

Kognitionspsychologie II: Session 6

Social Cognition

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Version: April 9, 2024

Learning Objectives

- Be able to define and give examples of social cognition, and outline key concepts and research paradigms.
- Discuss the **adaptive significance** of social cognition in past and current environments
- Learn about **comparative approaches** to study social cognition
- Learn about **lifespan trajectories** of social cognition
- Learn about **neural model(s)** of social cognition

Social cognition

- “... refers to the processes that subserve behavior **in response to** conspecifics (other individuals of the same species)” (Adolphs, 1999)
- “... the sum of those processes that allow individuals of the same species (conspecifics) to **interact with** one another.” (Frith & Frith, 2007)
- “... concerns the various psychological processes that enable individuals to **take advantage of** being part of a social group.” (Frith, 2008)
- “... the study of **information processing** in a social setting” (Frith, 2008)

Adolphs, R. (1999). Social cognition and the human brain. *Trends in Cognitive Sciences*, 3(12), 469-479.

Frith, C. D., & Frith, U. (2007). Social cognition in humans. *Current Biology*, 17(16), R724-R732.

Frith, C. D. (2008). Social cognition. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 363(1499), 2033-2039.

Social-cognitive abilities



Social-cognitive abilities

- Shared (joint) attention & referential communication
- Empathy
- Social learning
- Theory of mind

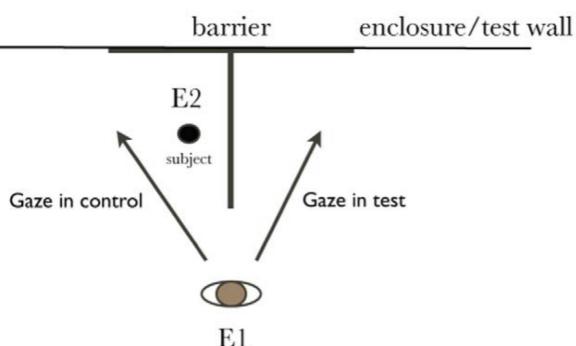
Bjorklund, D. F., Causey, K., & Periss, V. (2010). The evolution and development of human social cognition. *Mind the gap: Tracing the origins of human universals*, 351-371.

Paradigms

Gaze following
(Shared attention)



b



Range, F., & Virányi, Z. (2011). Development of gaze following abilities in wolves (*Canis lupus*). *PLoS One*, 6(2), e16888.

Consolation/targeted helping (Empathy)

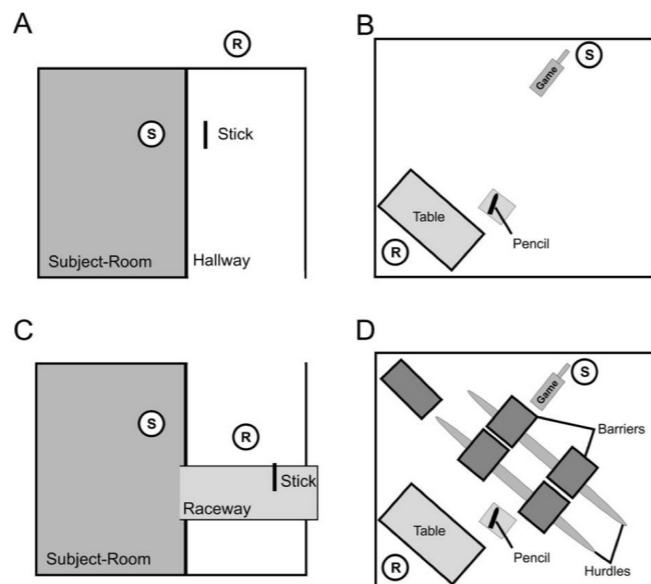


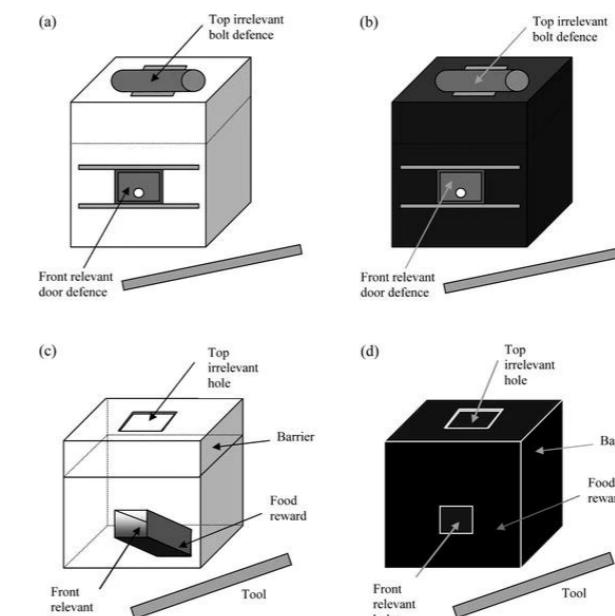
Table 1. Examples of problems used in child study.

Category	Task	Problem
Out-of-reach	Marker	The adult accidentally drops a marker on the floor and unsuccessfully reaches for it (experimental) or intentionally throws a marker on the floor (control).
Physical obstacle	Cabinet	The adult wants to put magazines into a cabinet, but the doors are closed so that he bumps into it (experimental) versus bumping into the doors as he tries to lift the magazines onto the cabinet (control).
Wrong result	Book	A book slips from a stack as the adult attempts to place it on top of the stack (experimental) or he places it next to the stack (control).
Wrong means	Flap	A spoon drops through a hole and the adult unsuccessfully tries to grasp it through the small hole, ignorant of a flap on the side of the box (experimental). Alternatively, he throws the spoon in the box on purpose (control).

Warneken, F., Hare, B., Melis, A. P., Hanus, D., & Tomasello, M. (2007). Spontaneous altruism by chimpanzees and young children. *PLoS biology*, 5(7), e184.

Warneken, F., & Tomasello, M. (2006). Altruistic helping in human infants and young chimpanzees. *science*, 311(5765), 1301-1303.

Puzzle boxes
(Social learning)



False belief task
(Theory of mind)

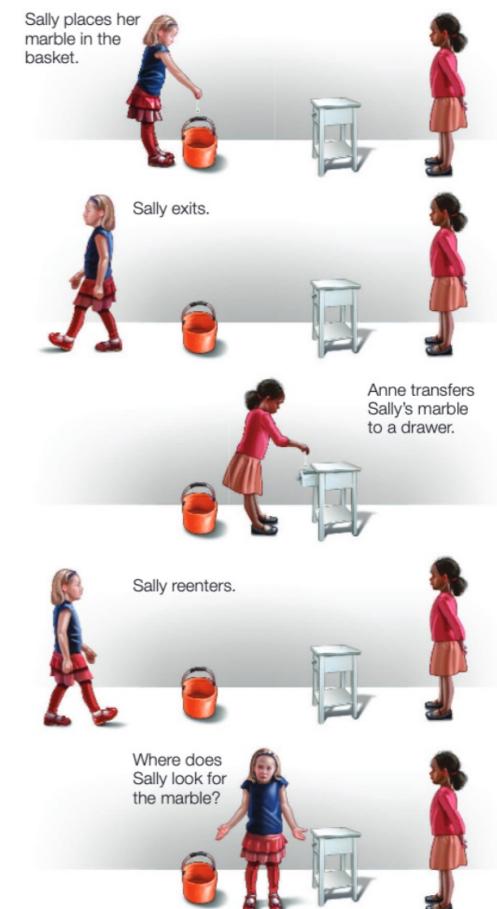


FIGURE 13.12 The Sally-Anne false-belief task for investigating theory of mind.

Horner, V., & Whiten, A. (2005). Causal knowledge and imitation/emulation switching in chimpanzees (*Pan troglodytes*) and children (*Homo sapiens*). *Animal cognition*, 8, 164-181.

Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (Eds.). (2019). Social Cognition. In Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (Eds.), Cognitive Neuroscience. The biology of the mind (5th ed., pp. 566-617). W.W. Norton & Company.

