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Emotions as the product of body and mind: The hierarchical structure of folk concepts of mental life among US adults and children

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Abstract

How are emotions understood to relate to other aspects of mental life? Among US adults, concepts of mental life are anchored by a distinction between physiological sensations (BODY), social-emotional abilities (HEART), and perceptual-cognitive capacities (MIND); these conceptual units are in place by 7-9y (Weisman et al., 2017a, 2017b, 2018). Here we reanalyze these datasets to explore the structural relationships among BODY, HEART, and MIND. Across six studies (N=1758), adults' assessments of the mental lives of robots, beetles, birds, goats, and other entities revealed a clear hierarchical structure: social-emotional abilities were virtually never granted to any entity perceived to lack physiological sensations or perceptual-cognitive abilities. This is consistent with a folk theory—similar to prominent theories in affective science—in which emotions emerge from the combination of more basic capacities for sensation and cognition. Studies of US children (4-9y, N=445) suggest that it takes years for children to acquire this understanding.

Keywords: emotion concepts; mind perception; conceptual change; folk psychology; cognitive development

Introduction

What are emotions, and where do they come from? How are capacities for happiness, guilt, anger, and love related to other aspects of our physical and mental lives? Are these rich emotional experiences unique to humans, or might they be shared with other animals, supernatural beings, or even sophisticated technologies?

Such questions date back to some of the earliest writings on human nature, from Plato's *Republic* and Aristotle's *De Anima*, to the Buddha's many teachings on sentience and suffering—but these are timeless questions. Indeed, in the past few decades, lively debate about the nature of emotions (e.g., Lazarus, 1984; Zajonc, 1985) laid the foundation for the burgeoning new field of "affective science."

Like ancient philosophers and affective scientists, ordinary people devote much time and energy to experiencing and thinking about emotions (e.g., Trampe et al., 2015). Recent research on *folk* theories of emotion—the concepts and explanatory frameworks that guide reasoning about emotions in everyday life—has focused primarily on how people predict and interpret the emotional responses of other people as those people navigate the world in pursuit of their own goals (e.g., Ong et al., 2015; Wellman et al., 2000). But a rich tradition of work in psycholinguistics—focusing in particular on the figurative invoked in descriptions of emotional experience—suggests that people also have coherent cognitive models of *emotion* itself: For example, expressions like *he lost his cool* or *her blood was boiling* reveal a common representation of the angry person as a "pressurized container," which might have roots in universal human physiology as well as culturally-specific values and emphases (Kövecses, 2010, Lakoff & Kövecses, 1987).

Here we focus on another, perhaps more metaphysical, aspect of folk theories of emotion: intuitions about the place of emotions in the broad range of capacities and experiences that constitute mental life.

Our approach to this question is based in recent work suggesting that emotions—particularly higher-order, social emotions like guilt and love—are one of three fundamental components of US adults' concepts of mental life, alongside physiological sensations and perceptual-cognitive abilities. This three-way distinction initially emerged in a series of studies in which US adults assessed the mental lives of robots, beetles, birds, goats, dogs, elephants, infants, adults, and various other target characters. Exploratory factor analyses aimed at identifying suites of tightly correlated mental capacities consistently revealed three factors that we termed BODY (defined by items like *getting hungry* and *experiencing pain*), HEART (e.g., *feeling embarrassed, experiencing pride*) and MIND (e.g., *remembering things*, *recognizing someone*) (Weisman et al., 2017a). These three "conceptual units" have since been replicated in several additional samples of US adults, and studies of US children have suggested that these three "conceptual units" are firmly in place by middle childhood (Weisman et al., 2018, 2017b).

In this paper, we re-analyze the datasets that first revealed BODY, HEART, and MIND to address another aspect of this folk ontology: the structural relationships among these conceptual units. Which conceptual units are considered most basic, most fundamental? Are any of these conceptual units thought to depend on the presence of others? What is the developmental trajectory of this aspect of conceptual structure? Our results offer a new glimpse of metaphysical intuitions about emotions among US adults and children.

Methods

In these studies, each participant judged 1-2 target characters on a wide variety of mental capacities, including various affective, perceptual, physiological, cognitive, agentic, social, and other abilities. These studies were designed to elicit variability in mental capacity attributions across participants—either by asking participants about "edge cases" in social reasoning (beetles and robots), whose mental lives were likely to be the subject of disagreement (Studies 1a-1c, Study 4), or by asking different participants to consider diverse characters whose mental lives were likely considered to vary dramatically (Study 1d, Study 3).

