

in the cognitive sciences about the power of intuition.

The risk – and the irony – is that removing felt-sense and aesthetics from design involves more than making design thinkers think like managers. It will make them think like managers of the past.

- 1 Karin Lindgaard and Heico Wesselius, “Once More with Feeling: Design Thinking and Embodied Cognition,” *She Ji: The Journal of Design, Economics, and Innovation* 3, no. 2 (2017): 83–92, DOI: <https://doi.org/10.1016/j.sheji.2017.05.004>.
- 2 See, for example: Ikujiro Nonaka and Hirotaka Takeuchi, *The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation* (New York: Oxford University Press, 1995).

Define Design Thinking

Lawrence W. Barsalou, Institute of Neuroscience and Psychology, School of Psychology, University of Glasgow, UK

Lawrence.Barsalou@glasgow.ac.uk

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Not working in the domain of design, I had no previous understanding of design thinking before reading Karin Lindgaard and Heico Wesselius’ article, “Once More with Feeling: Design Thinking and Embodied Cognition.”¹ Interestingly, and perhaps tellingly, Lindgaard and Wesselius do not appear to offer a definition. After studying accounts on Wikipedia and other top Google hits, I concluded that design thinking is more mystical than Tibetan Buddhism. Sometimes, design thinking is defined negatively, as not being problem-oriented thinking nor scientific reasoning. When defined positively, design thinking is described as solution-oriented, action-oriented, and needs based, and is associated with creative action, designer sensibility, technological feasibility, alternative solutions, emotional satisfaction, and constructive future results. While trying to formulate a coherent account, I wondered what alternative accounts of the design process exist, or whether design thinking is simply whatever designers do.

From this exercise, I could see why Lindgaard and Wesselius noted early on that the construct is often not well understood by the public or by those who practice it. Furthermore, if the construct is based largely on “anecdotal evidence” and covers domains as broad as “a cognitive style,” “a general theory of design,” and “an organizational resource,”² I can

further see why it might be struggling to gain acceptance and recognition. Perhaps my overly rigid scientific orientation is showing, but what appears to be a relatively vague construct might benefit from definition and refinement.

Alternatively, maybe I should lighten up and adopt a more intuitive and mystical perspective. Perhaps vagueness and intuitiveness constitute fundamental strengths of design thinking – what it offers would be lost with greater precision. If so, then “define design thinking” could be a Zen koan for achieving design enlightenment.

In their article, Lindgaard and Wesselius document the long-standing and continuing influence of cognitive science, not only on design thinking, but on design in general. Reading between the lines, the design community appears to have turned to cognitive science for two general reasons. First, cognitive science offers scientific explanations for understanding the design process in terms of cognitive and affective mechanisms (description). Second, cognitive science offers evidence-based principles for teaching and implementing optimal design practices (prescription).

Throughout their article, Lindgaard and Wesselius document the contributions of specific cognitive science traditions, beginning with European Gestalt Psychology and the subsequent Cognitive Revolution. From the perspective of Gestalt Psychology, cognition and perception are organized in holistic patterns of experience that include perception and action as parts. Drawing inspiration from Arnheim’s classic Gestalt work on visual thinking,³ design theorists have proposed that design originates in broad experiential patterns, which integrate perception, action, and other elements of conscious experience, including affect. Alternatively, from the perspective of the cognitive revolution, the design process has been viewed as the representation, manipulation, and execution of abstract symbolic structures, such as those in logic, language, and computer programming.⁴ Whereas the Gestalt approach suggests that design originates in holistic sensory-motor-affective experience, the classic cognitive approach suggests that design originates in symbol manipulation and linguistic processes.

Of primary interest to Lindgaard and Wesselius are recent developments in cognitive science associated with conceptual metaphor, embodied cognition, and emotion. Similar to Gestalt psychology and classic cognition, these approaches potentially offer insights into how the design process works, along with new principles for optimizing design practice and learning. Much like Arnheim’s Gestalt-oriented

approach, conceptual metaphor theory offers an account of how abstract ideas underlying design originate in non-verbal perceptual and bodily experience.⁵ More broadly, embodied cognition – also known as grounded cognition and situated cognition – proposes that cognition doesn't exist as an independent symbolic module in the brain, but depends critically on the modalities, body, and environment.⁶ Much like Gestalt psychology, cognition emerges as the brain, body, and environment coordinate situated action.⁷ Analogously, recent theories of emotion argue against viewing emotion as an independent brain module, proposing instead that affective and cognitive processes work closely together.⁸ Rather than being a source of distraction and bias, emotion plays fundamentally important roles in cognition.

