



# Why robots can't haka: skilled performance and embodied knowledge in the Māori haka

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## Abstract

To investigate the unique kinds of mentality involved in skilled performance, this paper explores the performance ecology of the Māori haka, a ritual form of song and dance of the indigenous people of Aotearoa New Zealand. We respond to a recent proposal to program robots to perform a haka as ‘cultural preservationists’ for ‘intangible cultural heritage’. This ‘Robot Māori Haka’ proposal raises questions about the nature of skill and the transmission of embodied knowledge; about the cognitive and affective experiences cultivated in indigenous practices like haka; and about the role of robots in the archival aspirations of human societies. Reproducing haka, we suggest, requires more than copying physical actions; preserving the ‘intangible’ entails more than programming postures and movements. To make this case, we discuss the history of European responses to the haka, and analyse its diverse performance features in cultural context. Arguing that indigenous movement practices incorporate genuinely embodied knowledge, we claim that skilled performance of haka is deeply mindful, embodying and transmitting dynamic, culturally shared understandings of the natural and social world. The indigenous psychologies incorporated in haka performance are animated by a shared history integrated with its environment. Examining haka performance through the lens of 4E cognitive skill theory for mutual benefit, we discuss the effects of synchrony in collective action, the social and environmental scaffolding of affect and emotion, and the multilayered relations between past and present. Culturally-embedded systems of skilled movement like the Māori haka may, we suggest, constitute specific ways of thinking and feeling.

**Keywords** Embodied cognition · Indigenous psychology · Distributed affect · Synchrony

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## 1 Introduction: movement, minds, and the Māori haka

Skilled bodily performance involves not only motor processes, but also a disparate suite of cognitive and affective processes. The practice of different forms of movement cultivates particular qualities of attention and sensory awareness alongside new physical abilities. Moving with other people in a coordinated group activity also develops intersubjective attention: skilful ways of relating to others, sharing and coordinating thoughts and intentions as well as actions with them. Different ways of moving may therefore constitute different ways of thinking.

The cognitive and affective nature of skilled movement is recognised and fostered in diverse cultural traditions, which scaffold specific forms of skill development in the course of enculturation. In many meditative and martial art traditions, for example, physical education is a central part of the formation of identity and the sculpting of psychological states within a community. Systems of movement come to embody systems of thinking and feeling as they are learned and transmitted over generations and across communities, cultivated afresh in each new person. The transmission of such systems amounts to the transmission of particularly significant forms of embodied knowledge and shared memory. Understanding the unique kinds of mentality involved in skilled performance therefore requires study of such entrenched systems of moving and thinking and the ways they regulate, transmit, and animate patterns of attention, emotion, and belief-formation in specific cognitive ecologies and cultural settings.

This paper explores the performance ecology of the Māori haka, a ritual form of song and dance of the indigenous people of Aotearoa New Zealand.<sup>1</sup> The western and wider world is familiar with haka through its role in the pre-game ritual of the New Zealand rugby union team, the All Blacks (Hokowhitu 2009). But sport is only one of many contexts in which haka are performed. As in ‘traditional’ times, haka are composed and performed today for many different occasions, including welcome ceremonies, protests, funerals, and celebrations of all kind. Despite its popularity and prominence on the world stage, the epistemic value of haka is largely underappreciated, and its cognitive dimensions overlooked. This is due to the popular misconception that haka is *just* a ‘traditional war-dance’; something performed in battles of former times to intimidate an enemy and to incite the performing party to violence and victory, and by analogy in sporting competition. But this understanding is partial at best, as it overlooks and obscures other psychologically and culturally significant facets of the practice.

Haka is a ‘posture dance’ accompanied by chanted or shouted lyrics (Matthews 2004). Each performance transmits a message or lays down a challenge. Although there are many different kinds of haka, and thousands of individual compositions, the popularity of the All Blacks’ performance of the haka ‘ka mate’ has led many to think of this singular item as *‘the haka’*; and has also led to it being the “most performed, the most maligned, and the most abused of all haka” (Kāretu 1993, p. 41).

<sup>1</sup> For accessible, introductory videos on Haka see: <https://youtu.be/vpG53BhLDGw> and <https://youtu.be/UuXA8fZHYYA>.

Multinational companies and Hollywood productions have co-opted the hyper-masculine, 'noble savage' imagery associated with haka in movies and marketing campaigns to build brands and sell products (Jackson and Hokowhitu 2002; Hapeta et al. 2018). Foreign governments have sought to ban haka performances at commemorative events, such as at ANZAC memorial services at Gallipoli (Simon 2015). These examples are mere instances in a long and sordid history of mockery and misappropriation of haka in New Zealand and abroad; critics and perpetrators often fail to see past the 'traditional war dance' narrative, or to appreciate the variety of functions that haka continues to serve today. These failures stem, in part, from a preoccupation with appearances, and the tendency to focus on what cultural performances 'look like' instead of attending to what they 'feel like' for both performers and audiences (Hokowhitu 2014). The performance of haka is a feat of skilful interpersonal coordination which constitutes a unique mode of collective expression, producing patterns of shared experience among performers that extend across communities and generations.

Recently, a team of robotics researchers programmed humanoid robots to 'perform' a haka (Ser et al. 2016; Sandoval et al. 2016; Rudhru et al. 2016).<sup>2</sup> Their stated aim in programming the robots to 'reproduce' the popular 'ka mate' haka was "to continue with the transmission of the Māori tradition even when humans are not available to perform" (Sandoval et al. 2016, p. 512). They propose that the robots may "be used as digital repositories of intangible cultural information" and can act as "cultural preservationists" for "traditions at risk of disappearing" (Sandoval et al. 2016). They hope the 'Robot Māori Haka' will help to establish a new field, 'Robotology', in which robots would be a "research instrument for anthropological, ethnographic and even philosophical practical studies" (Sandoval et al. 2016, p. 512). Such robots would not only record oral, musical, and dance traditions better than standard audio-visual recordings, but also potentially teach these skills to people. Ultimately, "future Robotologists could study robots as anthropological objects and have a clear idea about the traditions, interactions, arts, and body language of disappearing cultures" (Sandoval et al. 2016, p. 511). To their credit, Sandoval and colleagues acknowledge the preliminary nature of their ambitious proposal, and call for response, collaboration and community engagement: "We are in the early development of our case study. Our next goal is to expose interested volunteers to the robot and collect feedback about the feasibility of the robot as a repository of traditions... We are keen to discover whether New Zealanders perceive the robot to be accurately representing the spirit of the Haka, and if they feel that there is adequate respect for their traditions" (Sandoval et al. 2016, p. 511).

The curious 'Robot Māori Haka' (RMH) presents a challenge: can the robots' programming and 'performance' adequately reflect the human practice in ways that preserve 'intangible' culture? Contrasting the robots' performance with the human practice generates a rich opportunity to examine the kinds of thinking and feeling embodied in skilled haka performance. Robotic representation of complex sequences of postures and actions is extraordinarily difficult. But we ask if the

<sup>2</sup> The robot haka can be viewed at: <https://www.youtube.com/watch?v=mf8PmRgOsvU>.

project misconceives this skilled cultural practice more profoundly, by treating haka as *merely* physical performance; and whether oversimplifying the *psychological* significance of the practice undermines the goal of preserving it as intangible cultural heritage. Reproducing haka, we suggest, requires much more than copying physical actions, and preserving the ‘intangible’ entails more than programming postures and movements. We can use the RMH case to address questions about the nature of skill and the preservation of embodied knowledge repertoires; questions about the kinds of cognitive and affective experiences that are cultivated in indigenous practices like haka; and about the role of robots in the archival aspirations of human societies. Our analyses and criticisms are offered in the collegial spirit in which they have been invited.

