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4E Cognition and the Intention-Action Gap: Conceptual Resources for Behavior Change

Mark M. JAMES* & Tom FROESE*

ABSTRACT. The disconnect between intentions and actions remains a central challenge for understanding human behavior and facilitating meaningful change. While embodied cognitive science emphasizes agent–environment interaction, its contributions to this issue have thus far been limited. We argue that embodied approaches offer valuable conceptual resources for addressing intentional behavior change, particularly when habits, identities, and narratives are understood as dynamic, multiscale organisational forms, and change itself as a process of multiscale realignment. Drawing on the 4E framework, where behavior and cognition are understood to be embodied, enacted, embedded, and extended, we explore how each dimension deepens our understanding of the intention–action gap and informs interventions for behavior change. In doing so, we aim to broaden the conceptual foundations of current intervention models and lay the groundwork for more integrative, multiscale approaches to behavior change.

Keywords: 4E, intention-action gap, habit, narrative, multiscale, behavior change, embodied cognition.

RÉSUMÉ. Cognition 4E et écart entre l'intention et l'action : ressources conceptuelles pour le changement de comportement. Le décalage entre les intentions et les actions reste un défi majeur pour comprendre le comportement humain et faciliter un changement significatif. Bien que les sciences cognitives incarnées mettent l'accent sur l'interaction agent-environnement, leurs contributions à cette question ont jusqu'à présent été limitées. Nous soutenons que les approches incarnées offrent des ressources conceptuelles précieuses pour aborder le changement intentionnel de comportement, en particulier lorsque les habitudes, les identités et les récits sont considérés comme des formes organisationnelles dynamiques et multi-échelles, et le changement lui-même comme un processus de réalignement multi-échelles. En nous appuyant sur le cadre des 4E, dans lequel le comportement et la cognition sont considérés comme incarnés, énactés, intégrés et étendus, nous explorons comment chaque dimension permet d'approfondir notre compréhension du fossé entre l'intention et l'action et d'éclairer les interventions visant à modifier le comportement. Ce faisant, nous visons à élargir les fondements conceptuels des modèles d'intervention actuels et à jeter les bases d'approches plus intégratives et multiéchelles du changement de comportement.

Mots-clés : 4E, écart entre l'intention et l'action, habitude, narration, multiéchelle, changement de comportement, cognition incarnée.

INTRODUCTION

The great Irish painter Francis Bacon famously described himself, “not so much as a painter but as a medium for accident and chance” (Sylvester, 1980).

* Embodied Cognitive Science Unit, Okinawa Institute of Science and Technology, Graduate University, Japan. markmichaeljames<at>gmail.com

In the conversation from which this quote derives, Bacon also speaks about the "complete interlocking of image and paint" in which he was "taking advantage of what happens when you splash the bits down". Bacon did speak of "receiving" his images, but they were "handed down" for him to paint as part of the process, not in advance of it (*ibid*). Perhaps, then, a sober reading of Bacon's self-interpretation has something to do with his sense for the participatory and dynamic nature of painting. The idea that the realization of an artistic intention is as much a process of discovery and redirection as it is mere implementation.

Like Bacon's paintings, the process of closing the gap between our intentions and actions – whether to adopt a healthier lifestyle, build a community, or work toward a long-term project – rarely follows a preordained plan. Enacting these intentions involves a temporally extended meshwork of perception, action, affect, language, imagination, memory and anticipation. It unfolds as a kind of negotiated navigation, shaped by the interactions between and within our bodies and environments, including with other people. As Bacon put it, "every movement of the brush on the canvas alters the shape and implications of the image" (*ibid*). Sometimes these transformations are subtle. But sometimes too, they are drastic, unfolding in ways that could not have been foreseen. As such, the accomplished artist must learn not only to impose their will but to be responsive to the collaborative dynamic emerging between their needs, their capabilities, and the affordances of their changing environment and medium. Only by cultivating this responsiveness can the artist "take advantage of what happens" and balance it against both their trust in a longer trajectory that they must hand themselves over to and their intuitions about when, ultimately, to stop.

Anyone striving to address the gap between their intentions for how they would like to be in the world and their actions that enact those ways of being, finds themselves in a situation not unlike the artist at work. A notable difference, however, is that in the artist's case, we readily acknowledge the skills involved in realizing their intentions: an entanglement of trained perception, action, affect, language, imagination, memory and anticipation. In other words, we can intuit that for the artist to close the gap (or even attempt to) between their intentions and actions, it requires great skill. When it comes to more seemingly prosaic intentions, like eating more healthily, exercising regularly, or practicing the artistic skills required to become an artist in the first place, we often fail to recognize that these efforts demand comparable skill. We may acknowledge the ability to prepare nutritious meals or produce creative work as a skill, but we tend to overlook the fact that developing these abilities – sustaining the learning, repetition, and adaptation they require to stabilize – are themselves skills, or set of skills, in their own right. We tend, in other words, to overlook the fact that making changes that bring our actions more in line with our intentions, is itself a form of skilled intentionality.

It is worth noting that the intention–action gap, as typically formulated in behavioral science, concerns the failure of so-called *first-order intentions* – context-specific plans to act in particular ways (*e.g.*, to exercise, reduce sugar intake, or initiate a difficult conversation). Yet many such failures are interdependent with deeper tensions involving *second-order intentions*: intentions directed at forming, maintaining, or revising first-order commitments. While first-order intentions concern specific actions (*e.g.*, "I intend to go for a

run tomorrow"), second-order intentions involve reflective endorsements or renouncements of those intentions (*e.g.*, "I intend to become the kind of person who exercises regularly" or "I don't want to want to smoke"). A tradition in analytic philosophy has explored such distinctions (Frankfurt, 1971; Bratman, 1987; Holton, 2009; for an enactive treatment of these ideas see Maiese, 2023), wherein active regulation of behavior, is thought to result, in part, from the interactions between these first- and second-order intentions.

Alternatively, phenomenological approaches treat intentionality not as a nested structure of mental states, but as a foundational, world-directed feature of consciousness (Husserl 1960). Intentions, in this view, are not merely internal attitudes aimed at outcomes, but enacted orientations shaped by the body's attunement to meaningful possibilities in a shared world (*e.g.*, *ibid*; Merleau-Ponty 1962; Gallagher 2005). First-order intentions thus reflect not only goal-directed deliberation but the embodied momentum of prior engagements as they prospectively grip towards anticipated possibilities. What analytic traditions call second-order intentions may in this light be understood as transformations in the style or trajectory of one's being-in-the-world, which, in turn, and, perhaps, in part, undergird the bubbling forth of first-order intentions. Through this lens, repeated failures to act on our intentions may reflect a breakdown in the practical coherence of the self – a misalignment between the body's attunement, the unfolding situation, and one's overarching sense of who one is or is becoming.

While we do not engage either of these literatures in detail here, we recognize the importance of these distinctions and believe future work in this line of research will be well served by engaging with them more directly. The present paper, however, takes a different approach: it explores what conceptual resources embodied cognitive science offers for understanding how intentions become viable, or fail to, across time and space, and how this can inform more effective strategies for behavior change. In sum, our focus is not on the metaphysical status of intentions per se, but on how they are enacted, supported, or disrupted through the multiscale scaffolding of lived experience.

The ideas outlined here – alongside the conceptual frameworks developed elsewhere (see James *et al.*, 2025 for their development of the wayshaping framework; and James, 2023) – aim to provide individuals with the concepts and methods necessary to become active participants in their own ongoing evolution. By fostering a deeper understanding of the couplings between individual agency and the broader systems in which we are embedded, these approaches invite us to reimagine behavior change as a practice of situated and relational realignment. Viewed through this lens, we come to appreciate ourselves as brain-body-environment networks shaped by complex histories of negotiation among the many interdependent elements that comprise us. This perspective reframes behavior change as an adaptive collaboration between the constraints and affordances of our environments and the evolving norms and capacities of the embodied, situated self. Such an appreciation may help us more readily accept that redirecting ourselves requires skills akin to those of the artist: A dynamic coordination of perception, action, affect, language, imagination, memory and anticipation that allows us to metabolize the flows of matter, energy and information in our bodies and environments in ways that productively address the gaps between our intentions and actions.