Interestingly, these three recent developments have two things in common. First, they suggest that there is more to cognition than symbolic and linguistic processing. Instead, cognition depends critically on pre-symbolic and pre-verbal experience associated with perception, action, the body, and affect. Second, they all propose that complex patterns across multimodal domains of experience are central for cognition. Rather than operating independently of one another, perception, cognition, bodily experience, and action are tightly coupled, working together to produce effective action in the world. To the extent that these approaches are onto something, they suggest that design also depends critically on non-symbolic multimodal patterns, something that designers learned some time ago from Arnheim.⁹

What perhaps makes humans as unique and powerful as they are, however, is that they combine experiential patterns with language and symbolic processing.¹⁰ Rather than only relying on non-verbal experience – as do other, non-human animals – humans have powerful abilities for articulating, manipulating, and expressing these patterns via symbolic and linguistic processing. If we want to understand human cognition, we have to understand how these two kinds of processes work together. To the extent that integrating the experiential and the symbolic constitute the crux of human intelligence, it follows that design thinking probably reflects the coupling of experiential and symbolic processes as well. Rather than viewing experiential and symbolic approaches as competitors, it makes more sense to view them as complementary, both essential to explaining the remarkable character of human intelligence and behavior.¹¹

One other classic theoretical tradition from cognitive science also has potential for informing design – dual-process theories. Since at least William

James,¹² the distinction between implicit habitual processes and explicit regulatory processes has been used to explain probably all significant phenomena studied in the cognitive, social, and affective sciences.¹³ On the one hand, memories, concepts, and knowledge may often become active in relatively unconscious and implicit manners to influence design. On the other, a wide variety of regulatory and explicitly reflective conscious strategies may often regulate the immediate design process, and also its long-term development. Understanding design as the interaction of these two kinds of processes strikes me as another potentially fruitful direction to pursue.

As we have seen, insight into design thinking often tracks developments in cognitive science. As cognitive science develops new insights into human intelligence, these insights find their way into accounts of design thinking. Two points follow from this observation. First, design thinking could also potentially benefit from drawing on other recent developments in cognitive science not incorporated so far, including the importance of (1) statistical processing in connectionism, neural nets, and dynamical systems;¹⁴ (2) Bayesian inference;¹⁵ (3) crowd sourcing and big data as illustrated by Latent Semantic Analysis;¹⁶ and (4) neuroscience.¹⁷

Each of these perspectives potentially offers insight into the design process. From the statistical perspective, the design process is not likely to produce the same design solution to a design problem across occasions, but is likely to vary considerably, reflecting diverse subtle influences dynamically. From the Bayesian perspective, the design process relies heavily on habitual solutions (priors), but also reflects current contextual constraints (likelihoods). Similarly, from the crowd sourcing and big data perspective, the design process reflects thousands of relevant design and life experiences that simultaneously influence behavior. From the neuroscience perspective, the design process reflects a variety of intrinsic networks associated with attention, control, mind wandering, and feeling, as well as other diverse mechanisms such as neural reuse, neural plasticity, and processing hierarchies that project from topographically mapped feature areas to modal and cross-modal association areas.

A second point further follows from the observation that design thinking often tracks developments in cognitive science. As future developments continue to alter the landscape of cognitive science, they are likely to alter the landscape of design thinking as well. Because design thinking draws on the full scope of cognitive and affective processes in humans, new

insights in cognitive science are likely to percolate into the design community. Rather than being surprised by the co-evolution of cognitive science and design thinking, we should expect it.

In closing, I return to the koan: define design thinking. As design thinking incorporates evolving perspectives in cognitive science, its apparent nature is likely to change when viewed through the explanatory lens of each new perspective. A potentially interesting question is whether the same process simply looks different, or whether it actually changes in response to the current lens. Because designers often appear consciously motivated to achieve various design styles, absorbing current scientific thinking about what they're doing could potentially change their design habits via reflective processes (dual-process theory). If so, then attempting to define design thinking aims to define a moving target. From a scientific perspective, this obviously poses significant challenges. From the design perspective, however, forgetting about definitions and simply being in the design process is perhaps what it's all about. Allow new perspectives to reshape one's thinking, and then simply get on with it.

