

## PHILOSOPHY OF SCIENCE: PRE-LINGUISTIC COGNITION

**Course overview:** Far from a blank slate, recent work in cognitive science has been widely interpreted as showing that young human infants innately represent *numbers, causality, beliefs, agency*, and more. But what should we make of these claims? For a start, how could we possibly know the contents of a non-linguistic creature's mind? And why should we suppose that babies literally represent numbers of a sort that we might discuss in the math class, or appreciate that others have beliefs of a sort that can misrepresent reality? Aren't there simpler interpretations of the available results? Even if there are not, it seems we must still account for the manifest differences between young children's grasp of number or causation or agency or belief and that of mature, enculturated, thinkers, when they conceive of such abstract notions. How might we do this? In this class, we will take a deep dive into these issues at the intersection between philosophy and cognitive science, considering how the tools of analytic philosophy can be used to illuminate the relevant scientific results.

### Assessment:

- Participation (15%)
  - Be prepared to engage in discussion during class.
  - Students will be asked to present on the assigned readings on weeks arranged in class.
- Writing (85%) - Complete one of two paths:
  - Option A You will write two short papers of around 3,500 words each. The first (40% of course grade) is due March 15th, the second (45%) is due May 5th.
  - Option B You will write one research paper, around 7,500 words total, in two steps. A detailed proposal/extended abstract of around 1000 words (30% of course grade) is due April 11th, and the seminar paper (55%) is due May 5th.

### Weekly readings:

Week 1: Introduction

#### Required reading:

- Spelke, E. & Kinzler, K. (2007) 'Core Knowledge', *Developmental Science*, 10:1, 89-96.
- Carey, S. (2009) 'The Initial Representational Repertoire: The Empiricist Picture', Chapter 2 of *The Origin of Concepts*, OUP.

If you haven't come across 'core cognition' before, I'd recommend trying to get through the following:

- Chapters 1-3 of Carey's *The Origin of Concepts*. OUP.

If you're keen, try this too:

- Chapters 1-3 of Spelke's *What Babies Know*. OUP.

(Both books are amazing – a useful exercise would be to read [and re-read] them, soak up the science, and take a note of each of the philosophical claims being advanced/raised – later chapters may also introduce helpful case studies for your own research)

Week 2: *How does core cognition differ from mature knowledge?*, Part 1: Representational Content

**Required reading:**

- Clarke, S. & Beck, J. (2021) ‘The Number Sense Represents (Rational) Numbers’, *Behavioral and Brain Sciences*, 44: e178.
  - This was published with 26 commentaries and our response to these – you don’t need to read all of these, but some of the more philosophically interesting responses were those by Opfer, Samuels, Shapiro & Snyder, and by Gross, Kowalsky, and Burge.
- Nunez, R. (2017) Is there really an evolved capacity for number? *Trends in Cognitive Sciences*, 21(6), 409-24.

For further reading on this topic, follow up on references in the above papers. For background, see Chapter 4 of Susan Carey’s *The Origin of Concepts*.

Week 3: *How does core cognition differ from mature knowledge?*, Part 2: Perceptual Content

**Required reading:**

- Burr, D. & Ross, J. (2008) ‘A Visual Sense of Number’, *Current Biology*, 18(6): 425-8.
- Yousif, S., Clarke, S., & Brannon, E. (pre-print) ‘Number Adaptation: A Critical Look’ (try the demos)

**Further reading:**

- Sami Yousif and I have compiled a list of all published reports of number adaptation, here: <https://www.samiyousif.org/number-adaptation-bibliography>
- For another intriguing case of high-level adaptation, relevant to our discussions in class, see *causality adaptation*:
  - Rolfs, M., Dambacher, M., & Cavanagh, P. (2013) ‘Visual adaptation of the perception of causality’. *Current Biology*. 23(3): 250-4.
  - Kominsky, J.F., Scholl, B.J. (2020) ‘Retinotopic adaptation reveals distinct categories of causal perception’. *Cognition*. 203:104339.

Week 4: Interlude: Is perceptual adaptation the best way to characterize a perception-cognition border?

**Required reading:**

- Phillips, I. & Firestone, C. (2023) ‘Visual adaptation and the purpose of perception’, *Analysis*. 89(3): 555-75.
- Smortchkova, J. (2021) ‘After-effects and the reach of perceptual content’, *Synthese*. 198: 7871–90.
- Block, N. (2014) ‘Seeing-as in the light of vision science’, *Philosophy & Phenomenological Research*. 89(3): 560-72.