In what follows, we first address some broad limitations of traditional approaches to the intention-action gap and behavioral change more generally, emphasizing their over-reliance on nomothetic, linear, and mono-scale interpretations of behavior. We also offer preliminary reflections on alternative approaches that align more closely with the 4E framework. Following this, we turn to the concept of habit as a central conceptual resource within a 4E account, contrasting its conventional depiction as a stimulus-response association with an organicist perspective that integrates well with an embodied approach. Alongside this, we introduce a complementary understanding of identity and narrative, exploring how they interrelate with habits in shaping behavior. With this foundation in place, we examine each of the 4Es – embodied, enacted, embedded, and extended – in relation to intentional behavior change, articulating three key implications for change for each dimension. Finally, we conclude with a brief synthesis of these insights, some directions for future work, and some short reflections on their broader implications.

1 – MINDING THE GAPS IN THE GAP

The desire to shape our habits in line with personal intentions has deep roots in philosophical, religious and psychotherapeutic traditions, where it's often seen as a demanding and drawn-out practice. Yet our received, modernist self-image, which often casts us as rational agents navigating a neutral world, tends to assume that intentions should translate smoothly into action. When they don't, we're quick to interpret the failure as a personal flaw – a lack of willpower or consistency – which often gives rise to shame, frustration, and a diminished sense of agency. We feel out of sync with who we claim to be or aspire and intend to be. This disjunction, the so-called intention-action gap, is well-documented: when studied empirically, intentions fail to lead to action roughly half the time (*e.g.*, Godin *et al.*, 2010; Rhodes & de Bruijn, 2013). We expect that in the wild, the number is likely even higher. As Sheeran and Webb (2016, p.503) put it: "Bitter personal experience and meta-analysis converge on the conclusion that people do not always do the things that they intend to do."

In recent years, however, the project of narrowing the gap between our intentions and actions has been elevated to the status of a formal discipline, variously referred to as "behavioral insights" (Hubble & Varazzani, 2023), "nudge theory" (Thaler & Sunstein, 2021), "behavioral design" (Cash *et al.*, 2017), or "design for behavior change" (Niedderer *et al.* 2018). In essence, the focus of this field is on both studying the presence and prevalence of intention-action gaps and where they might be particularly destructive, and developing theories and methods for actively designing our habits and behaviors in alignment with our intentions and needs. While this field encompasses a wide range of approaches, much of its current practice is concentrated in governmental efforts to implement policy interventions, such as public health campaigns aimed at encouraging healthier behaviors or addressing what are viewed to be problematic practices in specific populations (Hastings *et al.*, 2024; Krpan, 2024). Marketers and product designers are also frequently using the principles emerging from this research to steer potential consumers toward the purchase of particular goods or services (Thaler & Sunstein, 2021).

Within behavioral science, numerous factors have been identified as mediators of this gap, from genes (de Geus *et al.*, 2014) and education (Conti *et al.* 2010), to the absence of effective strategies for change (Milkman, 2021). Likewise, a huge diversity of theoretical frameworks and interventions aimed at addressing this gap have been proffered (Michie *et al.*, 2011; Gollwitzer 1999; Hall & Fong 2007; Ajzen 1991). Many of these approaches have demonstrated considerable effectiveness in specific contexts – particularly in population-level interventions targeting simple behaviors around which individuals are unlikely to have deeply rooted commitments (Halonen, 2024). Indeed, at present, there are around 150 "nudge units" embedded in governments globally, tasked with translating public health, sustainability, and related policies into actionable behaviors. Additionally, there are several times as many industry-based services offering behavioral solutions for all manner of problems (Hubble & Varazzani, 2023). This institutional rise in the popularity of applied behavior science also finds parallels in mainstream culture. Self-help and pop-psychology works targeting habit formation have become bestsellers. The book *Atomic Habits* (Clear, 2018), for example, has sold approximately 20 million copies and has remained on the New York Times bestseller list for over 260 weeks – and counting – at the time of writing. In our age, as it was recently put, "habits have attained celebrity status and are presumed to be a winning strategy for creating sustainable change within the health-promotion and behavior-change worlds" (Segar 2022, p.1418).

On the face of it, given these developments, it would appear that behavioral design has been extremely successful. But is it that the discipline is so successful in achieving its aims, or is it rather that the promise of the discipline speaks to a broadly held and increasingly recognised need, or perhaps both? It is true that examples of the successes of existing approaches to behavioral design are not hard to find. One could, for instance, look at population level interventions that support better food choices (*e.g.*, Bryan *et al.*, 2019; Cadario & Chandon 2020), more sustainable agricultural practices (*e.g.*, Ferrari *et al.*, 2019), or reductions in missed court appearances (Fishbane et al. 2020). Or one could simply read some of the literally hundreds of thousands of positive reviews for James Clear's book on *Amazon.com*, or reflect on the fact that behavioral design, and in particular the work of BJ Fogg's *Stanford behavioral Design Lab*, has been central to the development of the virtual user interfaces that have so many of us returning to our mobile screens at unprecedented rates (see Shin *et al.*, 2022 for review). Of course, these approaches are not without their critics, in terms of the theory underlying them, the efficacy of the interventions they promote, and the ethical implications of their downstream effects (*e.g.*, Banerjee *et al.*, 2024; Heino *et al.*, 2021, 2022; Osler, forthcoming). There is much that could be said here, but in the interests of space and clarity we will confine ourselves to a few overarching and interlocking concerns.

1.1 Nomothetic Approaches

For starters, many existing models adopt a broadly nomothetic approach to behavior change – one that emphasizes generalization and seeks to identify universal laws or statistical regularities across populations (S. C. Hayes *et al.*, 2022). These models typically rely on between-subject data to detect what holds

on average, and they are often applied as though such findings will generalize unproblematically to individuals. This move depends on an implicit assumption of ergodicity – the idea that population-level trends reliably reflect the dynamics of any single individual across time (see Hasselman, 2023; or Olthof *et al.*, 2023 for deeper discussion of this idea as it relates to behavioral science). While this assumption simplifies prediction and intervention design, it is increasingly at odds with what we know about the non-ergodic nature of human behavior: people change in context-sensitive, history-dependent ways that rarely mirror group averages.

Nomothetic approaches remain indispensable for informing population-level policies, identifying broad patterns, and evaluating intervention outcomes at scale, and guiding the design of general-purpose interventions. They can also be valuable in providing probing heuristics that serve as first passes when working with individuals. But when these approaches are taken as guides for understanding or shaping individual behavior, they risk producing distorted or ineffective insights. They tend to reduce individuals to collections of quantifiable traits while neglecting contextual factors such as culture, history, material resources, fluctuating energy levels, and so on. As a result, they may offer far less predictive power than assumed and, in some cases, unhelpfully constrain individual autonomy by treating people as interchangeable. Without careful qualification, then, the promise of universality becomes a liability rather than a strength.

In line with recent calls by Heino *et al.* (2021) the ideas we introduce herein are more in line with a so-called idiographic approach. An idiographic approach, rather than seeking generalized population level findings, endeavors to understand the unique and complex characteristics of individual cases of human behavior in their specific contexts (*e.g.*, Cui *et al.*, 2023; Hasselman, 2023; Olthof *et al.*, 2020, 2023). This allows for personalisation of interventions and consequently can more carefully respect the autonomy of the client/patient/user. Indeed, such approaches often require the involvement of the client/patient/user as a co-designer throughout. However, these approaches are not without downsides too. For instance, they are much more time and resource intensive, and as such are not ideal for larger scale interventions; they resist generalization from individual cases to broader populations; the data deriving from these efforts can be extremely complex and it may be more prone to biases in interpretation than more quantitative data; and replicating studies can be challenging. Nevertheless, when we take seriously the non-linear and multiscale dimensions of human behavior outlined below, and the inescapable need for individual human beings to navigate their own inescapably personalised contexts, these shortcomings are seen as manageable trade-offs[1].

It is worth noting that this tension between nomothetic and idiographic approaches also reflects a deeper and longstanding philosophical divide. In the

[1] Interestingly, in the field of psychotherapy, there has been recent work highlighting the value and need for an *idionomic* approach that effectively combines the best of both the nomothetic and idiographic approaches, whilst avoiding their limitations (S. C. Hayes *et al.*, 2022, 2024). The applied behavioral sciences more generally may be well served by following suit.