First, we further explore the problem space created where robots meet, or clash with, skilled performances and intangible cultural heritage. We then offer an overview of haka, discussing its history of misunderstandings and some of its performance features. We consider the significance of synchrony in haka, discuss empirical research on synchronised actions, and contrast with the RMH. We present an analysis of the affective features of haka, made in connection with situated perspectives on emotions. We also explore some of the memory processes involved in haka. Each section is intended, first, to contribute towards clarifying hitherto misconceived accounts of haka, its psychological significance, and its preservation; and, further, to broaden understanding of minds in skilled traditions of cultural performance.

## 2 The problem space: robots, culture, and embodied skill

Robotics research that could be relevant for skill theory is highly diverse, with sub-fields including embodied, affective, social, and epigenetic robotics (Brawer et al. 2017; Lara et al. 2018). The simple Robot Māori Haka case is a helpful prompt to our discussion of how embodied knowledge persists in time, and is transmitted across individual lifespans and over generations. We note but set aside distinct but substantial traditions of aesthetic and design-centred projects on hybrid human–robot systems, where we might be ‘dancing with the nonhuman’ (Gemeinboeck 2019); and computationally intensive social robotics projects growing more directly out of contemporary cognitive neuroscience. One strand of the latter field is worth mentioning here, from research on memory and mental time travel in social robots. Introducing new machine learning techniques embedded in hybrid multi-modal synthetic memory architectures, Prescott and colleagues recently lament of the current generations of social robots that ‘despite having the possibility to store virtually everything that happens to them, such machines are poor at knowing what aspects of their own history are relevant to making decisions, performing actions or engaging with people in the here and now ... today’s robots are “marooned in the present”’ (Prescott et al. 2019, p. 2). We suggest that this problem, not unrelated to the frame problem for Artificial Intelligence, is even more pressing when we focus specifically on *embodied* forms of remembering in the context of skilled cultural practices.

Human and robot actions may be outwardly similar yet inwardly far apart. Robots have been made to ‘dance’ in a variety of forms and contexts. Robot ‘dances’ have been used to demonstrate the physical manoeuvrability and coordination capabilities of new technologies, and thus to encourage further development and funding. In the contested marketplace of robotics research and rhetoric, dance and other performance practices are key sites. On the one hand, robots have for decades been made to look and move like humans, as designers work to make the ‘humanoid’ resemble the ‘human’ in more ways than mere appearances. But on the other hand, dance practices may reveal that much human movement is conducted for reasons and in ways that are not readily apprehended. Indeed, ritual performances in general involve causally opaque actions: “deliberate social behaviors whose means-end purposes cannot be readily inferred from the action sequences of participant behaviors” (Fischer et al. 2013, p. 115; Konvalinka et al. 2011). The causal opacity of ritual action further complicates the replication or reproduction of such performances by robots. In this context, the concept of ‘embodiment’ has often been treated differently across disciplines. Ziemke (2016, p. 9) makes the point that “In embodied AI research robots are usually considered as ‘embodied’ as a matter of fact, simply because, unlike most traditional AI systems, they are physical and can interact with their environment through sensors and actuators. The fact that robot bodies in most cases actually have very little in common with the bodies of living organisms is not given equally much attention”. This concern becomes particularly salient when robots are called upon to perform skilled and expressive ‘bodily’ actions, and to capture the ‘intangible’ cultural information present in physical performances.<sup>3</sup>

In our 4E age, we have learned that the embodiment of cognitive and affective processes runs deep, and is often a matter of history and culture as well as mindful action (Hutchins 1995; Clark 1997; Menary 2007; Sterelny 2012; Sutton and Keene 2017; Newen et al. 2018). We argue, in particular, that the multimodal and multifaceted nature of cultural practices like haka affords fruitful angles both on the differences in the skilled performances of humans and robots, and on a range of independently-motivated questions in the contemporary cognitive sciences. To develop our claim that cognitive and affective states and processes in skilled performance are partly cultural in nature, we first query the premise of the ‘robotology’ proposal that ‘intangible cultural information’ can be represented or embodied in-and-through robots.

UNESCO defines ‘intangible cultural heritage’ in Article 2.1 from the *2003 Convention for the Safeguarding of Intangible Cultural Heritage* (2018 edition):

the practices, representations, expressions, knowledge, skills—as well as the instruments, objects, artefacts and cultural spaces associated therewith—that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation

<sup>3</sup> The bodies of actual robots of course have unique histories which carry specific information about their past. A richer robotics might embrace hardware damage, adaptive compensation, or reused parts as aids both in theorising particularity in robots’ behavioural styles, and in assisting robots better to track their own histories (Chella 2019).

to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity.

The importance of intangible cultural heritage, according to UNESCO, is not the cultural manifestation itself but rather the wealth of knowledge and skills transmitted through it from one generation to the next. UNESCO's list of Intangible Cultural Heritage includes over 200 instances of cultural dance, from nearly 100 different countries, and further identifies Intangible Cultural Heritage that is 'in need of urgent safeguarding'. In this context, the Robot Māori Haka project might be seen as an uncanny realization of Diana Taylor's critique of UNESCO's programs as 'salvage ethnography' which 'barely conceals a deep colonial nostalgia', as if seeking to fix 'a fetishized humanoid object ... for a living diorama in an installation' (2003, p. 24).

The Māori Haka does not figure on these UNESCO lists, but is indeed in need of safeguarding, less from disappearance than from misapprehension and misappropriation (Sweetman and Zemke 2019; Jackson and Hokowhitu 2002). More effective internal efforts towards safeguarding Māori intangible cultural heritage are underway. In the digital space, online archival projects (including Tāmata Toiere and Ngā Taonga Sound and Vision) have been developed for the preservation of waiata (songs) and haka (Ka'ai-Mahuta 2012). And then there is Kapa Haka, a contemporary combination of Māori performing arts practices (waiata, poi, haka, and more) formalised in a performance setting "at the intersection between ritual, theatre and sport" (Mazer 2011, p. 42). Kapa Haka has played a significant role in the revitalisation and retention of te reo Māori (language), tikanga (customs), and Māori histories (Pihama et al. 2014). Kapa Haka is one of the primary contexts in which haka are composed and performed in the 21st century. It is an artform in itself which extends the reach and contemporary relevance of Māori story-telling and sense-making far beyond 'traditional' concerns.<sup>4</sup> The huge popularity of Kapa Haka confirms that intangible cultural heritage is not fixed and static, but is constantly recreated as dynamic living skilled practice.

The preservation of intangible cultural heritage is an objective concerned with cumulative culture and the processes involved in the transmission of cultural knowledge over generations (Legare 2019). Cumulative culture rests in part on the cultivation of certain qualities of mind through skilful performance. Māori practices, including haka, like meditative and martial arts traditions in other contexts, embody and recreate legacies of cultural knowledge—forms, techniques, contexts, philosophies—that are developed and imparted across generations—for (among other things) their effects on the psychology of the performers. In creatively connecting past and present, in thus embodying shared knowledge and memory afresh, these aspects of 'mind' in skilled performance can be overlooked in some contemporary accounts of skilled performance. Much skill theory takes a purely synchronic

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<sup>4</sup> One of the authors, McArthur Mingon, is conducting fieldwork with Kapa Haka groups in Sydney, Australia, to explore these integrated features of Māori cultural practices in further detail.

perspective, addressing a skilled agent's abilities at a given time slice. The focus is on the qualities of mind during performance itself, what is in awareness or not, how the skill is delivered and monitored, or how the action is decided upon or revised. But as Victoria McGeer argues, those complex acquired movement capacities which must be 'dynamically sustained through practice' are 'quite different in kind' from 'statically atemporal' intrinsic features (McGeer 2018, pp. 363–368). In the case of practices like haka, adopting the 'intertemporal perspective' McGeer recommends for understanding the ongoing effort of active practice which is 'the very essence of skilled behaviour' also requires a focus on the cultural and collaborative features of performance. These are also the aspects of 'preservation' of 'intangible cultural heritage' which the RMH case fails to appreciate.

