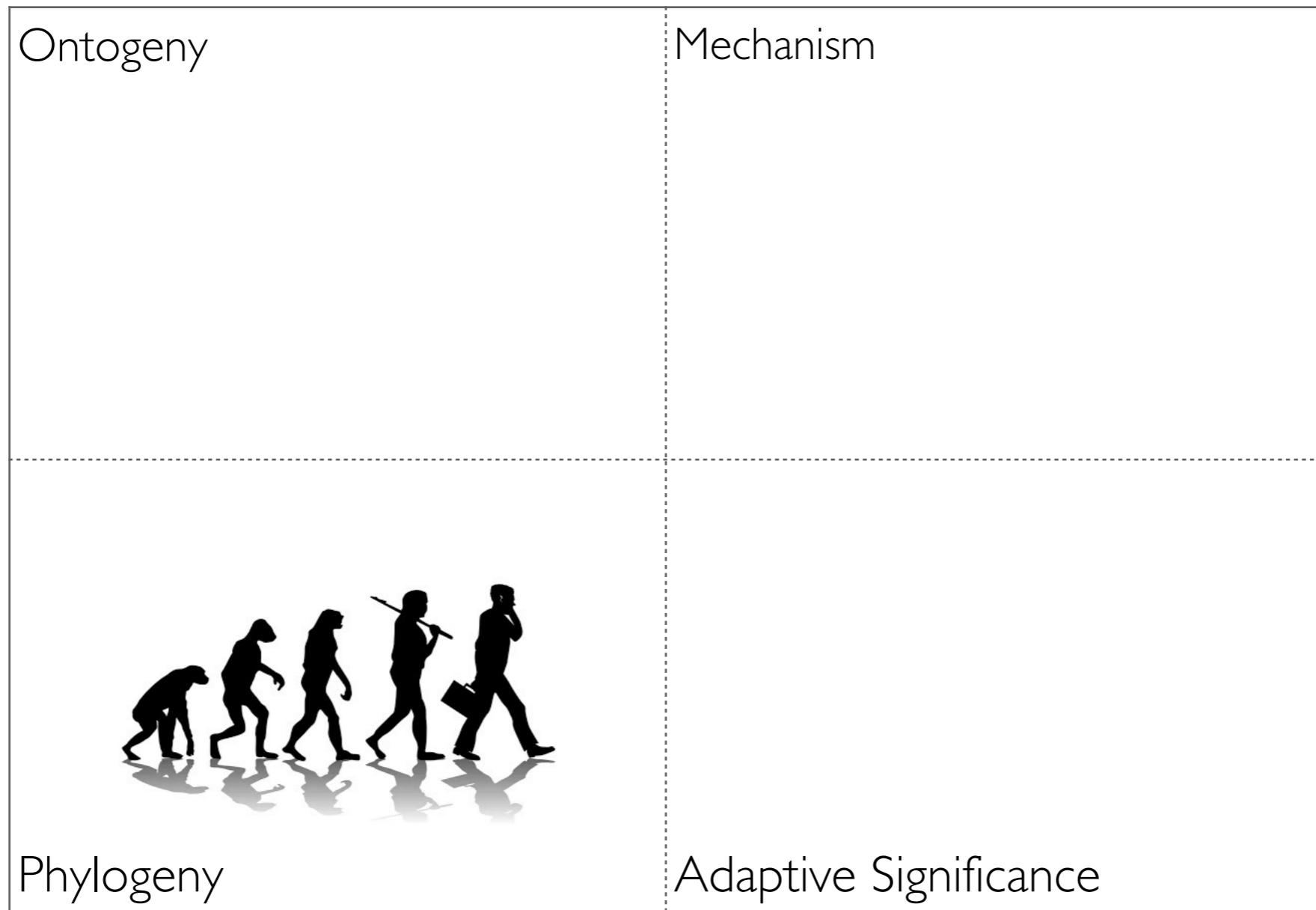
Content Theories: Self-determination Theory



Argument for distinguishing between types of motivation:

Intrinsic motivation (as measured by self-reported motivation) has overall average positive effects on both quantity and quality of performance, while extrinsic rewards (presence vs. absence of external rewards, such as monetary payoffs) have positive effects on quantity but not quality of performance.

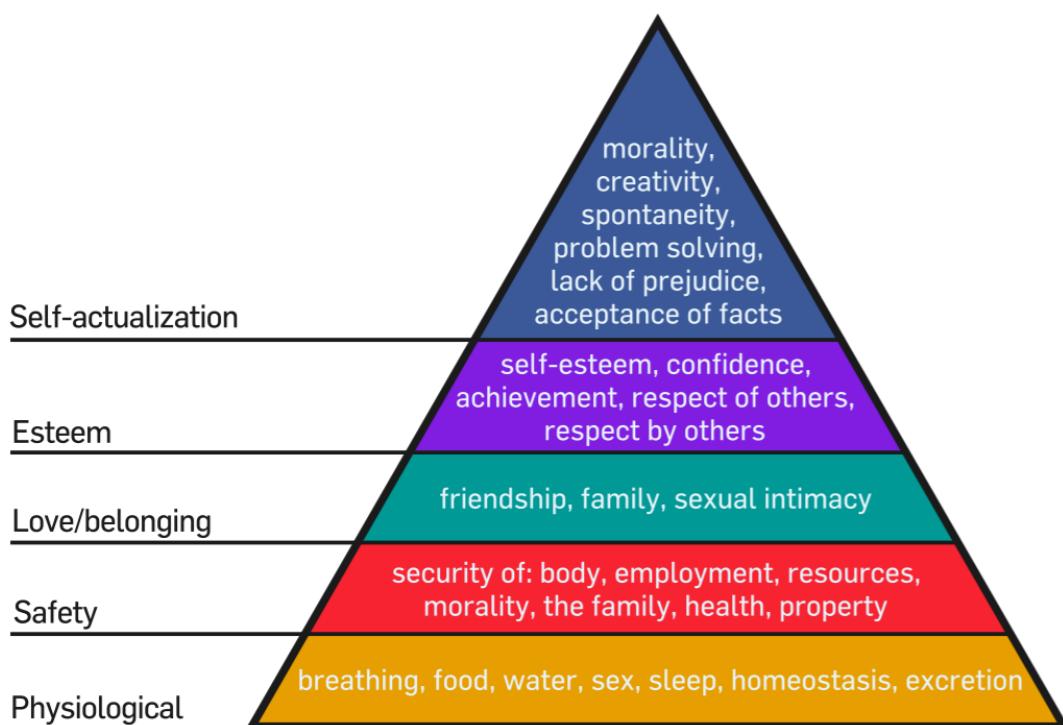
Motivation



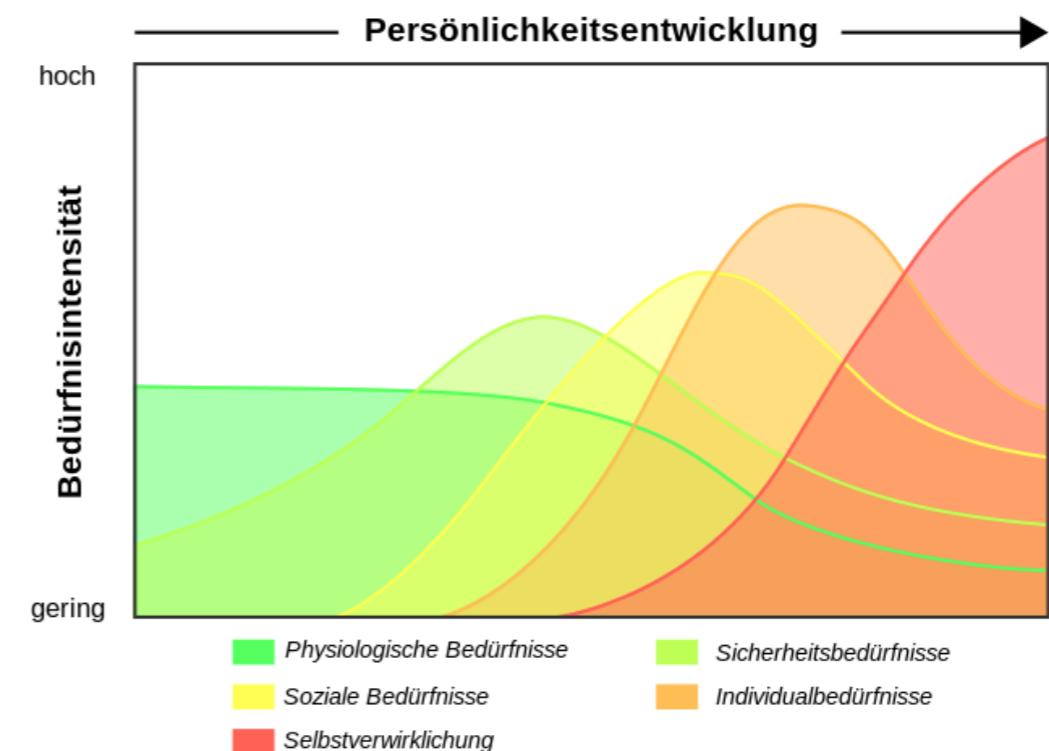
Motivation

Content Models: Maslow's hierarchy

"There are at least five sets of goals, which we may call basic needs. (...). These basic goals are related to each other, being arranged in a hierarchy of prepotency. This means that the most prepotent goal will monopolize consciousness and will tend of itself to organize the recruitment of the various capacities of the organism. The less prepotent needs are minimized, even forgotten or denied. But when a need is fairly well satisfied, the next prepotent ('higher') need emerges, in turn to dominate the conscious life and to serve as the center of organization of behavior, since gratified needs are not active motivators"



Typical depiction of Maslow's hierarchy of motives



Alternative depiction of the hierarchy of motives, that suggests that one motive does not need to be completely fulfilled to initiate another.



