Journal for the Theory of Social Behaviour

WILEY

ORIGINAL ARTICLE

What Is Grounded Simulation?

Michael Lee Wood[1] | Dustin S. Stoltz[2]

[1]Brigham Young University, Provo, Utah, USA | [2]Lehigh University, Bethlehem, Pennsylvania, USA

Correspondence: Michael Lee Wood (michaelwood@byu.edu)

Received: 11 November 2024 | **Accepted:** 28 March 2025

Keywords: anchoring | culture | deliberation | dual process | embodiment | simulation

ABSTRACT

The capacity to mentally simulate objects and events is an important yet underexplored component in sociological theorising. Recent sociological research drawing on simulation research from the cognitive sciences suggests opportunities for new insights via a richer interdisciplinary engagement. To this end, we provide a thorough review of the literature on grounded simulation theory, building on the nascent work in sociology engaging with grounded simulation theory, and discuss its potential for sociological analysis. We highlight its utility as a cognitively plausible framework for addressing important issues in the analysis of culture and action and culture and thinking, including questions of salience, novelty, implicit cognition, deliberation and the relation between Type 1 and Type 2 processing. We conclude with some considerations for future research.

1 | Introduction

Simulation, defined as the capacity to imagine or anticipate (real or fictional) objects and events, is an important cognitive ability for individual and collective life.[1] Simulation has been a persistent central theme in sociological theorising, though often left implicit or described in different terms. Simulation plays an implicit role, for instance, in Weber's discussion of social action, or "behaviour… where the meaning intended by the actor or actors is related to the behaviour of others, and the action is so oriented" (Weber 2019, 79). This social orientation includes "anticipation" or "expectations" about how others are likely to behave (Strand and Lizardo 2022; Weber 2019, 99). Simulation is also embedded in theories about the self. Cooley, for instance, describes the social self-concept as having three elements: "the imagination of our appearance to the other person; the imagination of his judgement of that appearance, and some sort of self-feeling, such as pride or mortification" (Cooley 1909, 184). Mead similarly describes self-perception as a function of simulating what others think: "One attains self-consciousness only as he takes, or finds himself stimulated to take, the attitude of the other. Then he is in a position of reacting in himself to that attitude of the other" (Mead 2015, 194). Goffman later made Mead's observations about taking the attitude of the other a main component of his work on the self and strategic interaction (Goffman 1970, 2021), and Du Bois expanded them by considering how race alters the social process of self-formation (Itzigsohn and Brown 2015).

More recently, simulation has emerged in theories of culture in action. Swidler, for example, argues that people's actions are constrained by what they imagine their actions mean to others (Swidler 1986, 2013; Tavory and Swidler 2009). In other words, people simulate what others think and how they might respond to possible actions, and orient their own actions accordingly. Martin has further developed these ideas in an "ecological" theory of action, in which enculturated people with an understanding of their social and material worlds are able to glean information from the environment such that the environment "tells us what to do" (Martin 2015, 240).

While sociological writing often assumes that humans have the capacity to simulate and argues that it is something we often do, it rarely explores how this process works and what forces shape it. Recent sociological work, drawing on the study of simulation in the cognitive sciences, suggests that deepening our understanding of this important cognitive process may improve our theories of culture in action (Cerulo 2018, 2019; Leschziner and

Brett 2019; Turner 2018). We further these goals by reviewing research on simulation theory from the cognitive sciences and discuss various ways that may be useful for analysing culture in action. More specifically, it can help social scientists better understand individual and situational variation in thought and behaviour, the capacity to imagine and produce novel responses, the relationship between Type 1 and Type 2 processing, the sense of "fit," which is important for deliberation, and deliberation as an unfolding process, and not just a post hoc justification.

The paper proceeds as follows. We begin with a thorough review of relevant research on memory and simulation. This research makes two primary observations about simulation: Simulation is "grounded" in embodied experience, and it involves the "bricolage" of memories from distributed, multimodal networks. To distinguish this perspective on simulation from other theories, we use the label "grounded simulation." Following this review, we discuss implications for analysing culture in action, and conclude with a discussion of opportunities for future research informed by simulation theory.

2 | Grounded Simulation: A Primer

We propose that action, deliberation, thinking, etc., all emerge from a cognitive process called *grounded simulation*—also referred to as embodied simulation and situated conceptualisation.[2] Such simulation involves "the re-enactment of perceptual, motor and introspective states acquired during experience with the world, body and mind" (Barsalou 2009, 1281). In simple terms, grounded simulation is a theory of memory recall and use.

With a few exceptions (Cerulo 2018, 2019; Leschziner and Brett 2019; Stoltz and Wood 2023), sociologists engage with simulation theories with respect to *imitation and enculturation* (Lizardo 2007, 2009; Sieweke 2014), or *empathy and intersubjectivity* (Bálint et al. 2020; Cerulo et al. 2021, 65–66; Hansson and Jacobsson 2014; Lizardo et al. 2020, 14–16; Martocci 2021; Pitts-Taylor 2016; Stoltz and Lizardo 2018; Van Ness and Summers-Effler 2016). Thus, the more expansive understanding of simulation we present here remains a largely untapped theoretical resource for the discipline.

Grounded simulation is a case of interdisciplinary convergence, involving findings from the philosophy of mind, neuroscience, linguistics, anthropology and psychology. Simulation was originally proposed as a solution to the question of how people infer the intentions of others and predict their actions.[3] "Simulation theory" posited that we can engage in a mental "rehearsal" that curbs "the behavioural output" (Gordon 1986, 161), and such "pretend play" can be used to predict people's actions. Simulation theory was advanced by several interdisciplinary discoveries. Neuroscientists discovered the neuronal capacity to implicitly "mirror" others' actions by observing them (Bonini et al. 2022; Gallese 2001; Rizzolatti et al. 1996). Linguists found language comprehension involves simulating what is being described (Bailey et al. 1997; Bergen 2012; Körner et al. 2023), and metaphor involves simulating (experientially grounded) source domains (Gibbs 2006; Lakoff 2009). Meanwhile, cognitive psychologists (Barsalou 1999, 2003) proposed that the reactivation of sensorimotor traces constituted the "elementary forms" of conceptual knowledge, and recalling events from our past involves "reconstructive episodic simulations" (Michaelian 2016).[4] As these findings crossed disciplinary boundaries, cognitive processes previously thought to be distinct—such as (among others) language comprehension, understanding others' intentions, autobiographical memory and using concepts—were increasingly seen as variations of the same process: simulation.

2.1 | Memory and Simulation

Grounded simulation involves *reusing* in the present what was learned previously. However, contemporary theories of simulation employ particular understandings of "memory" and "reuse" that clash with other common models. Let us first consider two of these misleading, yet pervasive, models. The first model is based on folk notions of memory. Here, memories are depicted as discrete objects, such as photographs or videos, stored in a container where they can be filed and withdrawn at will (Roediger 1980). Humans use long-term memory extensively in mundane activities, though rarely in the form of retrieving vivid mental snapshots of specific events. If simulation entailed reviewing detailed images of past events, it would be too slow and particular to guide perception and action outside of extraordinary cases (Glenberg 1996).

The second model presumes that memory consists of sets of amodal statements. Some philosophers, namely Jerry Fodor (1975), suggest that an amodal system akin to "computer code" exists in the brain: humans take in percepts, convert or "transduce" them into amodal concepts, perform computations and then retranslate them into outputs. Simulation based on such a "disembodied" system lost favour for numerous reasons, namely, there is neither empirical evidence for amodal "code" in the brain nor a principled explanation for how transduction would occur (Barsalou 1999; Harnad 1990; Ignatow 2007, 120–121).

Contemporary models of memory, upon which grounded simulation builds, contrast with these previous models in three significant ways: First, memories are not discrete objects, but properties of distributed networks. Second, memories are not limited to amodal concepts; rather, memories consist of rich, multimodal associations grounded in embodied experience. Third, neural networks consist of weighted ties, which grow weaker or stronger with experience. We review each in turn.

2.1.1 | Distributed Networks and Dynamic Simulation

Memories are not discrete, static things that can be picked up and put down like objects. Long-term memories are better represented relationally, specifically as *dynamic weighted networks*, without fixed boundaries or discrete structures (Barabási et al. 2023; Rumelhart and Ortony 1977; Stanley et al. 2019).[5] We experience the world as diffuse sensory information activating different sensorimotor patterns corresponding to different features of the experience. For example, riding a bike activates neurons for sight, proprioception, sound or emotion. This multimodal pattern of activation lingers. To an extent, this pattern is retained in long-term memory for procedural replication, as well as *representational* use.[6] What results is a patterned "assembly" formed by the intersection of different kinds of neurons and the state of the impulses flowing through them contemporaneously and sequentially (Changeux 1997). From this perspective, "memories" are better understood as "memory traces," defined as the "dispositional properties of neural networks… [to] re-activate, when triggered by the right cue, in roughly the same pattern of activation they underwent during encoding" (De Brigard 2014, 169, 171).