Our re-analysis of these datasets hinged on the following logic: If many participants endorse capacities associated with conceptual unit A without endorsing capacities associated with conceptual unit B, but very few participants do the reverse, this provides some evidence that A is more basic or fundamental than B, or that B somehow depends on A. For example, if there were many participants who, in their assessments of the target characters included in a given study, endorsed BODY more strongly than HEART—but very few who endorsed HEART more strongly than BODY—this would suggest that participants generally considered BODY more basic than—perhaps fundamental to—HEART.

Studies 1a-1d (US adults)

Participants Adults (Study 1a: n=405; Study 1b: n=406; Study 1c: n=200; Study 1d: n=431) participated via MTurk between December 2015 and January 2016. An additional 125 adults participated but were excluded for not completing the survey (n=42), failing an attention check (e.g., "Please select 4"; n=50), or not providing a year of birth (n=33).

Materials and procedure Participants assessed target entities on 40 capacities using a 7-point scale ranging from 0 ("not at all capable") to 6 ("highly capable"). Target entities were illustrated with a color photograph and labeled with a short noun phrase (e.g., "a robot"); no other information was provided about the entities. Capacities were presented in a random order for each participant. In Studies 1a and 1b, participants were randomly assigned to assess either a beetle or a robot. In Study 1c, each participant assessed both a beetle and a robot. In Study 1d, participants were randomly assigned to assess 1 of 21 diverse target entities (adult, child, infant, person in a persistent vegetative state, fetus, chimpanzee, elephant, dolphin, bear, dog, goat, mouse, frog, blue jay, fish, beetle, microbe, robot, computer, car, stapler).

Study 2 (US adults and children 7-9y)

Participants Adults (n=200) participated via MTurk in July of 2016. Children (7.01-9.99y, median age: 8.31y, n=200) participated at one of several SF Bay Area museums or at their sibling's preschool between July and December 2016. An additional 12 children participated but were excluded for being outside the target age range (n=7), being of unknown age (n=4), or being shown a target character other than a beetle or a robot (n=1).

Materials and procedure Participants were randomly assigned to assess 1 of 2 target entities (beetle, robot) on 40 capacities using a three-point scale ("no," scored as 0; "kinda," scored as 0.5; or "yes," scored as 1). These 40 capacities were child-friendly variants of the 40 capacities employed in Studies 1a-1d. Materials and procedure were otherwise very similar to Studies 1a-1d.

Study 3 (US adults and children 4-9y)

Participants Adults (n=116) participated via MTurk in September 2018. (Note: this adult sample was not included in Weisman et al., 2018.) An additional 22 adults participated but were excluded for failing to respond sensibly to an open-ended question about what they had been asked to do in the study (n=11) or for failing to pass one or more attention checks (e.g., "Please select no"; n=11).

Children participated at one of several SF Bay Area museums or at their preschool between July 2016 and June 2017. 7- to 9-y-old children (n=123, median age: 8.57y) and 4- to 6-y-old children (n=122, median age: 5.03y) were recruited separately. An additional 7 children participated but were excluded for being outside the target age ranges.

Materials and procedure Participants were pseudo-randomly assigned to assess 1 of 9 target entities (elephant, goat, mouse, bird, beetle, teddy bear, doll, robot, computer) on 20 capacities (a subset of the 40 capacities in Study 2). Materials and procedure were otherwise identical to Study 2.

Analysis plan

Our goals in reanalyzing these datasets were (1) To assess whether there were consistent asymmetries in US adults' attributions of BODY, HEART, and MIND; and (2) To investigate age-related changes in the direction or strength of these asymmetries among US children.

Scale construction and scoring For each study, we constructed a BODY scale, a HEART scale, and a MIND scale based on the exploratory factor analyses of adult samples reported in Weisman et al. (2017a, 2017b, 2018). We sorted capacities into categories according to which factor they loaded most strongly and positively onto, and selected the 6 highest-loading items for each scale; see Table 1. We then calculated mean scores for each scale, for each participant, rescaling all responses to range from 0-1 to facilitate comparison across studies. Each participant was thus associated with a score between 0-1 for BODY, HEART, and MIND for whichever character(s) they assessed.

Difference scores To assess asymmetries across the three conceptual units, we calculated difference scores between each pair of scales: BODY minus HEART, MIND minus HEART, and MIND minus BODY. We were particularly interested in whether there were any pairs of conceptual units which consistently yielded an abundance of non-zero

Table 1: Capacities in the BODY, HEART, and MIND scales. Wording varied across studies (e.g., *experiencing pain* vs. *feel pain*; *getting depressed* vs. *feel sad*).