Indigenous movement practices incorporate genuinely embodied *knowledge* in a number of ways. First, as we will argue, the fast and highly grooved joint actions are not merely overlearned automated sequences of song and movement, reproduced by performers each time without intention or agency. Rather, performers must not only understand the meaning and significance of the words and actions at a general level, but in an effective haka must actively *inhabit* the lyrics and movements at every stage, being fully present as individuals and as a group at each moment of performance. These performance contexts are not isolated events, but rich and multilayered ecologies, involving audience, settings, and shared histories. Such skilled performance is therefore deeply *mindful*, both embodying and transmitting dynamic and culturally shared understandings of both the natural and the social world. The indigenous psychologies incorporated in haka performance are holistic, in that they are animated by a history that is dynamic and integrated with the environment. They are also thus vulnerable: the suppression or appropriation of indigenous practices, whether embodied in performance or in craft for example, leads to the disruption or loss not only of techniques and habits, of longstanding know-how, but also of the culturally shared declarative knowledge or wisdom embodied in those practices (Daniels 2005; Campbell 2014; Kelly 2015).

So, cultural dance traditions represent arcs of embodied knowledge transmission which have deep cognitive and affective effects on their practitioners. In most cases, as in haka, the movement practices exhibit extensive interdependencies with other cultural practices and concepts. The cultural meaning of haka, its history and applications, its variations and philosophies, are all large topics which we can't address further here (see Kāretu 1993; Hokowhitu 2014; Salmond 2012, 2017; Moorfield et al. 2013). Indigenous scholars have a primary role to play in this discussion, exploring a diversity of epistemological frames of references and methods gleaned through sustained, collaborative, engaged action (Smith 2012). The individualist views of mind and self which 4E cognitive theories reject and seek to replace were implicated in colonial political violence in Aotearoa New Zealand as elsewhere (Waitoki et al. 2018). By separating mind and memory from body, society, and environment, Western internalism in its applied forms underwrote active colonial damage, in justifying colonial resistance to indigenous socialisation into community narrative practices, systems of norms, and embodied skills. It backed colonial neglect or destruction of indigenous practices of enculturation within specific places and ecologies, and into the capacities and performances of remembering, such as haka, which

carried and transmitted embodied knowledge.<sup>5</sup> In this paper, we focus on aspects of the practice directly relevant to the philosophy of skilled performance. We see these enquiries into culturally-specific embodied performance both as directly relevant in their own right for a richer, expanded, more accurate cognitive theory, and also as groundwork for future attempts to build definite cultural and political awareness in to a more critical or engaged research program in 4E cognition (cf. Slaby 2016; Williams 2016; de Jaegher 2019).

### 3 Haka: history and performance features

Haka reflects and is embedded in the history and mythology of the Māori peoples. A full account of Haka would elaborate on other elements of Māori epistemology—such as concepts of mana, mauri and wairua—which are constitutive of the ‘intangible cultural knowledge’ implicit in haka performance (Henare 2001; Clemente 2017). In this section we offer a brief overview of haka, describing some further Western responses and misapprehensions, and some of its performance features.

Often described as a ‘posture dance’ accompanied by chanted or shouted song, haka is one genre of waiata (song or chant), which conveys a kaupapa (a message), ignited by the kā (the spark) and fuelled by the hā (the breath) (Smith 2017, p. 12). For Alan Armstrong in *Māori Games and Haka*,

The haka is a composition played by many instruments. Hands, feet, legs, body, voice, tongue and eyes all play their part in blending together to convey in their fullness the challenge, welcome, exultation, defiance or contempt of the words. It is disciplined, yet emotional. More than any other aspect of Māori culture, this complex dance is an expression of the passion, vigour and identity of the race. It is at its best, truly, a message of the soul expressed by words and posture. (Armstrong 1964, p. 119).

There are many different kinds of haka, each performed for different purposes and occasions. As Arapeta Awatere (1975, p. 513) writes, each haka has “its own

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<sup>5</sup> There is no inevitable or determining relation between theory of mind and political action (Sutton and Tribble 2012). Yet particular Western assumptions about body and mind, moral development, propriety, and cognitive discipline animated both the perceptions and the judgements of haka by early European visitors and settlers. Brendan Hokowhitu (2014) quotes a number of striking examples. On Cook’s third voyage, Thomas Edgar wrote of the Māori ‘war dance’ which ‘consists of a variety of violent motions and hideous contortions of the limbs. There is something in them so uncommonly savage and terrible, their eyes appear to be starting from their head, their tongue hanging down to their chin’ (in Hokowhitu 2014, p. 279). And in 1867, the *Wellington Independent* lamented that ‘Forty years of civilization ought to have taught these people decency, but scrape a Māori, the most civilised, and the savage shows distinctly underneath. The “Haka” is an *expose* of the evil which lies at the root of their present prostrate condition, an exhibition of the utter immorality, depravity, and obscenity, which forms the ground work of their race... we shall do nothing until we alter their entire character, by taking in hand the education, per force, of the young growing saplings’ (in Hokowhitu 2014, pp. 281–282). In Sect. 5 below we discuss a haka performance by high school students in the streets of Christchurch after the 2019 terror attacks on the Muslim community, a powerful counter to such a chilling colonial threat.

convention: its own style of actions, postures, accoutrements, and presentation, and fulfils a social function in a social situation". Haka are context- and function-specific, though also flexible and adaptable within these categories. The same haka, when performed in different circumstances, takes on different significance and has different effects on both performers and audience. The ethnographer Elsdon Best contrasted haka with European culture and customs:

Of all forms of amusement indulged in by the Māori in former times perhaps none were so much appreciated as the haka, or posture dance. The haka may be described as a series of rhythmical movements of limbs and body accompanied by a song, or at least by a series of short refrains. This recreation was indulged in frequently and by both sexes. Public feeling often found expression in the form of a haka, and they were organized in connection with a multitude of subjects. Where we write to the papers to ventilate or right some wrong or grievance, the Māori composes a haka directed against his detractor or opponent. Where we sedately shake hands with a party of guests on their arrival, the Māori chanted rhythmic refrains to them, accompanied by vigorous and equally rhythmical action: this as a welcome. These effusions were composed in connection with many matters. In some cases the arms alone were brought into play in time to the words; in others the legs and the whole body were violently exercised. The war-dance itself is really a haka performed with arms in hand (1974, p. 134).

This indicates the variety of social functions that haka were (and are) directed towards; although descriptions and translations of this kind, referring to 'amusements' or 'pastimes', fail to capture the full significance of the practice. As the late Hamana Mahuika of Ngāti Porou noted, haka was "not merely a pastime, but it was also a custom of high social importance in the welcoming and entertainment of visitors. Tribal reputation often rose or fell on their ability to perform the haka" (quoted in Kāretu 1993, p. 25). The performance of haka communicates and reveals more than may be gleaned from an outside view.

Historically, European exposure to haka often comprised equal parts awe and confusion. M. de Sainson, naval secretary and artist on board the French voyaging ship the *Astrolabe*, recorded his bewilderment in his diary after witnessing a haka in March, 1826:

Was it a battle song that they performed for us? The solemn, profound character of their music might lead us to think so; yet some of the movements seemed to be appropriate to a rendering of a lovers' contest. Be that as it may, whatever their intention, whether it be victory or love that they celebrate in this manner, the fact remains that they have a music of overwhelming force. (D'Urville 1950, p. 250).