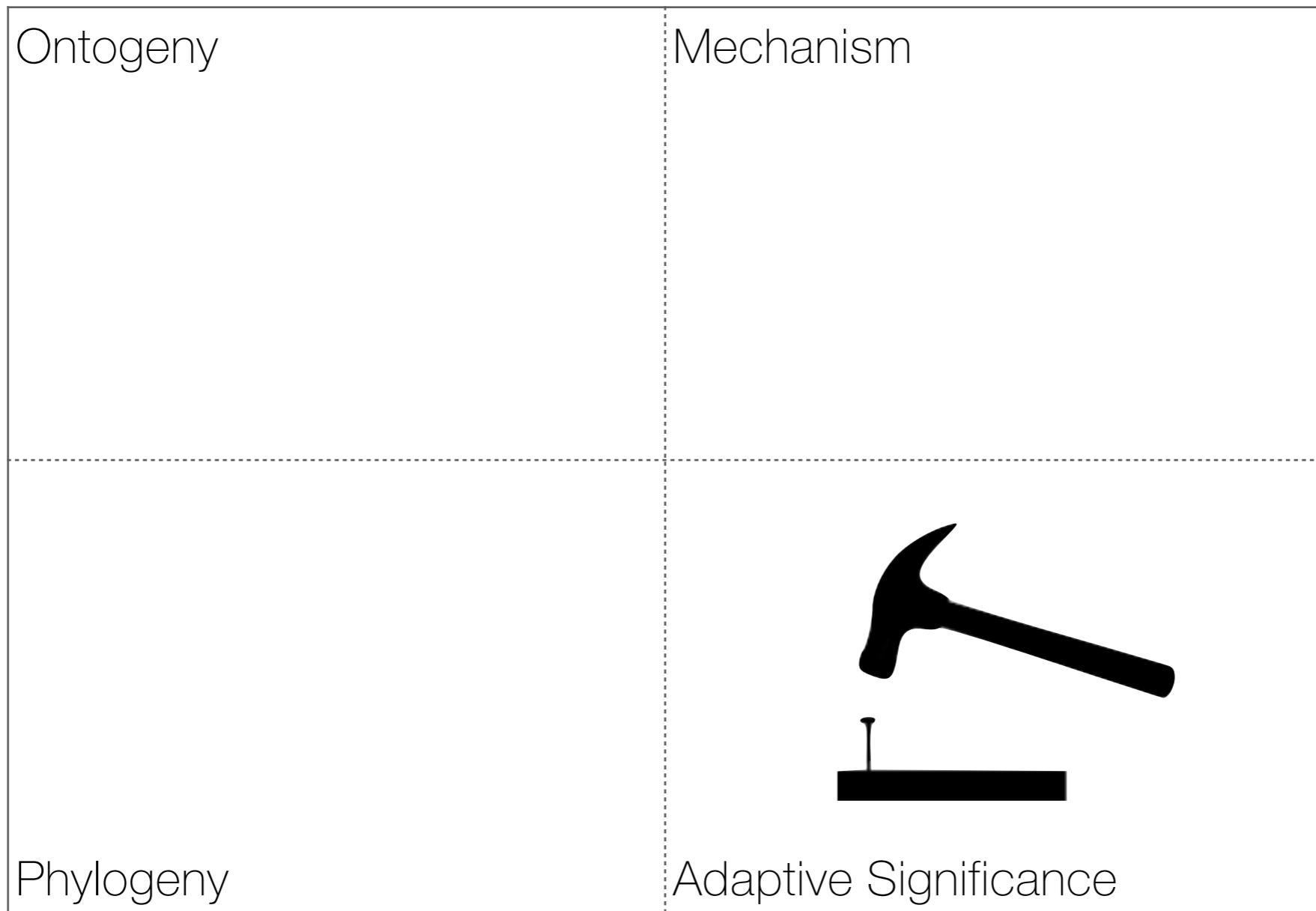
A note on social signals, senders, & receivers

- Social-cognitive abilities rely on the exchange of social signals: speech, facial expression, body posture and movement, eye gaze, marks, arrangements of objects, etc.
- Senders and receivers of signals can be unaware of the exchange
- Some exchanges require sender awareness: deliberate signaling for knowledge transfer (e.g., ostention)
- Some exchanges require receiver awareness: learning by observation versus learning by instruction

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Social cognition



Adaptive significance



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

Your turn!

Adaptive significance

Uniquely human social-cognitive abilities and processes that have led to the development of language, institutionalized teaching, and culture (cf. social intelligence versus ecological intelligence hypothesis)

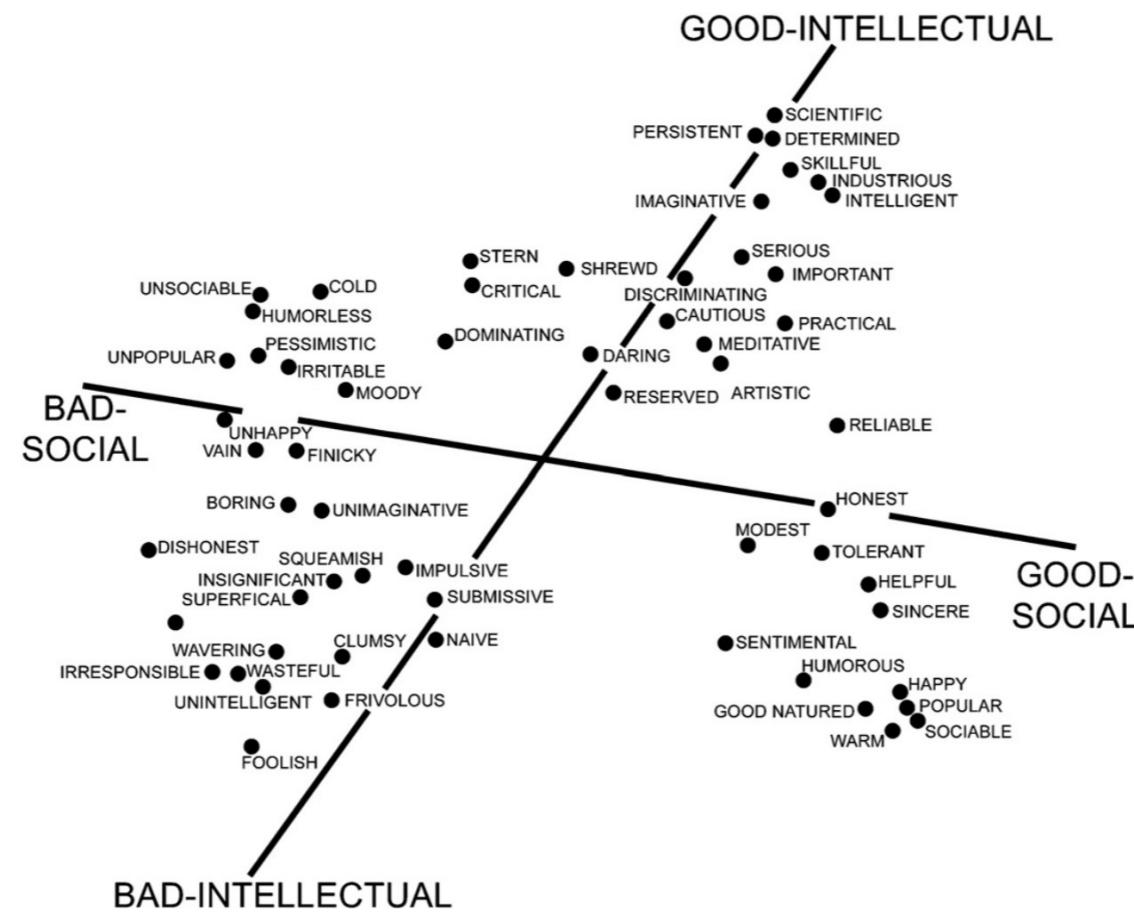
- Learning about the world from con/heterospecifics → time and energy efficient!
 - Avoid danger
 - Differentiate nice from nasty
 - Find locations of interest
- Creation of a shared world
 - Goal alignment and shared action
- Learning about con/heterospecifics
 - Detecting agency, goals, motivations, intentions, trustworthiness

Adaptive significance: Learning about others

Does this person have the **intention** to harm me?

Does this person have the **ability** to harm me?

Competence



Warmth

“New data confirm these two universal dimensions of social cognition: warmth and competence. Promoting survival, these dimensions provide fundamental social structural answers about competition and status. [...]. These universal dimensions explain both interpersonal and intergroup social cognition.”

Fiske, S. T., Cuddy, A. J., & Glick, P. (2007). Universal dimensions of social cognition: Warmth and competence. *Trends in Cognitive Sciences*, 11(2), 77-83.

Adaptive significance: Facial emotion recognition

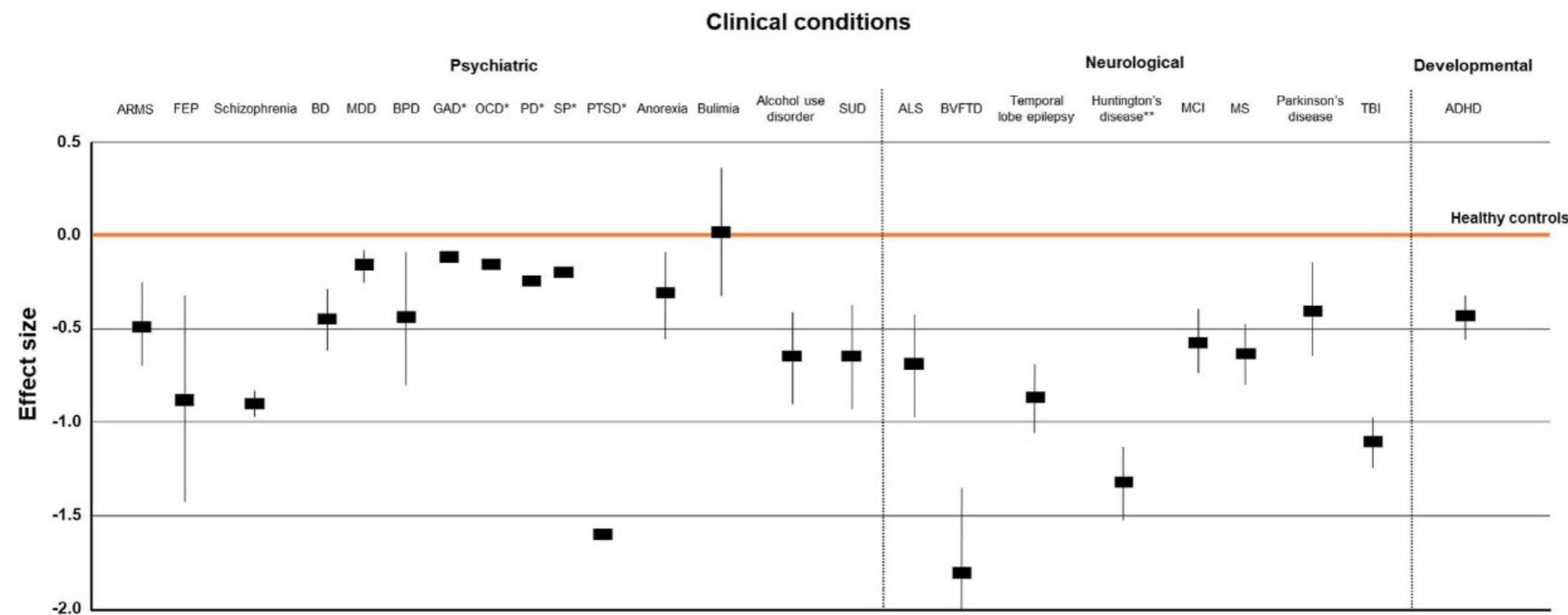


Fig. 2. Facial emotion recognition effect size estimates and corresponding 95% confidence intervals across clinical conditions relative to healthy controls.