		Study					
Scale	**Capacity**	**1a**	**1b**	**1c**	**1d**	**2**	**3**
BODY	hunger	x	x	x	x	x	x
	pain	x	x	x	x	x	x
	fatigue	x	x	x	x	x	x
	fear	x	x	x	x	x	x
	pleasure	x	x	x	x		
	free will	x					
	consciousness		x				
	desire			x			
	calm/safety				x	x	
	smell					x	x
	nausea						x
HEART	embarrassment	x	x	x	x		x
	pride	x	x	x	x	x	x
	love	x	x	x	x	x	x
	guilt	x	x	x	x	x	x
	belief	x			x		
	hurt feelings	x	x	x			x
	sadness		x	x		x	x
	morality				x		
	joy					x	
	happiness					x	
MIND	memory	x	x	x	x	x	x
	recognition of others	x		x		x	
	sensing temperatures	x		x	x		x
	communication	x	x	x	x		
	vision	x	x		x	x	
	depth perception	x		x	x	x	x
	hearing		x	x	x		
	goals		x				
	choice		x			x	x
	reasoning					x	x
	awareness						x

difference scores running in the same direction. As noted earlier, the current studies were designed with the express purpose of eliciting variability in mental capacity attributions across participants. If, despite this variability, participants nonetheless converged on a systematic pattern of *relative* endorsements across two conceptual units—e.g., if most participants endorsed BODY capacities more strongly than HEART capacities, regardless of the absolute strength of these endorsements—this would provide some evidence of a common conceptual framework that places these conceptual units in asymmetrical, perhaps hierarchical, relation to one another. Conversely, if participants had radically divergent difference scores, we considered this evidence *against* a systematic hierarchical relationships. Difference scores close to 0 provided no evidence for or against a hierarchical relationship, given the many scenarios that could yield a difference score of 0 (e.g., if someone attributed very little in the way of mental life to the target character, or if they attributed maximal capacities across the board).

Regression analyses of difference scores To assess consensus in the direction of difference scores between pairs of conceptual units, we compared these difference scores to 0 via linear regressions using the *stats* and *lme4* packages for R. We conducted a separate analysis for each pair of conceptual units, including fixed effects accounting for differences between target characters (effect-coded, to center the intercept at the grand mean) and random intercepts for participants in Study 1c (who assessed more than one target character). In interpreting these regressions, we were primarily interested in whether each intercept was estimated to be differentiable from 0.

Results

Planned analyses of adults' difference scores

BODY minus HEART In all studies, adults endorsed BODY more strongly than HEART, yielding positive BODY-HEART difference scores; see Fig. 1 and Table 2. There were very few cases in which any adult participant endorsed HEART more strongly than BODY for whichever target character they were assessing: Across samples, only 4-11% of BODY-HEART difference scores were negative, 19-40% were 0, and fully 54-76% were positive.

MIND minus HEART In an even stronger display of consensus, adults overwhelmingly endorsed MIND more strongly than HEART, yielding positive MIND-HEART difference scores; see Fig. 1 and Table 2. Across samples, only 1-4% of MIND-HEART difference scores were negative, 3-25% were 0, and fully 72-96% were positive.

MIND minus BODY Adults tended to endorse MIND more strongly than BODY, but these tendencies were less consistent across studies and individuals; see Fig. 1 and Table 2. Across samples, 23-46% of MIND-BODY difference scores were negative, 5-24% were 0, and 31-68% were positive. The lack of consensus was particularly striking in Studies 1d and 3, which featured wider ranges of targets.

Interim summary and secondary analysis of adults

In assessing the mental lives of beetles, robots, and other entities, participants attributed physiological sensations and perceptual-cognitive capacities at least as strongly, and often more strongly, than social-emotional abilities; i.e., they granted HEART only in the presence of BODY or MIND. In this conceptual representation, BODY and MIND appear to be more basic or fundamental than HEART.