The distributed, multimodal nature of memory has important implications for understanding simulation (Barsalou 2008, 624; Matheson et al. 2019). Grounded simulation entails reactivating and integrating previously experienced multimodal patterns. For example, the brain's capacity to remember what it is like to "ride a bike" is not limited to recalling a series of declarative statements (e.g., "the seat is hard" and "the pedals go round"). Rather, we *partially recreate* the embodied experience of riding a bike (e.g., the physical movements, tactile feelings, emotions, etc.) through the reactivation of the same neural substrate active when *actually riding* (Gallese and Lakoff 2005). For instance, in a study on visual perception, when participants viewed images of tools, neural patterns associated with grasping were activated, but not when viewing images of houses or faces (Chao and Martin 2000).[7] The modal characteristic of conceptual knowledge is in part why we "know more than we can tell" (Polanyi 2009). Perception and action are entwined, and thus, what a thing *means* to us "consists of what it affords" (J. J. Gibson 1971, 407).

After repeatedly experiencing instances of a category, such as encountering many bikes over time, the brain develops distributed networks of associations incorporating diverse information aggregated from different learning episodes. This distributed network is a person's concept of that category. Concepts are thus "embodied potential" for dynamic simulation. Although a person may have a vast conceptual understanding of bikes, only a portion of this network is active at any given time. Different parts of a person's *bike* concept network may be active while riding a bike as opposed to repairing a bike. In this way, simulation is a *situated* process (Barsalou 2016).

Johnson (2008, 268) describes the situated nature of simulation in a discussion on the meaning of the quality of "redness":

> [T]he quality of redness means different things in different experienced situations. The redness of blood means life (or loss of life), the redness of a ripe bing cherry means the possibility of a certain exquisite taste and texture available to me if I eat that cherry, and the redness of a swollen wound means bodily insult, infection, danger, suffering, and the need for remedial therapeutic action.

Concepts like "redness" consist of networks of associations grounded in a variety of embodied experiences, so they enable situated simulations appropriate for the moment. The probability a given area of a distributed network becomes active depends, in part, on its correspondence to the current situation (Barsalou 2011, 2016, 19; Clark 2013). Thus, the sight of red blood likely does *not* activate simulations associated with red fruit (unless this contamination were prompted by, say, a book cover for a best-selling vampire novel).[8] Nevertheless, the boundary between the different meanings of redness is always fuzzy, as Johnson writes as follows: "Any meaning that an isolated patch of red has for me will be *parasitic on* these other meanings of red–red lips, wounds, cherries, and sunsets" (Johnson 2008, 268 emphasis added).

Situated, partial reactivation of distributed neural networks is constant and routine: We are "always, already" in the middle of simulation. When one encounters an object, say a paintbrush and a canvas with colourful swipes of paint, features of previous encounters (either with the same or similar objects) may be simulated, such as what it might feel like to grasp the paintbrush, pinch the hog's hair, dab it into dark purple, navigate one's hand just close enough to the canvas, and swish one's arms to drag the bristles across the textured surface. These simulations allow predictive inference or *anticipation*—they help people know what they can expect to happen next and how they could or should respond (Bar 2009; Pezzulo 2011). For example, if we are a regular patron of coffee shops, we will probably feel relatively at ease at a coffee shop in an unfamiliar city because action in the new environment still relies on simulations from previous experiences. Even though we have never been in *this* coffee shop, we have an embodied readiness cultivated from past experiences, which can be called upon in this "new" situation. This facilitates a baseline *illusio* (Bourdieu 2000; Strand and Lizardo 2017) or "natural attitude"(-Garfinkel 1967; Schutz 1967; Stoltz and Lizardo 2018) despite never really encountering the same situation twice.

2.1.2 | Neural Reuse and "Bricolaged" Simulation

Long-term memories would be of limited use if they were packaged in discrete boxes that only applied to particular situations (e.g., if our sense of "hardness" only applied to billiard balls). However, the distributed nature of neural networks makes grounded simulation a remarkably flexible form of bricolage (Levi-Strauss 1988, 21; Sanchez-Burks et al. 2015). To use a silly term, we might say that simulation is "MacGyvered:" a term originating from an American television show whose main character (MacGyver) became famous for his resourceful repurposing of objects to solve problems. Like MacGyver's problem-solving, simulation entails constructing mosaics by repurposing memory traces on the fly.

Contemporary memory research rejects the notion that long-term memories are encoded in specialised, domain-specific modules. Consider the fusiform face area, an almond-shaped section at the back of the brain. It was initially believed to be used exclusively for facial recognition but was found to be active when recognising birds, cars, X-rays or chess moves (Bilalić 2016; Gauthier et al. 2000). That is, neural circuitry initially used for one task can be *repurposed* for other tasks, referred to as the principle of *neural reuse* (Anderson 2014). This provides a naturalistic mechanism for transposability: memory traces can be used "beyond the limits of what has been directly learned" (Bourdieu 1984, 170). Much of our internal phenomenology, then, is a kind of repurposing of the sensorimotor system. The internal monolog, for instance, is connected to "subvocalisation" or the partial reactivation of neural networks associated with speaking (Loevenbruck et al. 2019; Stephane et al. 2021), resulting in very slight movements in some articulatory muscles (Bruder and Wöllner 2021; Helou et al. 2021).

Research on neural reuse supports work by philosophers, linguists, sociologists, and psychologists on the fundamental role of analogy in cognition (Dennett 2017; Hofstadter and Sander 2013; Lakoff and Johnson 2008). For instance, time is often understood by analogy to space: Let's *move* the meeting *up* an hour. We are *getting close to* summer. Analogical reasoning is universal, but our bodies move through space in many ways, and so (systematic) variation exists. Consider "Next Wednesday's meeting is moved forward 2 days. What day is the meeting?" There is no unambiguous answer—it is either Friday or Monday—because it depends on whether time is moving towards us or we are moving towards the future. People who are flying are more likely to say "Friday" than if they were picking someone up at the airport (Boroditsky and Ramscar 2002). The former's bodily orientation was *moving forward*, which structured their abstract understanding of time.

We *recruit* a subset of neural patterns that are active in a source domain (say, "walking around") in a simulation that is used to make sense of a target domain (say, "scheduling a meeting"). Thus, features of the source domain may "contaminate" how we experience the target domain in fascinating ways. Consider the association between moral purity and physical cleansing (S. W. S. Lee et al. 2023; S. W. S. Lee and Schwarz 2020; Lizardo 2012). When people lie via a voicemail or a written note, metaphorically making their mouths or hands "dirty," they tend to positively evaluate things that would clean the offending body part, such as mouthwash or hand soap. Brain imaging shows that this positive evaluation is accompanied by sensorimotor activation in the offending body part when there is alignment between the form of lying and the cleansing product (Schaefer et al. 2015; see also Tang et al. 2017). As sociologists and anthropologists would expect (e.g., Douglas [1966] 2003Douglas (2003)), this association is not universal. In this case, the effect was found to be stronger among engineering than social science students (Schaefer et al. 2015).

2.1.3 | Entrenched Associations and Entrenched Simulations

Learning entails the "modification (e.g., strengthening or weakening of links) of neural pathways" (Lizardo 2017, 91) comprising memory traces. Importantly, this process is not binary (i.e., "on or off"), but graded: "When two neurons (or neuronal systems) fire together they wire together, and the more often they fire together the stronger the link becomes and the slower it decays over time" (Lizardo 2017, 94). In addition to repetition (Hebb 1961; Kahana et al. 2022; Thelen 2000) and attention (Hartshorne and Makovski 2019; Sherman and Turk-Browne 2022), the strengthening (or weakening) of associations is further mediated by age, emotion, stress, sleep, drugs, food, the microbiome and even breathing (Craik and Rose 2012; Heck et al. 2019; Ignatow 2022; Perl et al. 2019; Rasch and Born 2013; Schwabe et al. 2012; Söderlund et al. 2005).[9]

As grounded simulation reuses the weighted, distributed and dynamic networks that constitute long-term memory, it is *entrenched,* meaning simulation is biased towards features of a person's *typical* experiences. For example, for most people in the West, the "default" simulation of a car has four wheels because three-wheeled cars are rare there. Simulations are entrenched across multiple modalities. For example, simulations of an object may include emotional states based on the typical emotional experiences with that object (Lebois et al. 2020). Similarly, because objects are typically experienced from certain perspectives (e.g., in front of a person rather than above them), when describing objects people tend to emphasise properties that are apparent from those typical perspectives (Borghi and Barsalou 2019).