Motivation

Primary and secondary drives

"The position commonly held by psychologists and sociologists is quite clear: The basic motives are, for the most part, the primary drives -- particularly hunger, thirst, elimination, pain, and sex -- and all other motives, including love or affection, are derived or secondary drives. The mother is associated with the reduction of the primary drives -- particularly hunger, thirst, and pain -- and through learning, affection or love is derived. (...) There can be no question that almost any external stimulus can become a secondary reinforcer if properly associated with tissue-need reduction, but the fact remains that this redundant literature demonstrates unequivocally that such derived drives suffer relatively rapid experimental extinction. Contrariwise, human affection does not extinguish when the mother ceases to have intimate association with the drives in question. Instead, the affectional ties to the mother show a lifelong, unrelenting persistence and, even more surprising, widely expanding generality."

"As far as I know, there exists no direct experimental analysis of the relative importance of the stimulus variables determining the affectional or love responses in the neonatal and infant primate. Unfortunately, the human neonate is a limited experimental subject for such researches because of his inadequate motor capabilities."



FIG. 1. Response to cloth pad by one-day-old monkey.

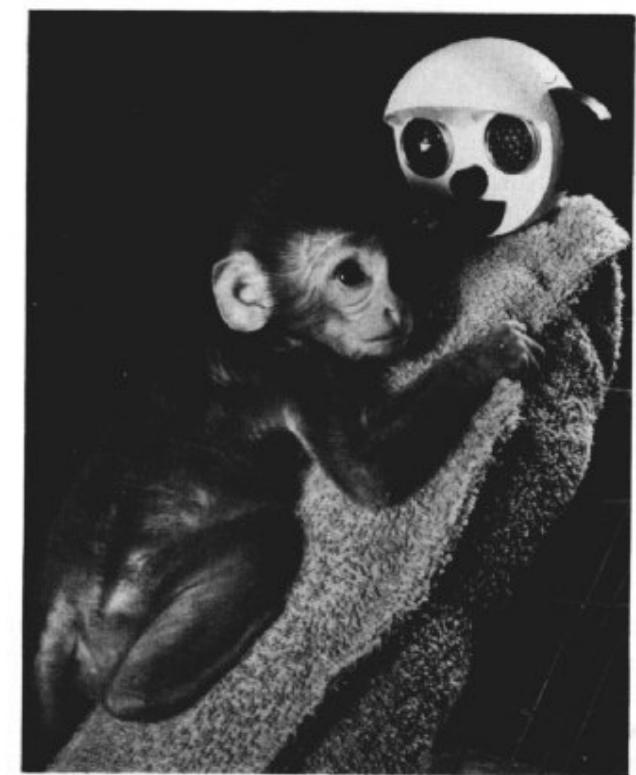


Figure 14. Typical response to cloth mother surrogate in fear test.

Motivation

Primary and secondary drives

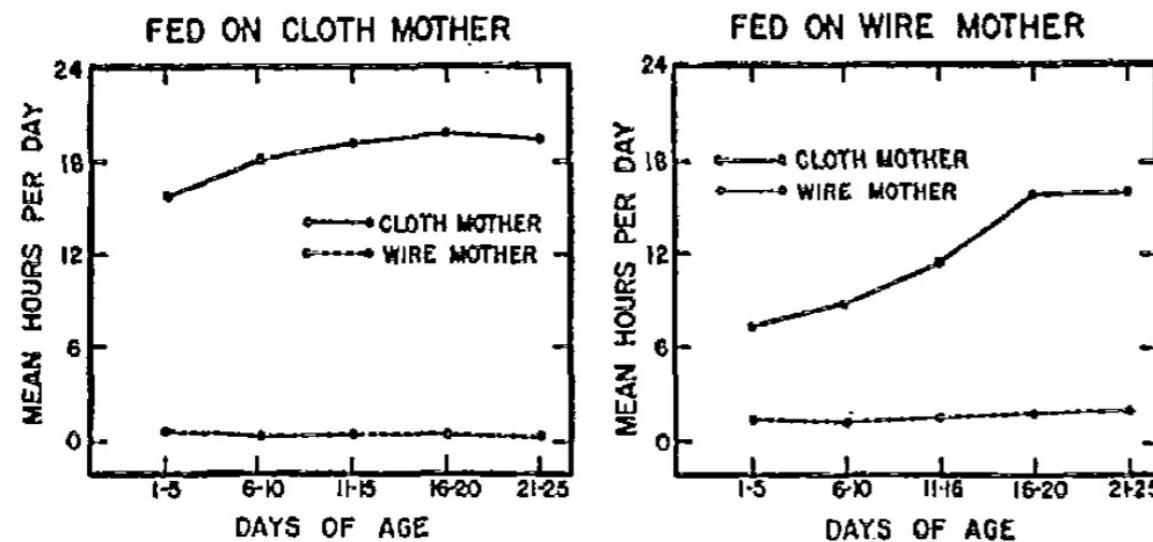


FIG. 5. Time spent on cloth and wire mother surrogates.

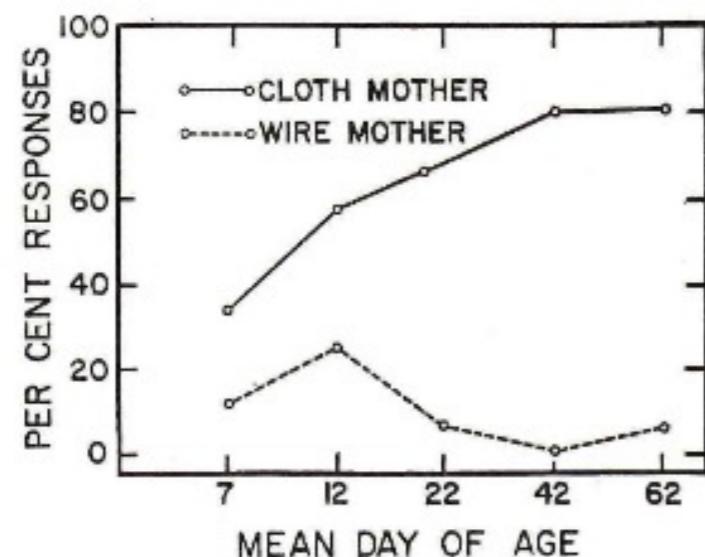


FIG. 15. Differential responsiveness in fear tests.