In what sense might BODY and MIND be considered fundamental? One possibility is that the hierarchical relations

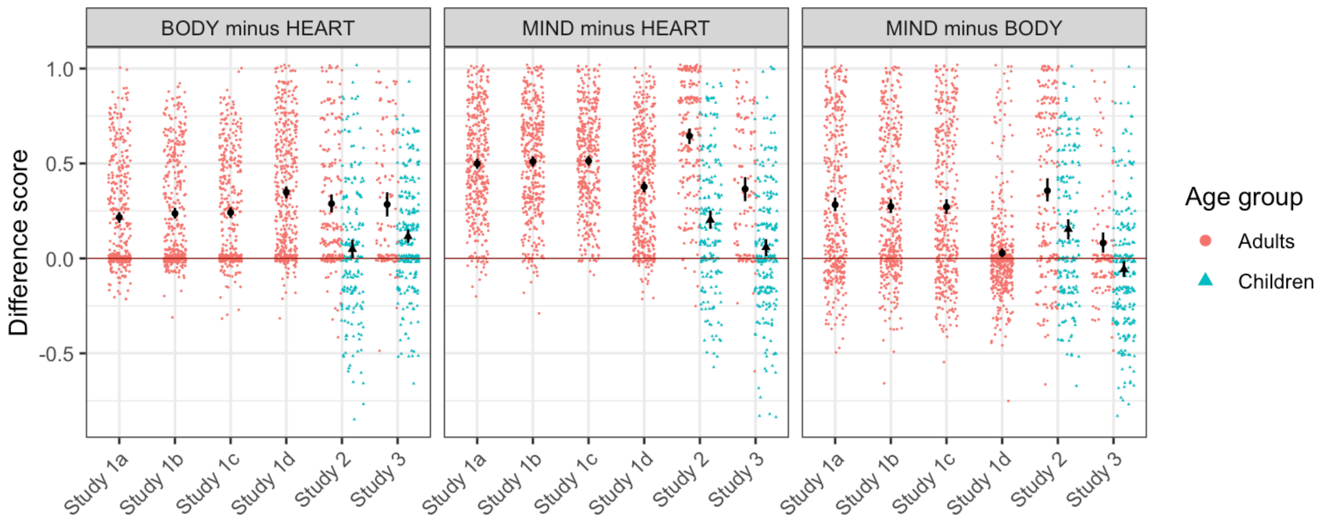

Figure 1: Difference scores comparing endorsements of BODY, HEART, and MIND, in all studies. Small colorful points represent individual participants; large black points are group means, and error bars are bootstrapped 95% CIs.

surfaced by the preceding analysis of difference scores emerged from a richer folk theory of mental life in which the social-emotional abilities of the HEART emerge from a combination of the physiological sensations of the BODY and the perceptual-cognitive abilities of the MIND. Such a theory would indeed resemble prevalent scientific theories of emotions (e.g., Barrett, 2012; Mauss et al., 2005). The current studies afford one way of exploring these intuitions, by examining the possibility of a *joint dependency* of attributions of HEART on attributions of BODY and MIND.

With this possibility in mind, we conducted an additional regression predicting HEART scores as a function of BODY and MIND scores and an interaction between them, using data pooled from all adult samples. This model included random intercepts for participants nested within studies and for each target character.

Results from this model aligned with the previous analyses of difference scores in that, when both BODY and MIND scores were 0, HEART scores were also undifferentiable from 0 (Intercept: b=0.01 [-0.06, 0.08]). Unsurprisingly, when MIND scores were 0, BODY scores were a positive predictor of HEART scores (b=0.20 [0.11, 0.28]). When BODY scores were 0, MIND scores were, if anything, a slightly negative predictor of HEART scores, but this effect was nearly indistinguishable from 0 (b=-0.04 [-0.08, 0.00]).

The primary parameter of interest here was the interaction between BODY and MIND scores: If attributions of HEART were *jointly dependent* on attributions of both BODY and MIND, then the interaction between BODY and MIND scores would be a strong predictor of HEART scores, above and beyond BODY or MIND scores on their own. Indeed, the interaction between BODY and MIND scores was by far the strongest predictor of HEART scores (b=0.34 [0.25, 0.44]): Strong endorsements of HEART were only present among participants who attributed *both* BODY *and* MIND to whichever target character they assessed; see Fig. 2.

Developmental comparisons

The original analyses of these datasets suggested that by middle childhood (7-9y), US children have converged on BODY, HEART, and MIND as the fundamental units in their conceptual representations of mental life (Weisman et al., 2017b, 2018). At what point are children sensitive to the hierarchical relationships among these conceptual units?

BODY minus HEART As a group, children endorsed BODY slightly more strongly than HEART, yielding BODY-HEART difference scores that were positive but much smaller than those of adults. Difference scores increased with age in Study 3 (4-9y), but not across the more restricted age range in Study 2 (7-9y). See Fig. 1 and Table 2.