As memory traces develop via repeated experience, variation in experience creates variation in how simulations are entrenched. For example, a simulation of "New Year's Day" might include cold, snowy weather for someone in the Northern Hemisphere, but a warm day at the beach for someone in the Southern Hemisphere. Similarly, Johnson (2008, 268) notes people's perceptions may vary depending on their expertise: "For those with medical knowledge, [the sight of a red wound] might signify any of a number of possible causes and suggest any of a number of possible medical treatments." Related research on athletes finds that experts with more motor dexterity perceive challenges differently than novices (Pezzulo et al. 2010) and exhibit a wider range of actions in response to changing situations (Seifert and Davids 2012). This does not mean that variation in personal experience makes certain simulations "unthinkable," but for a given simulation task, certain features may be more immediately salient than others depending on personal experience (Guhin 2016; Holland 1992), and some actions may be out of reach without further training.

Simulations are entrenched, then, in unevenly distributed ways (Reay 2010). A person may simulate an object idiosyncratically because they have had atypical experiences with those objects. Certain concepts, in contrast, may appear near-universal because of the ubiquity of the experiences forming them: Something about the social or material world renders certain experiences (nearly) invariant (Grady 1997; Hurtienne et al. 2010; Shore 1996). For instance, concepts like "power" and "goodness" are almost universally associated with the UP or HIGH spatial location, likely because babies "look up" to learn and are "picked up" to receive food and warmth (Marmolejo-Ramos et al. 2013; Schwartz 1981).

Extremely entrenched simulations may produce strong patterns similar to a "primary frame" (Fligstein et al. 2017; Goffman 1974); however, the degree to which deliberation is entrenched in a frame-like way is an empirical question, and should not be assumed from the outset. In other words, cultural analysts should be open to the possibility that there is no clear, pre-existing and overarching organising construct—that people instead wander, simulating until they settle on something that feels right, or until they give up. The organised way of thinking suggested by "schema" and "frame" concepts may apply best to limiting cases.

If remembering involves the dynamic, messy, reconstructed and repurposed process of grounded simulation, one might conclude human remembering is "bad." But the primary purpose of memory, and thus grounded simulation, is *not* recollecting episodes from our lives in vivid detail (De Brigard 2014; c.f. Martin 2010). Rather, grounded simulation guides perception and action and helps us anticipate a dynamic, yet patterned world (Glenberg 1996). From this perspective, our use of memory for recalling past events is an exaptation–using neuroanatomy for purposes other than that for which it initially evolved (Buzsáki and Tingley 2023). Indeed, features that are maladaptive for perfect recall are favourable for perceiving and planning (Schacter and Addis 2007). For memory to be useful, it cannot be fixed, particular and precise. Memory must be durable, yet continually updated and integrated with new information. Patterns associated with features of our environment that rarely change and, thus are experienced with great repetition, for example, gravity, acquire higher durability (J. J. Gibson 2014). Because grounded simulation reuses memory traces, it must also be situated *and* entrenched (Barsalou 2011, 2016, 19; Clark 2013).

2.2 | Memory and Imagination

So far, we focused on memory and grounded simulation *in the present*. Grounded simulation, however, also enables imagination and future thinking, as they are just further examples of neural reuse. Merely imagining riding a bike, for instance, activates (some of) the neural assemblies necessary to actually ride a bike. To put it plainly, we imagine scenarios that we have not (and even cannot have) experienced by reusing memory traces. Imagination is "like remembering what never happened" (Hustvedt 2011, 188).

Our ability to imagine relies on partially *suppressing* the role one's immediate environment would normally play in guiding simulation, drawing on long-term memory to simulate things not necessarily associated with one's surroundings. *Suppression* can be understood as continuous (Glenberg 1996), meaning the "break" we make with the environment varies from minor elaboration (e.g., changing the colour of an observed object) to imagining an entirely new world. In the extreme, grounded simulation may become "freed from the burden of modelling our actual presence in daily life" (Gallese 2011, 199). However, the capacity to suppress one's environment is likely limited, subject to depletion (like muscle use) and constrained by, inter alia, motivation and attention (Inzlicht et al. 2021).

Evidence that simulation undergirds imagination comes from observational and experimental research showing that episodic memory, that is, recollection of personal experiences (Tulving 1983, 2002), relies on the same neural substrates as those used to imagine future or hypothetical events (Bulley and Schacter 2020; Schacter and Addis 2007; Suddendorf and Corballis 1997; Suddendorf et al. 2022). The link between episodic memory and future or hypothetical imaging goes by different names, including episodic future thinking (Atance and K. O'Neill 2001, 2005; Szpunar 2010), episodic counterfactual thinking (Schacter et al. 2015), and prospection (Buckner and Carroll 2007; Gilbert and Wilson 2007).

Early evidence of the link between memory and imagination came from Tulving's (1985) interactions with a patient known as "K.C.," who suffered a traumatic head injury that impacted his cognitive functioning. Although K.C. retained the ability to remember recent information (short-term memory) and general factual information about the world (semantic memory), he had no ability to recall events from his past. Additionally, K.C. struggled to imagine future states, such as what he might do tomorrow. When asked to describe his mental state, he said his mind was blank. More recently, neuroimaging analyses found close associations in neural activity when people remember specific episodic memories and when they imagine future events (Benoit and Schacter 2015; Schacter et al. 2012). Importantly for deliberation, this activation for past and future imagining also is closely associated with systems associated with affective experience (Benoit et al. 2019; Iigaya et al. 2019). Contemporary research also finds close associations between episodic memory and creativity (Beaty et al. 2016; Duff et al. 2013; Madore et al. 2015).

Simulating possible futures facilitates deliberation by providing the means to reason about potential actions or outcomes. Simulations necessarily have the quality of subjective realism, meaning they can provide the experience of "being there"—of experiencing the thing as if it were actually present.[10] For example, the thought of a spider crawling up someone's arm may evoke a creepy feeling, even when only imagined. Similarly, simply witnessing someone else's actions may evoke strong emotions in us, even if we ourselves are unaffected (Cerulo 2018; Iacoboni 2009; Leschziner and Brett 2019; Lizardo 2009; Semino 2010; Stoltz and Wood 2023). In fact, imagining an action makes it more likely a person will perform the action—a benefit to athletes and a burden for those suffering from addiction (Pearson et al. 2015). Importantly, the subjective realism of grounded simulations applies not only to previously encountered situations but also to imaginary or hypothetical situations. By blending multimodal information from previous experiences, people can simulate things they have never encountered, and "pre-experience" them to a degree. For example, parents deliberating about where to hike with their young children may choose to avoid hikes with high cliffs because they simulate the disturbing possibility of their reckless child falling off, even if they have never experienced it themselves. The visceral simulation can be used to weigh decision-making.[11]

3 | Implications for Sociological Analysis

As recent research demonstrates (Cerulo 2018; Leschziner and Brett 2019), grounded simulation has much potential for sociological analysis. In what follows, we discuss the place of simulation as it relates to important issues in sociological theory, including salience and anchoring, routine and novel responses, and deliberation and intuition. We conclude with a discussion of future directions, including new methodological opportunities.

3.1 | Salience and Anchoring

Of all the things people could think or do in any given moment, why do they think and do the things they do, and why are their thoughts and actions so often patterned? Understanding thinking and action entails accounting for the salience of particular thoughts and actions, or why people are drawn to certain thoughts and acts at a given moment.[12] As Swidler (2013, 160) observes, "Because people hold multiple, sometimes ambiguous, sometimes competing cultural understandings, and because they know much more culture than they use at any given time, we must examine why people mobilise the culture they do and how they adapt or rework it before we can analyse how culture shapes experience and action." At any given moment, some ideas come immediately to mind, and some actions are automatic, or at least seem like a good idea. Salience is an important phenomenon because it makes life tractable. Without certain thoughts and actions becoming immediately salient, it is unclear how a person could accomplish tasks nonrandomly, given the virtually infinite number of things they could think about. In this way, accounting for salience is necessary to cognitive plausibility.

Grounded simulation theory helps clarify issues concerning salience. The difficult problem Swidler recognised is as follows: if cultural content consists of neutral information, then the link between culture and action is underdetermined. There must be some additional element(s) to "anchor" these adrift neutral elements. Grounded simulation theory allows a fresh approach to the issue by *denying the premise of neutral information*. Recall from above that memories are understood as properties of distributed, weighted and multimodal networks. The nature of memory is such that certain simulations are more "ready at hand" than others because certain experiences are more frequent, are associated with strong emotions or co-occur frequently with certain material cues. Thus, when a person encounters a problem, they do not do so as a neutral library of memories requiring selection. Rather, they are biased, such that certain ideas or solutions come immediately to mind. People are prepared to respond to situations in specific ways, before they even encounter them.