Similarly, for Augustus Earle in 1827, a draughtsman on 'The *Beagle*',

The dances of all savage nations are beautiful, but those of the New Zealanders partake also of the horrible. The regularity of their movements is truly astonishing, and the song, which always accompanies a dance, is most harmonious.

They soon work themselves up to a pitch of phrensy; the distortions of their face and body are truly dreadful, and fill the mind with horror (1832, p. 70).

Such descriptions draw attention to the striking effects of haka, on both performers and audience; the affective arousal leading to a state of ‘phrensy’ in the performers and ‘horror’ in the unfamiliar audience. The assumption that haka is primarily a ‘war-dance’, performed to intimidate enemy audiences and motivate warriors before battle, encourages misinterpretation of the intensity and fierceness expressed in haka performed in other contexts as merely symbolic of, or referring to, these ‘war-dance’ origins. The early Europeans were at a loss to understand how a ‘war-dance’ could be performed as a ‘welcome’, as they could not understand, or differentiate, what was communicated through different haka. Such misunderstandings persist to this day, both on and off the rugby field.

So, what is the art of performing haka? Henare Tiowai of Ngāti Porou Iwi (tribe) responded to that question by saying ‘kia kōrero te katoa o te tinana’—‘the whole body should speak’ (Kāretu 1993, p. 22). In haka, words and actions are mutually reinforcing, such that the intended message of the performance may be conveyed in a fullness beyond mere verbal expression. As Māori scholar Nathan Matthews explains (2004, p. 14),

Haka are composed in a way that ensures that performers understand the meaning contained in the composition and, subsequently, allows the performers to resonate this meaning through physical performance. Complete understanding of the message contained in the haka can only be obtained by understanding the significance of the words and culture, and by having appropriate actions arranged and performed to reinforce those words. There should be a fierceness of action in the haka, punctuated by appropriate actions by the individual performer to express his own personality.

While some physical actions embody cultural concepts and are understood by all performers and culturally informed audiences—those with shared language and history—other actions are performed to emphasise and elaborate the words of the composition. Multiple layers of meaning are embedded into the actions and content of each haka, from specific genealogies and historical episodes to the representation of local environmental features. Although the driving force behind haka is the rhythmic unison of the performing group, there is also room for individual expression. The multimodal nature of haka allows multiple forms of self-expression within the collective expression. For example, the beat (ia/cadence, rhythm) should be kept constant by all performers through the stamping of the feet, just as the arms may slap the chest in perfect synchrony. But within these constant actions an individual performer may depart from the group for a moment, perhaps breaking from chanting every word, and express personality through their actions, for example by pūkana (wild staring or rolling the eyes), or whētero (protruding of the tongue). Such actions are complementary to the message of the composition and the actions

of the rest of the group.<sup>6</sup> Although the actions in haka are strong and fierce, they may have a friendly intent, depending on the circumstances of performance and the message of the specific composition. This is less of a contradiction between message and method than it may seem, and more of a difference in cultural forms and norms of expression.

In haka, full effort and energy are expected of all performers in every instance. Armstrong explains that “in haka the sentiment expressed may well be peaceful, but the actions must still be vehement to convey the requisite heartiness and sincerity. They must be crisp, decisive and purposeful” (1964, p. 123). These features of haka are fostered by socio-cultural expectations of active participation by all performers and acknowledged criteria for an effective performance which leave no room for lacklustre efforts. The effectiveness of a given performance is determined by the appropriate expressiveness of actions, in a specific performance context. This performance ecology is essentially interactional or relational, with uptake or reception being an intrinsic component of the performance event, as specified through the interrelated concepts of *ihi*, *wehi* and *wana*:

*Ihi* is a psychic power that elicits a positive psychic and emotional response from the audience. The response is referred to as *wehi*; a reaction to the power of the performance. *Wana* is the condition created by the combination of the elicitation of *ihi* and the reaction of *wehi* during performance; it is the aura that occurs during the performance and which encompasses both the performers and the audience. (Matthews 2004, p. 10).

These three concepts ground Māori performance ideals and aesthetic judgement, as each must be present for a performance to be considered worthwhile. Only an active performance, comprising full and intentional bodily performance, can have *wana*, arising on the basis of *ihi* and *wehi* (compare Hyland 2015). When Sandoval and colleagues ask whether the robots can capture the ‘spirit’ of haka, they intend to catch the energetic effect that is produced by the performers and felt by the audience. The concepts of *ihi*, *wehi* and *wana* address the relationship between the performer and audience—and the exchange of energies that may arise. The question then is, can the Robots’ haka possess *ihi*, elicit *wehi*, and form *wana*? Or, rather, what does it take for *wana* to emerge through the coordination dynamics of haka performance? And in what ecological setting could the RMH mimicry produce similar energetic effects on performer and audience? We return to these questions below.

Haka, though often perceived as ‘wild’ and ‘primitive’, are actually highly structured and disciplined performances. Haka performers develop refined sensorimotor

<sup>6</sup> The famous ‘Ka mate’ haka, for example, was originally composed as a *ngeri*, a “short haka to stiffen the sinews” and “to summon up the blood”. *Ngeri* are unlike haka *taparahi* (ceremonial haka) in that they do not have set actions, “thereby giving the performers free rein to express themselves as they deem appropriate” (Kāretu 1993, p. 41). This, incidentally, renders moot the ‘Robot Māori Haka’ programmers’ laborious decomposition of “each movement of Haka” so as to move the robot repeatedly “into the required posture and then recording the joints’ positions in the software” (Ser et al. 2016, p. 549) in order to “accurately preserve the original movements of the (Ka mate) Haka and teach it to new generations of New Zealanders and interested parties” (Sandoval et al. 2016, p. 512).

and cooperative skills expressed in coordinated actions that depend on the sharing of psychological states and intentions. In haka performance, the rhythm is first set by the verbal instructions of the leader, adopted and carried by the group through the temporally matched stamping of feet, and by singing or chanting accompanied by actions. Slapping the thighs in time, striking a posture, enacting a gesture, all happens in concert with the words of each haka. The sensorimotor coordination required to perform these rhythmic, percussive actions in time with a large group of people, while also chanting or shouting a poem, must be refined through practice and instruction. Additionally, a great deal of effort is required to ensure that each word is enunciated properly, and in time with the group. Breathing, phrasing, coordination and rhythm, are important and are trained accordingly; as the skilful performance of haka is a difficult feat.

Haka skills are developed within localised contexts, and reflect local features of (sub)culture and history—and in their very development inculcate into performers an expression of identity that reflects this situation. Each Iwi (tribe) and Hapū (sub-tribe) have haka specific to their history, their ancestors and landscapes. These specifics are reflected in the lyrics and the style of actions, as the different landscapes of Aotearoa make for different haka styles. Actions and gestures may refer to, or mimic, local features of the environment, incorporating defining landmarks into the performance and in this way expressing the identity of the performing group. By incorporating elements of the environment into a haka, the performance is not only a collective expression of shared identity, but also a way of communing with the environment that supports it, embodying and sustaining Māori relationships with the land (Clement 2017).

Here we focus on specific aspects of the performance practice which reveal features of minds in skilled performance: the significance of synchronised actions, the affective dimensions of performance, and the kinds of remembering that are cultivated through performance.

#### 4 Synchrony: keeping together in time

Collective behaviours and rituals, such as dancing, singing, and chanting, often unfold through coordinated actions in synchronized forms. Moving together in time and participating in synchronously coordinated activity in a group context has long been claimed to facilitate social bonding and enhance group cohesion (McNeill 1997). So, one natural initial feature of haka to investigate is how movement synchrony may influence and enhance performers' cognition and affect.