Critique of Judgment, Kant (1790) distinguishes between *determinative* judgment, typical of the physical sciences, which begin from universal laws and apply them to particulars, and *reflective* judgment, which begins with particulars and seeks coherence without presupposing such laws. While the term *nomothetic* was coined later by Wilhelm Windelband (1894), it captures the spirit of Kant's determinative mode: the pursuit of general principles that apply across cases. Reflective judgment, by contrast, acknowledges that living systems, and the cognitive, affective, and behavioral dynamics that emerge from them, may resist full subsumption under universal laws. In turn, it invites us to consider that understanding human change requires more than external observation and statistical generalization; it may require an interpretive, situated engagement with how purposes, histories, and meanings unfold in context. In this light, the 4E perspective can be seen as part of a revival of this reflective mode of understanding, one more attuned to the purposive, context-sensitive, and self-organizing nature of lived experience.

1.2 Linear Models

A significant limitation of many existing behavior-change frameworks lies in their reliance on linear models of human behavior. A linear model assumes a straightforward cause-and-effect relationship, where specific inputs are processed to produce predictable and proportionate outputs, in the form of sensorimotor, affective, or linguistic activity. These frameworks often posit that by identifying and manipulating such relationships – for instance, by optimizing reinforcement regimes – desired behavioral changes can be achieved. And, of course, sometimes this is indeed true. We can point to many successes in the history of psychological science where, for instance, we have gained genuine insights about how to somewhat predictably shape the behavior of animals and humans through processes of conditioning and associated learning (see Gapenne & Khamassi 2024 for a thoughtful review of these, whilst situating them in the present landscape).

However, these models fall short when confronted with the full complexity of human behavior as it is expressed over varying spaces. Human behavior is not the outcome of simple, isolated inputs processed through fixed internal mechanisms, but emerges from a continuous and recursive interaction between the individual and their environment. As it unfolds across multiple timescales it is shaped by dynamic feedback loops, historical contingencies, shifting goals and needs, and evolving affective, social, and material contexts. Linear models, by contrast, presume a proportionality and predictability that do not hold in such settings. They tend to isolate variables in ways that ignore how patterns of behavior are co-constructed over time, often obscuring the deeper processes by which learning, adaptation, and transformation take place.

In recent decades, computational models, particularly those based on reinforcement learning (Sutton & Barto 2018), have made strides in capturing some of the non-linearity, feedback sensitivity, and adaptive learning characteristic of real-world behavior. These models depart from strict stimulus-response frameworks, incorporating history-dependence and probabilistic updating. And in many domains, they have yielded powerful predictive tools and practical successes. However, they remain largely rooted in representational,

input-output architectures. As such, they fall short of capturing the autonomous, sensorimotor, and normatively organized dynamics of living agents. As Gapenne & Khamassi (2024) argue, these models optimize from the outside rather than engaging in situated co-regulation with a world, and thus stop short of the embodied intentionality required for genuine behavior change, where learning is shaped in large part by what the system is trying to become.

To more fully appreciate the limitations of these approaches, and to understand why behavior change often proves so difficult, briefly reflecting on some core insights of non-linear systems theory can be helpful, as they help illuminate several easily recognizable challenges inherent to behavior change (for fuller discussion, see Heino *et al.*, 2021; A. M. Hayes *et al.*, 2007; Piccinini *et al.*, 2016; James *et al.*, 2025). Non-stationarity highlights that both the individual and their context are in constant flux: goals, action repertoires, and affordances evolve over time, rendering static interventions insufficient (Stanley & Lehman, 2015). Non-ergodicity (as mentioned above) emphasizes that individual trajectories cannot be reliably inferred from group averages or past behavior, pointing to the need for personalized, adaptive strategies (A. M. Hayes *et al.*, 2007; Piccinini *et al.*, 2016). Non-proportionality signals that the relationship between cause and effect is not always linear, small inputs can yield large outcomes and vice versa, demanding sustained attention and iterative refinement in change processes (Gladwell, 2006; Olthof *et al.*, 2020). Finally, non-additivity shows that the interaction of system components can produce outcomes that exceed the sum of their parts. While these effects can be beneficial, they may also cascade in unpredictable ways, highlighting the importance of attending to interdependencies and unintended consequences (Tukey, 1949; Strogatz, 2019).

This view of non-linear dynamics does not entirely negate the value of existing behavior-change frameworks, nor the principles underlying them, but it does begin to invite some reframing so as to be able to 1) better locate the value of existing frameworks, and 2) better account for the normative, emergent, and context-sensitive nature of human behavior, and allow for more responsive and sustainable strategies for change. These insights are closely aligned with the core commitments of 4E cognitive science, as will become evident in later sections[2].

1.3 Mono-scale Change

Many conventional frameworks fail to account for the multiscale nature of human behavior, even when they acknowledge external influences such as cultural, environmental, or technological factors (Aunger & Curtis, 2016; Michie *et al.*, 2011). While these influences are often treated as contextual variables to be manipulated, their reciprocal and system-level dynamics are frequently neglected. Most notably, such frameworks tend to ignore the

[2] It is worth noting, computational models more directly embedding the ideas being argued for herein are preliminary and not yet widespread, but there are some examples worth noting, *e.g.*, the *self-optimisation* models being developed by Weber *et al.* (2022; 2023; 2024), and IDSM models of habit regulation by Egbert *et al.* (2014; 2014).

bidirectional feedback loops through which behaviors both shape and are shaped by broader systems. This omission significantly limits their capacity to address the intention–action gap in a realistic or sustainable way.

Human behavior unfolds across nested biological, psychological, and social levels, each shaped by interlocking feedback dynamics. These loops, whether amplifying (positive feedback, *e.g.*, praise reinforcing a behavior) or dampening (negative feedback, *e.g.*, a failed joke reducing future attempts), drive the non-linear and emergent properties of behavior. Crucially, these effects are often difficult to anticipate, especially from the perspective of an individual agent. Behaviors do not occur in isolation: they are embedded within, or themselves embed, other processes operating across biological, ecological, social, organizational, and economic scales. The dynamics at these levels can constrain or enable behavioral change, often in ways that remain opaque to individual awareness (see James *et al.* 2025 for a deeper discussion of the dynamics of multiscale interaction).

In this context, it becomes reasonable to ask: do our behaviors shape our relationships, or do our relationships shape our behaviors? The answer is both. This reciprocity adds layers of complexity to the intention–action gap, as behaviors simultaneously act as inputs and outputs for multiple systems. The resulting interdependencies undermine simple, unidirectional models of causality. Instead, we should begin to understand behavior as a form of multiscale mediation, an ongoing negotiation between the subsystems within us and the larger systems we inhabit. Our actions are not merely isolated expressions of intention, but *two-sided mediators* that are always amplifying or dampening processes across scales, thereby stabilizing or destabilizing broader trajectories in often unpredictable ways (Kiran, 2015; James & Leader, 2023). By becoming more attuned to these dynamics, we gain leverage to foster meaningful and sustainable change.

2 – HABITS, IDENTITIES AND NARRATIVES

Having outlined the general concerns above, we turn our attention to the more constructive dimensions of this work. We begin by introducing the account of habit that will be drawn on throughout the rest of the article. That said, we start this section again with some short reflections on the limits of the notion of habit as it is deployed in more traditional approaches, informing the applied behavioral sciences, *e.g.*, the so-called associationist notion of habit (Barandiaran & Di Paolo, 2014). These models, rooted in basic science conducted in highly controlled environments – often using animal subjects – may accurately describe habits under stable and constrained conditions. However, as already highlighted above, we should be cautious about extending these insights to the full complexity of human life. In these approaches, habits are typically modeled as automatic behaviors formed through cue–action–reward cycles, where exposure to a specific stimulus (cue) triggers a learned response (action) that has been reinforced by prior outcomes (reward) (Duhigg, 2012; Wood & Rünger, 2016). The advice derived from such studies tends to be most effective in similarly stable contexts, which, while occasionally found in the wild, represent only a small subset of the environments in which we, and

thus also our habits, typically operate. And so, while this account offers insight into how behavioral patterns are stabilized, it tends to obscure the agentive, affective, and socio-material dimensions through which habits are enacted and transformed.

In contrast, we draw on an alternative organicist view of habits, widely discussed in the philosophy of habit but, to date, with much less influence in applied behavioral sciences. Unlike associationist models, which often reduce habits to stimulus-response mechanisms, the organicist approach sees habits as the foundation for skillful improvisation within recurring types of situations (Barandiaran, 2017; Barandiaran & Di Paolo, 2014; Egbert & Canamero, 2014; Egbert & Barandiaran, 2014). This view traces back to Aristotle's (2014) conception of *hexis* in the *Nicomachean Ethics (Book II)*, where habits are understood as dispositional structures formed through repetition and crucial to moral and practical development. This lineage extends through German Idealism (*e.g.*, Hegel 1971) and American Pragmatism (*e.g.*, Dewey 1922), and continues to inform enactive and ecological approaches that treat habits as dynamic, self-organizing systems (*e.g.*, Di Paolo *et al.*, 2017).