This perspective adds insight into the idea of cultural "anchors." Anchoring begins with experience resulting in neuronal ties being formed, strengthened and/or weakened. External environments such as institutions may function as anchors first by organising people's experiences in routine ways, resulting in neural networks with particular configurations of weighted ties. Lizardo's (2009, 725) discussion of ritual is apropos: "Rituals and conventions structure learning and processes of embodied simulation by restricting the organisation of time and space, thus enabling the amassing of bodies at designated times, and helping to produce the collective synchronization of embodied rhythms that aid in the encoding and retrieval of practical information." Here, rituals are a type of "anchor" insofar as they shape people to have a certain embodied readiness. Then, in the present, external environments anchor thinking and action by providing cues that activate these prepared networks, yielding patterned simulations and responses.

Cerulo's (2018) work on smell highlights the role of grounded simulation in cultural anchoring. Cerulo found that when research participants smelled different perfumes, the experience often triggered rich simulations that pulled together social, emotional and olfactory experiences:

> When participants tied meaning to a positive experience or admired person, they often reported feeling "warm all over," "tingly," or "happy," and they showed positive markers such as smiles or what one participant called "self-hugs." In contrast, participants who associated the meaning of a scent with something or someone negative regularly displayed scowls or frowns, shuddered, and backed away from the group table; they said things such as "ugh," "oh no," or "blecchh" and reported feeling "headachy" or "nauseous".
>
> (p. 378)

Participants' conceptual understanding of perfumes seemed to be anchored by both institutional conditioning (e.g., the marketing work of scent manufacturers) and idiosyncratic autobiographical experiences. Cerulo found that although most participants "correctly decoded the manufacturers' intended message, target users, and sites of use," (p. 363) smelling also invoked rich autobiographical memories that sometimes conflicted with these intended meanings. At times, participants' simulations were complex and contradictory bricolages, such as when smelling something they recognised as pleasant-smelling but which they associated with a bad memory or a difficult person.

3.2 | Routine and Novel Responses

Importantly, people are prepared to respond in particular ways to routine *and* novel situations. Responses to novel situations are neither necessarily discrete "scripts" transposed to new contexts nor are they *ex nihilo* creations. Grounded simulation theory is agnostic regarding how organised or coherent associations are and does not necessitate any higher-order organising construct.[13] The distributed nature of memory casts suspicion on frameworks that treat internalised implicit contents as discrete and static entities. It is plausible that in certain cases, there may be strong networks of associations that produce a limited, predictable range of responses to a wide range of situations (likely resulting from scaffolded experiences, discussed above), but following grounded simulation theory, this would be understood as a network property, rather than the result of possessing a discrete entity. Importantly, however, such strong coherence is not necessary.

When confronting novel situations, persons may create new simulations, forming a bricolage from multiple semi-relevant experiences. New or unfamiliar situations are never entirely foreign, and people do not face them as blank slates. Most situations have at least some similarities to more familiar situations, which affords analogical reasoning whereby people think about less familiar things in terms of more familiar things, providing immediate "suggestions" (Dewey 1938, 110). Thus, even when placed in a new organizational context, people can come up with relevant ideas by attending to familiar structural features. However, the fact that people can simulate and respond to new situations does not necessarily mean that they are adequate responses. Simulation can result in hysteresis when responses to novel situations are inadequate (Strand and Lizardo 2017).

The capacity of people to respond to novel situations without issue is seen among improv actors who try to "get out of their heads" and be present in the current situation. As one improv performer reported to Brett (2022, 191),

> Trying to come up with ideas–that's the hardest thing to wrap your head around with improv. You have to come up with ideas, obviously, but the less you think about the ideas, the better are the ideas you come up with! It's when you put pressure on your brain that you're lost; that you're thinking too much and you're not listening, as opposed to trusting that your brain will have something when you're just there in the moment.

The implication behind the instruction to "listen" and "be in the moment" is that if the contrived situation were real, the actor would know how to respond, even if the situation was completely new and strange. The actor's imperative to listen and be present is not designed to invoke an artificial way of being, but to access the body's capacity to respond to real, novel situations via grounded simulation.

3.3 | Deliberation Meets Intuition

Understanding how simulations are anchored and how they afford novel cognition affords further insights about the relationship between deliberative and automatic cognition. Following the introduction of dual process models in sociological research (Lizardo et al. 2016; Moore 2017; Shepherd 2014; Vaisey 2009; Vila-Henninger 2021), some research has turned to the question of how Type 1 (deliberative) and Type 2 (intuitive) processes interact (Cerulo 2018; Leschziner and Brett 2019; Leschziner and Green 2013; Pagis and Summers-Effler 2021; Price 2024). As Leschziner and Brett (2019, 344) note, researchers studying culture in action "have observed actors who routinely move back and forth between the two [types of processing]," suggesting the need for a theory that does not explicitly or implicitly posit an "either-or" dichotomy. Research on exclusively measuring Type 1 processing also speaks to this need, insofar as the task is difficult because common measures such as surveys typically involve a mix of Type 1 and Type 2 processing (Miles et al. 2019, 315).

Grounded simulation addresses this need by opening ways of understanding creative thinking and action that involves both automatic and deliberative cognition. As seen above, people do not encounter new situations as blank slates. Previous experiences produce weighted conceptual and affective associations, such that certain simulations come immediately to mind, an example of Type 1 processing. Simulation emerges immediately from a "mesh" of present situational qualities and entrenched associations (Glenberg 1997), and these simulations can give people (fuzzy) objects to "think with." From this perspective, deliberation is understood as a back-and-forth process of simulation and reflection (Cerulo 2018). That is, the end may not be consciously known from the beginning, as one simulation leads to another in a chain of reasoning. Thus, we can understand deliberation as both partially predictable (because it is grounded in previous experience) and creative, open-ended, and not reducible to automatic processing.[14] Discussing chefs, Leschziner and Brett (2019, 353) observe the following:

> When they create a dish, chefs draw on their capacity to reexperience tastes and sensations and combine these sensorial memories with conceptual knowledge about food, such as the flavour profiles of ingredients, good ingredient combinations, and the physics and chemistry involved in cooking.

With these memories and associations, depending on their cognitive style, chefs will appeal to heuristics or engage in a deliberative analytic process involving simulations of potential combinations and perhaps some trial and error. This view of deliberation mirrors Dewey's description of reasoning, whereby an immediate "suggestion" is "examined with reference to its functional fitness." (Dewey 1938, 110). Fitness has been recognised as an important component of cultural explanation. According to Swidler (2013, 30), "[W]hat makes a particular image, metaphor, or argument acceptable is its *fit* within a given mode of life" (emphasis added). Cognition researchers refer to this phenomenological experience as the "feeling of rightness" (FOR) (Leschziner and Brett 2019, 358; Thompson et al. 2009; Vega et al. 2021). Grounded simulation plays an important role here by allowing people to "pre-experience" imagined situations that may or may not evoke a FOR. Thus, chefs do not need to physically test every possible ingredient combination to have a sense that some are much more promising than others. These simulations are biased and limited and may be inaccurate (Firestone and Keil 2016), but they can provide (or fail to provide) a FOR that marks an adequate solution with a directive to act (Johnson 2008, 81). Absent such a feeling, people may be motivated to keep searching for an adequate solution. Alternatively, people may stop deliberating for external reasons, but feel uneasy about the solution because they did not have a FOR.

In addition to cognitive style (Leschziner 2015; Leschziner and Brett 2019), expertise and familiarity with the situation at hand can have a strong impact on reasoning because simulation is grounded in a person's understanding about how the world works (Pezzulo et al. 2010). A novice simulating a proposed solution might have a sparser simulation and believe that the solution will work, but an expert's simulation may include all kinds of salient variables that fundamentally change the way they simulate the proposal, and "know" that the proposed solution will fail.

4 | Concluding Remarks

Grounded simulation is a central cognitive capacity that is deeply entwined in social life. Understanding this process deepens our understanding of human social behaviour, adds insight into contemporary questions and debates, and opens new possibilities for empirical research. However, understanding simulation is only the starting point.

For the sake of space, our discussion focused on individual-level processes, which are nevertheless deeply social. Future research should investigate grounded simulation in the context of social interaction. Grounded simulation is an individual process in that it is something individuals do, but is necessarily entwined with the larger material and social environment. Our limited discussion should not be read as a defence of "cognitive individualism" (Zerubavel and Smith 2010) or a dismissal of analyses of collective imagining or deliberation (Eliasoph and Lichterman 2003; Fuist 2021; D. R. Gibson 2017; Mische 2014). From the perspective developed here, collective deliberation involves a back-and-forth process in which interlocutors simulate things and verbally share these simulations, triggering simulations in others. Disagreements may occur when people simulate things differently, for example, when someone believes something is realistic and another thinks it is wishful thinking. When deliberation is adversarial and oriented towards an audience, such as in a debate, it may involve simulating how the audience might respond and attempting to frame issues to evoke certain simulations while avoiding others (Wood et al. 2018). Future research would benefit from investigating how simulations unfold in dynamic social situations.