Introducing their experimental work on the effects of verbal synchrony on cooperation and cognition in large groups, von Zimmermann and Richardson (2016, p. 1) speculate that the haka (which they describe as “a traditional Māori war dance”) “might scare the enemy on the battlefield or rugby pitch, but it might also strengthen intragroup bonds and have a significant impact on the group's performance”. In line with this suggestion, their study found that verbal synchrony (chanting words together in a group) increased affiliation among participants, enhanced memory performance (recall of words), and improved participants' coordinated efforts in a

subsequent joint action task (video game). These findings join a growing array of studies on the socio-affective and cognitive dimensions of performing synchronous actions. Synchrony has been linked, for example, to higher levels of pro-sociality (defined as helpfulness, compassion, liking and cooperation) towards co-performers (Hove and Risen 2009; Reddish et al. 2013), and improved memory recall of co-performers' appearance and utterances (Macrae et al. 2008). Mogan et al. (2017) meta-analysis of synchrony's effects on behaviour, cognition, perception and affect, includes 42 independent studies (N=4327). Their systematic analysis of synchrony experiments found that, in comparison with non-synchronous conditions, synchronous movements and vocalisations: (1) increase prosocial behaviours, (2) enhance perceived social bonding, (3) improve social cognition, and (4) increase positive affect. They found "clear support that synchrony as exact behavioural matching increases social bonding behaviours, perceptions and social cognition over and above generally socially coordinated behaviour" (2017, p. 19).

Activities which feature synchrony can vary depending on the form and function of the exercise. Some activities are more physically demanding than others, requiring more effort and training to perform effectively. Haka performance demands high energy to enact its expressive intensity. It also requires high levels of cultural learning and social coordination, as all participants must deeply know the words, the actions, and how they work together. Multi-modal complexity is a defining characteristic of haka, in that multiple layers of activity occur at once: verbal synchrony in chanting the words, movement synchrony in stomping the feet in rhythm, and in the choreographed actions. Further, in haka, the performing group has the express intention of communicating a message through collective expression—the synchronous actions are not just performed for their effect on the performers themselves, but for the effect they have on the audience.

Movement rhythms have been shown to be an important source of information that observers use to infer the extent to which individuals are a social unit—known as 'perceived entitativity' (Lakens 2010). From the perspective of an audience, observing synchronous movements increases perceived rapport and enhances judgements about the interpersonal connectedness of the observed group (Miles et al. 2009; Lakens and Stel 2011). Merely listening to an audio recording of footsteps marching in synchrony increases assessments of the formidability and cohesion of the perceived group (Fessler and Holbrook 2016). For Māori, observing a haka performance (within their own tribal groups or watching other groups perform) is a way of assessing the dynamics of the group (Kāretu 1993). If the group performs in tight coordinated synchrony, with intensity and vigour, they are acknowledged to be a cohesive and formidable group. However, if a group demonstrates poor coordination during haka performance, lacking in energy or commitment, it may be taken as evidence of the group's lack of cohesion and indicative of weakness in their social coordination. Historically, these kinds of judgements would have been significant and instrumental, not only in the context of warfare, but also in everyday intertribal relations.

Further research on synchrony has examined how physical exertion itself may enhance social bonding and cooperation. Rhythmic and repetitive behaviours that require a high level of physical exertion produce mild euphoric effects

(sometimes labelled, for example, ‘runner’s high’), associated with the release of endorphins (commonly measured by changes in pain thresholds). In experiments with college rowers, Cohen et al. (2010) demonstrated that rowing as part of a group significantly increased participants’ pain thresholds in comparison to solo rowers. They matched individual and group conditions for levels of physical exertion (monitored via power output), so a difference between conditions would reflect the effect of performing in a group. The authors suggest that “the heightened effect in the group condition appears to have been owing in some way to the effect of working together as a highly coordinated team” (Cohen et al. 2010, p. 107). These findings have been replicated and extended by Tarr et al. (2015) in a group dance context; and in further studies by Sullivan and colleagues (Sullivan and Rickers 2013; Sullivan et al. 2015). These studies indicate that synchrony and exertion have independent positive effects on social bonding and pain thresholds (Tarr et al. 2015), and that activities which incorporate both features may produce an amplified effect.

Participating in synchronised actions produces measurable physiological and psychological effects. These effects of synchrony have not yet been introduced into the discussion around intangible cultural heritage—or the role robots could play in it. Human performers moving in synchrony are engaged in *social* motor coordination (Schmidt et al. 2011), they are responsive to each other as well as to an external beat. In contrast, each haka robot is on a programmed movement trajectory of its own. Human movement synchrony is hard to maintain, a dynamic equilibrium with constant recalibration and interdependence: there are no precise inbuilt timers in our motor system. Could synchronised robot performances, in any context, produce the socio-cognitive-affective effects suggested by this empirical research? Moreover, what impact do the socio-affective effects of synchronised actions have in the transmission of embodied knowledge? Should these effects be considered part of the knowledge itself? We expand on these questions in the remaining sections and offer preliminary responses in Sect. 7.

Turetzky (2002, p. 122) argues that the rhythmic features of haka “operate to augment the intensity of a haka’s power, increasing its many capacities... its capacity to draw the dancers together making them feel as one... its capacity to attract increasing numbers eventually drawing even strangers or potential enemies into its body, its capacity to increase the dancers’ degree of excitement, its capacity to heighten certain feelings appropriate to the function of a particular haka (feelings of joy, courage, or aggression, for example)”. These capacities are realised through the rhythms within the group performance, rhythms of synchrony and rest, steadfastness and crescendos, which extend outwards to incorporate the audience: “Intensities increase internally with the fierceness in a haka’s execution—with the precision and grace of the dancers—and externally with the approval and affective inclusion of the onlookers and, in the case of the war dance (the *peruperu*), with the degree of threat posed by the enemy” (Turetzky 2002, p. 122). The manipulation of movement rhythms in haka for their affective effects, on performer and audience, is a way of tailoring each performance to the unique performance occasion. Thus, part of the skill in performance of haka is in awareness of these affect/rhythm dynamics and their appropriate utilization.

## 5 Situated affect and feeling together

Dancing, singing and moving together in time give rise to emotional experiences that may be unavailable to individuals in other settings, such as communal experiences of ecstatic joy (Ehrenreich 2007). Historian William McNeill, in *Keeping Together in Time: Dance and Drill in Human History* (1997), considers how activities involving moving and feeling together in unison contribute to the maintenance of social bonds. Examining diverse cultural rituals and practices throughout history, McNeill proposes that “moving our muscles rhythmically and giving voice consolidate group solidarity by altering human feelings” (1997, p. viii).

Affect has increasingly been approached and studied as a social or group-level phenomenon (Tamminen et al. 2016; Barsade and Gibson 2012; von Scheve and Salmela 2014; Hufendiek 2020). The domain of affective phenomena (including feelings, emotions, and moods) can be treated in a manner consistent with externalist or distributed approaches in philosophy of cognition: “if the processes of believing, remembering, and decision-making in certain circumstances spread across neural, bodily, and environmental resources, the same may hold for grieving, loving, and other kinds of feeling” (Sutton 2018, p. 182). In contrast to traditions which view affective phenomena as wholly internal processes, distributed approaches see our affective experiences and our strategies of emotion-regulation as arising in coordination with the details of our complex socio-cultural environments, replete with artifacts and other agents, that enable and amplify, as well as shape and constrain, the realisation of affective states (Griffiths and Scarantino 2009; Krueger 2014; Colombetti and Krueger 2015; Colombetti and Roberts 2015; Slaby 2016). Social, technological, and material resources “play an ongoing role in scaffolding the real-time performance and experience of emotions” (Krueger 2016, p. 248).