*95% CI data not available.

**Negative emotions subscale score, comprising total score for anger, disgust, sadness and fear facial affect recognition tasks only.

Abbreviations: ADHD: Attention deficit hyperactivity disorder; ALS: Amyotrophic lateral sclerosis; ARMS: At-risk mental state; BD: Bipolar disorder; BPD: Borderline personality disorder; BVFTD: Behavioural variant frontotemporal dementia; FEP: First-episode psychosis; GAD: Generalised anxiety disorder; MCI: Mild cognitive impairment; MDD: Major depressive disorder; MS: Multiple sclerosis; OCD: Obsessive-compulsive disorder; PD: Panic disorder; PTSD: Post-traumatic stress disorder; SP: Social phobia; SUD: Substance use disorder (non-alcohol); TBI: Traumatic brain injury.

Deficits (compared with healthy controls) in aspects of social cognition are observed across a large set of psychiatric, neurological and developmental disorders.

Adaptive significance: Theory of mind

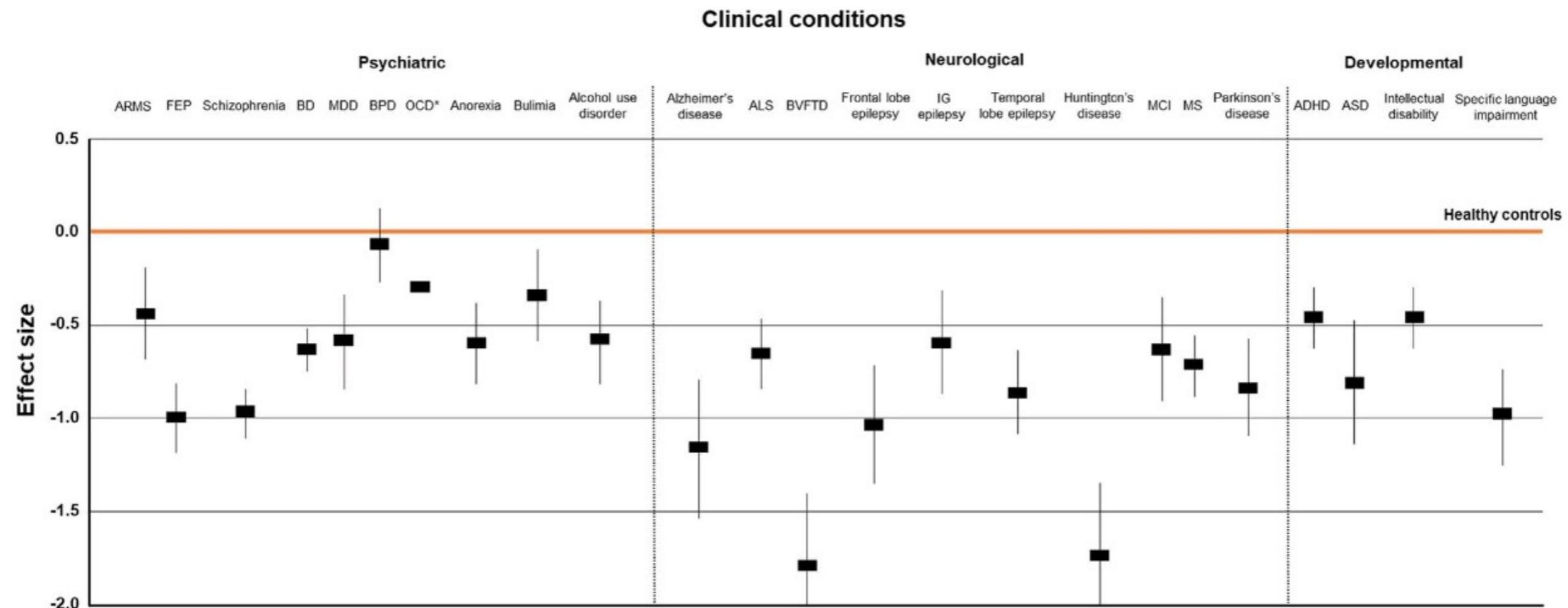


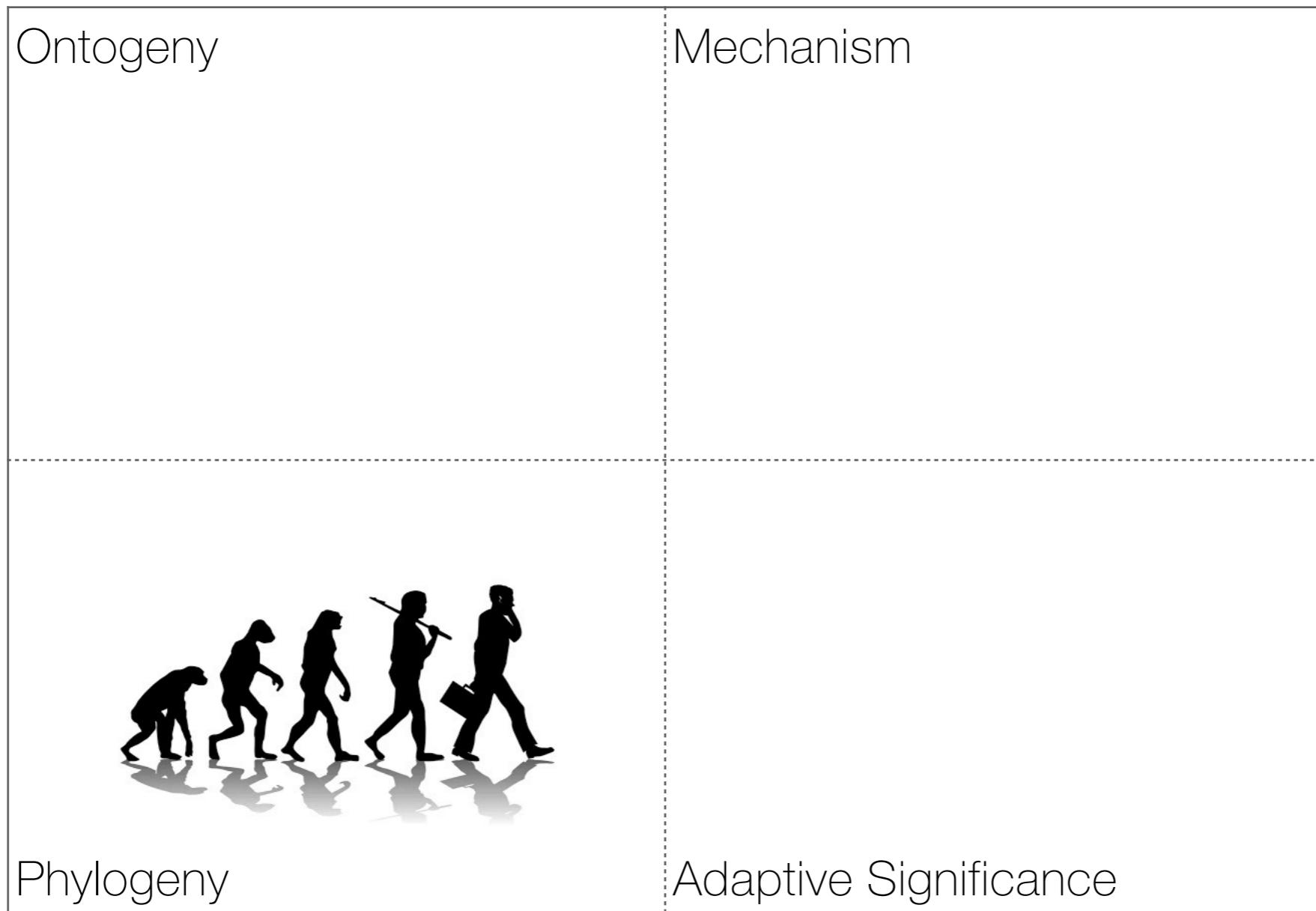
Fig. 3. Theory of mind effect size estimates and corresponding 95% confidence intervals across clinical conditions relative to healthy controls.

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Abbreviations: ADHD: Attention deficit hyperactivity disorder; ALS: Amyotrophic lateral sclerosis; ARMS: At-risk mental state; ASD: Autism spectrum disorder; BD: Bipolar disorder; BPD: Borderline personality disorder; BVFTD: Behavioural variant frontotemporal dementia; FEP: First-episode psychosis; IG: Idiopathic generalised epilepsy; MCI: Mild cognitive impairment; MDD: Major depressive disorder; MS: Multiple sclerosis; OCD: Obsessive-compulsive disorder.