The above discussion focused on implications of grounded simulation for sociological *theory*, but future work should also consider how grounded simulation theory can improve *measurement* in sociological research. Because simulation is grounded in current, concrete situations, research on thinking and action would benefit from "situating" questions and/or research tasks. As Dutriaux et al. (2023, 2) observe, "From the perspective of situated cognition, it is striking how disconnected traditional assessment instruments often are from real-life situations." Recent work in the cognitive sciences (Lebois et al. 2020; Rodger et al. 2024) has made inroads in this direction; sociology and these other cognitive sciences would mutually benefit from a more interdisciplinary dialogue on this topic.

Endnotes

[1] Although related, our use of the term "simulation" should not be confused with artifacts designed to approximate experiences in a controlled setting (e.g., flight simulators).

[2] These are used synonymously. We prefer *grounded* simulation as it encompasses both the embodied and the situated aspect of simulation.

[3] This is also known as "Theory of Mind" or "mind-reading" and is considered a capacity that enables, inter alia, intersubjectivity and empathy.

[4] For the sake of comprehensiveness, we also note that simulation is a proposed mechanism underlying dreaming, daydreaming and mind-wandering (e.g., Domhoff 2017).

[5] A recent alternative, but still relational, conceptualisation is that of a topological field of activation patterns (Pang et al. 2023).

[6] "Representation" carries significant baggage in the cognitive sciences. We are noncommittal here, but even extreme "contentless" approaches allow for some contentful reconstructions in working memory.

[7] In other studies (Iani et al. 2019), participants were shown pictures of tea kettles and asked to determine whether they were inverted. When the handle of the kettle was masked with a nondescript square, response times declined. If the image showed a hand grasping the handle, however, the response times were identical to baseline tests.

[8] For the author's take on the symbolism:https://stepheniemeyer.com/the-books/twilight/twilight-faq/#apple

[9] Additionally, recalling long-term memories can entail the strengthening, weakening and even erasure of associations (Nadel et al. 2012). Memory reactivation puts long-term memory in a fragile state. New experiences can interweave into associations and modify future recollections (Hupbach et al. 2009; J. L. C. Lee et al. 2017).

[10] Tulving called this capacity "autonoetic consciousness" (Wheeler et al. 1997, 335).

[11] See also Johnson (2008, 81). In this way, grounded simulation also overlaps with research on how the material environment "tells" people what to do (J. J. Gibson 2014; Martin 2015, 232).

[12] Salience sometimes refers to emotional investment in certain topics in addition to attention (Guhin 2016), but here, we define salience more generally as the quality of task relevance. Salience could have emotional and moral dimensions, but it is not a necessary condition following our use of the term.

[13] See Martin and Desmond (2010) for an example of a study that assumes individual variation in the degree to which people's responses are coherent.

[14] From this perspective, treating deliberation as only post hoc justification of action is unjustifiably limiting.

References

Anderson, M. L. 2014. *After Phrenology*. MIT Press.

Atance, C. M., and D. K. O'Neill. 2001. "Episodic Future Thinking." *Trends in Cognitive Sciences* 5, no. 12: 533–539. https://doi.org/10.1016/s1364-6613(00)01804-0.

Atance, C. M., and D. K. O'Neill. 2005. "The Emergence of Episodic Future Thinking in Humans." *Learning and Motivation* 36, no. 2: 126–144. https://doi.org/10.1016/j.lmot.2005.02.003.

Bailey, D., J. Feldman, S. Narayanan, and L. George. 1997. "Modeling Embodied Lexical Development." In *Proceedings of the 19th Cognitive Science Society Conference*, 19–24.

Bálint, K. E., J. Nadine Blessing, and B. Rooney. 2020. "Shot Scale Matters." *Poetics* 83: 101480. https://doi.org/10.1016/j.poetic.2020.101480.

Bar, M. 2009. "The Proactive Brain." *Philosophical Transactions of the Royal Society of London* 364, no. 1521: 1235–1243. https://doi.org/10.1098/rstb.2008.0310.

Barabási, D. L., G. Bianconi, Ed Bullmore, M. B., et al. 2023. "Neuroscience Needs Network Science."

Barsalou, L. 1999. "Perceptual Symbol Systems." *Behavioral and Brain Sciences* 22, no. 4: 577–609, discussion 610–60. https://doi.org/10.1017/s0140525x99002149.

Barsalou, L. 2003. "Abstraction in Perceptual Symbol Systems." *Philosophical Transactions of the Royal Society of London* 358, no. 1435: 1177–1187. https://doi.org/10.1098/rstb.2003.1319.

Barsalou, L. 2008. "Grounded Cognition." *Annual Review of Psychology* 59, no. 1: 617–645. https://doi.org/10.1146/annurev.psych.59.103006.093639.

Barsalou, L. 2009. "Simulation, Situated Conceptualization, and Prediction." *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* 364, no. 1521: 1281–1289. https://doi.org/10.1098/rstb.2008.0319.

Barsalou, L. 2011. "Integrating Bayesian Analysis and Mechanistic Theories in Grounded Cognition." *Behavioral and Brain Sciences* 34, no. 4: 191–192. https://doi.org/10.1017/s0140525x11000197.

Barsalou, L. 2016. "Situated Conceptualization." In *Foundations of Embodied Cognition*, edited by Y. Coello, Vol. 290, 11–37. Routledge.

Beaty, R. E., M. Benedek, P. J. Silvia, and D. L. Schacter. 2016. "Creative Cognition and Brain Network Dynamics." *Trends in Cognitive Sciences* 20, no. 2: 87–95. https://doi.org/10.1016/j.tics.2015.10.004.

Benoit, R. G., P. C. Paulus, and D. L. Schacter. 2019. "Forming Attitudes via Neural Activity Supporting Affective Episodic Simulations." *Nature Communications* 10, no. 1: 2215. https://doi.org/10.1038/s41467-019-09961-w.

Benoit, R. G., and D. L. Schacter. 2015. "Specifying the Core Network Supporting Episodic Simulation and Episodic Memory by Activation Likelihood Estimation." *Neuropsychologia* 75: 450–457. https://doi.org/10.1016/j.neuropsychologia.2015.06.034.

Bergen, B. K. 2012. *Louder than Words*. Basic Books.

Bilalić, M. 2016. "Revisiting the Role of the Fusiform Face Area in Expertise." *Journal of Cognitive Neuroscience* 28, no. 9: 1345–1357. https://doi.org/10.1162/jocn_a_00974.

Bonini, L., C. Rotunno, E. Arcuri, and V. Gallese. 2022. "Mirror Neurons 30 Years Later." *Trends in Cognitive Sciences* 26, no. 9: 767–781. https://doi.org/10.1016/j.tics.2022.06.003.

Borghi, A. M., and L. Barsalou. 2019. "Perspective in the Conceptualization of Categories." *Psychological Research* 85, no. 2: 697–719. https://doi.org/10.1007/s00426-019-01269-0.

Boroditsky, L., and M. Ramscar. 2002. "The Roles of Body and Mind in Abstract Thought." *Psychological Science* 13, no. 2: 185–189. https://doi.org/10.1111/1467-9280.00434.

Bourdieu, P. 1984. *Distinction*. Routledge & Kegan Paul.

Bourdieu, P. 2000. *Pascalian Meditations*. Stanford University Press.

Brett, G. 2022. "Dueling With Dual-Process Models." *Sociological Theory* 40, no. 2: 179–201. https://doi.org/10.1177/07352751221088919.

Bruder, C., and C. Wöllner. 2021. "Subvocalization in Singers." *Psychology of Music* 49, no. 3: 567–580.

Buckner, R. L., and D. C. Carroll. 2007. "Self-Projection and the Brain." *Trends in Cognitive Sciences* 11, no. 2: 49–57. https://doi.org/10.1016/j.tics.2006.11.004.

Bulley, A., and D. L. Schacter. 2020. "Deliberating Trade-Offs With the Future." *Nature Human Behaviour* 4, no. 3: 238–247. https://doi.org/10.1038/s41562-020-0834-9.

Buzsáki, G., and D. Tingley. 2023. "Cognition From the Body-Brain Partnership." *Annual Review of Neuroscience*. https://doi.org/10.1146/annurev-neuro-101222-110632.

Cerulo, K. A. 2018. "Scents and Sensibility." *American Sociological Review* 83, no. 2: 361–389. https://doi.org/10.1177/0003122418759679.

Cerulo, K. A. 2019. "Embodied Cognition." In *The Oxford Handbook of Cognitive Sociology*, 81–100.

Cerulo, K. A., V. Leschziner, and H. Shepherd. 2021. "Rethinking Culture and Cognition." *Annual Review of Sociology* 47, no. 1: 63–85. https://doi.org/10.1146/annurev-soc-072320-095202.