**Further reading:**

- For an extended defense of the idea that adaptation is a mark of the perceptual, see: Block, N. (2022) *The border between seeing and thinking*. OUP.

- For other ways of thinking about the perception-cognition border, see: Clarke, S. & Beck, J. (2023) 'Border disputes: Recent debates along the perception-cognition border', *Philosophy Compass*. 18(8): e12936.
- For ways in which this might all be relevant to our treatment of core number cognition, see:
  - Franconeri, S. L., Bemis, D. K., & Alvarez, G. A. (2009). Number estimation relies on a set of segmented objects. *Cognition*, 113(1), 1–13.
  - Moyer, R. S., & Landauer, T. K. (1967). Time required for judgements of numerical inequality. *Nature*, 215(5109), 1519–1520.

Week 5: *How does core cognition differ from mature knowledge?*, Part 3: Conceptual Content

**Required reading:**

- Beck, J. (2012) The Generality Constraint and the Structure of Thought. *Mind*, 121, 483: 563–600
- Halberda, J. (2016). Epistemic Limitations and Precise Estimates in Analog Magnitude Representation. In *Oxford series in cognitive development. Core knowledge and conceptual change* (pp. 171–190).

**Further reading:**

- You could check out sections 2-3.2 of Clarke, S. (2023) 'Compositionality and Constituent Structure in the Analogue Mind', *Philosophical Perspectives*, for a summary of what (I think) has gone wrong in Beck's argument. (This may not be necessary – Halberda's paper is probably harder going, but more authoritative on these points).
- Sanford, E. and Halberda, J. (2023). Successful discrimination of tiny numerical differences. *Journal of Numerical Cognition*.
- For a fantastic intro to concepts, see the intro to Margolis, E. & Laurence, S. (1999) *Concepts: Core Readings*. MIT Press

Week 6: *How does core cognition differ from mature knowledge?*, Part 4: Format

**Required reading:**

- Beck, J. (2019). Perception is Analog: The Argument from Weber's Law. *The Journal of Philosophy*, 116(6), 319–349.
- Fodor, J. (2007). Revenge of the Given. In Brian P. McLaughlin & Jonathan D. Cohen (eds.), *Contemporary Debates in Philosophy of Mind*. Blackwell. pp. 105–116
- Carey, S. (2009). 'Core cognition: Number', Chapter 4 of *The Origin of Concepts*. OUP.

**Further reading:**

- Quilty-Dunn, J. (2020). 'Perceptual Pluralism', *Nous*.
- Clarke, S. (2022). 'Mapping the Visual Icon', *Philosophical Quarterly*.

Week 7: *A puzzling dissociation*

**Required reading:**

- Spelke, E. (2023). 'Number', Chapter 4 of *What babies know: Core knowledge and composition, Volume 1*. OUP.
- Feigenson, L., Dehaene, S., Spelke, E. (2004). 'Core systems of number'. *Trends in Cognitive Science*. 8(7):307-14.

**Further reading:**

- There is lots of work on subitizing, or small number representation, out there. Follow the references in Spelke's book for more. For a philosophical treatment of these abilities, see Eric Margolis (2020) 'The Small Number System' in *Philosophy of Science*.
- For a related puzzle (in the case of infant object cognition) see also Chapter 6 of Stephen Butterfill's (2020) *The developing mind: A philosophical introduction*, Routledge.

Week 8: *From number to social cognition: The case of false belief*

**Required reading:**

- Apperly, I. & Butterfill, S. (2009) 'Do humans have two systems to track beliefs and belief-like states?' *Psychological Review*, 116(4): 953-70.
- Carruthers, P. (2016) 'Two systems for mindreading?', *Review of Philosophy and Psychology*, 7:141-62.

**Further reading:**

- Follow up the references in the above, especially:
  - Butterfill, S. & Apperly, I. (2013) 'How to construct a minimal theory of mind', *Mind & Language*. 28(5): 606-37.

Week 9: Action perception: Intention or goals?

**Required reading:**

- Gergely, G., & Csibra, G. (2003). Teleological reasoning in infancy: The naïve theory of rational action. *Trends in Cognitive Sciences*, 7(7), 287–292.
- Helton, G. (2018) 'Visually perceiving the intentions of others', *The Philosophical Quarterly*, 68(271): 243-64.
- Burge, T. (2018). 'Do infants and nonhuman animals attribute mental states?' *Psychological Review*, 125(3): 409-34.

**Further reading:**

As will be clear from the main readings (especially Helton's article) there is a question of whether the relevant discriminations are perceptual in nature. See:

- Scholl, B. J., & Gao, T. (2013). Perceiving animacy and intentionality: Visual processing or higher-level judgment? In M. D. Rutherford & V. A. Kuhlmeier (Eds.), *Social perception: Detection and interpretation of animacy, agency, and intention* (pp. 197–229). Boston Review.