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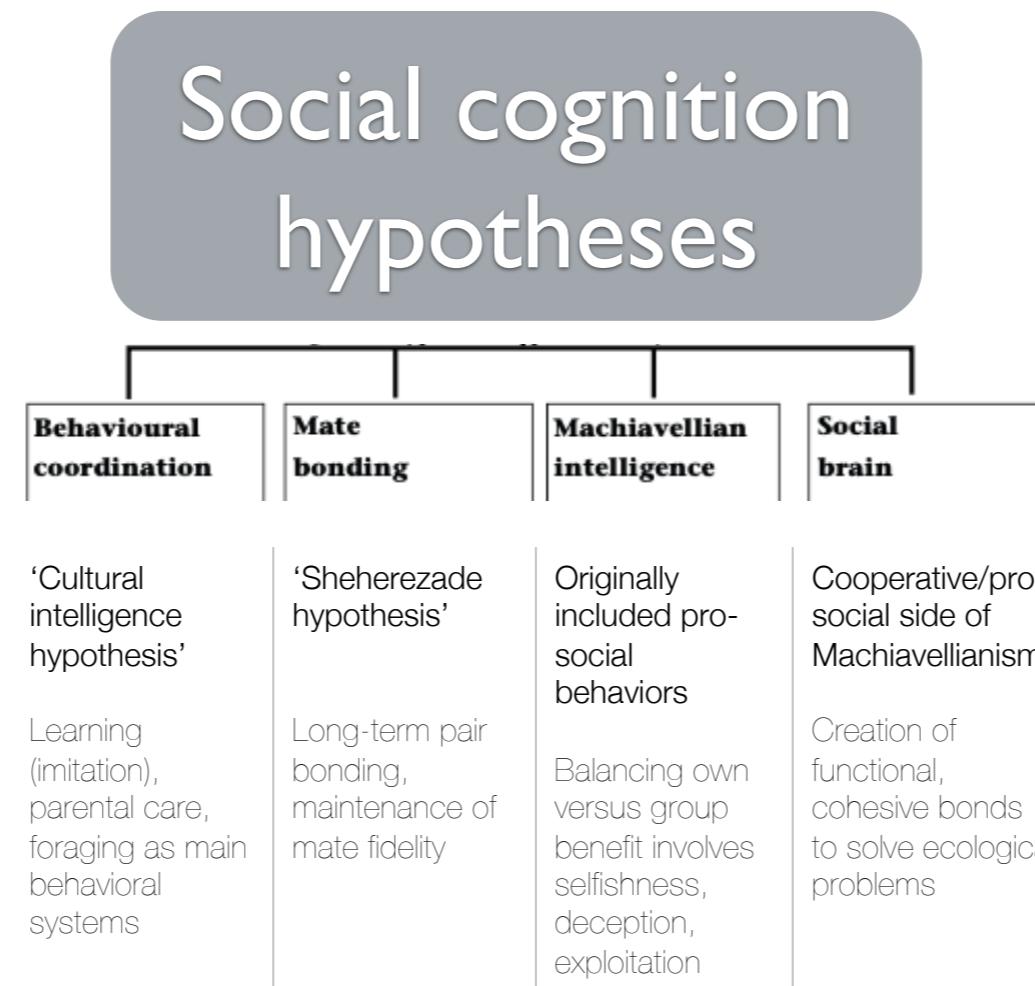
Social cognition



Evolution of (human) social cognition

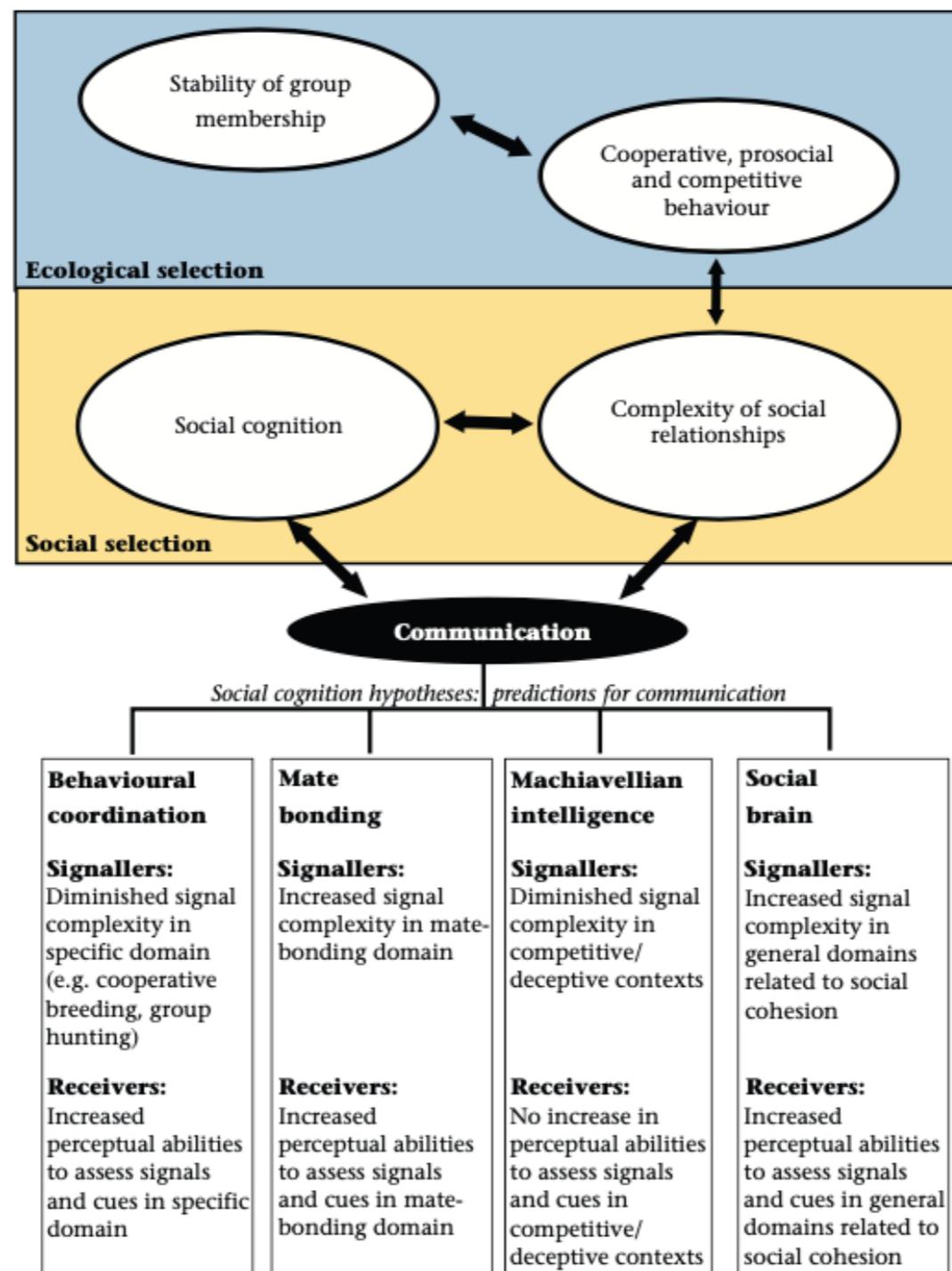
"... intellectual evolution was driven by the need to deal with conspecifics. As such, human social cognition can be viewed as the more primary form of thought, with *H. sapiens'* impressive suite of intellectual abilities being essentially the derivative of cognition initially evolved to cooperate and compete with fellow hominids."

Evolution of (human) social cognition



Freeberg, T. M., Gentry, K. E., Sieving, K. E., & Lucas, J. R. (2019). On understanding the nature and evolution of social cognition: a need for the study of communication. *Animal Behaviour*, 155, 279-286.

Evolution of (human) social cognition

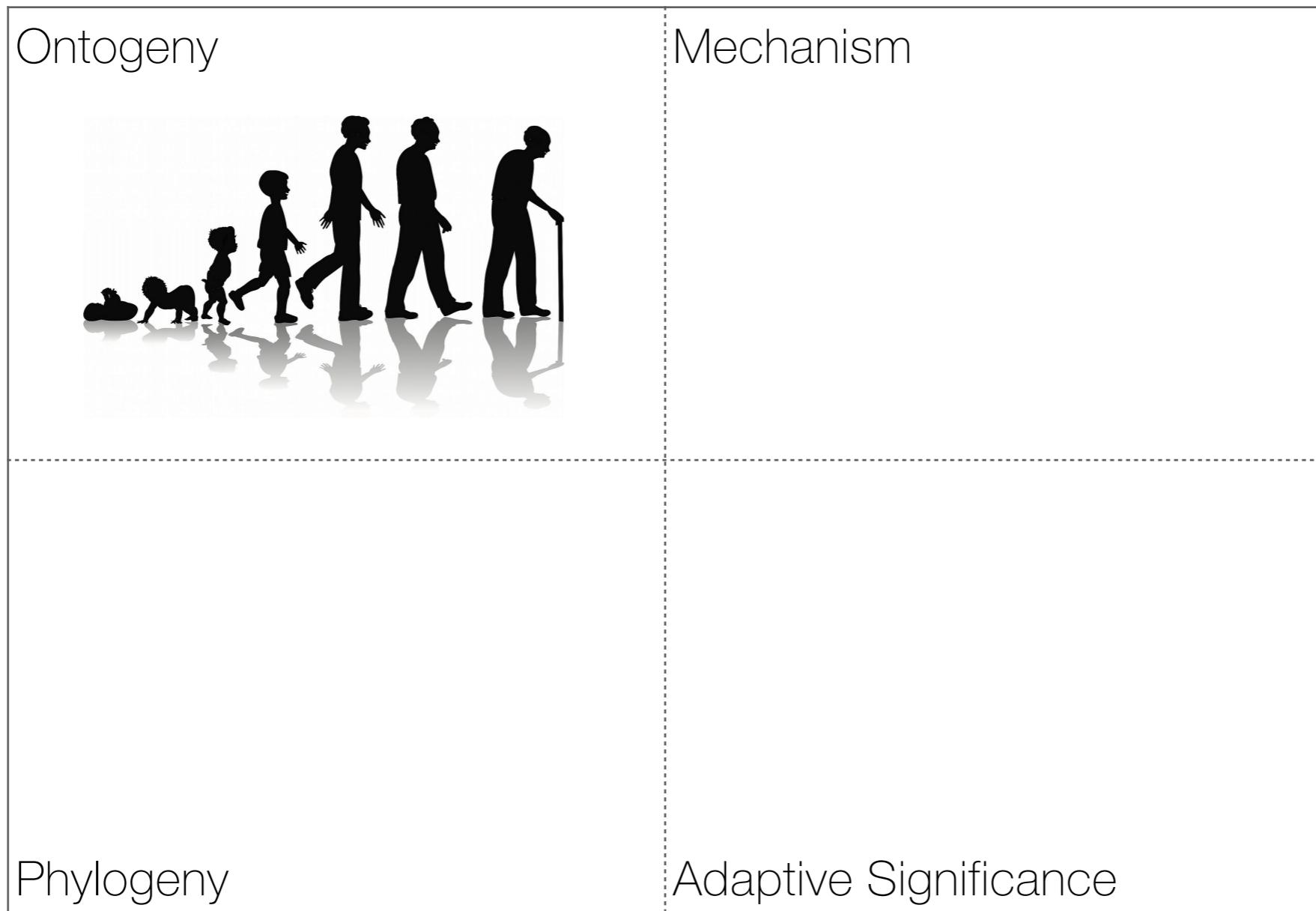


"We raised four major hypotheses to explain the evolution of social cognition, and for each discussed predictions for communication systems under those hypotheses. [...] That such predictions about the role of communication in the evolution of social cognition have rarely been tested is both unfortunate and surprising."