MIND minus HEART Children also tended to endorse MIND more strongly than HEART, yielding positive MIND-HEART difference scores, but again these differences were smaller than those of adults. Difference scores increased substantially with age in both studies. See Fig. 1 and Table 2.

MIND minus BODY As among adults, the MIND-BODY comparison varied across studies. In Study 2, children tended to endorse MIND somewhat more strongly than BODY; but in Study 3, children as a group actually endorsed BODY slightly more strongly than MIND—the opposite tendency to that of adults. Among all age groups, however, Study 3—which featured a wider range of target characters—generated a wide distribution of difference scores on either side of 0. This suggests that participants, perhaps especially children, were sensitive to the identity of the target character in assessing whether perceptual-cognitive capacities might exist in the absence of physiological sensations, or vice versa. In both studies, age was associated with more "adult-like" response patterns; see Table 2.

HEART as a function of BODY and MIND To assess the joint dependency of HEART on BODY and MIND among children, we ran an analysis parallel to the secondary analysis described earlier, using data pooled from all child samples, modified to include age (centered at the empirical mean of 7.48y) and all possible interactions with age.

As was true among adults, when both BODY and MIND scores were 0, HEART scores were undifferentiable from 0 (Intercept: b=0.01 [-0.11, 0.14]), and when MIND scores were 0 BODY scores were a positive predictor of HEART scores (b=0.63 [0.42, 0.83])—a relationship that was stable across the age range (b=-0.02 [-0.11, 0.08]). Unlike adults, among children MIND scores were also a positive predictor of HEART scores when BODY scores were 0 (b=0.21 [0.03, 0.40])—again, a relationship that was relatively stable across the age range (b=-0.08 [-0.17, 0.01]).

Of primary interest, however, was the interaction between BODY and MIND scores—our test of the *joint dependency* of HEART on BODY and MIND. We observed no evidence of such an interaction among children (b=-0.08 [-0.36, 0.20]), and no reliable increase in this interactive effect across the age range (b=0.06 [-0.09, 0.21]), suggesting that this is an aspect of children's folk theories of mental life that may not be detectable until later childhood or adolescence; see Fig. 2.

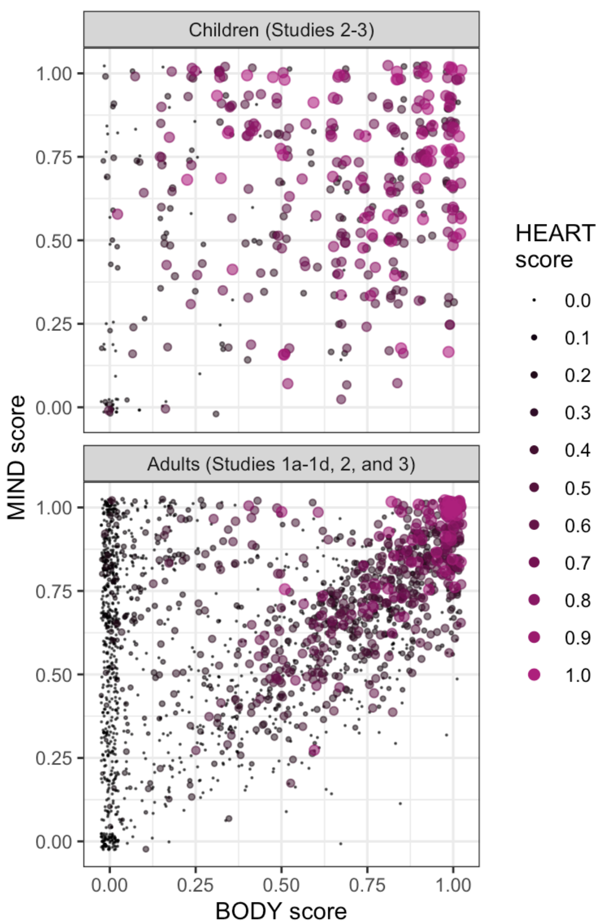

Figure 2: Visualization of the joint dependency of HEART scores on BODY and MIND scores across age groups in all studies. Each point represents an individual participant's assessment of a particular target character.

Cluster analysis What is the nature of these developmental differences in asymmetries between attributions of BODY, HEART, and MIND? Are these data more consistent with changes across the age range in the *degree* of hierarchical relationships among these conceptual units (i.e., the gradual enrichment of nascent adult-like theories), or with changes in the *nature* of this conceptual structure (i.e., radical conceptual change; Carey, 1991)? As an initial foray into addressing this question, we conducted agglomerative hierarchical clustering analyses over individual children's response patterns using the *agnes* function in the *cluster* package for R. We posited that radical changes in conceptual structure would be associated with strong evidence for clustering structure, with clusters marked by qualitative differences in response patterns, and a tendency for older children to fall into more "adult-like" clusters; while gradual enrichment would be reflected in weaker clustering structures with clusters marked by more graded differences in response patterns, and weaker relationships between age and cluster.