Habits, in this view, are dynamic processes that prepare us to act in generalized contexts, reducing the effort required for action therein, while remaining in service of our agency rather than overriding it (Maiese, 2022; Maiese & Hanna, 2019; Ramírez-Vizcaya & Froese, 2019). From this perspective, habits that become rigidly automatic – whether they manifest as obviously harmful behaviors (*e.g.*, self-harm) or ostensibly healthy ones (*e.g.*, overwork, excessive exercise) – are better understood as disordered. Addictive behaviors such as smoking or alcoholism offer especially salient examples, where first-order intentions (*e.g.*, "I want to quit") repeatedly fail to gain traction against deeply sedimented patterns of behavior. This sharpens the tension within the intention–action gap and highlights the need for models that acknowledge the autonomous dynamics and social embeddedness of habitual systems.

By embracing an organicist conception of habit, we are better able to understand change as an emergent property of dynamic systems. This view foregrounds the agent's capacity for context-sensitive improvisation, rather than mechanical repetition, and thus provides a more realistic foundation for designing interventions that support sustainable change across real-world, fluid contexts. Within the embodied perspective, habits are understood to be self-sustaining patterns of behavior and cognition that emerge and are sustained through the continuous interaction between an agent and their environment. Barandiaran (2017) defines a habit in the sensorimotor domain as a "self-sustaining pattern of sensorimotor coordination formed when the stability of a particular mode of sensorimotor engagement is dynamically coupled with the stability of the mechanisms generating it." In other words, habits are self-organizing entities that exhibit circular self-production. The action of enacting a habit reinforces the neural, bodily, and environmental interdependencies that sustain it, creating a closed-loop dynamic akin to the autopoietic processes seen in living systems. Through repetition, a habit becomes increasingly autonomous, taking on a "life of its own", as both the cause and consequence of its enactment (Di Paolo *et al.*, 2017). Far from being reflex-like associations or rigid procedural processes, habits represent a fundamental blending category between

biological and psychological domains, serving as the building blocks of an organicist conception of mind (Egbert & Barandiaran, 2014).

This self-sustaining nature of habits means they generate their own norms of viability. These norms specify the conditions – such as rate of repetition or presence of certain social or material constraints – required for the habit's ongoing reproduction. For example, the habit of brushing one's teeth depends on the availability of a toothbrush and toothpaste, as well as the social and personal norms around hygiene that sustain the practice – and it also disposes one to care about such things. In this regard, habits are not merely functional tools but act as sense-making frames, *i.e.*, they provide a background against which or through which meaning is generated and actions are organized (James, 2021). This perspective echoes Merleau-Ponty's view on habits as integral to how our bodies "assimilate a new meaningful frame of reference" (see Butler & Gallagher, 2018; Miyahara & Tanaka, 2023).

Sense-frames are not static but evolve through interaction with the environment, shaping and being shaped by the agent's experiences. In this process, new habits emerge, existing habits converge, compete, or cooperate depending on the conditions in which they are enacted (Di Paolo *et al.*, 2017). Habits sometimes get organized into networks of habits and expand into more encompassing *identities*, playing out over longer timescales or more generalized contexts. For instance, the habit of picking up soap with one's right hand may be nested within the broader routine of handwashing, which itself is part of a bedtime *micro-identity* – all of which reflect and reproduce a portable *personal-identity* of being hygienic. At each scale, relatively stable habitual organizations provide normative frames that prefigure actions under specific conditions, creating a layered ecology of habits and identities spanning various timescales. These dynamic structures also take shape within social relationships, where patterns in interpersonal interactions sediment into shared habits and identities that acquire some autonomy over time (James, 2021; James & Loaiza, 2020; Gallagher, 2022).

When these habitual dynamics intersect with our linguistic capacities, they can be organized into narratives of various kinds, including self-narratives – *i.e.*, the stories we tell ourselves about ourselves. Self-narratives tend to be self-producing, framing our sense-making in ways that resolve in predictable patterns. As Miyahara & Tanaka (2023, p.15) argue, these stories are inherently circular: They shape how we recollect and make sense of our experiences, which, in turn, reinforce those very narratives. In sum, we see the same circular self-production in self-narratives that we observe in habits, identities, and other sense-frames. Just as our habits and identities are intertwined, so too are they entangled with our narratives. Self-narratives can shape the formation of habits, while habits, in turn, constrain and guide the stories we tell about ourselves. Self-narratives may also allow for the integration of otherwise disparate habits, linking patterns across contexts and supporting the emergence of more coherent identities, which are also shaped by these very processes.

But, again, just like our sensorimotor habits, these processes are not rigid determinants of our actions or self-conceptions. They are more like grooves within which we improvise. Our habits, identities, and narratives are the means through which we both achieve stability and initiate change. Together, they form

an ecology of sense-making frames that dynamically shape and are shaped by our embodied interaction with ourselves and our environments.

3 – THE 4ES AND CHANGE

Embodied cognitive science is something of an umbrella term for what is in fact a wide range of perspectives on the nature of information in cognition, the role, if any, of the body, or of mental representations, the formal models used to understand cognitive processes, and so on (*e.g.*, Chemero, 2011; Di Paolo *et al.*, 2017; Gibson, 1979; Kelso, 1995; Varela *et al.*, 1992; Friston *et al.*, 2016; Rietveld & Kiverstein, 2014). The notion of 4E – embodied, enactive, embedded and extended – cognition is sometimes used to acknowledge this diversity while also recognizing some shared concern, a set of family resemblances (Newen *et al.*, 2018). The degree to which any particular approach draws on one or another of the Es may differ, and indeed some approaches tend to drop an E. For example, Nielsen (2023) has questioned the value of the "extended" mind thesis and instead advocates for a 3E model. Others propose adding to the 4Es. Stilwell & Harman (2021) introduce a fifth E: emotive, to emphasize the role of affectivity in cognition. Meanwhile, Gallagher (2021) offers a complementary framework of "4As" – affect, agency, affordance, and autonomy – as additional organizing lenses to highlight motivational and existential dimensions often underemphasized in 4E discussions. However, for our present purposes, rather than engaging in any of the background debates that inform such decisions, and with the goal of simply advocating for the introduction of insights from embodied cognitive science into the the discussion around behavioral change, we will focus on a level of understanding around which there is broad, if not perfect, consensus. And so, in what follows we will concentrate only on the original four Es, developing each in terms of its basic explication and how it informs our understanding of the notion of habit and has implications for behavioral change. Some of the other Es and As, will come out in this process. To accord with the space provided, the discussion has been limited to three implications for each E.

3.1 Embodied

Within embodied cognitive science, cognition and behavior are understood as inherently embodied, serving and reflecting the organization and form of the living body while manifesting through dynamic interactions with the environment. As Thomas Fuchs emphasizes, even higher-order cognitive functions like planning and reasoning are downstream of more fundamental dynamics, such as the self-production of our living form (autopoiesis) and the motivations that emerge from it – survival, belonging, reproduction, and so on (Fuchs, 2021). This continuity between life and mind has led some to propose that cognitive capacities are not exclusive to humans or intelligent animals but may extend to all forms of life, including single cells. This idea is especially prominent in the autopoietic tradition (Maturana & Varela 1970), and in the Paris school of biological enactivism (*e.g.*, Varela & Coutinho 1991), where, for instance, the immune system has also been framed as a fully cognitive system. However, such proposals remain controversial. Critics (*e.g.*, Pradeu 2012) have

raised concerns that attributing cognition to cellular or immune processes may involve an overly metaphorical projection, importing phenomenological concepts into biological domains that may not warrant them. Others (*e.g.*, Di Paolo, 2005; Deacon 2011) have asked whether the concept of life alone is sufficient to account for cognition or whether additional organising principles must be added.