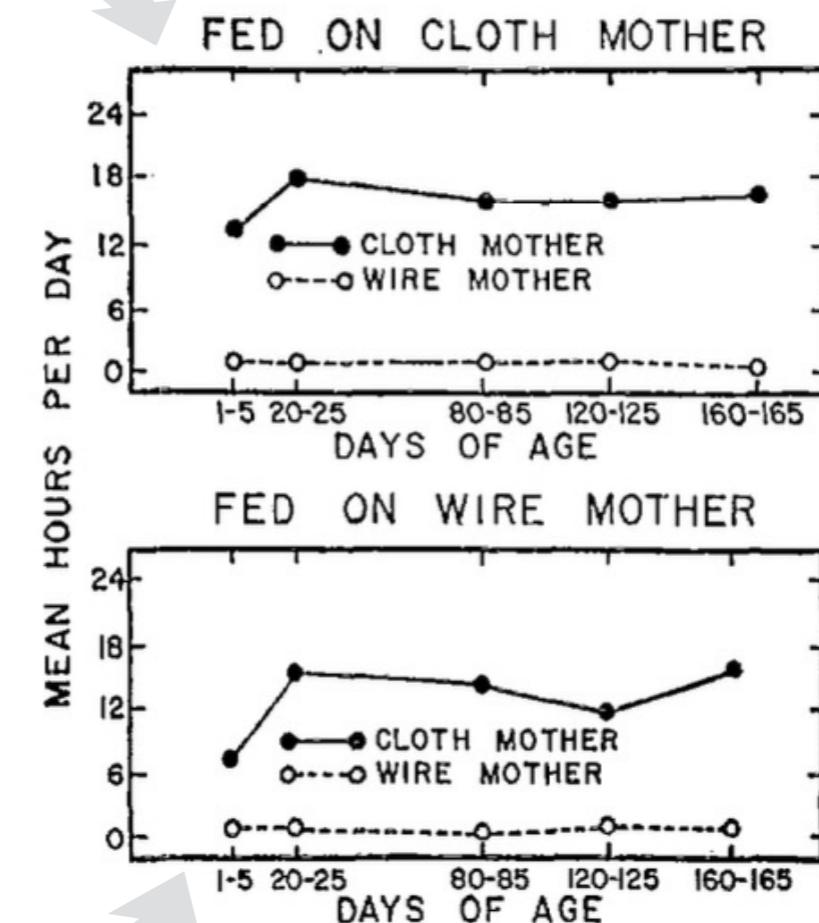


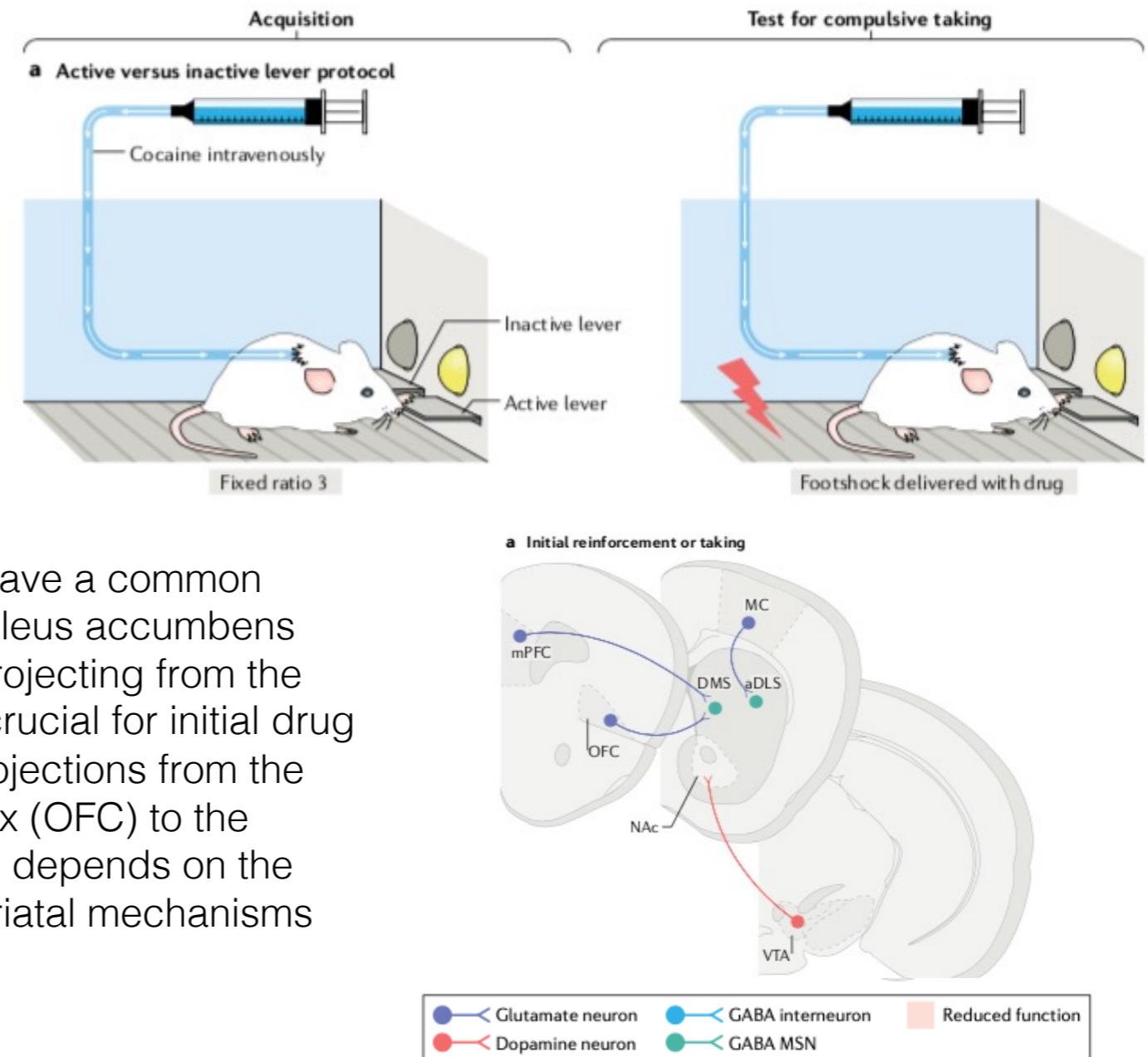
FIG. 6. Long-term contact time on cloth and wire mother surrogates.

Harlow's results emphasize the importance of affective and safety needs (and how these do not need to be derived/learned from primary physiological contingencies), while suggesting that a hierarchy of needs may be quantified through experimentation.

Motivation

Habit formation in addiction

In an operant chamber with an active lever and an inactive lever, responding on the active lever results in drug infusion (drug taking), and a presented light stimulus becomes a drug conditioned stimulus through Pavlovian conditioning (left panel). Compulsive drug taking is defined as persistent responding when the lever press is punished at the same time as drug infusion (right panel).