Social cognition in non-human primates

Social-cognitive ability	Evidence for social cognition in non-human primates	Evidence against social cognition in non-human primates
Joint attention & referential communication	<ul style="list-style-type: none">• Gaze following in chimps, and monkeys (joint attention)• Situation-specific pointing or grooming (referential communication)	<ul style="list-style-type: none">• Gaze following specific to some contexts and not sufficient for joint attention• Question of enculturation
Empathy	<ul style="list-style-type: none">• Simple forms (emotional contagion and sympathy) observed in a range of wild social animals• Spontaneous helping behavior in enculturated apes	<ul style="list-style-type: none">• Sympathy and contagion are NOT (cognitive/emotional) empathy
Social learning	<ul style="list-style-type: none">• Chimps show extensive social learning and thereby transmit nongenetic information across generations (e.g., greeting, grooming, foraging)• Chimps engage in emulation and do not imitate irrelevant actions (puzzle boxes)	<ul style="list-style-type: none">• No unequivocal evidence of imitation (mimicry) in the wild (though enculturated apes will imitate a model)• No active facilitation of instruction-based learning or teaching
Theory of mind	<ul style="list-style-type: none">• Chimpanzees and other great apes engage in deception towards conspecifics but also humans in laboratory/nursery environments	<ul style="list-style-type: none">• Chimpanzees chose randomly between careaker with/without eye occlusion when required to make a begging gesture to receive out-of-reach treat• No evidence to suggest chimps can solve false belief task

Social cognition



Development of social cognition in humans

Social-cognitive ability

Developmental stages



Caregiver effects

Joint attention (triadic interaction) & referential communication	<ul style="list-style-type: none">• Neonates orient towards human faces, dyadic exchange (e.g., reciprocity) by 2 months, looking into same direction as someone else by 3-4 months → precursors to shared attention, typically seen around 9 months (coincides with infants perceiving others as intentional agents with goals and intentions)• Pointing towards object to inform others by 12 months, use of others' gaze as a directive cue by 12-18 months
Empathy	<ul style="list-style-type: none">• Neonates show contagion (e.g., crying in response to other babies' crying), while cognitive empathy (examined via helping/consolation behavior) observable ~2 years of age• Co-development of self-objectification (assessed using the mirror "rouge" task) and empathy (e.g., prosocial and helping behavior), the former required for the latter
Social learning	<ul style="list-style-type: none">• From imitation (exact copying) to goal emulation (focusing only on the end result); cf. opaque/transparent puzzle box experiments• Neonatal imitation (e.g., tongue protrusion), with more selective, insightful learning (e.g., goal emulation) by 18 months → rational imitation by 14 months• Overimitation observed for 3-4 year-olds may indicate a learning strategy
Theory of mind	<ul style="list-style-type: none">• Accurate belief-desire reasoning around 4 years of age (cf. false belief tasks)• 3-year olds fail false-belief task, but even 14-18-months old children understand that others have beliefs, desires, knowledge that is different to their own (cf. preferred food task)• Developmental patterns found for ToM are universal but cultural difference in onset

Social cognition across the lifespan

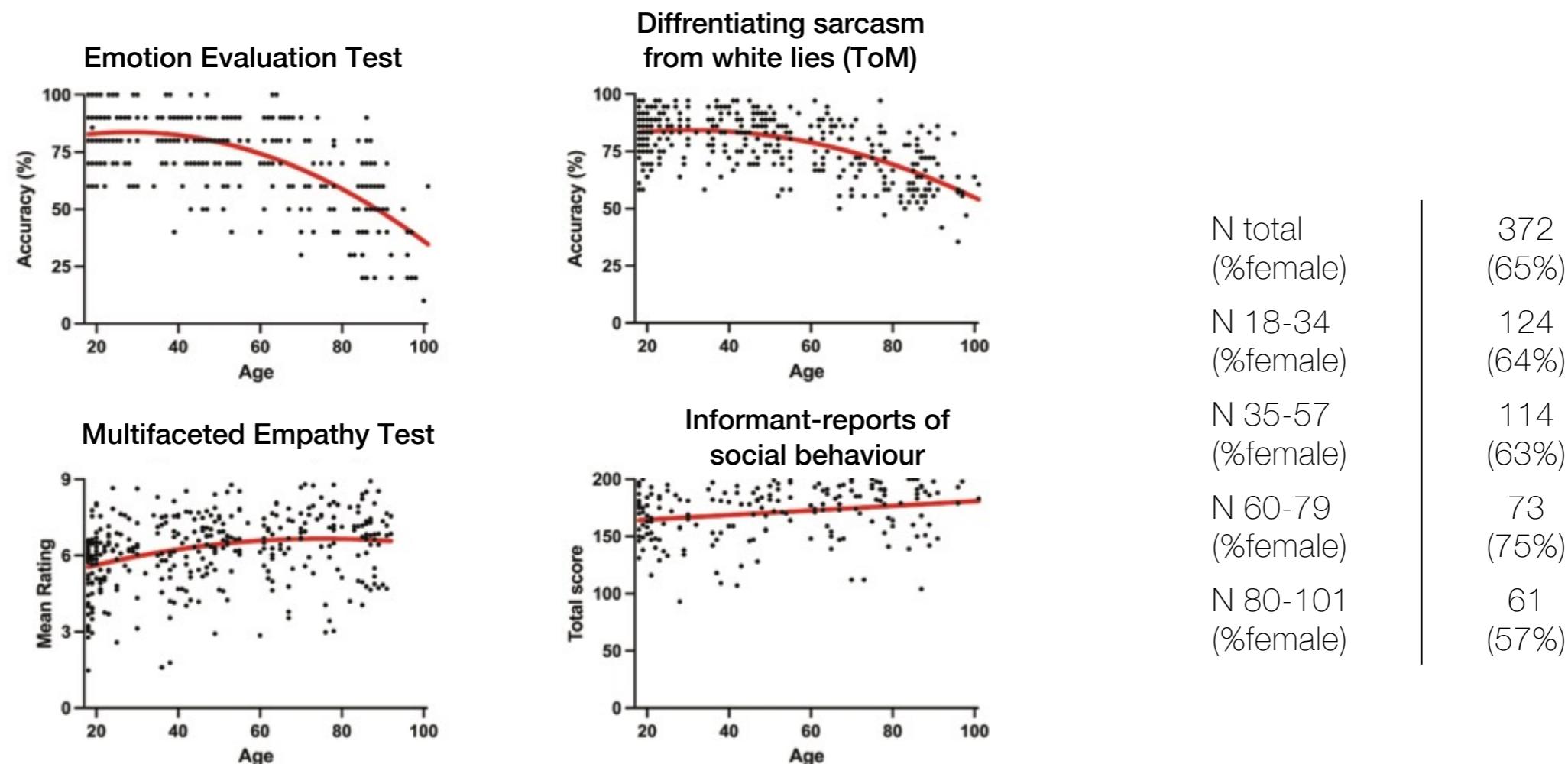


Figure 1. The association between age and (A) social perception, (B) theory of mind, (C) affective empathy, (D) social behavior. Full color version is available within the online issue.

“[...] normative aging is associated with both gains and losses in social cognition that occur at distinct points of the adult life-span, and that are at least partially independent of general age-related cognitive decline.”