Changeux, J.-P. 1997. *Neuronal Man*. Princeton University Press.

Chao, L. L., and A. Martin. 2000. "Representation of Manipulable Man-Made Objects in the Dorsal Stream." *NeuroImage* 12, no. 4: 478–484. https://doi.org/10.1006/nimg.2000.0635.

Clark, A. 2013. "Whatever Next? Predictive Brains, Situated Agents, and the Future of Cognitive Science." *Behavioral and Brain Sciences* 36, no. 3: 181–204. https://doi.org/10.1017/s0140525x12000477.

Cooley, C. H. 1909. *Two Major Works*. Free Press.

Craik, F. I. M., and N. S. Rose. 2012. "Memory Encoding and Aging." *Neuroscience and Biobehavioral Reviews* 36, no. 7: 1729–1739. https://doi.org/10.1016/j.neubiorev.2011.11.007.

De Brigard, F. 2014. "Is Memory for Remembering? Recollection as a Form of Episodic Hypothetical Thinking." *Synthese* 191, no. 2: 155–185. https://doi.org/10.1007/s11229-013-0247-7.

Dennett, D. C. 2017. *Consciousness Explained*. Little.

Dewey, J. 1938. *Logic: The Theory of Inquiry*. H. Holt.

Domhoff, G. W. 2017. *The Emergence of Dreaming*. Oxford University Press.

Douglas, M. [1966] 2003. *Purity and Danger*. Routledge.

Duff, M. C., J. Kurczek, R. Rubin, N. J. Cohen, and D. Tranel. 2013. "Hippocampal Amnesia Disrupts Creative Thinking." *Hippocampus* 23, no. 12: 1143–1149. https://doi.org/10.1002/hipo.22208.

Dutriaux, L., N. E. Clark, E. K. Papies, C. Scheepers, and L. W. Barsalou. 2023. "The Situated Assessment Method (SAM2)." *PLoS One* 18, no. 6: e0286954. https://doi.org/10.1371/journal.pone.0286954.

Eliasoph, N., and P. Lichterman. 2003. "Culture in Interaction." *American Journal of Sociology* 108, no. 4: 735–794. https://doi.org/10.1086/367920.

Firestone, C., and F. C. Keil. 2016. "Seeing the Tipping Point." *Journal of Experimental Psychology: General* 145, no. 7: 872–881. https://doi.org/10.1037/xge0000151.

Fligstein, N., J. S. Brundage, and M. Schultz. 2017. "Seeing Like the Fed." *American Sociological Review* 82, no. 5: 879–909.

Fodor, J. A. 1975. *The Language of Thought*. Harvard University Press.

Fuist, T. N. 2021. "Towards a Sociology of Imagination." *Theory and Society* 50, no. 2: 357–380. https://doi.org/10.1007/s11186-020-09416-y.

Gallese, V. 2001. "The 'shared Manifold' Hypothesis. From Mirror Neurons to Empathy." *Journal of Consciousness Studies* 8, no. 5–6: 33–50.

Gallese, V. 2011. "Embodied Simulation Theory." *Neuropsychoanalysis* 13, no. 2: 196–200. https://doi.org/10.1080/15294145.2011.10773675.

Gallese, V., and G. Lakoff. 2005. "The Brain's Concepts." *Cognitive Neuropsychology* 22, no. 3–4: 455–479. https://doi.org/10.1080/02643290442000310.

Garfinkel, H. 1967. *Studies in Ethnomethodology*. Prentice-Hall.

Gauthier, I., P. Skudlarski, J. C. Gore, and A. W. Anderson. 2000. "Expertise for Cars and Birds Recruits Brain Areas Involved in Face Recognition." *Nature Neuroscience* 3, no. 2: 191–197. https://doi.org/10.1038/72140.

Gibbs, R. W. 2006. "Metaphor Interpretation as Embodied Simulation." *Mind & Language* 21, no. 3: 434–458. https://doi.org/10.1111/j.1468-0017.2006.00285.x.

Gibson, D. R. 2017. *Talk at the Brink*. Princeton University Press.

Gibson, J. J. 1971. *More on Affordances*. Reasons for Realism.

Gibson, J. J. 2014. *The Ecological Approach to Visual Perception*. Psychology Press.

Gilbert, D. T., and T. D. Wilson. 2007. "Prospection." *Science* 317, no. 5843: 1351–1354. https://doi.org/10.1126/science.1144161.

Glenberg, A. M. 1996. "What Is Memory for." *Behavioral and Brain Sciences* 20: 1–55.

Glenberg, A. M. 1997. "What Memory Is for: Creating Meaning in the Service of Action." *Behavioral and Brain Sciences* 20, no. 01: 41–50. https://doi.org/10.1017/s0140525x97470012.

Goffman, E. 1970. *Strategic Interaction*. University of Pennsylvania Press.

Goffman, E. 1974. *Frame Analysis*. Harvard University Press.

Goffman, E. 2021. *The Presentation of Self in Everyday Life*. Knopf Doubleday Publishing Group.

Gordon, R. M. 1986. "Folk Psychology as Simulation." *Mind & Language* 1, no. 2: 158–171. https://doi.org/10.1111/j.1468-0017.1986.tb00324.x.

Grady, J. E. 1997. *Foundations of Meaning*, edited by G. P. Lakoff and E. E. Sweetser. University of California, Berkeley.

Guhin, J. 2016. "Why Worry About Evolution? Boundaries, Practices, and Moral Salience in Sunni and Evangelical High Schools." *Sociological Theory* 34, no. 2: 151–174. https://doi.org/10.1177/0735275116649220.

Hansson, N., and K. Jacobsson. 2014. "Learning to Be Affected." *Society & Animals: Social Scientific Studies of the Human Experience of Other Animals* 22, no. 3: 262–288.

Harnad, S. 1990. "The Symbol Grounding Problem." *Physica D: Nonlinear Phenomena* 42, no. 1: 335–346. https://doi.org/10.1016/0167-2789(90)90087-6.

Hartshorne, J. K., and T. Makovski. 2019. "The Effect of Working Memory Maintenance on Long-Term Memory." *Memory & Cognition* 47, no. 4: 749–763. https://doi.org/10.3758/s13421-019-00908-6.

Hebb, D. O. 1961. "Distinctive Features of Learning in the Higher Animal." *Brain Mechanisms and Learning*.

Heck, D. H., R. Kozma, and L. M. Kay. 2019. "The Rhythm of Memory." *Journal of Neurophysiology* 122, no. 2: 563–571. https://doi.org/10.1152/jn.00200.2019.

Helou, L. B., B. Welch, W. Wang, C. A. Rosen, and K. V. Abbott. 2021. "Intrinsic Laryngeal Muscle Activity During Subvocalization." *Journal of Voice* 37, no. 3: 426–432. https://doi.org/10.1016/j.jvoice.2021.01.021.

Hofstadter, D., and E. Sander. 2013. *Surfaces and Essences*. Basic Books.

Holland, D. 1992. "How Cultural Systems Become Desire." *Human Motives and Cultural Models*: 61–89.

Hupbach, A., R. Gomez, and L. Nadel. 2009. "Episodic Memory Reconsolidation." *Memory* 17, no. 5: 502–510. https://doi.org/10.1080/09658210902882399.

Hurtienne, J., C. Stößel, C. Sturm, et al. 2010. "Physical Gestures for Abstract Concepts." *Interacting with Computers* 22, no. 6: 475–484.

Hustvedt, S. 2011. "Three Emotional Stories." *Neuropsychoanalysis* 13, no. 2: 187–196. https://doi.org/10.1080/15294145.2011.10773674.

Iacoboni, M. 2009. "Imitation, Empathy, and Mirror Neurons." *Annual Review of Psychology* 60, no. 1: 653–670. https://doi.org/10.1146/annurev.psych.60.110707.163604.

Iani, C., L. Ferraro, N. Vincenzo Maiorana, V. Gallese, and S. Rubichi. 2019. "Do Already Grasped Objects Activate Motor Affordances?" *Psychological Research* 83, no. 7: 1363–1374. https://doi.org/10.1007/s00426-018-1004-9.

Ignatow, G. 2007. "Theories of Embodied Knowledge." *Journal for the Theory of Social Behaviour* 37, no. 2: 115–135. https://doi.org/10.1111/j.1468-5914.2007.00328.x.

Ignatow, G. 2022. "The Microbiome-Gut-Brain and Social Behavior." *Journal for the Theory of Social Behaviour* 52, no. 1: 164–182. https://doi.org/10.1111/jtsb.12315.

Iigaya, K., T. U. Hauser, Z. Kurth-Nelson, J. P. O'Doherty, P. Dayan, and R. J. Dolan. 2019. "Hippocampal-Midbrain Circuit Enhances the Pleasure of Anticipation in the Prefrontal Cortex." 37.