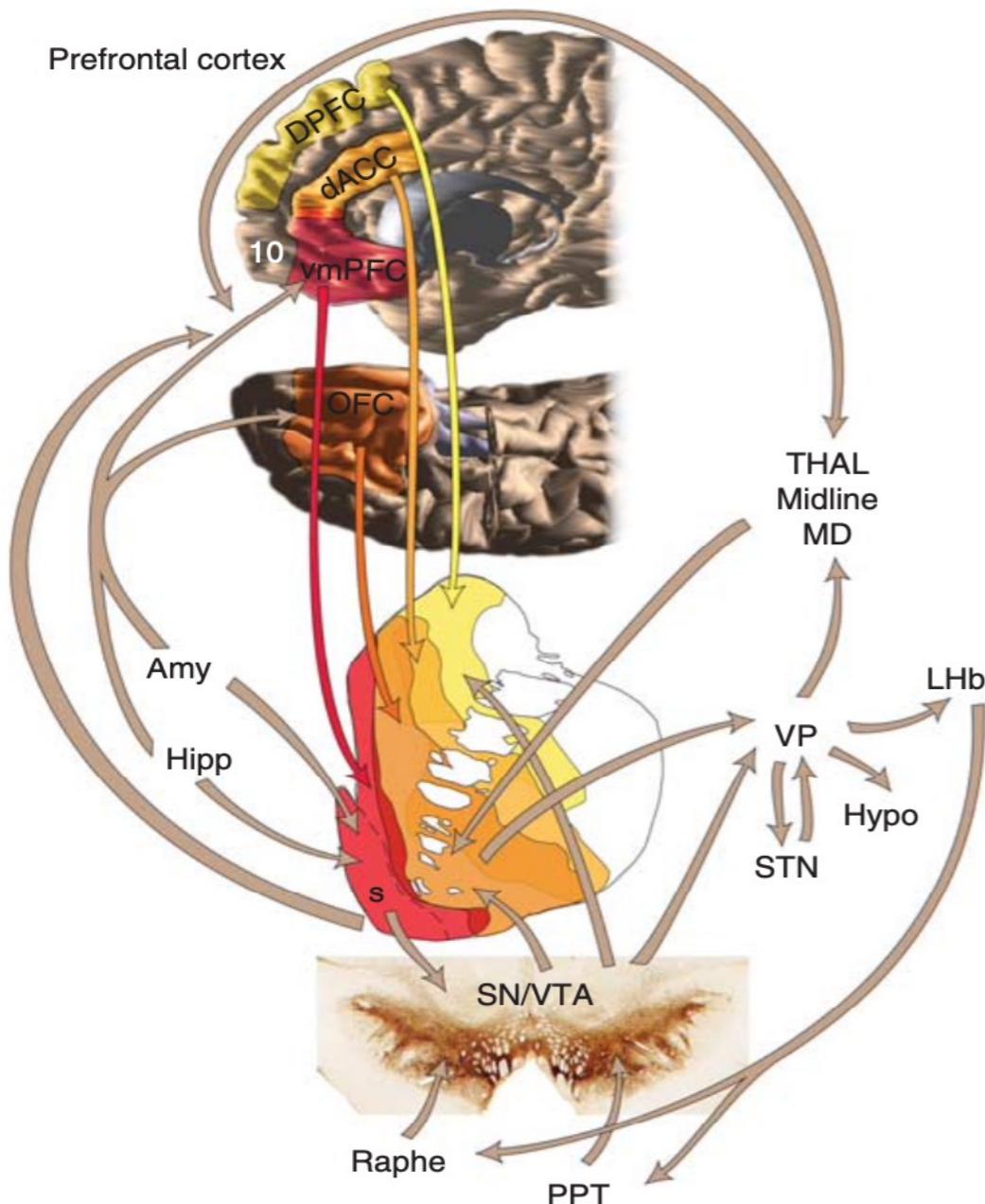


Addictive drugs of different pharmacological classes have a common initial effect of increasing levels of dopamine in the nucleus accumbens (NAc) — particularly dopamine released by neurons projecting from the ventral tegmental area (VTA). This effect is viewed as crucial for initial drug reinforcement. Drug taking depends on plasticity of projections from the medial prefrontal cortex (mPFC) and orbitofrontal cortex (OFC) to the dorsomedial striatum (DMS). Compulsive drug seeking depends on the loss of prefrontal cortical ‘top-down’ control over the striatal mechanisms underlying drug-seeking habits.

Animal models have been instrumental in understanding the neural basis of habit formation and its regulation; motivation as the dynamic interaction between valuation/reward system(s) and top-down control (frontal cortex).

Motivation

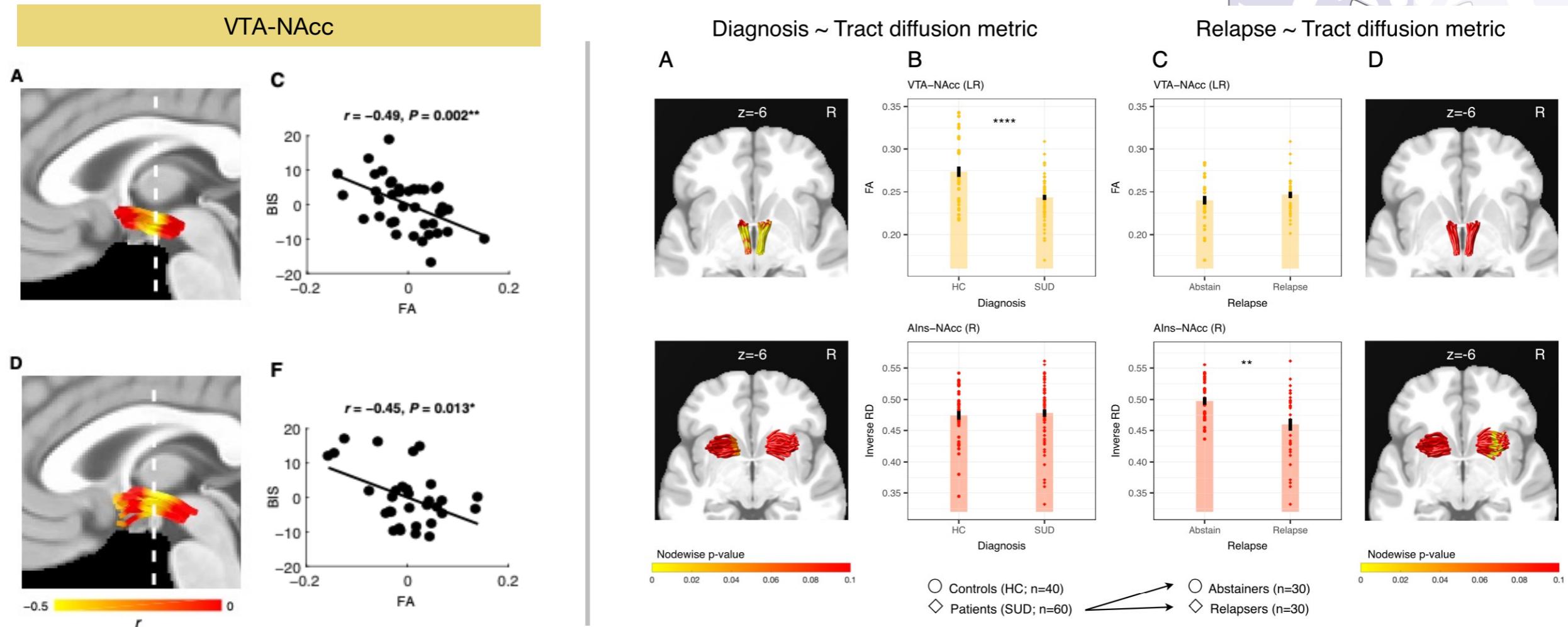
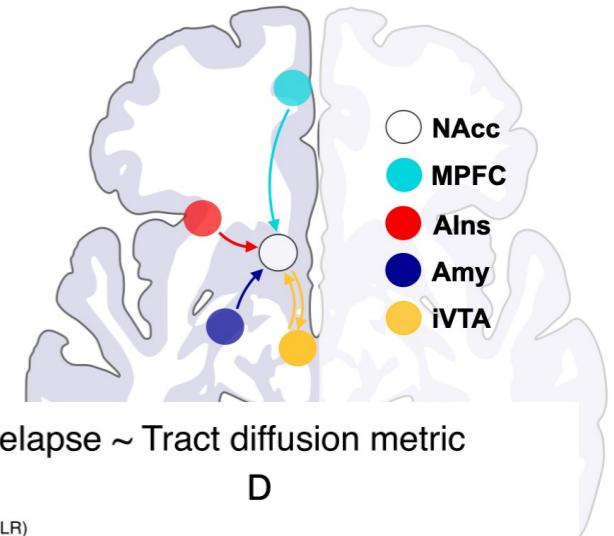
Comparative studies of the brain's reward circuitry



"Although cells in many brain regions respond to reward, the cortical-basal ganglia circuit is at the heart of the reward system. The key structures in this network are the **anterior cingulate cortex**, the **orbital prefrontal cortex**, the **ventral striatum**, the **ventral pallidum**, and the **midbrain dopamine neurons**. In addition, other structures, including the dorsal prefrontal cortex, amygdala, hippocampus, thalamus, and lateral habenular nucleus, and specific brainstem structures such as the pedunculopontine nucleus, and the raphe nucleus, are key components in regulating the reward circuit. [...] Advances in neuroimaging techniques allow better spatial and temporal resolution. **These studies now demonstrate that human functional and structural imaging results map increasingly close to primate anatomy.**"