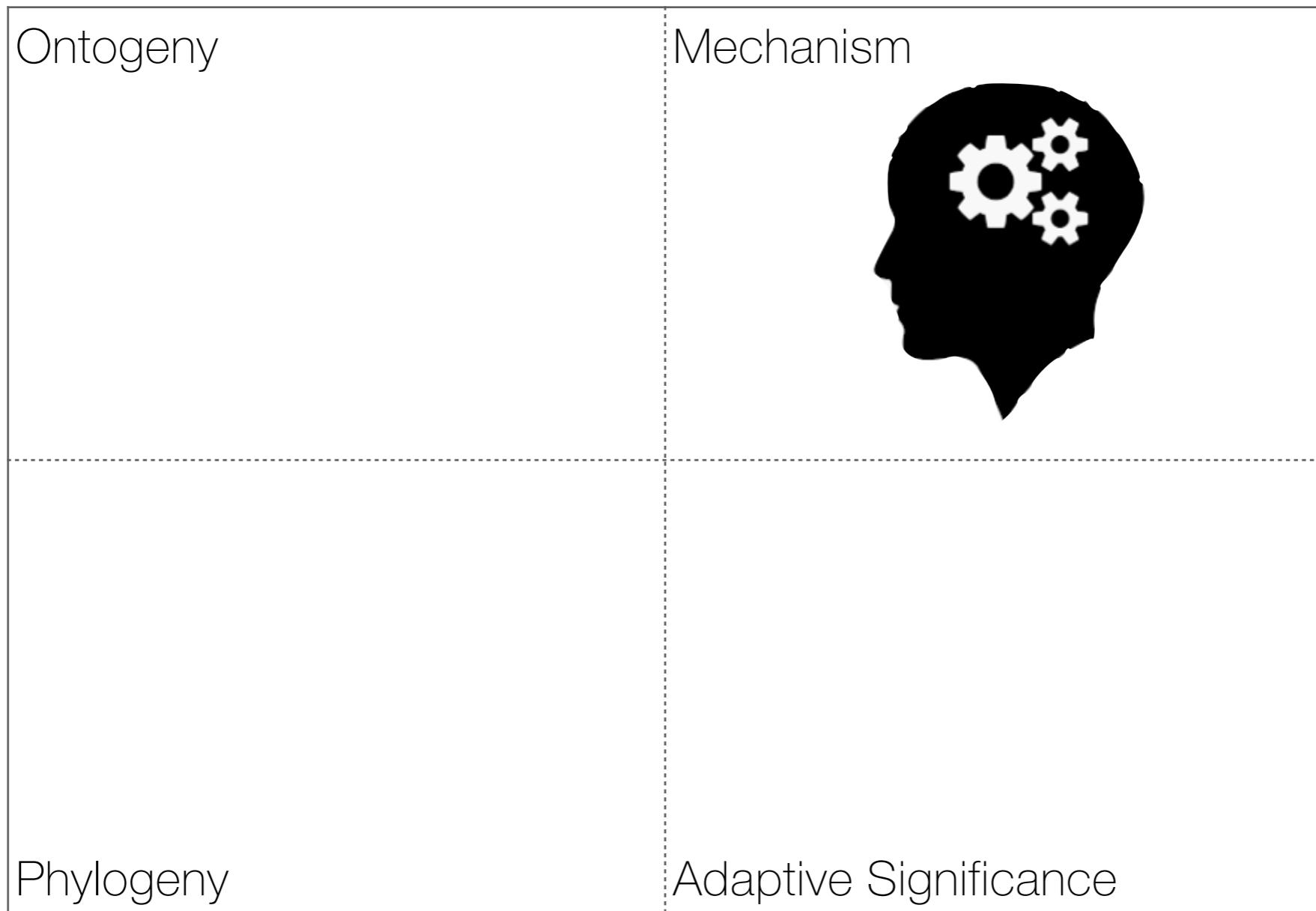
Grainger, S. A., Crawford, J. D., Riches, J. C., Kochan, N. A., Chander, R. J., Mather, K. A., ... & Henry, J. D. (2023). Aging Is Associated With Multidirectional Changes in Social Cognition: Findings From an Adult Life-Span Sample Ranging From 18 to 101 Years. *The Journals of Gerontology: Series B*, 78(1), 62-72.

Social cognition across the lifespan: Aging

NIMH domains	Definition	Summary
Emotional Identification	"the ability to infer affective information from the other's facial expression, body posture, prosody, or from a combination of these"	- Literature consistently suggests impaired performance in older adults for facial emotion identification → BUT: methodological artefact as a result of static (ecologically invalid) stimuli
Theory of Mind	"the ability to infer others' mental states while understanding that they can be different from ours"	- Literature consistently suggests impaired performance on ToM tasks for older adults, though less homogeneous findings than for emotion identification → BUT: influence of lack of motivation to accomplish the task (ecological validity)
Social Perception	"the ability to judge social roles, as well as rules that are applied to each social context"	- Complex literature marked by inconsistent findings - More studies that suggest age-related differences (this includes both no, positive, or negative effects of age) than similarities between younger and older adults → BUT: lack of a systematic review

"Our review highlights that aging may affect all domains of social cognition, even if a preserved or even improved performance is occasionally found. It is not clear how the effect of aging in one domain may influence performance on the remaining domains. In this regard, future studies are needed to clarify the hierarchical relationship and reciprocal influence of these subdomains of social cognition."

Social cognition



Neural substrates of social cognition

Historical anecdote

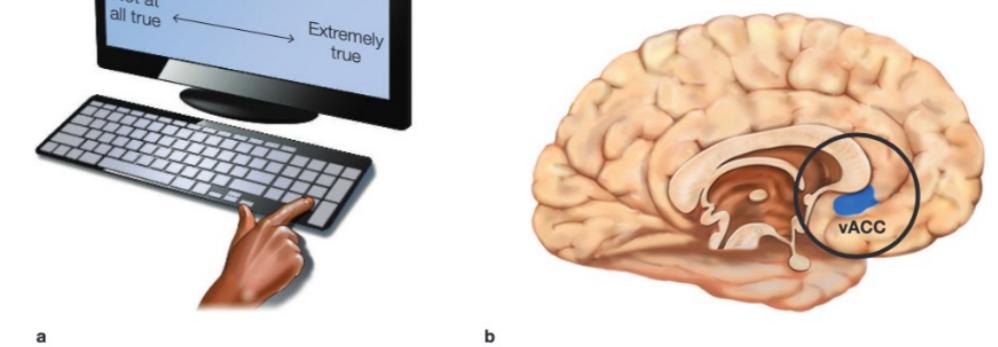
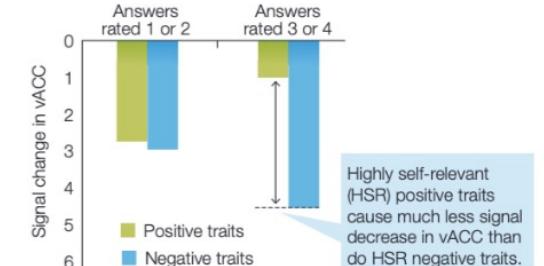
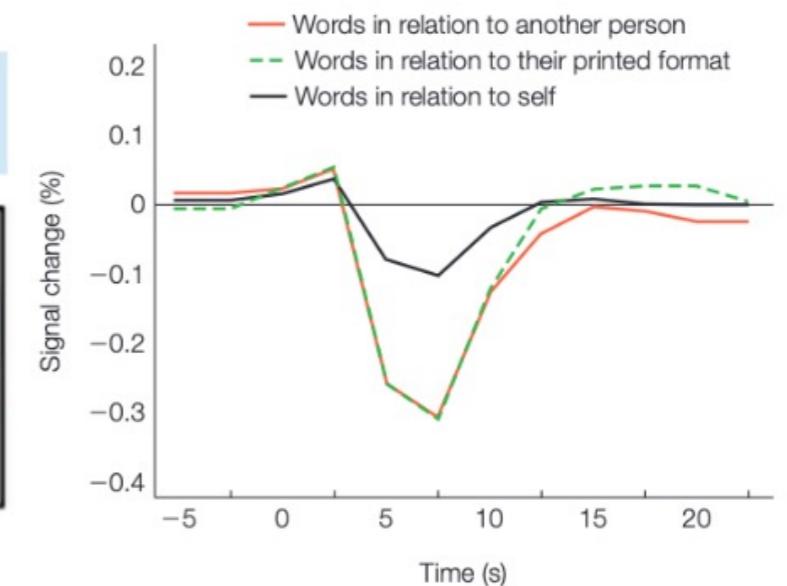
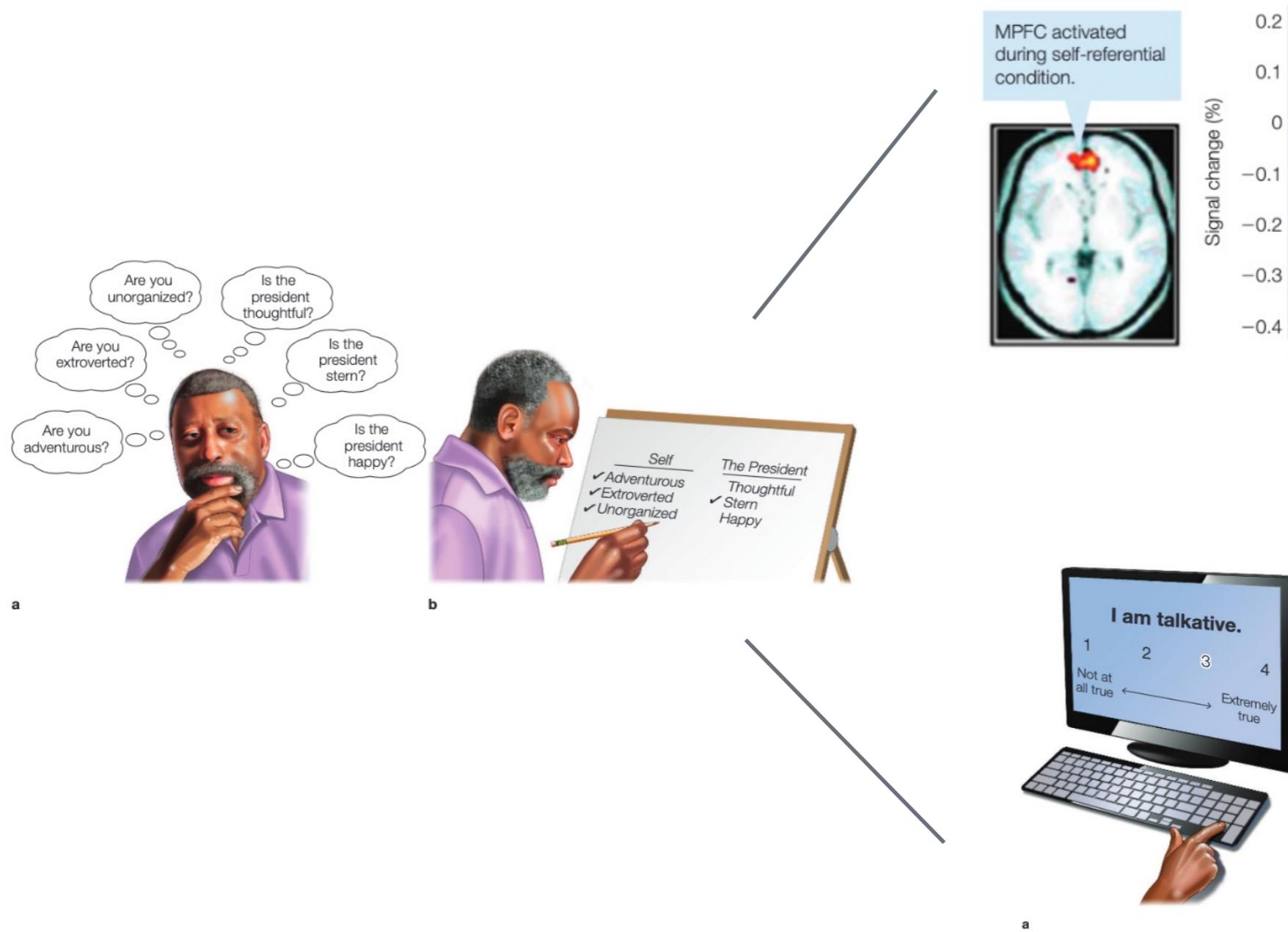


https://commons.wikimedia.org/wiki/File:Phineas_Gage_injury_-_animation.gif

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Neural substrates of social cognition