To better understand how these perceptual discriminations operate, see:

- van Buren, B., Gao, T., & Scholl, B.J. (2017) 'What are the underlying units of perceived animacy? Chasing detection is intrinsically object-based.' *Psychonomic Bulletin*. 24(5):1604-1610.

For recent philosophical work on these issues, see:

- Westfall, M. (2023) 'Perceiving agency', *Mind & Language*, 38(3): 847-65.
- Neufeld, E. (2020) 'Can we perceive mental states?' *Synthese*, 197(5): 2245-69.

Week 10: Is action perception a problem for minimal mindreading?

**Required reading:**

- Butterfill, S. & Apperly, I. (2013) 'How to construct a minimal theory of mind', *Mind & Language*. 28(5): 606-37.

- Michael, J. & Christensen, W. (2016) 'Flexible goal attribution in early mindreading' *Psychological Review*, 123(2): 219-227.
- Butterfill, S. & Apperly, I. (2016) 'Is Goal Ascription Possible in Minimal Mindreading?' *Psychological Review*, 123(2): 228-33.

**Further reading:**

- All the readings from Week 9 will be relevant here.
- To better understand where Butterfill and Apperly are coming from, Google the 'motor theory of speech perception', e.g., Liberman, A. & Mattingly, I. (1985) 'The motor theory of speech perception revised', *Cognition*, 21: 1-36.

Week 11: *Replication crises in developmental psychology*

**Required reading:**

- Lavelle, J.S. (2022) 'When a crisis becomes an opportunity: The role of replications in making better theories', *British Journal for the Philosophy of Science*, 73(4): 965-86.
- Lavelle, J.S. (MS.) 'Growth from uncertainty: Understanding the replication "crisis" in Infant Cognition', available at: [http://philsci-archive.pitt.edu/22679/1/PoS\\_final\\_Oct\\_2023-2.pdf](http://philsci-archive.pitt.edu/22679/1/PoS_final_Oct_2023-2.pdf)

**Further reading:**

- Feest, U. (2016) 'The experimenter's regress reconsidered: Replication, tacit knowledge, and the dynamics of knowledge generation', *Studies in History and Philosophy of Science Part A*, 58:34-45.

Week 12: Beyond genetics 1: Cognitive gadgets

**Required reading:**

- Heyes, C. (2019) 'Précis of *Cognitive Gadgets: The Cultural Evolution of Thinking*', *Behavioral and Brain Sciences*, 42: e169.
- Look through at least some of the commentaries (and Heyes' response to these)

**Further reading:**

- Heyes' theory of cognitive development is laid out more comprehensively in her (very readable) *Cognitive Gadgets: The Cultural Evolution of Thinking*.
- To understand where Heyes is coming from, see earlier work like her (2014) 'False belief in infancy: a fresh look' *Developmental Science* 17(5): 647-59 (and commentaries), and (2017) 'Apes submentalize', *Trends in Cognitive Sciences* 21(1): 1-2.

Week 13: Beyond genetics 2: Cumulative culture

**Required reading:**

- Tennie, C., Bandini, E., van Schaik, C.P. & Hopper, L.M. (2020). The zone of latent solutions and its relevance to understanding ape cultures. *Biology & Philosophy*. 23, 55.
- Tennie, C., Premo, L.S., Braun, D.R. & McPherron, S. P. (2017). Resetting the null hypothesis: early stone tools and cultural transmission. 58, 652-672.
  - See also the responses to the above target article.

Week 14: Beyond genetics 3: Concept learning

**Required reading:**

- Carey, S. & Barner, D. (2019) 'Ontogenetic Origins of Human Integer Representations', *Trends in Cognitive Sciences*. 23(10):823-835.
- Spelke, E. (2017) 'Core knowledge, language, and number', *Language Learning and Development*, 13(2): 147-70.
- Clarke, S. (MS.) 'Number Nativism'.

**Further reading:**

- Carey's *The Origin of Concepts* is the crucial reference point in this literature. For (sympathetic) philosophical discussion, see:
  - Shea, N. (2011) 'New concepts can be learned', review essay on Susan Carey, *The Origin of Concepts* (OUP, 2009), *Biology & Philosophy* 26, 129-139
  - Beck, J. (2017) 'Can bootstrapping explain concept learning?', *Cognition* 158:110-21.
- Also interesting is Richard Samuels and Eric Snyder's new book 'Number Concepts' CUP.