We can begin to link these theoretical claims to the case of haka by way of Colombetti and Roberts’ account of emotions in expression and performance:

Occurrent moods and emotional episodes, unfolding over time, can be realized and structured through acts of musical or written expression, for example, in such a way that it does not make sense to single out the neural constituents as the privileged locus of the episode in question. The agent’s capacities for emotional feeling are enhanced in such an encounter; emotional experiences of hitherto-unattainable forms, depths, and clarity are made possible by an individual’s world-engaging performances. (Colombetti and Roberts 2015, p. 1260).

So, we can examine the dynamics of haka as a skilled communal performance ecology which expresses, enhances or transforms affective experiences. To tap features of haka as a social practice in which emotions are expressed and experienced, we can work with four features of situated or distributed emotions identified by Griffiths and Scarantino (2009, pp. 437–438):

## 5.1 Emotions function in a social context

Haka are composed and performed for context-specific and social purposes, whether in general celebrations or in demonstrating defiance. The act of performance creates a social context in which appropriate emotional expression and experience is not just socially accepted, but is expected, socially enhanced, collectively supported and meaningfully directed. For example, in the aftermath of the terrorist attack in Christchurch in March 2019, haka were performed by many community groups as a means of coordinating, amplifying, and managing support and sympathy for those affected. In one instance, a large group of school students assembled in the street outside the al-Noor mosque, where the attack had been committed. A vigil for the victims was underway, as the community mourned with their Muslim members. The scene was marked with sadness, but also with anger and fear, as flowers were laid and candles lit; gestures as statements of solidarity, objects and acts as expressions of emotion. Amidst this scene young students stood, when a sudden call cries out from their ranks—“Ōtautahi!” (Christchurch!)—which incites a collective response from the student group, “Maraka! Maraka!” (Rise up! Rise up!). The group springs forth in highly coordinated action and perform their haka—Tahu Pōtiki.<sup>7</sup> Their vigorous movements are imbued with the mood of the preceding moments; their tensions transformed and released as the dance builds. Their voices unify and resound in ferocious, yet disciplined, intensity. The students’ haka expresses their grief and anger, sadness and sympathy, but also defiance in the face of terrorism. Their haka articulates a challenge, to the community and to themselves, to be vigilant, like the ruru (owl), and remain resolute in their convictions—“Ōtautahi kia kaha, hi!”—“Christchurch be strong!”.

## 5.2 Emotions are forms of skilful engagement with the world that need not be mediated by conceptual thought

Bodily and socially coordinated skilful engagement in haka performance rouses affective responses which in themselves do not require conceptual or symbolic thought. In the bodily performance and expression of affect, there need not be a formalised or categorised conception of the emotion being expressed. For example, haka performed during funerals can be a collective expression of, and communion with, the grief and sorrow associated with loss.<sup>8</sup> In the process of performance, a complex mixture of feelings may find experience and expression and release, without having necessarily being articulated prior to the experience, or indeed fully articulable at all.

<sup>7</sup> Video ‘Students remembering mosque shooting victims’ [https://www.youtube.com/watch?v=HO\\_2ES4deY8](https://www.youtube.com/watch?v=HO_2ES4deY8). The Tahu Potiki haka, named for the ancestor of the local iwi (tribe) Ngai Tahu, had also been used widely in Christchurch in the wake of the destructive 2011 earthquakes in which 185 people died.

<sup>8</sup> An example can be seen here, in the video “In memory of Jarom Hadley Nathaniel Rihari. Haka ‘Tau Ka Tau.’” <https://www.youtube.com/watch?v=PdkC8hRoyj4>.

### 5.3 Emotions are scaffolded by the environment

Haka serves as an environmental scaffold for the ‘unfolding’ of emotions both at a time and over time. Synchronically, throughout the performance of haka, emotions ‘unfold’ in the moment-to-moment activity of the dance as directed by the social circumstances of the performance setting. Diachronically, the practice itself is a socio-cultural resource which provides emotional scaffolding for a range of different affective phenomena, and can be utilised at different times across the daily, weekly, and yearly calendar, towards different ends. The ways that haka performance can translate and enhance emotional experiences in specific places and contexts, at a range of timescales, is illustrated for example in Jim McKay’s (2013) study of New Zealand tourists at war memorials in Gallipoli, Turkey. ‘Anthony’, one participant in a ceremony at Chunuk Bair, recounts his experience (McKay 2013, p. 128):

It was when I went to where the Māori battalion had fought that it really struck home—these guys had actually given up their lives for us. That hit home and it hit me really hard. Then we did the haka and for some reason up there it was a surreal feeling. I just felt all emotional and looking out [at the national memorial] gave me a shiver that ran up my spine and I just opened up. I’d never felt anything like that—ever.

Another participant, ‘Hannah’, said that while she already knew that ‘what happened there... was pretty horrific’, before performing she had not ‘appreciated just how deeply that place and the haka was going to affect me. I can’t even put words to it now’. This example confirms the role of *place* in realising affective experiences through performed actions, and how the performance of haka works to channel and amplify affective phenomena.

### 5.4 Emotions are dynamically coupled to an environment which both influences and is influenced by the unfolding of the emotion

The dynamic coupling of emotion and environment is an important element of our account of haka performance. Consider first Joel Krueger’s work on ‘musical scaffolds’ and ‘emotional niche construction’. Krueger explains that one of the central ways we use music is to ‘actively manipulate social space’: “by selectively engineering our environments with music, it becomes part of a self-stimulating feedback loop that drives, structures, and regulates the development of various embodied processes responsible for emotional action and experience” (Krueger 2015, p. 49). Krueger draws our attention to the ‘materiality’ of music, as something that we use and do things with, that is also mediated by artifacts and environments that afford different uses. In this way, music is a material resource for constructing an emotional niche, “a soundworld deliberately used to modify, regulate, and sustain (i.e. scaffold) particular emotional episodes” (2015, p. 46). Krueger (2015) is primarily concerned with the active ways in which we listen to music, and how music-playing technologies allow for the ‘personalisation of public space’. This is a useful way

of approaching haka—even though it is an altogether different and unique kind of music.

Haka is a genre of song (*waiata*), a composition played with many instruments: hands, feet, legs, body, voice, tongue and eyes (Smith 2017; Armstrong 1964). So, the material dimensions of the Māori haka are the composed haka themselves (the choreographed songs) along with the embodied skills and coordinated activity of the performers. As for the vast majority of human history, music listening has been inextricably connected with music playing, and music playing has been an inherently social and participatory practice. If a culture's musical scaffolds are inherently participatory and social, then so will be the affective experiences they afford, as these experiences rely upon the coordination of the group for the scaffolded experience to remain available and effective. For Māori, the performance of haka plays a crucial role in setting the emotional scene of social engagements, but performances are also maintained by appropriate protocols in each setting, ensuring that they are carried out consistently and in accordance with cultural beliefs. The practice of haka therefore mutually supports both situated emotional engagements and the ongoing maintenance of the cultural forms and protocols which allow their expression. The flip side of this picture is that when aspects of material culture are lost, or destroyed by culture-stripping forces, the associated repertoire of emotional functions are also disrupted.

Return to the contrast with the Robot Māori Haka. The robots' haka performance does not involve an inwardly felt and outwardly expressed array of emotional experiences. But such experiences are central to determining the how and why of particular performances. Each performance of the same haka is a unique event in itself. Each performance is a psychological intervention by, for, and on the performer, the group, and the audience.