Motivation

Impulsivity versus compulsivity in human stimulant addiction

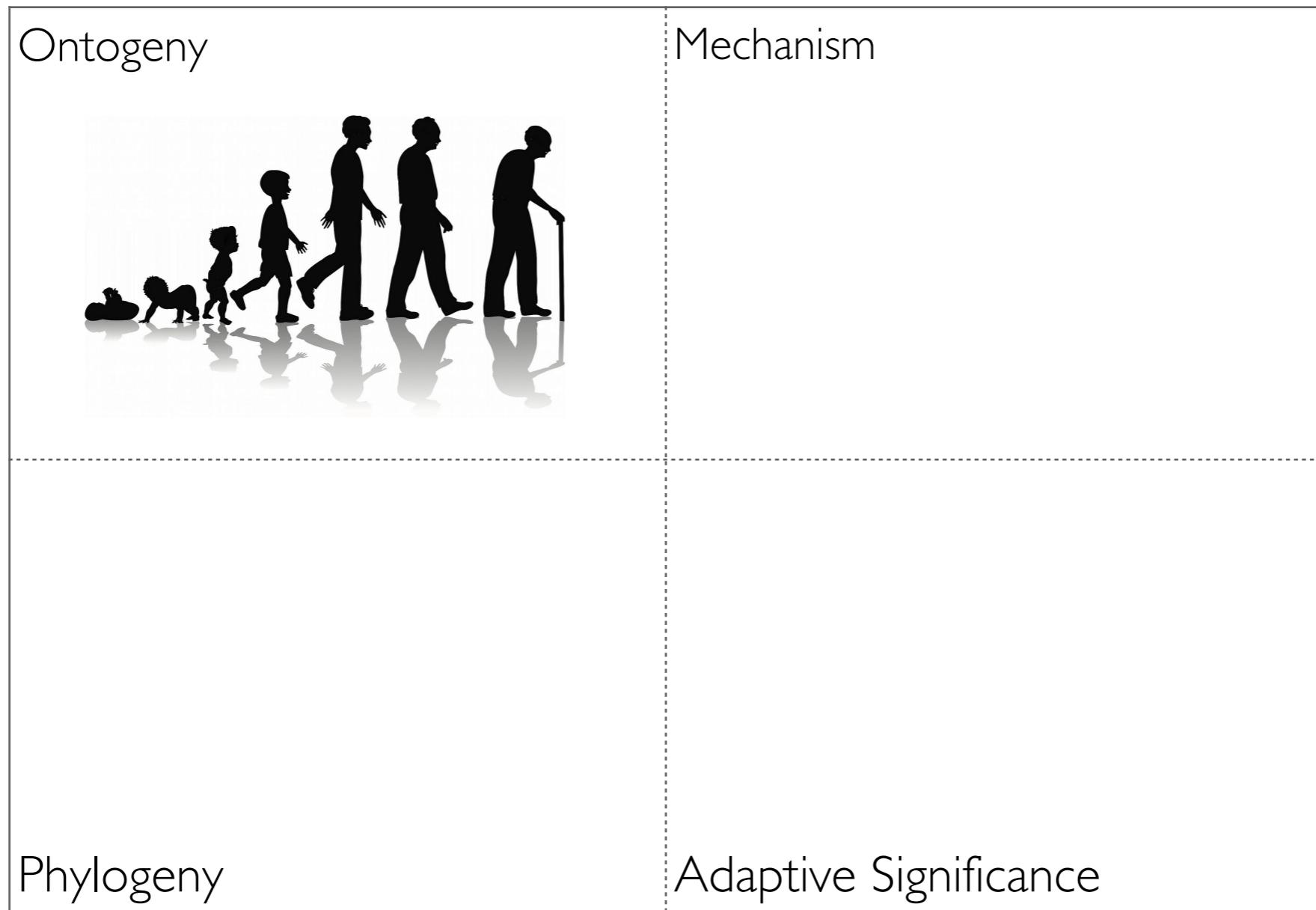


[...] reduced diffusion metrics of a tract projecting from the right anterior insula to the NAcc were associated with subsequent relapse to stimulant use, but not with previous diagnosis. These findings highlight a structural target for predicting relapse to stimulant use and further suggest that distinct connections to the NAcc may confer risk for relapse versus diagnosis."

MacNiven, K. H., Leong, J. K., & Knutson, B. (2020). Medial forebrain bundle structure is linked to human impulsivity. *Science Advances*, 6(38), eaba4788.

Tisdall, L., MacNiven, K. H., Padula, C. B., Leong, J. K., & Knutson, B. (2022). Brain tract structure predicts relapse to stimulant drug use. *Proceedings of the National Academy of Sciences*, 119(26), e2116703119.

Motivation



Motivation

Motivational Theory of Life-Span Development

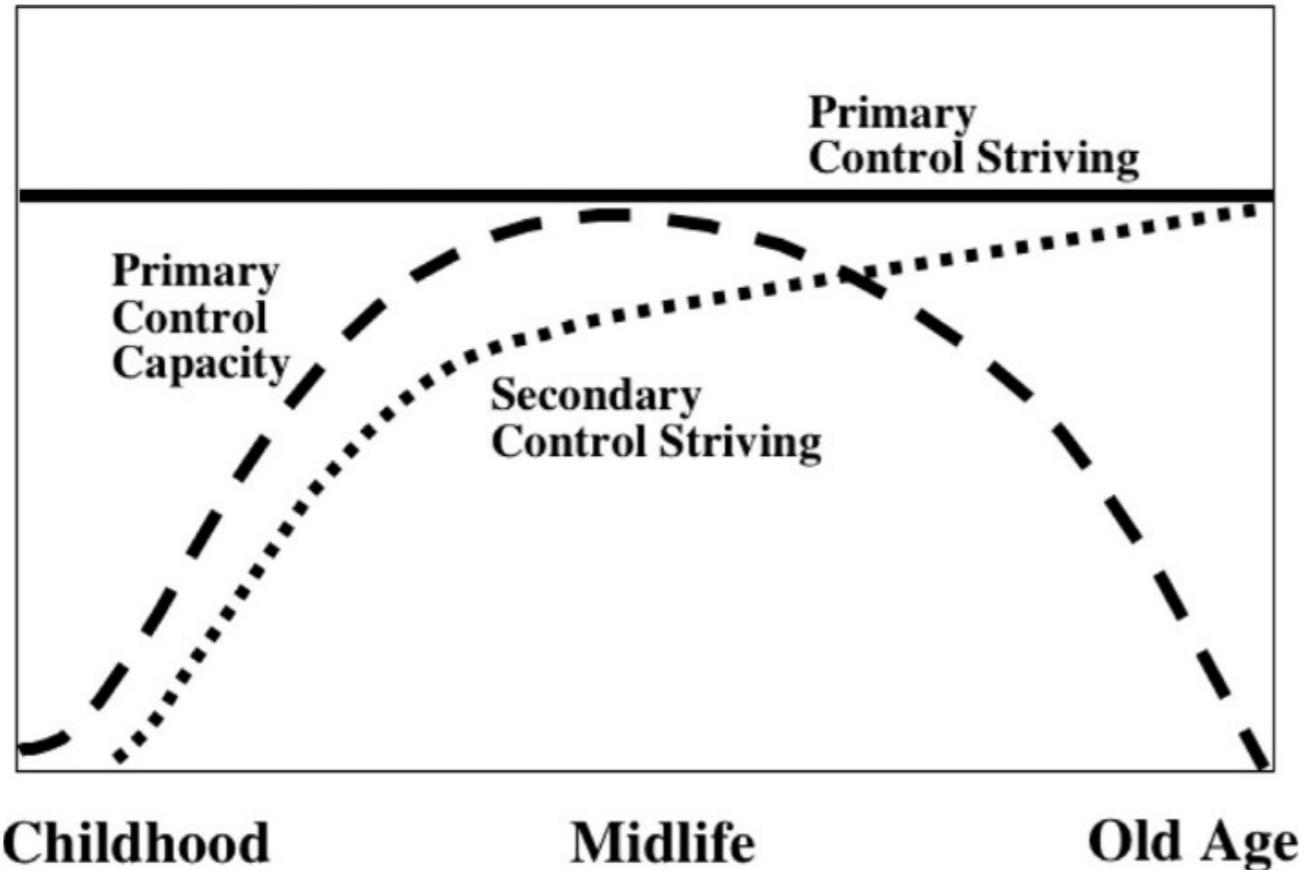


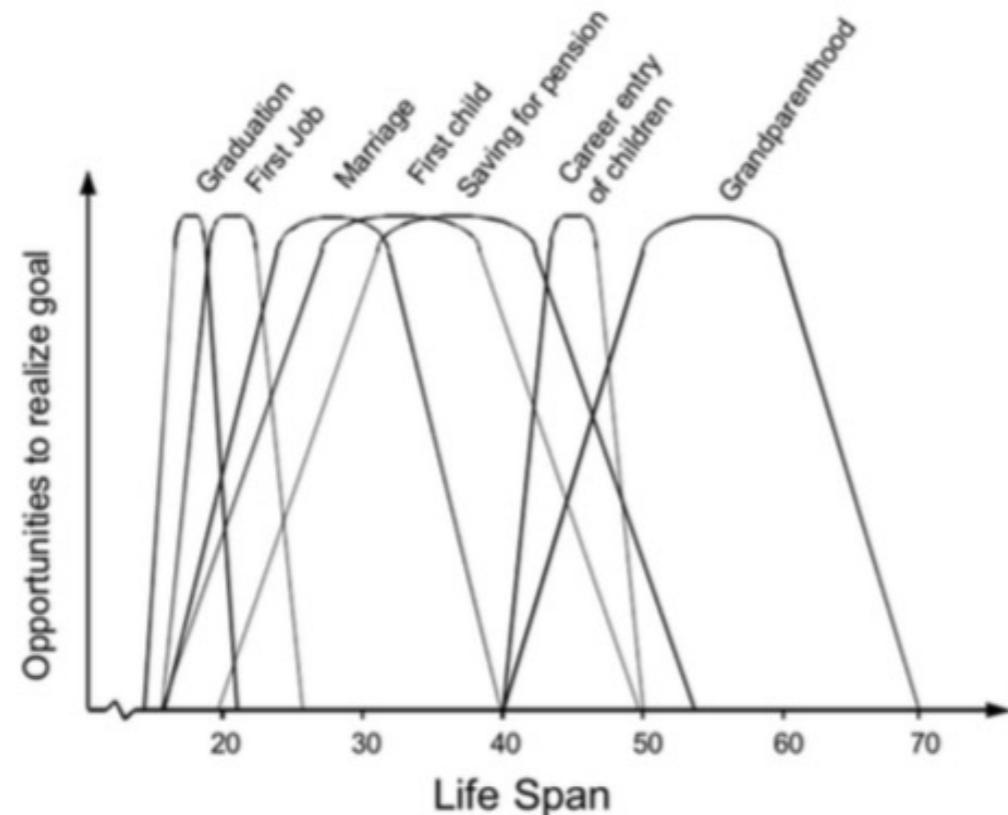
Figure 1. Hypothetical life-span trajectories for primary control potential and primary and secondary control striving.