While we do not resolve these debates here, it is important to note that even within 4E research, life–mind continuity is not universally endorsed. Nevertheless, the broader insight that different forms of embodied agency bring with them different cognitive repertoires – each tuned to a distinct problem space – remains a valuable orienting idea and does inform our inquiry here (Hiott, 2022). In the case of humans, our bodies are not singular entities but coordinated, nested networks of cells and other ostensibly goal-directed processes, working in concert toward shared ends – what Levin (Levin, 2022) terms a multiscale competency architecture. This coordination reflects a kind of collective intelligence, wherein our personal autonomous agency – however it feels subjectively – is a manifestation of this broader system. But it is only one particular manifestation. Within this network, our habits, identities and even self-narratives are themselves autonomous agents of sorts (albeit with varying degrees of autonomy and agency), which, like other sub-systems within the network, often cooperate in service of our intentions and needs, but not always. It is the rooting of these habits in precarious bodily processes that gives them the kind of normative force we associate with them. Not just our life, then, but our ways-of-life take on a life of their own (Di Paolo *et al.*, 2017).

3.1.1 Implications for Change

The body as a resonance board: Perhaps the most important implication of embodied cognition for behavior change is that behavior is not an isolable function but is intimately tied to the other patterns and processes of our bodies. It cannot, for instance, be assumed to be distinct from our moods, emotions and existential feelings, our language, the functioning and morphology of our physiology, or the bacterial ecologies present throughout our bodies. Nor is it independent of the immune, endocrine, or nervous systems, or of the rhythmic interactions emerging between these and other systems – such as the rhythms of our hearts and breathing, the flow of blood pressure, the peristaltic rhythms of digestion, or bioelectric oscillations coordinating across our nervous systems. While the precise relationships between any particular system or process and a given behavior may be impossible to discern in a specific instance, the fact of such relationships is certain, and it may be that through more synergistic interventions, over time we can weight them in favor of our capacities for change and particular desirable changes.

The body acts as a kind of resonance board, where events and influences propagate through its systems in diverse ways, shaping both the possibilities for behavior and the capacity for behavioral change. Consider the extremes: consumption of depressant drugs, such as opioids, narrows the repertoire of behavioral expressions and reduces the resources available for self-directed change. On the other hand, a highly stimulating drug like amphetamine significantly increases activity and impulsivity, shifting behavioral tendencies

far from baseline. Some substances also target bodily processes related to more specific behavioral changes. For instance, semaglutide (marketed as Ozempic), by influencing appetite regulation and promoting feelings of fullness, directly supports modifications in eating habits, facilitating weight loss and healthier dietary practices around the consumption of food. Psychedelics like psilocybin provide another example, enhancing neural plasticity and enabling profound experiences that can fundamentally alter behavioral trajectories (Hipolito *et al.* 2023). These examples demonstrate how changes in the body's internal biochemical states can act as powerful levers for transforming behavioral outcomes.

While drug interventions underscore how changes in bodily processes influence behavior, an overemphasis on pharmacological approaches risks reducing behavior and cognition to neurochemical dynamics alone. But such a narrow focus would obscure the broader context of interdependencies highlighted above. The success of drug interventions certainly validates the point that modulating bodily processes, such as our neurochemistry, has downstream effects on behavior. But an embodied perspective shows that this is only one route among many. Modifications to diet, breathing, movement patterns, physical exertion, attentional capacities, stress tolerances, and so on, all are likely to have downstream and spillover effects on our abilities to better shape our habits, identities and narratives to be more in line with our intentions over time.

Another class of interventions relevant to changing habits and narratives are generative shocks or perturbations. Shocks have the capacity to destabilize entrenched patterns and create opportunities for the emergence of new behaviors more attuned to situational demands. Psychedelics, just mentioned, are one illustrative example, often described as acting through shocks that function as "pattern breakers" (Hipólito *et al.*, 2023). However, shocks need not be so dramatic and are actually a ubiquitous feature of life. Listening to unfamiliar music, journaling on unexamined topics, entering novel social situations, physical exertion, participating in intense sports, engaging in rituals, undertaking pilgrimages and retreats, and so on, all have the potential to perturb established patterns and appear to support behavioral and narrative flexibility (see James *et al.* 2025 for more examples and a deeper discussion of these ideas).

Interestingly, shocks may also be endogenous (Laroche *et al.* 2024). Sighs, yawns, and spontaneous stretches (or *pandiculations*) for example, are plausible candidates for self-generated perturbations, potentially aiding both physiological and psychological transitions. Moreover, Froese (2023; 2024) has speculated that even consciousness itself might function as a generator of endogenous perturbations, or "irruptions", that destabilize existing patterns and open new possibilities for change. Better understanding how endogenous and exogenous shocks operate in living systems could deepen our knowledge of why certain interventions succeed and how they might be better designed. From this embodied perspective, behavior change cannot be isolated from the dynamics of the body. This understanding opens up a wide range of potential interventions beyond conventional methods. By considering the body as a whole, along with its many resonant processes, we gain a richer understanding of how action and

intention can be better aligned, offering new and principled ways to approach the challenges presented by the intention-action gap.

Misaligned regulatory demands: The bio-psycho-social subsystems that make up our embodied network do not always align seamlessly. At times, these subsystems generate incompatible regulatory demands, resulting in alignment struggles. In the bio-physiological domain, misalignment can lead to diseases like cancer, where cells dissociate from their surrounding milieu (the tissues) and act in ways that conflict with the organism's overall regulation (Levin, 2021). More relevantly for behavioral change, these misalignments often play out in the interactions between biological, psychological, and social domains. A habit that aligns with a biological need, like eating for nourishment, may conflict with an identity (*e.g.*, emotional eating) or social expectations (*e.g.*, restrictive dieting to conform to cultural norms). Similarly, a personal identity rooted in a need for individual freedom may clash with shared narratives that prioritize collective values or obligations.

In the context of habit change, addressing these misaligned demands involves negotiating between competing goals and needs, both within the individual (bio-psychological) and between the individual and their environment. This negotiation is not merely about compromise but about finding ways to support the emergence of new patterns that harmonize these demands across scales. Often, adopting a playful experimental approach to a given change can be a good way to feel into the alignments that exist there. For example, a habit that supports biological health, like regular exercise, might also be designed to align with social needs, such as participating in group activities, thereby reducing conflict between subsystems. The generative shocks mentioned above may serve precisely this function, acting as perturbations that temporarily destabilize misaligned patterns and create opportunities for multiscale realignments to emerge. Such approaches may be further supported by environmental scaffolds, structured supports that help maintain new patterns while they stabilize – a topic we will explore more fully below.

By recognizing that change often involves resolving these tensions, we shift from the stance of the controlling dictator to that of a curious mediator. This process also helps reduce feelings of inadequacy when change doesn't come easily; instead, it emphasizes that behavioral alignment is an ongoing, iterative negotiation shaped by many interconnected factors, many of which are outside our control, but which we may nevertheless come to know and work with.

Rhythms, cycles, and limits: The body operates through natural rhythms and cycles, influencing our energy, readiness for action, and capacity for change. These rhythms range from daily circadian cycles to seasonal shifts and major life transitions, and they offer opportunities to align interventions with periods of heightened receptivity. For instance, the start of a new week or year, a birthday, or even the slower pace of a weekend can open a window for change. Similarly, daily energy fluctuations and transitional periods, like recovering from illness or settling into a new environment, can create conditions where introducing new habits may be more likely to succeed.

At the same time, these rhythms reveal the limits of change. Some patterns are deeply embedded in our bodily processes and resist adaptation altogether, or not without significant time or energy costs. For example, attempting to

reconfigure a well-worn routine that runs counter to one's natural rhythms, like pushing for an early-morning productivity routine when one's energy peaks in the evening, is likely to be unsustainable. Recognizing these limits helps set realistic expectations and guides us toward gradual, more sustainable shifts rather than insensitive overhauls that ignore the body's present rhythms and needs (of course, the latter might also have its place, *e.g.*, breaking from an abusive relationship or addictive pattern).

As noted previously, any change itself is a two-sided and non-linear mediation: amplifying some processes while dampening others, and having spillover effects across scales. A successful habit change might, for instance, boost one's energy or sense of agency in one area, enabling further positive developments, while simultaneously introducing strain in another, by disrupting existing routines or increasing demands in social domains. Designing interventions means taking these trade-offs seriously, balancing effort and recovery to cultivate new habits and narratives without destabilizing the broader systems in which they are nested in ways that are counterproductive. Of course, sometimes it may be necessary to also change the larger social structures within which we act in service of our change. But we should keep in mind that just as our bodily networks will backlash against some efforts towards change, so too will our social networks, and often with more detrimental consequences than we may be willing to welcome, *e.g.*, disapproval or even ostracisation. By working with our rhythms and cycles, and by appreciating the limits of what can be changed at any given time, we create conditions for sustainable transformation that honour these non-linear and multiscale realities.