A full discussion of these analyses is beyond the scope of the current paper; here we briefly describe one variant of this approach. For each of the two studies involving adults and children, we pooled data from all age groups, clustered participants according to their three difference scores, and determined where to cut clusters via their average silhouette width (using the *fviz_nbclust* function in the *factoextra* package for R). In both studies this yielded three clusters: (A) A cluster composed of adults as well as some older children, nearly all of whom had assessed animate target characters (Study 2: beetle; Study 3: beetle, bird, mouse, goat, or elephant). Among these participants BODY-HEART and MIND-HEART difference scores were nearly uniformly positive, while MIND-BODY difference scores were distributed across 0. (B) A cluster of adults as well as some older children, nearly all of whom had assessed inanimate target characters (Study 2: robot; Study 3: computer, robot, doll, or teddy bear). Among these participants, BODY-HEART difference scores tended to be slightly positive, while MIND-HEART and MIND-BODY difference scores were nearly uniformly large and positive. (C) A cluster composed primarily of children on the younger end of the age range, including participants who had assessed the full range of target characters featured in the study in question. In this cluster, all three difference scores were characterized by wide distributions spanning zero, including many participants with large *negative* difference scores even in the BODY-HEART and MIND-HEART comparisons. See Fig. 3 for results from Study 3; Study 2 results were very similar.

In sum, across two studies this analysis revealed two variants of the conceptual structure characteristic of US adults—one for representing the minds of animals and another for the "minds" of technologies and toys—both of which honored strict hierarchical relationships between BODY and MIND on the one hand, and HEART on the other. Some older US children also demonstrated these response patterns, but many children demonstrated a qualitatively different response pattern, in which one or more of these

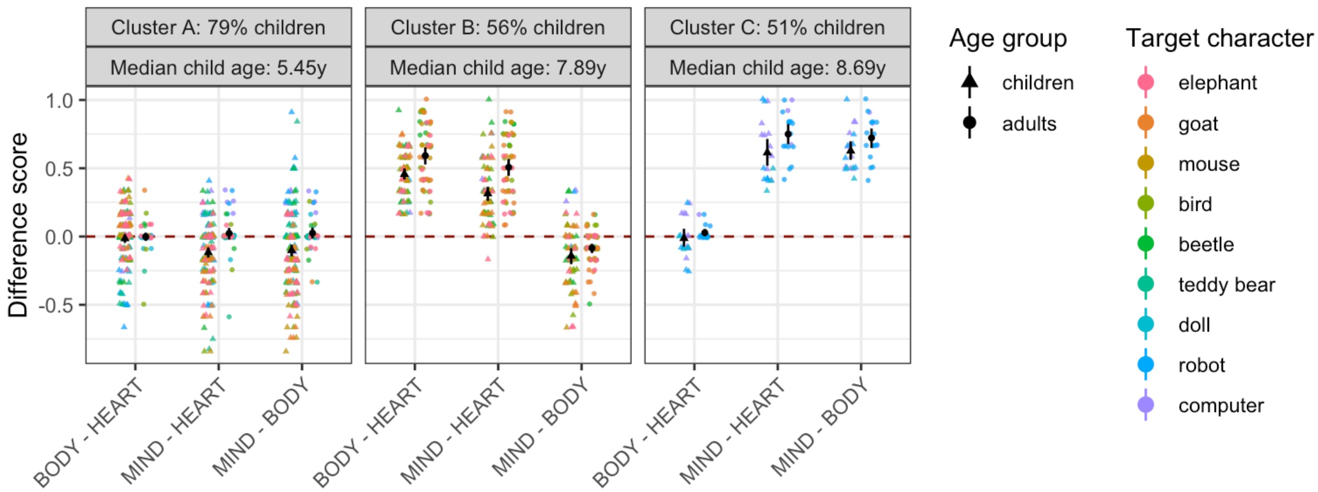

Figure 3: Difference scores by cluster and age group in Study 3. Small colorful points represent individual participants; large black points are group means, and error bars are bootstrapped 95% CIs.

hierarchical relationships was violated. Although we urge caution in drawing strong conclusions from these preliminary findings, these initial results appear to be consistent with a more "radical" form of conceptual change.