primary control: processes directed at changing the world to bring the environment into line with one's wishes

secondary control: processes directed at changing the self to bring oneself into line with environmental forces

Motivation

Motivational Theory of Life-Span Development

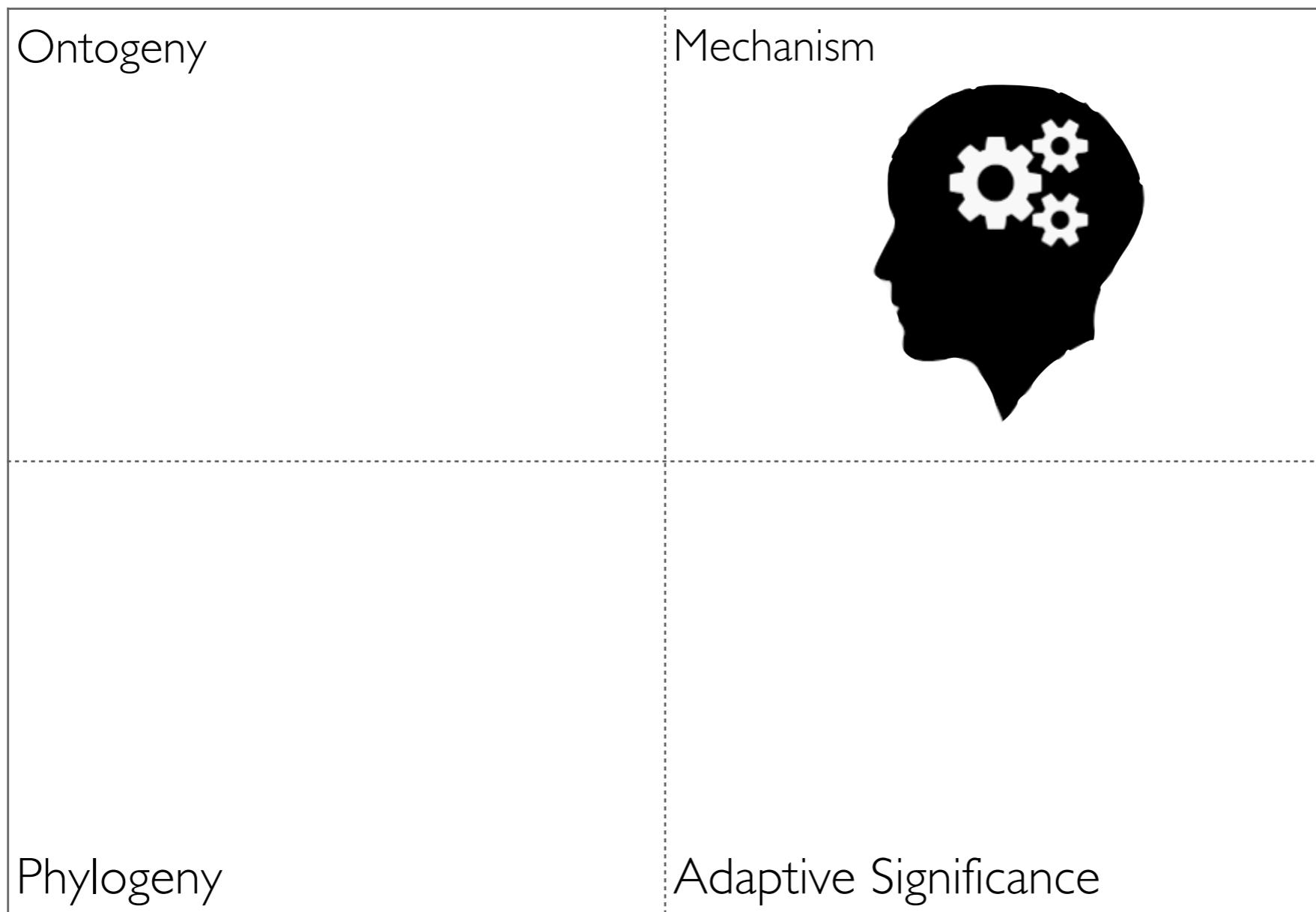


Control Processes Involved in Goal Engagement and in Goal Disengagement

Control process	Description
Goal engagement	
1. Selective primary control	Invest behavior, effort, time, skills, persistence
2. Selective secondary control	Volitional self-regulation to enhance motivational commitment to chosen goal. Avoid distractions, enhance perceived control, imagine positive incentives of goal attainment
3. Compensatory primary control	Seek out help or unusual means or ways to overcome shortfall of primary control resources
Goal disengagement	
1. Distancing from goal	Devalue chosen goal, downgrade importance of goal, enhance value of conflicting goals
2. Self-protection	Protect motivational resources from negative implications of failure or loss experiences

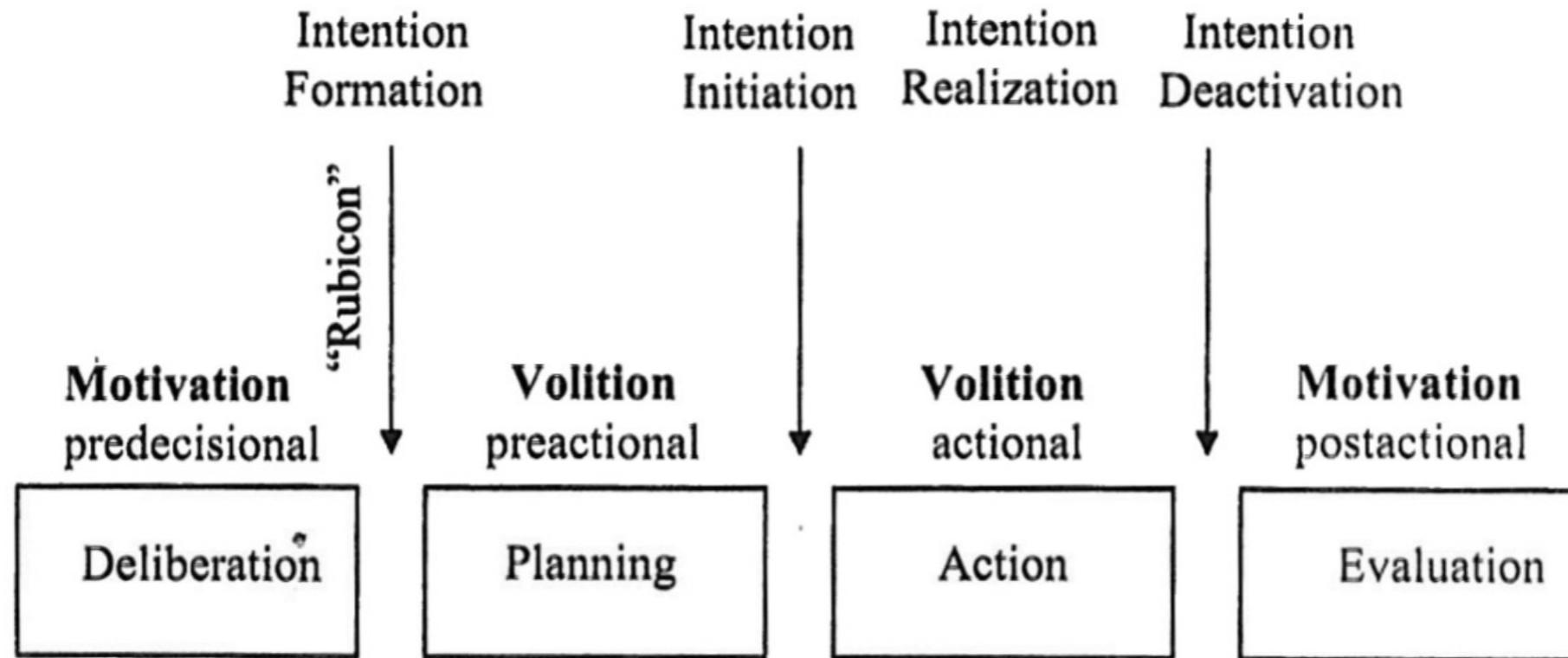
Developmental theories see motivation as an adaptive process of engagement and disengagement with different goals that are age- and context appropriate. These theories aim to describe the selection of specific control strategies (e.g., primary vs. secondary control) and how this may change across the life span (secondary control may be more prevalent later in life when there is less potential for exacting change in the world due to physical and cognitive decline).