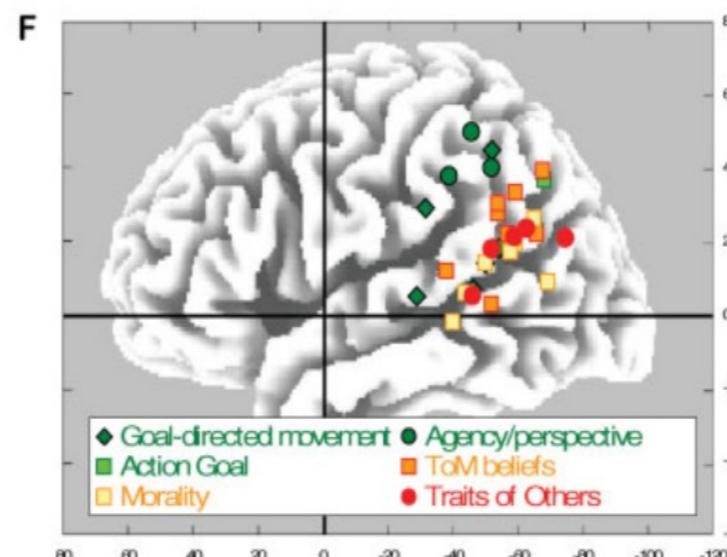
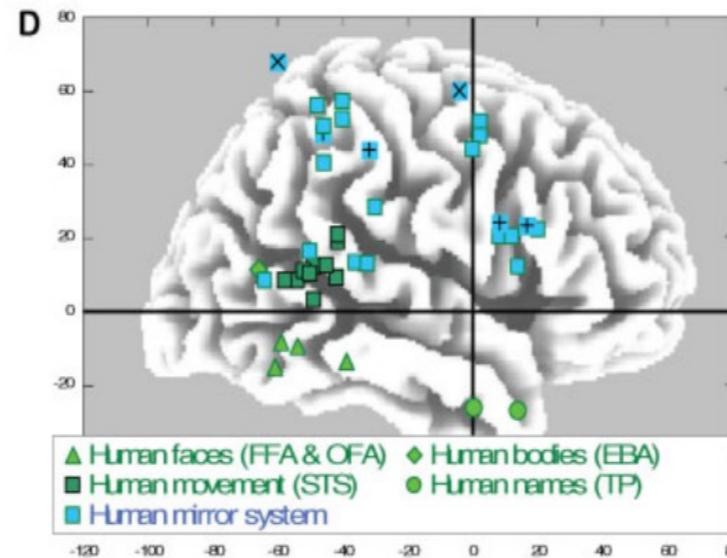
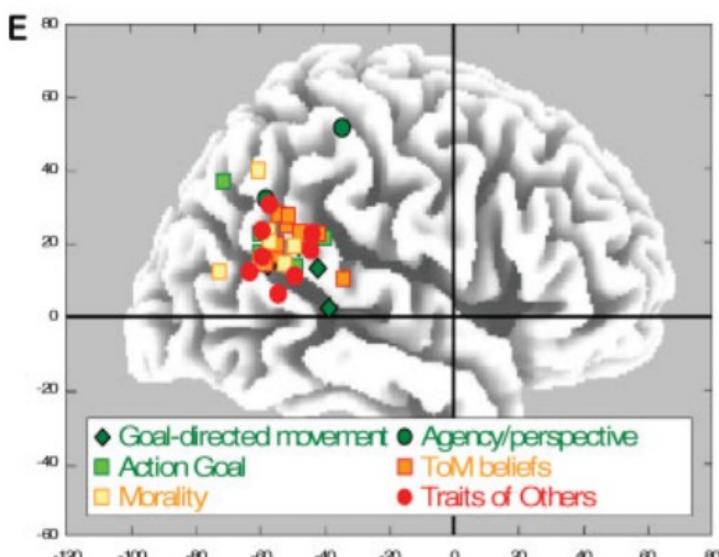
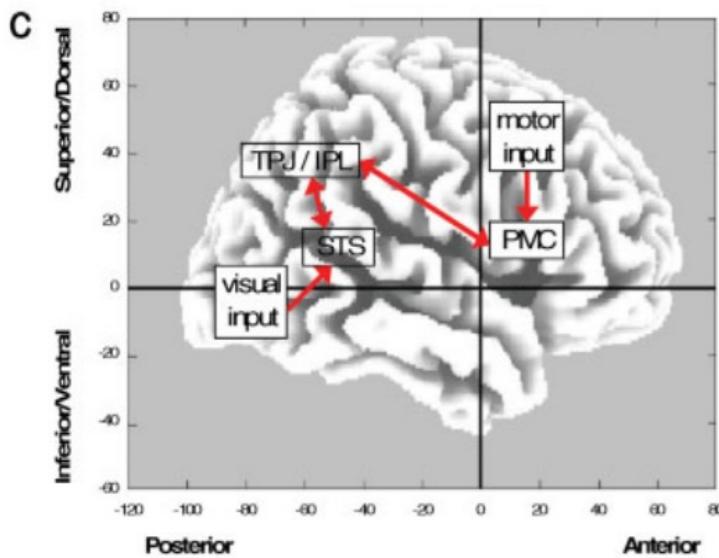
Self-knowledge – experimental fMRI studies



Neural substrates of social cognition

Meta-analyses

Mirror system

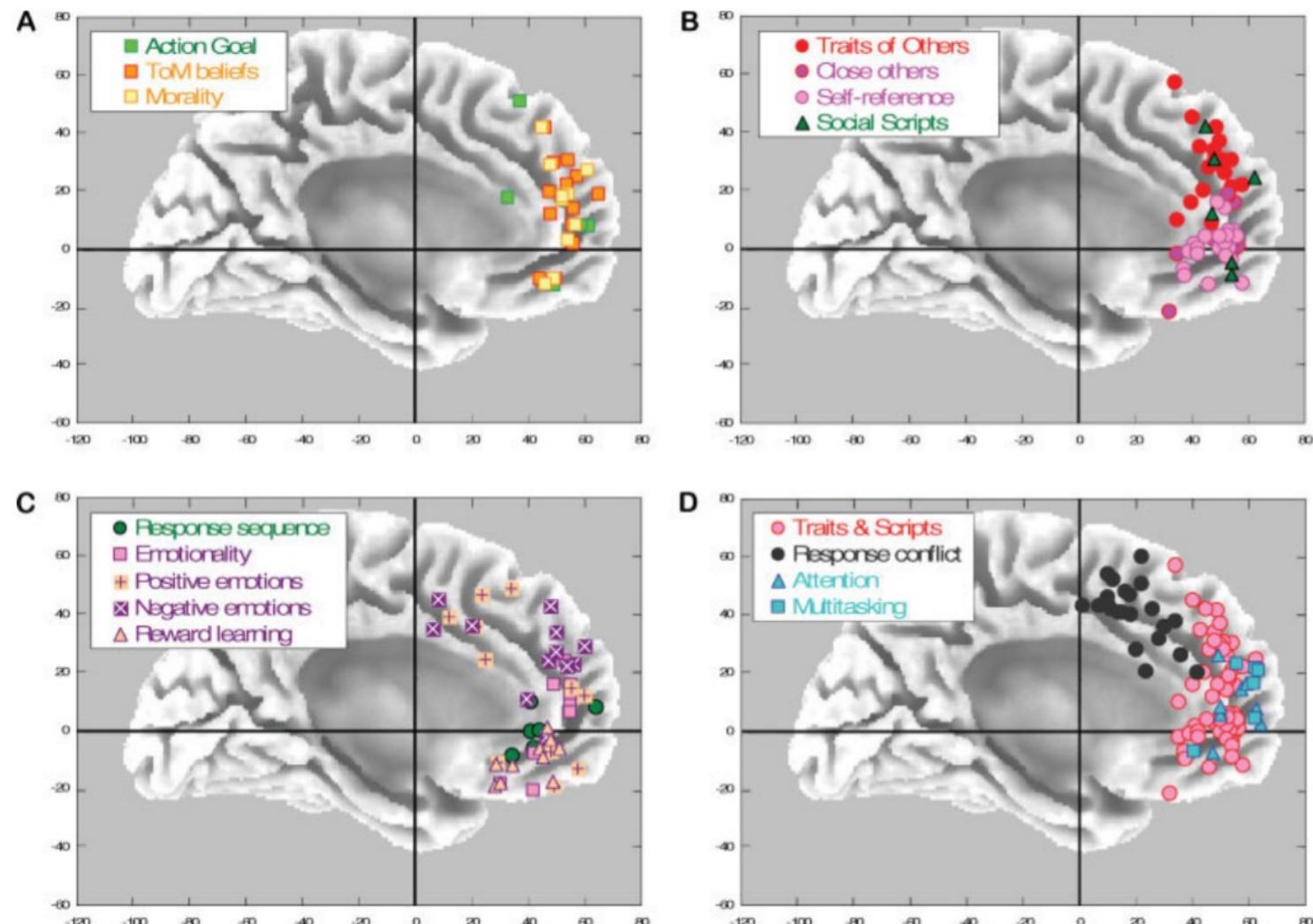


TPJ for temporary inferences involving the detection and identification of a person's goals and goal-related beliefs

"[...] large agreement that the human visual information detected at a lower level in the STS as well as verbal information, informs the higher-level analysis at the TPJ. If our suggestion is correct that the TPJ is a key mirror site for social cognition, then the TPJ should be involved in the identification of the goals and intentions of humans."