Discussion

Across six studies, US adults endorsed the physiological sensations of the BODY and the perceptual-cognitive abilities of the MIND at least as strongly, often more strongly, and almost never less strongly, than the social-emotional abilities of the HEART. This was true regardless of whether participants were assessing the mental lives of robots, beetles, goats, elephants, humans, or any number of other target characters, and regardless of the exact abilities they were asked to assess.

Across studies, 89-96% of individual adults' assessments of target characters yielded BODY scores that were at least as high or higher than HEART scores, and fully 96-99% yielded MIND scores that were at least as high or higher than HEART scores. This is a remarkable level of consistency across participants and studies, given that participants were responding to questions presented in a random order, with no indication of which capacities would be grouped together in these analyses; and given different participants assessed different target characters through the lens of their own experiences and beliefs. Despite these important sources of variability, exceedingly few adult participants answered these questions in such a way as to indicate that any of the target characters included in these studies had more in the way of social-emotional abilities than physiological sensations or perceptual-cognitive abilities. We interpret this as evidence for a strong consensus among US adults that physiological sensations (BODY) and perceptual-cognitive abilities (MIND) are the more fundamental aspects of mental life, while social-emotional abilities (HEART) are less basic.

Further analyses revealed are consistent with a richer folk theory of mental life specifying that social-emotional abilities like love and pride depend on a *combination* of sensation and cognition. This resonates with recent, increasingly prominent scientific theories of emotion, in which emotional experience is understood to involve the coordination and interaction of physiological responses (e.g., changes in respiration or heart rate), cognitive appraisals, and social-cultural knowledge (Barrett, 2012; Mauss et al., 2005; see also Kövecses, 2010).

Our analyses of US children suggested that the structural relations among sensations, emotions, and cognition take years to fully resemble the "mature" adult theory. Even 7- to 9-year-old children—whose BODY-HEART-MIND distinction is quite similar to US adults' (Weisman et al., 2017b, 2018)—demonstrated notably weaker asymmetries in their attributions of BODY, HEART, and MIND, and much less consensus across individuals. As a group, children's responses were consistent with the belief that the social-emotional abilities of the HEART are in some sense less basic than—but perhaps not strictly *dependent* on—the physiological sensations of the BODY and the perceptual-cognitive abilities of the MIND; and we observed no evidence that children shared adults' belief that HEART requires a *combination* of BODY and MIND. Preliminary results of cluster analyses revealed subsets of mostly older children who demonstrated qualitatively different response tendency, with strict asymmetries similar to those of adults', raising the possibility that this is a domain of more "radical" conceptual change rather than graduate enrichment (Carey, 1991). In either case, the strict hierarchical structure and joint dependency that characterized US adults' understanding of mental life appears to be the site of prolonged development, extending through late childhood and likely beyond.

This long developmental trajectory highlights the importance of socialization and enculturation in acquiring folk theories of emotions, which—like folk theories in other domains (ojalehto & Medin, 2015), and like many other aspects of emotional life (e.g., Markus & Kitayama, 1994)—are likely to vary across cultural settings. The current analyses lay the foundation for further studies of the cultural and developmental origins of folk theories of emotion. They also raise questions about the possible consequences of developmental, cultural, and individual variation in such theories: Are developmental differences in folk theories of emotion associated with changes in children's emotion regulation strategies, or their reasoning about others' emotions? Could cultural or individual differences in these theories shape other metaphysical beliefs, such as the belief that social-emotional life continues after biological death (Astuti & Harris, 2008), the possibility that there exist beings—whether technological or supernatural—whose social-emotional presence is not bound to animal bodies? These are fascinating directions for future work.

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References

Astuti & Harris (2008). Understanding mortality and the life of the ancestors in rural Madagascar. *CogSci*, *32*, 713-40.

Barrett (2012). Emotions are real. *Emotion*, *12*, 413-29.

Carey (1991). Knowledge acquisition: Enrichment or conceptual change? In Carey & Gelman (Eds.), *The Epigenesis of Mind*, 257-91. Erlbaum.

Kövecses (2010). Cross-cultural experience of anger: A psycholinguistic analysis. In Potegal, Stemmler, & Spielberger (Eds.), *Intl Handbook of Anger*. Springer.

Lakoff & Kövecses (1987). The cognitive model of anger inherent in American English. In Holland & Quinn (Eds.), *Cultural Models in Language and Thought*. Cambridge.

Lazarus (1984). On the primacy of cognition. *Am Psychol*, *39*(2), 124-9.