Motivation



Motivation

Process Models: Rubicon Model

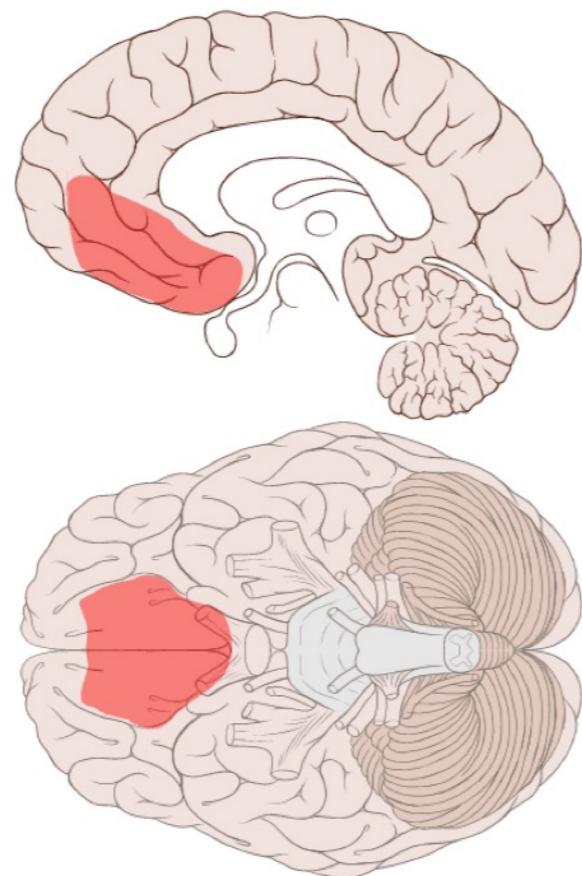
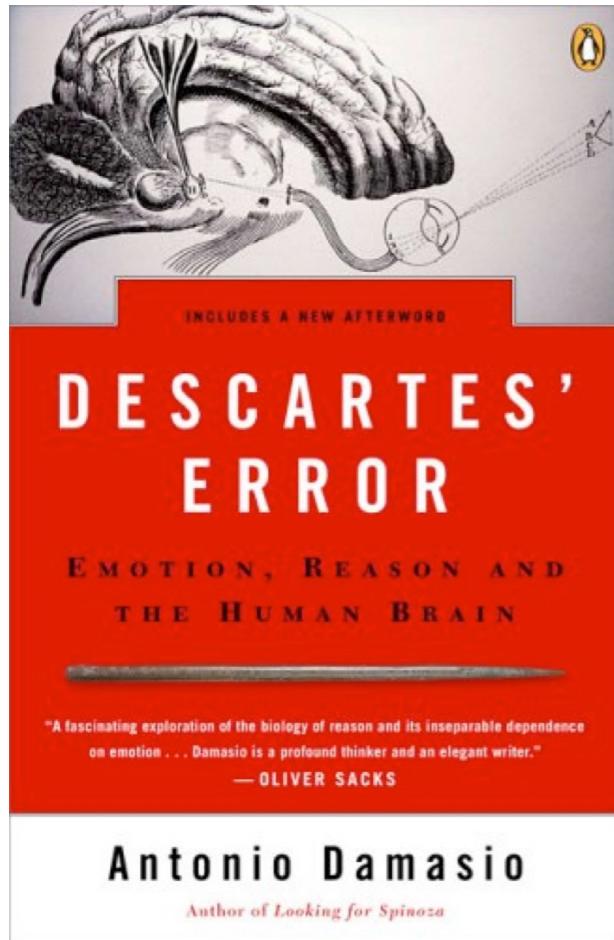


"The four phases of the Rubicon model differ in terms of the tasks that have to be addressed before the individual can move on to the next phase. Motivational episodes are thus broken into natural and seemingly independent phases. Critically, the Rubicon model seeks to explain both goal setting and goal striving."

The Rubicon model is a very simple, (toy-like) model of motivation but the field of decision science has done much to pry open the “black box” of deliberation using experimentation and mathematical modeling.

Motivation

Process Models: Cognitive Neuroscience



1994

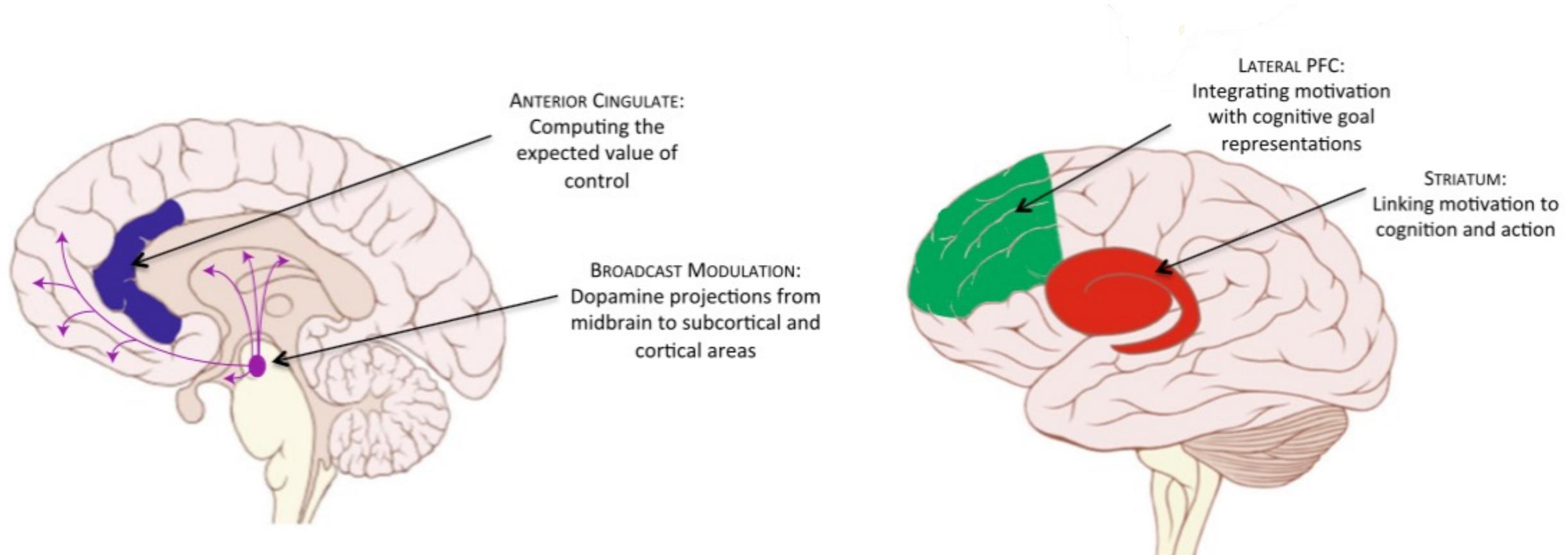
“Gage fits a neuroanatomical pattern that we have identified to date in 12 patients (...). Their ability to make rational decisions in personal and social matters is invariably compromised and so is their processing of emotion. On the contrary, their ability to tackle the logic of an abstract problem, to perform calculations, and to call up appropriate knowledge and attend to it remains intact. The establishment of such a pattern has led to the hypothesis that emotion and its underlying neural machinery participate in decision making (...)”

Damasio argued that Descartes' “error” was the dualist separation of rationality and emotion.

Damasio, H., Grabowski, T., Frank, R. Galaburda, A. M. & Damasio, A. R. (1994). The return of Phineas Gage: clues about the brain from the skull of a famous patient. *Science*, 264, 1102–1105.

Motivation

Process Models: Cognitive Neuroscience



Cognitive neuroscience models of motivation typically relate aspects of information integration needed for control, for example the integration of the potential costs and benefits of actions (reward and punishment) and the links between different hierarchical goals ("I want to do well on this exam because I want to finish my degree so I can become a X").