Inzlicht, M., K. M. Werner, J. L. Briskin, and B. W. Roberts. 2021. "Integrating Models of Self-Regulation." *Annual Review of Psychology* 72, no. 1: 319–345. https://doi.org/10.1146/annurev-psych-061020-105721.

Itzigsohn, J., and K. Brown. 2015. "Sociology and the Theory of Double Consciousness." *Du Bois Review: Social Science Research on Race* 12, no. 2: 231–248. https://doi.org/10.1017/s1742058x15000107.

Johnson, M. 2008. *The Meaning of the Body*. University of Chicago Press.

Kahana, M. J., N. B. Diamond, and A. Aka. 2022. "Laws of Human Memory."

Körner, A., M. Castillo, L. Drijvers, M. Fischer, and F. Günther. 2023. "Embodied Processing at Six Linguistic Granularity Levels." *Psyarxiv.com*.

Lakoff, G. 2009. "The Neural Theory of Metaphor."

Lakoff, G., and M. Johnson. 2008. *Metaphors We Live by*. University of Chicago Press.

Lebois, L. A. M., C. Wilson-Mendenhall, W. Kyle Simmons, L. F. Barrett, and L. Barsalou. 2020. "Learning Situated Emotions." *Neuropsychologia* 145: 106637. https://doi.org/10.1016/j.neuropsychologia.2018.01.008.

Lee, J. L. C., N. Karim, and D. Schiller. 2017. "An Update on Memory Reconsolidation Updating." *Trends in Cognitive Sciences* 21, no. 7: 531–545. https://doi.org/10.1016/j.tics.2017.04.006.

Lee, S. W. S., K. Millet, A. Grinstein, et al. 2023. "Actual Cleaning and Simulated Cleaning Attenuate Psychological and Physiological Effects of Stressful Events." *Social Psychological and Personality Science* 14, no. 4: 381–394. https://doi.org/10.1177/19485506221099428.

Lee, S. W. S., and N. Schwarz. 2020. "Grounded Procedures." *Behavioral and Brain Sciences* 44: e1. https://doi.org/10.1017/s0140525x20000308.

Leschziner, V. 2015. *At the Chef's Table*. Stanford University Press.

Leschziner, V., and G. Brett. 2019. "Beyond Two Minds." *Social Psychology Quarterly* 82, no. 4: 340–366. https://doi.org/10.1177/0190272519851791.

Leschziner, V., and A. I. Green. 2013. "Thinking About Food and Sex." *Sociological Theory* 31, no. 2: 116–144. https://doi.org/10.1177/0735275113489806.

Levi-Strauss, C. 1988. *The Savage Mind*. Weidenfeld & Nicolson.

Lizardo, O. 2007. "'Mirror Neurons,' Collective Objects and the Problem of Transmission." *Journal for the Theory of Social Behaviour* 37, no. 3: 319–350. https://doi.org/10.1111/j.1468-5914.2007.00340.x.

Lizardo, O. 2009. "Is a 'Special Psychology' of Practice Possible?" *Theory & Psychology* 19, no. 6: 713–727. https://doi.org/10.1177/0959354309345891.

Lizardo, O. 2012. "The Conceptual Bases of Metaphors of Dirt and Cleanliness in Moral and Non-Moral Reasoning." *Cognitive Linguistics* 23, no. 2: 367–393. https://doi.org/10.1515/cog-2012-0011.

Lizardo, O. 2017. "Improving Cultural Analysis." *American Sociological Review* 82, no. 1: 88–115. https://doi.org/10.1177/0003122416675175.

Lizardo, O., R. Mowry, B. Sepulvado, et al. 2016. "What Are Dual Process Models? Implications for Cultural Analysis in Sociology." *Sociological Theory* 34, no. 4: 287–310. https://doi.org/10.1177/0735275116675900.

Lizardo, O., B. Sepulvado, D. S. Stoltz, and M. A. Taylor. 2020. "What Can Cognitive Neuroscience Do for Cultural Sociology?" *American*

Journal of Cultural Sociology 8, no. 1: 3–28. https://doi.org/10.1057/s41290-019-00077-8.

Loevenbruck, H., R. Grandchamp, L. Rapin, et al. 2019. "Neural Correlates of Inner Speaking, Imitating and Hearing." In *ICPhS 2019-19th International Congress of Phonetic Sciences*. hal.science.

Madore, K. P., D. R. Addis, and D. L. Schacter. 2015. "Creativity and Memory." *Psychological Science* 26, no. 9: 1461–1468. https://doi.org/10.1177/0956797615591863.

Marmolejo-Ramos, F., M. Rosa Elosúa, Y. Yamada, N. F. Hamm, and K. Noguchi. 2013. "Appraisal of Space Words and Allocation of Emotion Words in Bodily Space." *PLoS One* 8, no. 12: e81688. https://doi.org/10.1371/journal.pone.0081688.

Martin, J. L. 2010. "Life's a Beach but You're an Ant, and Other Unwelcome News for the Sociology of Culture." *Poetics* 38, no. 2: 229–244. https://doi.org/10.1016/j.poetic.2009.11.004.

Martin, J. L. 2015. *Thinking through Theory*. W. W. Norton.

Martin, J. L., and M. Desmond. 2010. "Political Position and Social Knowledge1." *Sociological Forum* 25, no. 1: 1–26. https://doi.org/10.1111/j.1573-7861.2009.01154.x.

Martocci, L. 2021. "The Capacity to Intervene." *Sociological Inquiry* 91, no. 1: 114–139. https://doi.org/10.1111/soin.12288.

Matheson, H. E., A. M. Familiar, and S. L. Thompson-Schill. 2019. "Investigating Grounded Conceptualization." *Psychological Research* 83, no. 2: 216–226. https://doi.org/10.1007/s00426-018-0997-4.

Mead, G. H. 2015. *Mind, Self, and Society*. University of Chicago Press.

Michaelian, K. 2016. "Mental Time Travel."

Miles, A., R. Charron-Chénier, and C. Schleifer. 2019. "Measuring Automatic Cognition." *American Sociological Review*: 0003122419832497.

Mische, A. 2014. "Measuring Futures in Action." *Theory and Society* 43, no. 3–4: 437–464. https://doi.org/10.1007/s11186-014-9226-3.

Moore, R. 2017. "Fast or Slow." *Sociological Science* 4: 196–223. https://doi.org/10.15195/v4.a9.

Nadel, L., A. Hupbach, R. Gomez, and K. Newman-Smith. 2012. "Memory Formation, Consolidation and Transformation." *Neuroscience and Biobehavioral Reviews* 36, no. 7: 1640–1645. https://doi.org/10.1016/j.neubiorev.2012.03.001.

Pagis, M., and E. Summers-Effler. 2021. "Aesthetic Engagement." Supplement, *Sociological Forum* 36, no. 1: 1371–1394. https://doi.org/10.1111/socf.12768.

Pang, J. C., K. M. Aquino, M. Oldehinkel, et al. 2023. "Geometric Constraints on Human Brain Function." *Nature* 618, no. 7965: 566–574. https://doi.org/10.1038/s41586-023-06098-1.

Pearson, J., N. Thomas, E. A. Holmes, and S. M. Kosslyn. 2015. "Mental Imagery." *Trends in Cognitive Sciences* 19, no. 10: 590–602.

Perl, O., A. Ravia, M. Rubinson, et al. 2019. "Human Non-Olfactory Cognition Phase-Locked With Inhalation." *Nature Human Behaviour* 3, no. 5: 501–512. https://doi.org/10.1038/s41562-019-0556-z.

Pezzulo, G. 2011. "Grounding Procedural and Declarative Knowledge in Sensorimotor Anticipation." *Mind & Language* 26, no. 1: 78–114. https://doi.org/10.1111/j.1468-0017.2010.01411.x.

Pezzulo, G., L. Barca, A. Lamberti Bocconi, and A. M. Borghi. 2010. "When Affordances Climb Into Your Mind." *Brain and Cognition* 73, no. 1: 68–73. https://doi.org/10.1016/j.bandc.2010.03.002.

Pitts-Taylor, V. 2016. *The Brain's Body*. Duke University Press.

Polanyi, M. 2009. *The Tacit Dimension*. University of Chicago Press.

Price, T. 2024. "Cognition, Interaction, and Creativity in Songwriting Sessions." *Social Psychology Quarterly* 88, no. 1: 1–21. https://doi.org/10.1177/01902725241266138.

Rasch, B., and J. Born. 2013. "About Sleep's Role in Memory." *Physiological Reviews* 93, no. 2: 681–766. https://doi.org/10.1152/physrev.00032.2012.

Reay, M. 2010. "Knowledge Distribution, Embodiment, and Insulation." *Sociological Theory* 28, no. 1: 91–107. https://doi.org/10.1111/j.1467-9558.2009.01363.x.