Contrast this with the nursery rhyme with accompanying actions, 'if you're happy and you know it (clap your hands)'. Robots could be programmed to reproduce the rhyme with the appropriate actions, and could foreseeably demonstrate this activity more or less successfully with a participating audience of human children. For this activity the robot does not need to possess emotions or the introspective ability to 'know' what it is 'feeling' in order to deliver a genuine expression of the rhyme. We need only for the robot to repeat what it has been programmed to do and say, and to do so clearly and comprehensibly. The participating children will do the feeling and the knowing, forming a hybrid human-machine system in which these simple emotion expressions find a place. This kind of robot 'performance' may be useful in a whole suite of practical activities when robots could be worthwhile interaction partners as tools or as prompts to human action. However, the RMH is more ambitious than this. And, Haka is more complicated than that. Rather than being a one-way performance activity *from* performer *to* audience, or even a call-and-response activity like the nursery rhyme example above, haka is "a conversation in which the audience is explicitly involved" (Hyland 2015, p. 24). The language of this conversation is multimodal, involving speech and gesture, and the performance context provides crucial information about the content or message of each performance. *Ihi*, *wehi* and *wana* are concepts which describe the energetic exchanges that are achieved in this kind of conversation. These features have distinct phenomenological profiles

relating to their visceral effects; for example, *wehi* is often associated with feeling a shiver going down the spine, hairs standing on end, and/or the urge to cry. In order for a robot to take part in such a conversation not only would their skilled bodily performance have to be convincing, but they would need to be responsive to the unique configuration of each performance context as well as the affective reaction of the audience. This is a substantial extension of the classic Turing test, and highlights the complexity of replicating culturally elaborate modes of communion.

## 6 Memory: putting the shared past into play by singing and moving

The past is ever-present in Māori culture. A range of practices reactivate the memory of the ancestral past and embody the knowledge that memory brings. From routine reflections in the passage of everyday events, as in *karakia* (incantations/ prayers) said before many daily activities, to the immersive power of mass re-enactments of historic battles and migrations, the past plays an active role in nearly all areas of Māori social life (McRae 2017). This is captured by the *whakataukī* (proverb)—*Kia whakatōmuri te haere whakamua*—which translates as ‘I walk backwards into the future with my eyes fixed on my past’ (Palmer 2017). The Māori oral tradition contains many mnemonic strategies for learning and recalling knowledge, and passing it down over the generations. Research in developmental psychology suggests that Māori adults remember events from earlier in their childhoods than adults in other cultural groups, perhaps as a result of the particular significance given to practices of reminiscing about the past in Māori families (Macdonald et al. 2000; Reese and Neha 2015). The various memory practices within the Māori ecology are mutually reinforcing, with each contributing to the maintenance of others, and to the goal of preserving the Māori way of life and the lessons of history. Hemoperiki Hoani Simon (2015) has called *haka* “cultural and collective memory in action”, as each performance revives a memory achieved through collaborative activity. Such practices fill out and form the epistemic and cognitive niche of a culture and community, affecting the ongoing development of subsequent generations by patterning their activities in ways that give access to experiences and expressions that are in contact with those of the past.

Nicola Hyland (2015, p. 69) sees *haka* as “a mode that both retains and contains the history” of the Māori people. Each *haka* composition is part of the cultural inheritance of Māori *iwi* (tribes) and the practice constitutes a vehicle for the transgenerational preservation of knowledge (history, genealogy, cosmogony, worldview). However, this preservation of knowledge is not ‘storage’ in an archival sense. It is not a matter of committing static information to stone—or programming specific motions in software. In practice, through the development of a physicality imbued with a history of movement choreography, connected to a specific environment and to ongoing relationships with it, modes of experience are cultivated which are otherwise unavailable. *Haka* cultivates a mode of collaborative remembering which emphasises the embodied and affective aspects of cultural memory. It is not just about what is remembered, but in what way, and in which contexts. The process is part of the content of inherited embodied knowledge systems: *what* is transmitted includes the

skills and abilities regrown as part of the collaborative education of attention in each generation (Ingold 2000, p. 5). Yet the active repertoire of cultural performance is not the simple opposite of the archive: rather, the archive and the repertoire, as Taylor puts it, ‘usually work in tandem’, in constant if often strained interaction (2003, p. 21). In particular scenarios (such as the Christchurch haka for the victims of the mosque attacks), patterned practices do not merely reproduce or duplicate past performances or recorded wisdom, but simultaneously reactivate, transmit, and embody afresh the meanings and knowledge incorporated in the history of performance. Or, in the language of the cognitive sciences of memory, we might say that declarative or explicit remembering and procedural or embodied remembering here operate together: *what* is known or remembered must itself be constructed or manufactured in and through performances in the moment which carry and reorganise the past in their rhythms (Bartlett 1932, pp. 201–202; Turetzky 2002, pp. 128–131; Sutton 2007; Sutton and Williamson 2014).

In ‘communities of memory’, such as families and tribes, the members “share in a certain habit-like memory, that is, the non-explicit, nearly invisible values, behaviors, and beliefs that are the geological deposit of enduring relationships. This habit-memory is itself a form of the persistence of the past; it is memory, but quite different from the active, deliberate work of recollection” (Booth 2006, pp. xi–xii). In haka, this shared form of habit-memory may be seen to operate underneath or alongside the deliberate work of remembering that also takes place in overtly commemorative performances, as well as in the recital of the learned composition. Greg Downey (2005, p. 85) illustrates this point in the context of the Afro-Brazilian martial dance tradition, capoeira, when discussing how capoeiristas ‘put the past into play by singing’:

songs in capoeira performance are not, from a phenomenological perspective, historical storage. Sung historical references do not primarily preserve information or recount a narrative. In fact, they are usually a meagre source of information and too poorly organised to serve as history. The sparse shifts in projection are too disorienting, the detail provided too sparse, and the jumble of the historical sequence during a game too confusing. The most salient experiential dimension of this form of remembering is the affective weight, the violent gravity that these events evoke. Historical references, like coaching, are an evocative form of applied poetry. A capoeirista does not sing in the *roda* primarily to remember; he or she remembers through song to feel the deeper truth of the game.

Haka function as commemorative vehicles; as a means of engaging with cultural history in the present. Although the specific message of a given haka may be directed at a local, political event or context, the practice itself, through its physicality and forms, re-capitulates the Māori forms of the past and commemorates their place in the present. Haka are performed to maintain the ancestral past and the established connections with land and ancestry. Through the re-enactment of ancestral events and the retelling of stories of creation and loss, the bonds with lands and waters are maintained, the interdependence of these relationships are reinforced, along with tribal and personal identity—as *tangata whenua*, people of the land, and the

responsibilities that these relations entail. The Māori past is embodied in haka, and in this way it persists; in the performers and their refined abilities, in the physical and lyrical forms of the practice, and in the recursive exhibition of cultural concepts, genealogy and philosophy, as embedded in the formal and structural features of the practice. As a practice of memory, interdependent with and mutually supportive of the rest of the Māori cognitive ecology, haka unifies the collective and instantiates cultural concepts, in an elaborated process of physical, spiritual and cultural education that is put to service in the wide variety of socio-cultural occurrences in everyday life.

Each haka is a composition, comparable to an annotated song, though retained in cultural memory and custom rather than stored in print. Each composition is a cultural artefact, and each performance engages with or realises the function of the composition as it applies to the particular setting of each new performance. Its transmission over communities and across generations is the transmission of a practice that prescribes particular kinds of bodily engagements in a shared social space. Following Krueger (2016), we can see musical and movement practices such as haka as forms of ‘intergenerational scaffolding’ which afford the inhabiting of shared inherited ‘soundworlds’, with their associated affective states. The inheritance of the scaffolds that provide access to specific forms of experience and expression is an underappreciated form of cultural and cognitive inheritance and transmission.