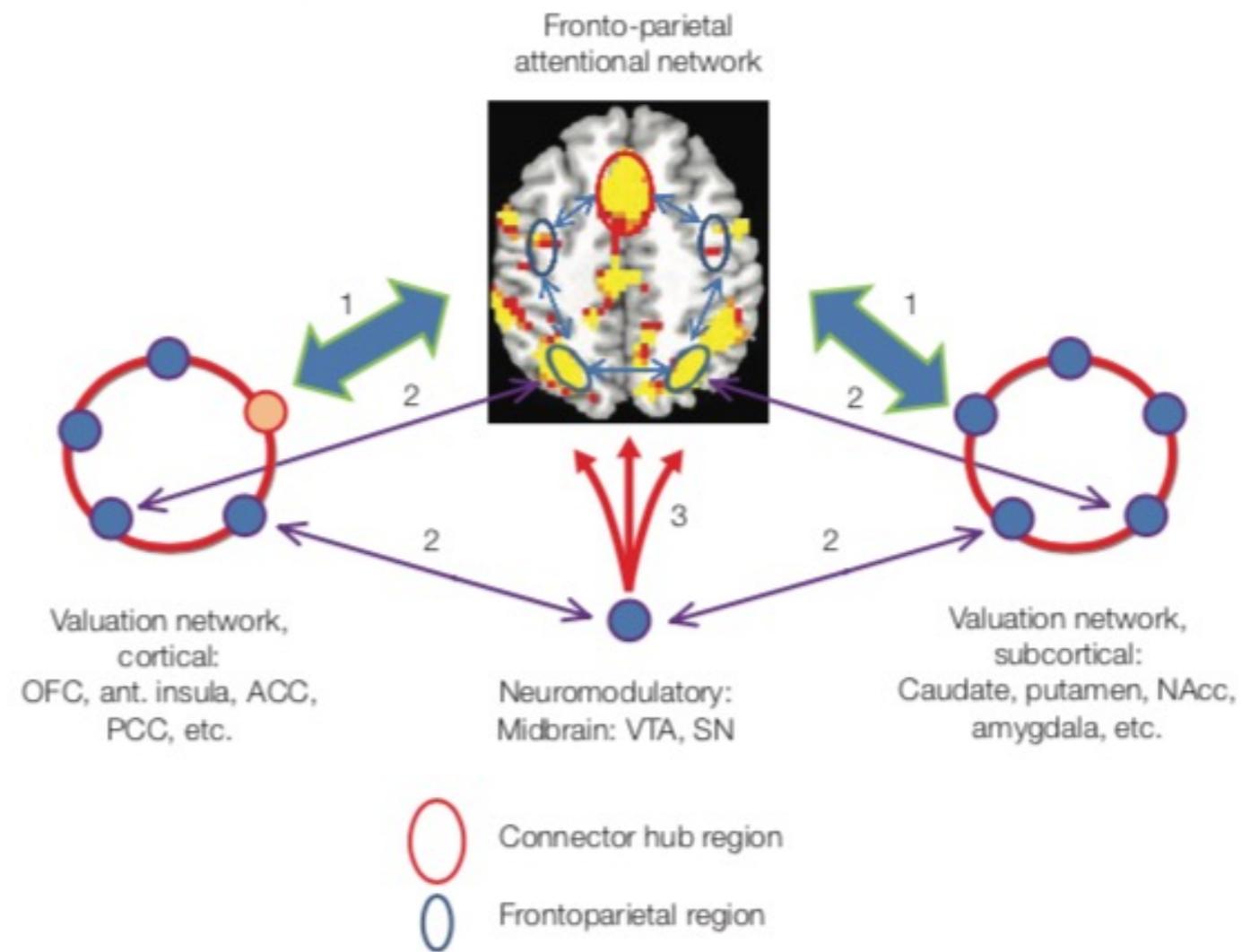
Braver, T. S., Krug, M. K., Chiew, K. S., Kool, W., Westbrook, J. A., Clement, N. J., et al. (2014). Mechanisms of motivation-cognition interaction: challenges and opportunities. *Cognitive, Affective, & Behavioral Neuroscience*, 14(2), 443–472.
<http://doi.org/10.3758/s13415-014-0300-0>

Motivation × Cognition to Goal-directed Behavior

Process Models: Cognitive Neuroscience

Modes of communication between cognitive and motivation networks illustrated for attentional-motivational interactions.

- (1) Interactions rely on connector “hub” regions, such as the anterior cingulate cortex, which are part of both attentional and motivational networks (indicated via the red outline in both the valuation-cortical and attentional networks).
- (2) In addition, specific regions may link the two networks, either directly or via the thalamus.
- (3) Finally, motivational signals are embedded within cognitive mechanisms via the action of diffuse neuromodulatory systems.



Models of motivation emphasize the role of integration of different valuation networks (cortical and subcortical). The link between models of motivation, emotion, and cognition is important because it emphasizes the idea that cognition is not value neutral.

Motivation: Different Perspectives Coexist

Table 1 Do we speak the same language? Disciplines of research on motivation have had substantially different foci and operationalizations, but frank conflicts in terminology and usage are relatively few

Terminology	Animal Literature Emphasis	Social & Personality Psychology Emphasis	Reinforcement Learning Emphasis	Human Cognitive Neuroscience Emphasis	Consistency, Conflict, or Gaps in Accounts
Motivation	Components: Directional component orients toward goal state, and activation component invigorates and energizes action.	Motives: Expectations, needs, and efficacy of the individual, more than quantifiable incentive values. Energization and directional components are recognized.	"Motivated" behavior = action selection/decision making driven by considerations of reward or utility; these are modulated by motivational state.	Quantification: Neural representations of the expected value of future events predict decisions to invest effort	<p>Consistency</p> <p>1) Behavior is driven by reward or utility; not limited to drive reduction</p> <p>2) Moderated by perceived efficacy</p> <p>3) Regulates effort investment</p> <p>Gap</p> <p>Individual motives are usually neglected in the cognitive and animal literature, whereas quantification is limited in social accounts.</p>
Goal	Internal subjective states that generate activational and directional components of motivation	Mental representations of desired states, characterized by feasibility and desirability, commitment, and beliefs	The implicit, constant goal of the organism is to maximize reward.	Operationalized as active maintenance of internal representations of desired states	<p>Consistency</p> <p>All postulate desired and predicted states that may differ from current state.</p> <p>Gap</p> <p>Cognitive neuroscience and animal literature emphasize transient goals; reinforcement learning and social accounts include study of common stable goals; personality research focuses on individual differences in goals.</p>
Goal pursuit	Learning which actions bring about the valued outcome—unlike habit, goal pursuit behavior is sensitive to outcome revaluation.	Distinctions between goal setting or mere activation of a goal representation and goal striving	Nested goal hierarchies are a necessary framework for model-based reinforcement learning.	In some accounts, conceptualized in terms of affective valence states	<p>Consistency</p> <p>All accounts emphasize effort.</p> <p>Gap</p> <p>Not all disciplines recognize subprocesses.</p>
Habit	Stimulus-response associations unmoored from modification by outcomes or incentive salience	Goal-action links causing automatic activation of behavior	May depend on prior model-free reinforcement learning	Mostly considered in research on addiction, mainly recapitulates animal literature.	<p>Consistency</p> <p>Represents highly automatized link to action</p> <p>Conflict</p> <p>Social psychology concept of habit as goal-oriented is at odds with animal literature account of habit as goal-independent.</p>
Incentive value	Eventually decoupled by learning from hedonic impact of incentives	Not typically discussed, except in terms of individual motives	Defined by Magnitude × Success Probability	Defined by Magnitude, Valence × Success Probability	<p>Consistency</p> <p>Value includes Magnitude × Success Probability</p> <p>Gap</p> <p>Computation of incentive value is relatively unexamined in terms of individual motives.</p>
Incentive salience	Dictated by learned incentive value and current state	Not typically discussed, but implied by emphasis on individual motives	Salience concept is ambiguous, sometimes meaning "associability" rather than value	Inferred from activation of motivational architecture during anticipation and subsequent instrumental behavior	<p>Consistency</p> <p>Quantifies influence of a stimulus on behavior</p> <p>Gap</p> <p>Current definitions do not consider individual motives or long-term goals.</p>
Intrinsic vs. extrinsic motivation	Animal models have found this distinction challenging to explore.	Intrinsic motivation is engagement in a task for inherent satisfaction; extrinsic reinforcement may undermine this effect.	Classically, no distinction (recent work has included information structure as a reinforcer)	Most cognitive neuroscience work has focused on extrinsic motivation, given focus on quantifiable reinforcement.	<p>Consistency</p> <p>Most approaches acknowledge but do not manipulate this distinction.</p> <p>Conflict</p> <p>Tension with ideas about common currency of "reward"</p>

Summary

- **Adaptive Significance:** Motivational factors are important correlates/predictors of academic and work performance. A number of theories have tried to systematize the types of goals (contents) of motivation by referring to evolutionary theory (i.e., certain cues are motivating because they signal a good mate) but most are based on plausibility or normative arguments.
- **Comparative approaches:** Animal models have been (and still are) instrumental in helping understand hierarchy of needs and the neural basis of simple motivational processes, such as habit formation (e.g., drug addiction).
- **Developmental theory:** Motivational theories of development try to capture the dynamics of goal engagement and disengagement across the life span; emphasis on different types of control (primary vs. secondary) and context dependency (as a function of needs and resources).
- **Cognitive and neural models:** cognitive models have focused on distinguishing phases such as deliberation and action phases; neural models of motivation overlap with neural models of cognition (e.g., attention) and emotional processing, involving aspects of information integration (prefrontal cortex) and valuation (cortical/subcortical).