- 1 Karin Lindgaard and Heico Wesselius, "Once More with Feeling: Design Thinking and Embodied Cognition," *She Ji: The Journal of Design, Economics, and Innovation* 3, no. 2 (2017): 83–92, DOI: <https://doi.org/10.1016/j.sheji.2017.05.004>.
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- 3 Rudolph Arnheim, *Visual Thinking* (Berkeley: University of California Press, 1969).
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- 7 Lawrence W. Barsalou, "Simulation, Situated Conceptualization, and Prediction," *Philosophical Transactions of the Royal Society B: Biological Sciences* 364, no. 1521 (2009): 1281–89, DOI: <https://doi.org/10.1098/rstb.2008.0319>; Lawrence W. Barsalou, "Situated Conceptualization Offers a Theoretical Account of Social Priming," *Current Opinion in Psychology* 12 (2016): 6–11, DOI: <https://doi.org/10.1016/j.copsyc.2016.04.009>; Lawrence W. Barsalou, "Situated Conceptualization: Theory and Application," in *Perceptual and Emotional Embodiment: Foundations of Embodied Cognition, Volume 1*, ed. Yann Coello and Martin H. Fischer (Abingdon: Routledge, 2016), 11–37; Lawrence W. Barsalou, Cynthia Breazeal, and Linda B. Smith, "Cognition as Coordinated Non-cognition," *Cognitive Processing* 8, no. 2 (2007): 79–91, DOI: <https://doi.org/10.1007/s10339-007-0163-1>.
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- 10 For example, see Lawrence W. Barsalou, "Perceptual Symbol Systems," *Behavioral and Brain Sciences* 22, no. 4 (1999): 577–660, DOI: <https://doi.org/10.1017/S0140525X99532147>; Lawrence W. Barsalou, "Continuity of the Conceptual System Across Species," *Trends in Cognitive Sciences* 9, no. 7 (2005): 309–11, DOI: <https://doi.org/10.1016/j.tics.2005.05.003>.
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- 13 For example, see Lawrence W. Barsalou, "Understanding Contemplative Practices from the Perspective of Dual-Process Theories," in *Mindfulness in Social Psychology*, ed. Johan C. Karremans and Esther K. Papies (Abingdon: Routledge, 2017), 30–49; Shelly Chaiken and Yaacov Trope, eds., *Dual-Process Theories in Social Psychology* (New York: The Guilford Press, 1999); Jeffrey W. Sherman, Bertram Gawronski, and Yaacov Trope, eds., *Dual-Process Theories of the Social Mind* (New York: The Guilford Press, 2014).
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Stepping Stones between Design Research and Cognitive Science

Kees Dorst, University of Technology Sydney, Australia

Kees.Dorst@uts.edu.au

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In their article, Karin Lindgaard and Heico Wesselius¹ have rather courageously set out to link urgent questions that arise from developments in contemporary design thinking to the theories of embodied cognition that have emerged within cognitive science over the last thirty-odd years – 26 years, to be precise, if we take the 1991 work entitled *The Embodied Mind* as the landmark publication.² To do this paper justice and provide a thoughtful response to what it sets out to achieve, we must take a step back to reflect on the journey Lindgaard and Wesselius take us.

Design research, as a field, tends to base itself on fundamental insights from many other academic fields. This is quite understandable and commendable. Design research needs a strong and consistent basis – an appropriate ontology, epistemology, a theory of perception, and, as Lindgaard and Wesselius argue, a theory of cognition as lenses that can be brought to bear on design. Such specialist academic fields have dealt with these fundamental issues at length, and as design researchers, we need to learn from their insights. Over the years, design researchers have become avid borrowers. While there is nothing wrong with this in principle, there are four critical observations to be made about the way in which this done: (1) *while design research borrows, it never returns*, (2) *design research cherry-picks*, (3) *design research jumps to conclusions*, and (4) *design research tends to borrow only once*. Let's investigate this borrowing behavior more broadly, and then use these four critical reflections as a framework to look at Lindgaard and Wesselius's article.

(1) Consider the first point: design research focuses on designers' practices, behavior, and thinking. To understand these, design researchers use theories from Artificial Intelligence (AI), systems thinking, psychology, sociology, linguistics, education, and so on – yet their research results never seem to question the theories that are borrowed from these fields very deeply, while new insights generated in the study of design are almost never looped back into the academic discussion about these theories in their parent fields. An example could be educational theory. While design researchers and educators take concepts from didactics and apply those in thinking about design education, the results of these studies tend to be disseminated at conference sessions on design education, rather than on the mainstream educational research podiums of the world. This will not do – design education research should be up to the standards of the educational field and be appreciated there. This also happens to be a huge missed opportunity. As some design practices are now seen as generally applicable twenty-first-century skills, educating students in them is becoming an urgent issue across all levels of education and many professional fields. The design education research community must have many valuable practices and insights to share beyond the confines of its journals and conferences. Perhaps the reason for this is a natural modesty – but I fear that is not the case. The more likely reason is that design research borrows without having a proper overview of the field it is borrowing from, and hence it is simply not capable of engaging in the intellectual discussion in that field.

(2) Design researchers tend to select the theories that they like, or that resonate with their existing knowledge of design practices. This, of course, is very dangerous. By just selecting what is agreeable, design research misses out on the challenges that theories from other fields can pose to our current understanding of design. Such work might be self-affirming, rather than critically engaging with its subject matter. It means that design research is merely looking at a Rorschach blot in which it sees whatever it wants instead of critically studying design. This gives a false sense of security and stymies progress.

(3) That statement neatly segues into the third criticism: having borrowed a fundamental theory that confirms design researcher's insights about design, design researchers tend to draw far-reaching conclusions for design practice. Imagine that cognitive scientists have discovered how perception works, on the level of a split-second interaction between the actor and their environment. Surely this insight cannot be