Markus & Kitayama (1994). The cultural shaping of emotion: A conceptual framework. In *Emotion and Culture: Empirical Studies of Mutual Influence*, 339-51.

Mauss, Levenson, McCarter, Wilhelm, & Gross (2005). The tie that binds? Coherence among emotion experience, behavior, and physiology. *Emotion*, *5*, 175-90.

ojalehto & Medin (2015). Perspectives on culture and concepts. *Annu Rev Psychol*, *66*, 249-75.

Ong, Zaki, & Goodman (2015). Affective cognition: Exploring lay theories of emotion. *Cognition*, *143*, 141-62.

Trampe, Quoidbach, & Taquet (2015). Emotions in everyday life. *PLoS ONE*, *10*, 1-15.

Weisman, Dweck, Markman (2017a). Rethinking people's conceptions of mental life. *PNAS*, *114*, 11374-9.

Weisman, Dweck, & Markman (2017b). Children's intuitions about the structure of mental life. *Proc CogSci Soc*.

Weisman, Dweck, & Markman (2018). Folk philosophy of mind: Changes in conceptual structure between 4-9y of age. *Proc CogSci Soc*.

Wellman, Phillips, & Rodriguez (2000). Young children's understanding of perception, desire, and emotion. *Child Dev*, *71*, 895-912.

Zajonc (1985). The primacy of affect. *Am Psychol*, *40*, 849-50.

Table 2: Coefficient estimates (*b*) and 95% CIs from regression analyses. Parameters of primary interest are in bold. Models for Study 1c also included random intercepts by participant. For child samples, age was centered at the empirical mean (S2: 8.35y; S3: 6.73y).

			BODY minus HEART		*MIND minus HEART*		*BODY minus MIND*	
Study		Parameter	*b*	95% CI	*b*	95% CI	*b*	95% CI
ADULTS	1a	Intercept	**0.22**	[0.20, 0.24]	**0.50**	[0.47, 0.52]	**0.28**	[0.26, 0.30]
		Robot vs. grand mean	-0.22	[-0.24, -0.20]	0.09	[0.06, 0.11]	0.31	[0.28, 0.33]
	1b	Intercept	**0.24**	[0.22, 0.26]	**0.51**	[0.48, 0.54]	**0.27**	[0.25, 0.30]
		Robot vs. grand mean	-0.22	[-0.24, -0.21]	0.05	[0.03, 0.08]	0.28	[0.25, 0.30]
	1c	Intercept	**0.24**	[0.23, 0.26]	**0.51**	[0.49, 0.54]	**0.27**	[0.25, 0.30]
		Robot vs. grand mean	-0.24	[-0.25, -0.22]	0.08	[0.06, 0.10]	0.32	[0.29, 0.34]
	1d	Intercept	**0.35**	[0.33, 0.37]	**0.38**	[0.36, 0.40]	**0.02**	[0.01, 0.04]
		[20 character comparisons]	…	…	…	…	…	…
	2	Intercept	**0.29**	[0.26, 0.32]	**0.64**	[0.60, 0.68]	**0.35**	[0.32, 0.38]
		Robot vs. grand mean	-0.25	[-0.28, -0.22]	0.13	[0.09, 0.17]	0.38	[0.35, 0.41]
	3	Intercept	**0.29**	[0.24, 0.33]	**0.35**	[0.30, 0.40]	**0.06**	[0.03, 0.10]
		[8 character comparisons]	…	…	…	…	…	…
CHILDREN	2	Intercept	**0.04**	[0.00, 0.08]	**0.21**	[0.16, 0.25]	**0.17**	[0.14, 0.20]
		Age (in y, centered)	**0.05**	[0.00, 0.09]	**0.12**	[0.06, 0.17]	**0.07**	[0.04, 0.11]
		Robot vs. grand mean	-0.20	[-0.24, -0.16]	0.09	[0.04, 0.13]	0.29	[0.26, 0.32]
		Age × char.	-0.01	[-0.06, 0.04]	0.03	[-0.02, 0.09]	0.05	[0.01, 0.08]
	3	Intercept	**0.11**	[0.07, 0.14]	**0.06**	[0.02, 0.10]	**-0.05**	[-0.08, -0.02]
		Age (in y, centered)	**0.02**	[0.00, 0.04]	**0.05**	[0.03, 0.07]	**0.03**	[0.01, 0.05]
		[8 character comparisons]	…	…	…	…	…	…
		[8 age × char. interactions]	…	…	…	…	…	…