3.2 Enacted

The idea that mind is enacted highlights that meaning emerges through active, ongoing processes of exchange between bodies and their socio-material environments – what Buddhist philosophy refers to as *dependent co-arising*. Rather than simply perceiving a pre-given world, we actively participate in bringing forth the very world we experience through our embodied interactions with it. The experiencing subject emerges at this intersection, co-constituted through a history of interactions that simultaneously shape both the agent and the environment as it is experienced. As such, cognition, sometimes referred to in terms of *sense-making*, is already present in our acting and perceiving and not limited to *offline* operations in our heads, like abstract reflection. Indeed, much, if not most of our meaning-making activities, occur through sensorimotor, affective and linguistic engagements with ourselves and the world.

All of this activity leaves traces that constrain future actions without determining them. The phrase *laying down a path in walking* is often used to encapsulate the spirit of cognition as enaction. Here, walking signifies the embodied subject actively engaged in a process of becoming, rather than a self merely executing pre-determined actions. The *path* laid down represents the evolving relationship between the subject and their environment – a history of interdependencies that, for a time, scaffold the experiencing subject and later sediment as constraints on future possibilities. Through our organismic, sensorimotor, social, and linguistic sense-making, we enact ourselves, our

relationships with others (as *participatory sense-making*; De Jaegher & Di Paolo, 2007), and our *umwelts* – our worlds as they are particular to us.

3.2.1 Implications for Change

Meaning matters: Given what we've just said about sense-making, the idea that our habits are merely stimulus-response associations becomes questionable. Of course, as previously acknowledged, there are instances where a behavior may appear to be just that. But, as Dewey warned, such interpretations often fall prey to the *fallacy of selective emphasis* – the tendency to reduce complex phenomena to their most stable or observable elements, while ignoring the broader dynamics in play. Under certain conditions, especially in tightly constrained environments, some habits may indeed appear as highly stable associations between stimulus and response. But such cases are likely the exception rather than the rule in the wild. Even in controlled laboratory settings with non-human animals, variability tends to persist within conditioned responses despite extensive reinforcement (for discussion, see Gapenne & Khamassi, 2024). This suggests that even the most well-trained behavior retains a degree of openness, ambiguity, and responsiveness to context.

Within the embodied account, habits are not automatic reactions but dispositions toward certain types of meaningful relationship with the world. They constrain and orient our action, but do not determine it. They ready us for specific engagements, while still allowing for improvisation and responsiveness. In this sense, habits are less like fixed programs and more like lane-assist systems: they guide and channel, but rarely take full control of the wheel (except, perhaps, when disordered). Understanding habits in this way helps us reframe the challenge of changing them. Instead of asking how to override a habit, we might ask: What larger structure of meaning is this habit embedded within or intending to serve? What does this habit mean – not just for me, but for my relationships, community, and ecology? Such questions help surface sources of resistance to change, as well as openings – places where change might already be underway, and could be amplified. Reframing a habit in this context often involves changing its meaning: weaving it into an existing ecology of practices in a way that allows it to stabilize more naturally. Meaning, in this sense, becomes a medium for shaping change – not just an afterthought. We can recognize the dimension of meaning in these structures most clearly in our self-narratives, where it has already taken linguistic form. But from this perspective, as already indicated, self-narratives are not a radical departure from bodily habits, but a continuity in the evolution of meaning-laden sense-frames.

Cues and rewards: The non-linearity inherent in our embodied being suggests that models based on static cues and rewards, while possessing significant explanatory power in stable environments, are often insufficient for supporting change in the dynamic flux of daily life. As Segar (2022) notes, "people often need to do their health behaviors and make healthy choices across different daily contexts, not just the ones with pre-programmed cues." The challenge is that real-world contexts are not pre-programmed. The science of habits has, of course, developed models of great sophistication to account for this complexity, pushing beyond simple Stimulus-Response (S-R) models to include more advanced associative accounts, such as response-response or

action-chaining models, where one action directly cues the next even in the absence of a distinct external stimulus (Dezfouli & Balleine, 2012; Miller *et al.*, 2019).

Yet, even these sophisticated models risk what Dewey (1986), in his foundational critique of the "reflex arc concept", argued was a fragmentation of lived experience. By focusing on the associative chain, they still bracket the underlying structure of meaning that makes the entire sequence relevant to the agent. Action and perception are not discrete stages in a linear process but are components of a continuous cycle that enacts an agent's world as it adjusts to shifting goals and needs. What constitutes a "cue" or which action sequence becomes salient is never objective; it is deeply shaped by why, how and toward what we are acting.

In other words, cues, rewards, and action-chains only function when we care about them. Our embodiment provides the dynamic, shifting horizon that determines their relevance: water solicits drinking when we are thirsty but is unnoticed when we are well-hydrated; a particular song lyric stands out when we are heartbroken but might pass us by in other states. Beyond focusing exclusively on strengthening associative links (which is no doubt useful), we can ask where a readiness for change may already exist and design ways to support and cultivate these emerging potentials.

This perspective both aligns with and seeks to critically deepen influential approaches like Nudge theory. We share the emphasis on designing environments, or "choice architecture", to facilitate desired outcomes (Thaler & Sunstein, 2021). However, we also share the concerns of critics like Gigerenzer (2015), who argues that libertarian paternalism can overestimate the irrationality of agents while underestimating their capacity to learn and use adaptive heuristics. When a nudge works by bypassing a person's conscious reasoning, it may achieve a short-term goal, but it does little to enhance their autonomy or sense-making capabilities.

Our embodied approach therefore points toward a more participatory and reflexive form of design. The goal is not simply to engineer an environment that steers a supposedly flawed agent, but to create "scaffolds" that actively support that agent's autonomy. Instead of designing systems that work despite the user, we advocate for co-designing interventions that work with and through them. By focusing on identifying intrinsic motivations and aligning with an individual's existing structures of meaning, we cultivate change that is not only effective but also experienced as authentic and empowering, leading to more durable and deeply integrated outcomes. Changing our habits in this view is a process of multiscale realignment between the biological, psychological and social dimensions of our being.

Ubiquity of change opportunities: The enactive perspective emphasizes that processes of change are inherently present – or at least latent – in all our memories, actions, perceptions, emotions, judgments, and anticipations. Consequently, any meaningful approach to change should integrate all these dimensions. This perspective broadens our understanding of when and where habit change occurs. If all our sense-making activities have the potential to reconfigure paths that shape future possibilities, opportunities for change are truly ubiquitous. The sense we make of a situation – whether through

sensorimotor, affective, or linguistic channels, and whether in real, virtual, or imaginary contexts – becomes part of that situation's legacy. This legacy either enables or constrains the possibilities that unfold in future recurrences in a stigmergic-like fashion. Indeed, as a general rule, the more meaning we generate from an experience, the more indelible its traces become. Moreover, these domains of sense-making are deeply interwoven: changes in one dimension, such as the affective, often spill over into others, such as the sensorimotor. Working with these spillover effects becomes part of the skill of cultivating change.

A corollary of these ideas is the recognition of a powerful feedback loop: the way we approach making change fundamentally shapes how we understand ourselves, and in turn, the way we understand ourselves fundamentally shapes how we approach change. For example, framing change as the task of a rational mind overcoming cognitive biases may lead us to see ourselves as locked in a perpetual struggle against our own limitations. Similarly, viewing change as simply aligning motivations and capabilities might encourage us to seek idealized "recipes" for transformation, an approach that risks neglecting the non-linear dynamics that underlie our behavior. By contrast, viewing change as the negotiated outcome of a network of interacting agencies invites a more empowering self-image, in which we come to see ourselves as cultivators of cooperation. This perspective acknowledges the interconnectedness of our embodied, affective, and social dimensions, positioning us as active participants in facilitating meaningful change across scales. Such a vision, which resonates with scientific work on the "bodily inscription of cognitive dynamics" and its impact on human freedom (Khamassi & Lorenceau, 2021), may be particularly adaptive in these complex times, as we learn to navigate the multitude of forces that shape our lives.

3.3 Embedded

Embeddedness, or situatedness, posits that our cognition is both fundamentally shaped by the environments in which it occurs, and often relies on that environment for functional support. Rather than treating meaning-making processes – even abstract reflection – as isolated, internal events confined to the brain, this perspective emphasizes how they are often distributed across the body, the immediate environment, and the broader social, material, and technological contexts. As such, all these processes are mutually engaged in shaping one another, and intervening on any particular one has the capacity to drive change in others. Some important concepts for this understanding are the ideas of affordances, scaffolds, and optimal grip, which we will say a little about each now.