Rizzolatti, G., L. Fadiga, V. Gallese, and L. Fogassi. 1996. "Premotor Cortex and the Recognition of Motor Actions." *Brain Research. Cognitive Brain Research* 3, no. 2: 131–141. https://doi.org/10.1016/0926-6410(95)00038-0.

Rodger, A., L. W. Barsalou, and E. K. Papies. 2024. "Habitualness, Reward and External Constraints." *Applied Psychology. Health and Well-Being* 16, no. 4: 2458–2483. https://doi.org/10.1111/aphw.12598.

Roediger, H. L. 1980. "Memory Metaphors in Cognitive Psychology." *Memory & Cognition* 8, no. 3: 231–246. https://doi.org/10.3758/bf03197611.

Rumelhart, D. E., and A. Ortony. 1977. "The Representation of Knowledge in Memory." In *Schooling and the Acquisition of Knowledge*, edited by R. C. Anderson, R. J. Spiro, and W. E. Montague. Erlbaum.

Sanchez-Burks, J., M. J. Karlesky, and F. Lee. 2015. "Psychological Bricolage." *Oxford Handbook of Creativity, Innovation, and Entrepreneurship*: 93–102.

Schacter, D. L., and D. R. Addis. 2007. "The Cognitive Neuroscience of Constructive Memory." *Philosophical Transactions of the Royal Society of London* 362, no. 1481: 773–786. https://doi.org/10.1098/rstb.2007.2087.

Schacter, D. L., R. G. Benoit, F. De Brigard, and K. K. Szpunar. 2015. "Episodic Future Thinking and Episodic Counterfactual Thinking." *Neurobiology of Learning and Memory* 117: 14–21. https://doi.org/10.1016/j.nlm.2013.12.008.

Schacter, D. L., D. Rose Addis, D. Hassabis, V. C. Martin, R. Nathan Spreng, and K. K. Szpunar. 2012. "The Future of Memory." *Neuron* 76, no. 4: 677–694. https://doi.org/10.1016/j.neuron.2012.11.001.

Schaefer, M., M. Rotte, H.-J. Heinze, and C. Denke. 2015. "Dirty Deeds and Dirty Bodies." *Scientific Reports* 5, no. 1: 18051. https://doi.org/10.1038/srep18051.

Schutz, A. 1967. *The Phenomenology of the Social World*. Northwestern University Press.

Schwabe, L., M. Joëls, B. Roozendaal, O. T. Wolf, and M. S. Oitzl. 2012. "Stress Effects on Memory." *Neuroscience and Biobehavioral Reviews* 36, no. 7: 1740–1749.

Schwartz, B. 1981. *Vertical Classification*. University of Chicago Press.

Seifert, L., and K. Davids. 2012. "Intentions, Perceptions and Actions Constrain Functional Intra-and Inter-Individual Variability in the Acquisition of Expertise in Individual Sports." *Open Sports Sciences Journal* 5, no. 1: 68–75. https://doi.org/10.2174/1875399x01205010068.

Semino, E. 2010. "Descriptions of Pain, Metaphor, and Embodied Simulation." *Metaphor and Symbol* 25, no. 4: 205–226. https://doi.org/10.1080/10926488.2010.510926.

Shepherd, H. 2014. "Culture and Cognition." *Sociological Forum* 29, no. 4: 1007–1011. https://doi.org/10.1111/socf.12134.

Sherman, B., and N. Turk-Browne. 2022. "Attention and Memory."

Shore, B. 1996. *Culture in Mind*. Oxford University Press.

Sieweke, J. 2014. "Imitation and Processes of Institutionalization." *Schmalenbach Business Review* 66, no. 1: 24–42. https://doi.org/10.1007/bf03396868.

Söderlund, H., E. S. Parker, B. L. Schwartz, and E. Tulving. 2005. "Memory Encoding and Retrieval on the Ascending and Descending Limbs of the Blood Alcohol Concentration Curve." *Psychopharmacology* 182, no. 2: 305–317. https://doi.org/10.1007/s00213-005-0096-2.

Stanley, M. L., B. Gessell, and F. De Brigard. 2019. "Network Modularity as a Foundation for Neural Reuse." *Philosophy of Science* 86, no. 1: 23–46. https://doi.org/10.1086/701037.

Stephane, M., M. Dzemidzic, and G. Yoon. 2021. "Keeping the Inner Voice inside the Head, a Pilot fMRI Study." *Brain and Behavior* 11, no. 4: e02042. https://doi.org/10.1002/brb3.2042.

Stoltz, D. S., and O. Lizardo. 2018. "Deliberate Trust and Intuitive Faith." *Journal for the Theory of Social Behaviour* 48, no. 2: 230–250. https://doi.org/10.1111/jtsb.12160.

Stoltz, D. S., and M. L. Wood. 2023. "Grounding Oughtness." *SocArXiv*.

Strand, M., and O. Lizardo. 2017. "The Hysteresis Effect." *Journal for the Theory of Social Behaviour* 47, no. 2: 164–194. https://doi.org/10.1111/jtsb.12117.

Strand, M., and O. Lizardo. 2022. "Chance, Orientation, and Interpretation." *Sociological Theory* 40, no. 2: 124–150. https://doi.org/10.1177/07352751221084712.

Suddendorf, T., and M. C. Corballis. 1997. "Mental Time Travel and the Evolution of the Human Mind." *Genetic, Social, and General Psychology Monographs* 123, no. 2: 133–167.

Suddendorf, T., J. Redshaw, and A. Bulley. 2022. *The Invention of Tomorrow*. Basic Books.

Swidler, A. 1986. "Culture in Action." *American Sociological Review* 51, no. 2: 273–286. https://doi.org/10.2307/2095521.

Swidler, A. 2013. *Talk of Love*. University of Chicago Press.

Szpunar, K. K. 2010. "Episodic Future Thought." *Perspectives on Psychological Science* 5, no. 2: 142–162. https://doi.org/10.1177/1745691610362350.

Tang, H., X. Lu, R. Su, Z. Liang, X. Mai, and C. Liu. 2017. "Washing Away Your Sins in the Brain." *Social Cognitive and Affective Neuroscience* 12, no. 7: 1149–1158. https://doi.org/10.1093/scan/nsx036.

Tavory, I., and A. Swidler. 2009. "Condom Semiotics." *American Sociological Review* 74, no. 2: 171–189. https://doi.org/10.1177/000312240907400201.

Thelen, E. 2000. "Grounded in the World." *Infancy* 1, no. 1: 3–28. https://doi.org/10.1207/s15327078in0101_02.

Thompson, V. A., J. S. B. Evans, and K. Frankish. 2009. "Dual Process Theories." *Ariel* 137: 43–51.

Tulving, E. 1983. *Elements of Episodic Memory*. Oxford University Press.

Tulving, E. 1985. "Memory and Consciousness." *Canadian Psychology* 26, no. 1: 1–12. https://doi.org/10.1037/h0080017.

Tulving, E. 2002. "Episodic Memory." *Annual Review of Psychology* 53: 1–25. https://doi.org/10.1146/annurev.psych.53.100901.135114.

Turner, S. P. 2018. *Cognitive Science and the Social*. Routledge.

Vaisey, S. 2009. "Motivation and Justification." *AJS: American Journal of Sociology* 114, no. 6: 1675–1715. https://doi.org/10.1086/597179.

Van Ness, J., and E. Summers-Effler. 2016. "Reimagining Collective Behavior." In *Handbook of Contemporary Sociological Theory, Handbooks of Sociology and Social Research*, edited by S. Abrutyn, 527–546. Springer International Publishing.

Vega, S., A. Mata, M. B. Ferreira, and A. R. Vaz. 2021. "Metacognition in Moral Decisions." *Thinking & Reasoning* 27, no. 1: 124–141. https://doi.org/10.1080/13546783.2020.1741448.

Vila-Henninger, L. A. 2021. "A Dual-Process Model of Economic Behavior." *Sociological Forum* 36, no. S1: 1271–1296. https://doi.org/10.1111/socf.12763.

Weber, M. 2019. *Economy and Society*. Harvard University Press.

Wheeler, M., D. Stuss, and E. Tulving. 1997. "Toward a Theory of Episodic Memory." *Psychological Bulletin* 121, no. 3: 331–354. https://doi.org/10.1037/0033-2909.121.3.331.

Wood, M. L., D. S. Stoltz, J. Van Ness, and M. A. Taylor. 2018. "Schemas and Frames." *Sociological Theory* 36, no. 3: 244–261. https://doi.org/10.1177/0735275118794981.

Zerubavel, E., and E. R. Smith. 2010. "Transcending Cognitive Individualism." *Social Psychology Quarterly* 73, no. 4: 321–325. https://doi.org/10.1177/0190272510388998.