Neural substrates of social cognition

Meta-analyses



MPFC for enduring inferences of personality traits and interpersonal scripts and norms

"In all these enduring social judgments, the mPFC is almost uniquely engaged. Trait information about unfamiliar others selectively engages the dorsal part of the mPFC, whereas the ventral part is implicated when making trait inferences about familiar others or the self. The dmPFC can thus be considered the neural substrate of trait processing of other people, whereas the vmPFC can be considered the anatomical substrate of core experiences of the self and close others. Knowledge on social scripts involves both parts of the mPFC."

Going back, now we have a tentative answer ...

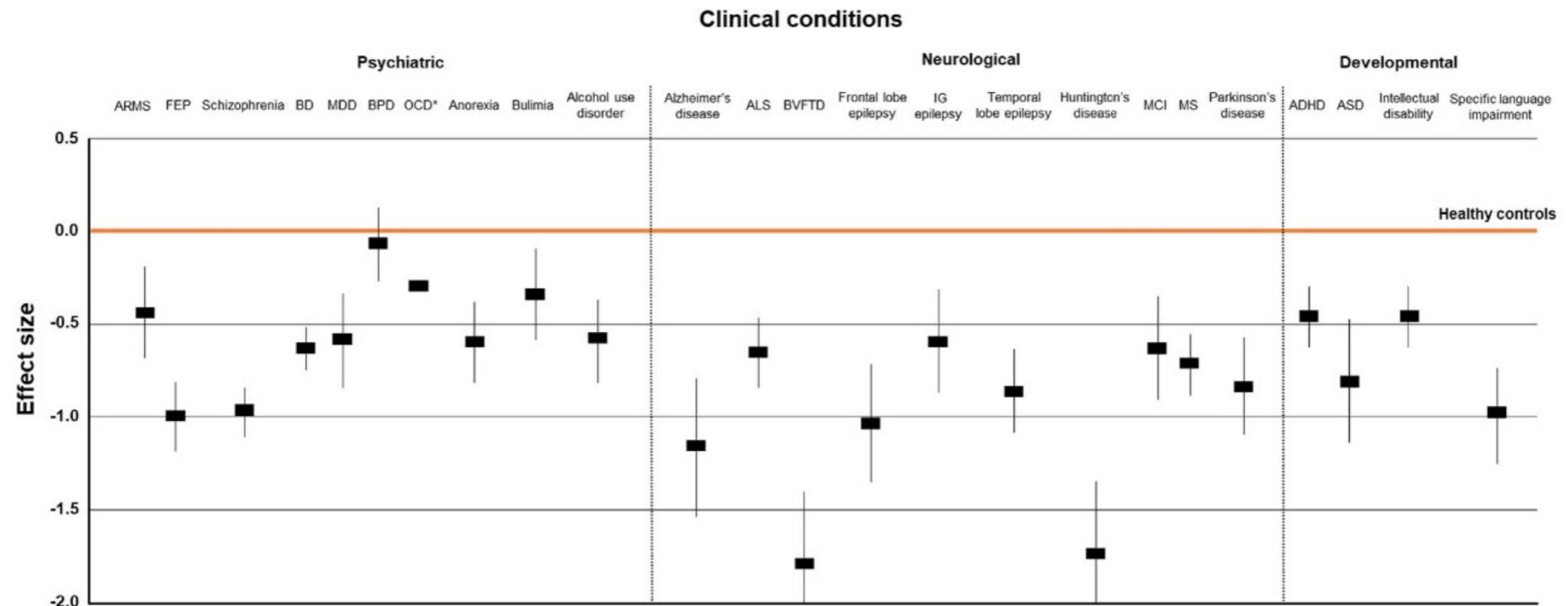


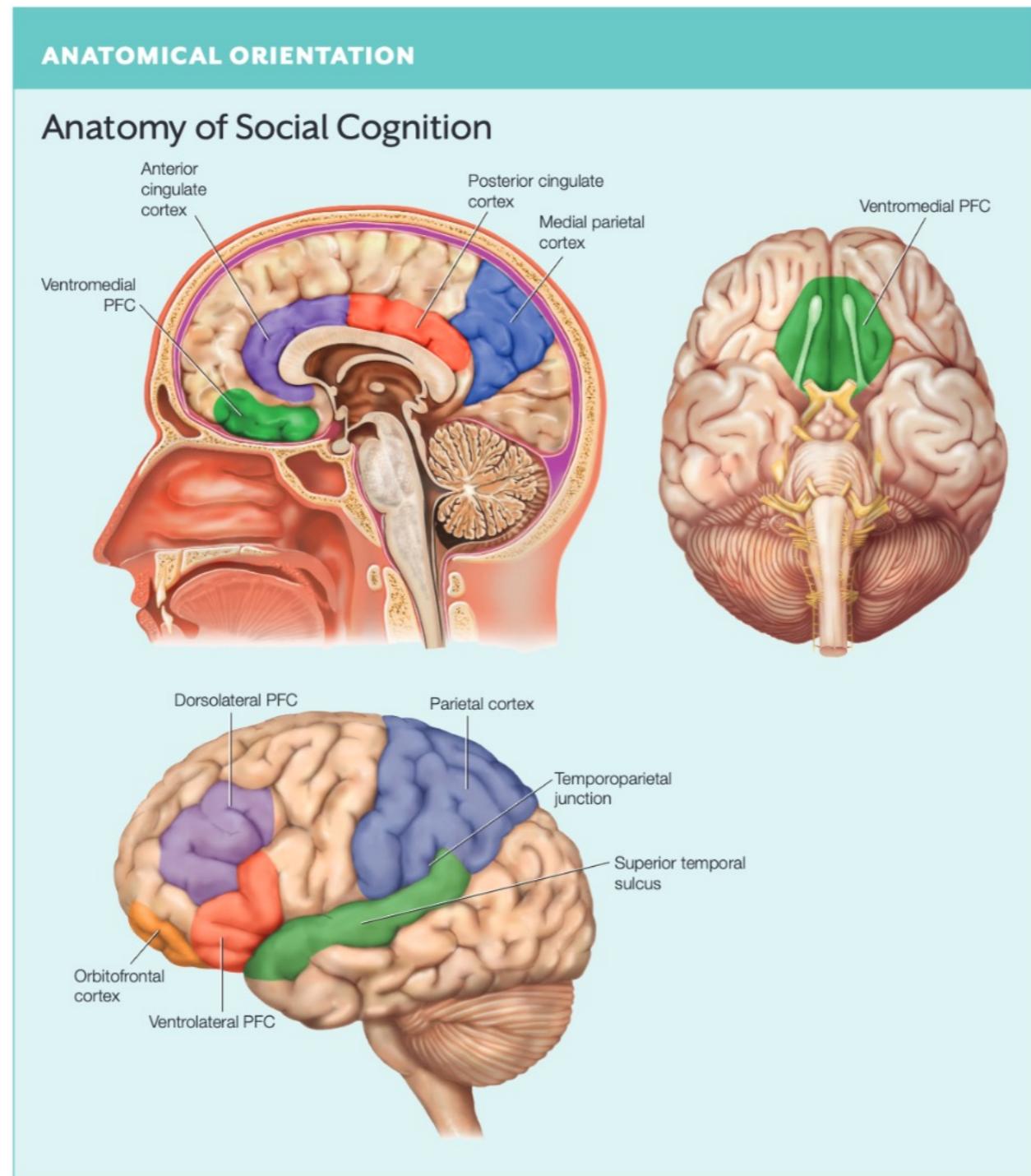
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"[...] neuroimaging studies suggest that these domains rely on different (though partially overlapping) neural systems, while analysis of performance on social and neurocognitive tasks demonstrate that these also form different factors"

Neural substrates of social cognition



Summary

- **Adaptive Significance:** Social cognition provides individuals with a range of benefits, including enhanced communication skills, improved cooperation and collaboration within social groups, increased ability to navigate complex social hierarchies, and better understanding of others' intentions and emotions.
- **Phylogeny:** Comparative approaches to social cognition have revealed striking similarities in cognitive abilities across various species, emphasizing the evolutionary conservation of social intelligence. However, these studies also highlight the nuanced differences in social cognitive skills among species, shedding light on the adaptive advantages and specific challenges faced by different social organisms.
- **Ontogeny:** Research on the lifespan development of social cognition reveals that it undergoes significant transformations across various life stages, from infancy through adulthood. These studies highlight the emergence of early social understanding, the refinement of complex social skills during childhood and adolescence, and the continued adaptation of social cognition to changing interpersonal dynamics in later life.
- **Mechanism:** Neuroscientific research suggests the existence of a "social brain," a network of interconnected brain regions dedicated to processing social information. Key areas, such as the TPJ, prefrontal cortex, and mirror neuron system, contribute to various aspects of social cognition, including emotional processing, perspective-taking, and understanding others' intentions. Neuroscientific approaches can also offer concrete insights into the cognitive aspects of social cognition.