Within an understanding of embeddedness, we often speak of our sense-making as being attuned to our environment in terms of fields and landscapes of affordances (Rietveld & Kiverstein, 2014). Affordances are effectively constellations of constraints in the environment that provide opportunities for action (Gibson, 1979). The field of affordances includes the immediate social, material, and cultural constraints that the embodied subject dynamically interacts with to support their immediate aims. For instance, a hammer on a workbench affords grasping and swinging to a carpenter, but may hold no such

meaning for someone unfamiliar with its purpose. In contrast, landscapes encompass broader, more enduring structures that provide ongoing support for a given practice, such as cultural norms and societal infrastructures.

Agents are attuned to multiple affordances simultaneously. For example, one might be responding to the affordances of the ground while gardening, and simultaneously anticipating an important call from the hospital, which requires coupling with affordances that provide a context for one's actions but are not immediately present.

Embedded cognition also emphasizes the concept of scaffolding, where the environment actively supports our cognitive processes. Scaffolds may be temporary, like a tutor guiding a child, or permanent, like written language supporting abstract thought (Shvarts & Bakker, 2019; Stapleton, 2022). Scaffolds can also evolve dynamically with the agent, such as when tools are adapted to a user's growing skill level (see James *et al.*, 2025). Effectively, scaffolds support our ability to perceive and act towards affordances that would be difficult or impossible to engage with in their absence. Given this ability to shape our sense-making, self-scaffolding is the primary means by which we realise behavioral changes from the standpoint of embodied cognition (Bickhard, 1992). As we noted previously, what counts as cuing or rewarding is often too volatile for that to be our primary strategy. Rather, through the creation and modification of scaffolds, we shape our own fields and landscapes of affordances to increase the probability that desirable habits will take hold.

The last concept to mention here is optimal grip, a notion that perfectly illustrates the intimate coupling between our embodied being and our embedded situation (Bruineberg & Rietveld, 2014). Optimal grip describes our ubiquitous tendency to move towards a kind of situational consonance within every context in which we act; it is the lived experience of embodiment finding its groove within its embedded world. For instance, when reading, I will adjust my position relative to the screen until I find a comfortable reading position and recover a sense of 'grip' on the task. But this needn't be limited to a single goal. On a busy train, I may simultaneously adjust my position to find an optimal compromise between a set of potentially conflicting needs, *e.g.*, for personal space, for respecting others' privacy, and for reading my book. Tending towards optimal grip, then, appears to describe a general tendency to minimise any sense of dissonance or strain arising between our bodily goals and the situation's constraints. In the context of driving change, scaffolds work alongside this tendency. They can skillfully introduce new tensions – a new goal, a new tool – that disrupt our current grip, motivating us to seek out a new, more desirable state of equilibrium. If skillfully configured, this has the benefit of leading to novel habits, identities, and narratives.

3.3.1 Implications for Change

Scaffolds as the foundations for change: Habits are not merely internal patterns but are deeply reliant on scaffolds, external structures in our environment that support and sustain cognition and behavior. Scaffolds can take many forms, from physical tools and social supports to conceptual frameworks. Effective habit change begins with intentionally configuring these scaffolds to

stabilize or destabilize behaviors as needed. Over time, scaffolds can transition from external supports in the environment to embodied processes, making the behaviors they sustain more flexible and portable. For example, a meditator might initially rely on a recording of someone chanting to maintain focus, but later internalize a silent mantra or counting process to achieve and maintain a sense of grip relative to their situated needs. Not all scaffolds, however, are under our direct control. People, places, and shared practices often act as powerful scaffolds, shaping our behaviors in profound ways. By positioning ourselves within particular contexts, be they communities, environments, or traditions, we can draw on these external supports to catalyze growth aligned with the habits and practices cultivated there. This realization can alleviate some of the burden of change, allowing us to actively participate in, but also be shaped by, the scaffolds provided by a community or place. Moreover, it highlights a mutual dynamic: while we draw on these shared scaffolds, we also contribute to the scaffolding of others, reinforcing the interdependence at the heart of this understanding of habit formation and change.

Scaffolds Are Not Crutches: Recognizing the role of scaffolds can reduce the shame often associated with relying on so-called "crutches", a shame that may lead us to dismiss options that could have otherwise fostered positive trajectories. When we understand that so much of our capacity is scaffolded to varying degrees, we can place ability and disability on a continuum shaped by available resources. This perspective reframes scaffolding as an integral part of navigating and leveraging the affordances in our environments, rather than as evidence of inadequacy. Functionally, a scaffold works by shaping the flow of stresses – cognitive, affective, or physical – on an agent. By providing an external structure, it offers a point of orientation to organize one's actions around, offloading the immense work of constant decision-making and self-regulation.

In behavioral science, the distinction between "naives" and "sophisticates" underscores this point (Milkman, 2021). A naive individual has not yet embraced the idea of using their environment as a resource, while a sophisticate has. The need for such a distinction reflects a lingering alienation rooted in the outdated view that the mind operates solely "inside the head". By acknowledging scaffolds as central to growth, we move beyond this alienation, shifting from a narrative of weakness to one of adaptive intelligence and resourcefulness. This reframe not only cultivates a more compassionate approach to habit change but also emphasizes collaboration with our environments over isolated effort, allowing us to see scaffolds as active participants in the dynamic process of getting a grip on the world around us.

Expanding circles of care: Recognizing ourselves as embedded within fields and landscapes of affordances, and understanding the pervasive role of scaffolds, can sharpen our awareness of the conditions that shape our habits, identities and self-narratives. When we see our behavior as a reflection of those conditions, we may find ourselves extending care not only toward our actions but also toward the environments that enable them. This perspective encourages a more relational consciousness and cultivates a compassionate, interconnected view of ourselves and the world. Through this lens, care for ourselves expands to encompass the people, systems, and technologies that comprise our lived

realities, acknowledging that our well-being is inextricably tied to these networks of relations and affordances. Advanced technologies, such as AI, are an increasingly significant part of these scaffolding systems. By appreciating our techno-material constitution, we may better resist techno-fatalism, the belief that technological evolution is beyond our control, and learn to integrate tools like AI as dynamic, multipurpose scaffolds. This perspective may help shift us from alienation toward empowerment, recognizing technologies not as external forces that determine us, but as resources we can regulate intelligently and draw upon in service of our multi-scale needs. By framing ourselves as collaborators with these systems, we can better leverage their potential while remaining grounded in a broader, more relational ecology of care.

3.4 Extended

The Extended Mind Hypothesis posits that cognitive processes are not confined to the brain but can extend into the external world. Its intellectual history is often described in waves. The "first-wave" formulation (Clark & Chalmers, 1998) was defined by the Parity Principle: if an external resource functions equivalently to an internal one, it counts as part of the mind. This was critiqued by a "second wave", which proposed cognitive integration instead (Menary, 2010). Here, the focus is not on equivalence, but on the dynamic coupling of internal and external resources to perform a specific cognitive task. Building on this, a "third wave" deepens the integrationist account, arguing that our minds and very selves are diachronically co-constituted by our ongoing engagement with a world structured by cultural practices and technologies (Kirchhoff & Kiverstein, 2019). The present account is perhaps most aligned with the latter two waves of cognitive extensions. We can illustrate this alignment by imagining we happen upon the studio of Francis Bacon while he has briefly stepped outside.

Entering the studio, we see a work-in-progress on the easel. Smears of pigment, brushes left at specific angles, reference photos tacked to the wall – the entire scene makes an intention physically manifest. We don't need to read the artist's mind to discern that he is holding the intention to produce a painting; it is observable in the material distribution of his environment. This scene is a snapshot of second-wave cognitive integration in action. Bacon's creative process, as we made apparent at the outset of this article, is clearly not a case of a pre-formed idea being executed; It's a dynamic, hybrid system in which his brain, body, and materials are coupled in nested processes of feedback. The state of the canvas and the distribution of materials in his environment are active components of his ongoing cognitive act.

Now, consider Bacon himself returning to the studio. If he was momentarily distracted, the environment calls him back not just to a general task, but to the specific stage of his work-in-progress. The half-finished form on the canvas, the particular colour on his palette, these serve as powerful constraints that help him restore his grip relative to his artistic intention. This demonstrates the active role of bodily and environmental manipulation, but the implications run deeper, moving us into the third wave. This process, repeated over a lifetime, does more than just help him paint; it constitutes his very identity. When Bacon described himself "not so much as a painter but as a medium for accident and chance"

(Sylvester, 1980), he was not speaking metaphorically. He was describing a self that was diachronically formed by this extended, responsive process, a self "dependent for its existence on a temporal unfolding over various media: some neural or bodily, others involving other people and the resources provided by an environment shaped by our cultural activities and patterns of practice" (Kirchhoff & Kiverstein, 2019, p. 25).

Bacon's studio was notoriously messy; so much so that it has been preserved and is on permanent display in the Hugh Lane gallery in Dublin. Bacon is said to have cultivated this mess, with the "chaos" of it, as he is quoted, helping to "breed images" (Laster 2021). In this sense, it is not simply that the brush or easel form functional integrations for a given task, but that the environment as a whole prefigures and enables an orientation for Bacon that is a central dimension of his identity and a constitutive element of his imagination. Writing in support of the messy artist's studio, artist and writer Austin Kleon (2017) describes this as part of the readiness of the artist to engage in creative production. Such language is well aligned with the account we have been developing herein, where our habits and identities reflect structural body-environment couplings that ready us to act. Bacon's studio shows us how this is true not just for the scaffolding of functional capacities with tools and materials, but also for the entire affective and orienting atmospheres that we inhabit.

This has profound implications for behavioral change. The skills we develop to close the gap between our intentions and actions are also a form of skilled intentionality forged in an extended system that has as its target our ability to forge such extended systems in a recursive fashion. Our identities as a "healthy person" or a "budding artist" are not simply internal decisions but co-constituted over time through our extended, integrated actions, but so too is our identity as someone who can make changes in line with our needs. The external elements of our lives – our kitchen, our running shoes, our communities, the art and paint on our walls, the communities we are part of, and so on, are not just props; they are active, functional components of the sensorimotor, affective and linguistic machinery that brings our goals and, ultimately, ourselves into being in an ongoing way.

3.4.1 Implications for Change

Intention loading: The concept of intentional loading suggests that we can strategically configure our environments with scaffolds that support not only the production and reproduction of sensorimotor patterns but also more semiotic and meaning-laden functions. This involves embedding salient signs – whether objects, symbols, or arrangements – that signify and scaffold the intentions we aspire to realize more consistently over time. The idea is to load our surroundings with cues that amplify the salience and meaningfulness of these intentions, effectively increasing the "weight" of the intentional load. Intentional loading can take various forms, from the inclusion of meaningful artifacts, such as an expensive notebook purchased specifically to practice drawing, to immersive environmental changes, like dedicating a purpose-built room for a particular practice or goal. The effectiveness of these loads depends on factors such as intensity (*e.g.*, how many senses they engage), duration, frequency, and variability. Together, these elements attune and reattune us to patterns of action,

feeling, and thought that align with our deeper aspirations but have not yet been fully internalized or sedimented. As a general principle, the greater the intentional load imposed by the environment, the more likely it is to entrain the body and mind in ways that support the desired outcomes. This dynamic, however, warrants further exploration, particularly in light of recent developments in semiotics and the study of affective affordances (Krueger & Colombetti, 2018; Krueger & Osler, 2019), which emphasize how environments can evoke and sustain emotional and motivational states.

The intention-intention gap: The so-called intention-action gap is central to the discussion around behavior change. If the present account is on track, this gap can–at least sometimes–be thought to exist alongside what we might term the intention-intention gap, *i.e.*, a gap between our reflective intentions and the distribution of intentions that is loaded into our environment. For example, one might hold a reflective intention to "eat more healthily" while their kitchen environment is loaded with the competing intention to "eat convenient junk food". The resulting inaction or struggle is a direct consequence of this environmental conflict, not just a failure of internal willpower. Viewing intentions in this more extended fashion, we come to see our efforts at designing environments to support change as a kind of intentional stigmergy, or *wayshaping*, whereby we indirectly coordinate in the local-present with some desirable version of our future selves, to shape it in line with what we understand to be our more enduring needs (Borghini, 2017; Heylighen, 2016). Importantly, however, these traces may not be limited to our environments, but might also be left in our bodies, *e.g.*, through practice; or, maybe even in our imaginations. It may be that the success of so-called implementation intentions – which are a kind of if-then imagining of future actions that are known to make those imagined actions more likely – function by leaving traces around which imagined actions are more likely to self-organise in future similar situations. Such considerations are rich and would benefit from thorough conceptual elaboration, but even this cursory set of reflections has practical benefit and seems to indicate some promising avenues for further consideration.

Shared Intentions: If our intentions exist in the world and not solely in our heads, they are not entirely our own – they inevitably shape the affordances of others, offering sensorimotor, affective, or linguistic scaffolds. This influence holds even when others are not directly implicated in our intentions. As long as we are indirectly coordinating across spaces and times of any but the most local and immediate distances and times, our actions contribute to the conditions others must navigate. This highlights the inherently relational nature of intentions, where even designs aimed at supporting our individual actions shape collective environments. While there is much more to be explored here, particularly in connection to theories of social stigmergy, it suffices to note that this interdependence imbues our environmental designs, even when focused on personal goals, with an ethical responsibility to consider their broader impact. Our efforts to align our spaces with our intentions must be cognizant of how these spaces scaffold, constrain, or reshape the intentions and behaviors of others who share or interact with them.

CONCLUSION

Behavior change, as traditionally framed, often treats the intention-action gap as a failure of a rational mind to control a mechanistic body. Throughout this paper, we have argued that the 4E cognitive science framework offers a more compelling diagnosis: the problem is not a gap to be bridged, but a misalignment within a complex, self-organizing, brain-body-environment system. Our investigation has offered several conceptual resources to this end. The embodied dimension underscores the entanglement of behavior with the body's rhythms and needs. The enactive perspective reveals intention as an emergent, negotiated process. Embeddedness highlights the role of environmental scaffolds in making behaviors probable. Finally, the extended mind shows how our tools and environments are not just supportive but active, constitutive components of our intentions and identities over time.

A deeper critique, central to the 4E tradition, would question whether the 'intention-action gap' is itself an artifact of a representationalist view of the mind – a view that frames intentions as abstract states that must be translated into action, thereby creating the very divide we seek to bridge. While a full treatment of that foundational question is beyond our present scope, this work is intended to be a productive step in that direction (for related work see *e.g.*, Kelso, 1995; Paans & Ehlen, 2022; Froese, 2023, 2024; Mitchell, 2023). By focusing on the readily observable enacted dynamics and distributed processes rather than the metaphysical status of intentions, we sidestep, for now, many traditional causal puzzles while still offering some conceptual resources that we believe will be valuable for that future work.

Beyond conceptual refinement, this work also demands a necessary evolution in research methods in the science of behavior change. Phenomenological methods, such as in-depth phenomenological interviews, are needed to capture the first-person, lived experience of negotiating change. Multiscale observations and ethnographies are essential for mapping the crucial role of social and material environments and how they intersect with individual dynamics within this process. Finally, computational tools like agent-based and dynamic systems models can help simulate the non-linear, emergent, and recursive dynamics that are central to our account. By combining these first-person, third-person, and computational perspectives we can begin to paint a full picture of situated and temporally extended human change.

Ultimately, this perspective reframes the personal experience of change. The goal is not to control the self, but to collaborate with it. This does not absolve the individual of effort. As this account makes clear, we are a powerful loci of agency embedded within our worlds. Consider the metaphor of steering a boat through rapids: even with the finest vessel, success depends on the skill to read the local conditions and adapt in ways relevant to our needs. Maintaining and recovering our health and well-being and the behavior changes required to do so, are similar practices – the work of cultivating the skills to navigate uncertainty remain essential. Perhaps the most profound implication of this work is that this is the cultivation of a recursive meta-skill, a process we refer to elsewhere as *wayshaping* (James *et al.*, 2025). The ultimate target is not just a single change, but our very ability to forge the supportive systems that enable future change – in essence, the practice of evolving our own evolvability. These conceptual developments are some additional stepping stones along this way.

This account is intended to be inclusive for anyone – clinicians, coaches, designers, educators, or individuals – engaged in the ongoing work of fostering positive change. By moving beyond mechanistic models to an understanding of change as a process of exchange and realignment within brain-body-environment systems, we can cultivate a more compassionate, realistic, and effective approach to the science and art of individual and collective becoming.

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