## 7 Enculturated skills and the robot haka

Examining haka performance through the lens of 4E cognitive skill theory, we suggest, brings benefits both ways. In discussing the effects of synchrony, the social and environmental scaffolding of emotion, and the multilayered relations between past and present, we begin a dialogue between worlds and projects. We hope that collaborative and careful engagement in that dialogue by cognitive researchers, indigenous scholars, and haka performers can produce mutual benefits across independently-motivated but newly-interactive projects. On the one hand, attention to the complex Māori world in which haka performance is deeply embedded can test, refine, and expand cognitive theory across many domains, such as the cases of joint action, affect, and memory on which we’ve focussed here: the widespread 4E urge to study rich and full cognitive *ecologies* (Hutchins 2010; Sutton 2015) can be satisfied and sharpened in collaborative theoretical and ethnographic work informed not only by work on cumulative culture and embodied cognition but also by decolonising methodologies (Smith 2012). In turn, on the other hand, 4E cognition may afford novel perspectives on the enculturation and performance of the remarkable skills of haka practitioners: in particular, attention to the genuinely *mindful* features of skilled performance and the ways that moving can thus carry thinking and remembering may help to satisfy and sharpen cross-cultural understanding of the seamless integration of movement, meaning, affect, and memory in this and other Māori cultural practices.

We have sought to show how deeply haka is embedded in a broader ecology of cultural practices. Learning particular skills in such a context is a matter of

deep enculturation, a matter of ‘becoming a certain person—a knower in a context where what it means to know is negotiated with respect to the regime of competence of a community’ (Wenger 2010, p. 181). It is not the maintenance either of a fixed doctrine or of mechanical movement sequences that carries a community of this kind: rather, enculturated training works by ‘certain modes of co-participation in which it [the training] is embedded’ (Hanks 1991, p. 15). As Charles Goodwin puts in, we can come to ‘inhabit each other’s actions’ through the ‘progressive development of, and apprenticeship within, diverse epistemic ecologies’, as communities ‘invest their members with the resources required to understand each other in just the ways that make possible the accomplishment of ongoing, situated action’ (2013, p. 8). So, such collaborative cultural processes and systems are fragile, always dynamic and often vulnerable. With this take on enculturated skill in mind, it is time we returned to the robots.

The claim that robots could be sufficient to provide future anthropologists with a ‘clear idea’ about human cultural practices, such that “even if the last human being vanishes from the world, the human culture would not” (Sandoval et al. 2016, p. 512), reflects an impoverished conception of what constitutes ‘human culture’ and skilled performance. As it stands, the RMH case continues a tradition of misdiagnosing and then misappropriating haka, running the risk of reducing complex cultural phenomena to robotic caricature. The robot haka lacks many crucial features, some of which reflect limitations in the current technology and physical capabilities, such as lacking facial expressions and fluid mobility, others an inability to tap the intangible benefits of participation in haka, achieved through synchrony and affective intensity, and others which are more contextual, such as the ecological aspects of each performance which determine the how (and why) of each haka.

The Robotology proposal for ‘cultural preservation’ challenges us to a comprehensive, integrative and collaborative response; for robots to be able to ‘represent, record, perform, and teach’ cultural practices, such simple models will not do. The ‘embodied’ and ‘situated’ turns in AI research are moves in the right direction—the next great step is to recognise the contributions of enculturation, and how it is incorporated in bodies, situations and minds. ‘Cultural Robotics’, as described by Bennett and Eglash (2013, p. 336), acknowledges these challenges:

...in order to successfully integrate robots into social contexts ... roboticists will need collaboration with both the users and with other multidisciplinary experts so the cultural differences in many dimensions (ethnic, economic, religious, etc.) can be taken into account. Humans differences in languages, visual understanding, body conceptions, and myriad other modalities will influence the way they decode the meaning of a designed form, and that will in turn affect their experience with the designed form.

Coding ‘meaning’ into robot behaviours is a project that depends fundamentally on cultural participation. The RMH project misconceives what is intangible about cultural traditions like haka, and so misidentifies the features that would need to be preserved in order to accurately archive or transmit and deliver them to the future.

## 8 Conclusion: methods, culture, and embodied skill

Reflecting on the status of haka at the end of the twentieth century, Kāretu (1993, p. 87) wrote:

Haka will survive well into the next millennium because it still continues to provide a platform for the composer to vent his spleen, to sing someone's praises, to welcome his guests, to open his new meeting house or dining hall, to pay his respects to his dead, to honour his ancestors, to teach his traditions to the succeeding generations. While the language continues to survive so will haka continue to be composed.

Haka survives because of the things that it does. As an avenue of expression and experience, haka remains relevant and valuable because of its effectiveness. As Nicola Hyland (2019, p. 258) notes, “the haka does not just say/show something—it does something”, it “engenders” rather than “represents” the message of the performance. Such ritual practices do not require exact same-ness over time to be effective. Tradition-based ritual is compatible with modification and innovation, as what matters is the way performances are conducted; it is conducted in unique scenarios that “makes manifest the spirit of ritualized activity which, without this spirit, falls into the emptiness of bare repetition” (Casey 2000, p. 228). The directive to ‘make the whole body speak’ in haka cannot be achieved through lacklustre efforts, just as the coordination required to be in unison with the group demands great effort, leaving little room for divided attention or mindless participation. Haka does not persist through hollow repetition, but through the intentional use and re-use of the practice and the benefits it affords. As in contemporary Kapa Haka practice, it may be applied to new problems, and updated to suit new settings, while maintaining the key, unifying features of the underlying orientation and actions, as sanctioned by the culture.

Māori cultural exponents have embraced new technologies to aid in the preservation of cultural knowledge and history. ‘Ngā Taonga’ is an online example that archives recordings of haka and waiata and speeches—and reflects efforts to archive with digital technology (Ka’ai-Mahuta 2012). However, the RMH and Robotology proposal is more ambitious than a digitised library. It proposes that the robotic haka could be sufficient to preserve the intangible aspects of Māori cultural knowledge that are implicit in haka performance. This proposal mistakes haka for mere movement which can be replicated, and words that can be recorded. However, robot ‘performance’ cannot embody or transmit intangible cultural heritage in the same ways that enculturated human learning and performance can. Haka is a dynamic practice; it is not a static ‘dance’ akin to the choreographed performances that accompany popular songs.<sup>9</sup> There may still be roles for robots in the archival aspirations of

<sup>9</sup> Examples of popular choreographed dances which robots have been programmed to ‘perform’ include, ‘Single ladies’ by Beyoncé <https://youtu.be/vgEFC8Eb6i4> and ‘Gangnam Style’ by Psy <https://youtu.be/51vQo-ime4Q>.

human societies, but this role will not be in replicating the complex suite of activities that constitute our most culturally elaborate forms of communion.

The preservation of human culture has always involved both archives and repertoires, both technologies and performances (Donald 1991; Taylor 2003). We hope to have shown in this paper that the practice and performance of haka is the preservation of Māori embodied knowledge in action and is a process that cannot simply be offloaded to robots. Greater recognition of the embodied, interpersonal and historical foundations of ‘culture and cognition’ can lead to promising new directions for the study of minds in skilled performance—and also for robotics and AI research. We hope to have highlighted the potential of cross-cultural engagements in 4E cognitive theory, and to have indicated the epistemic potency of haka. The tools and technologies that help tell the stories of our shared and disparate pasts play significant roles in crafting our future histories and the ways we engage with them. Therefore, we would be wise to attend to and care about what is gained and lost with each new technique for telling old stories.

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## Compliance with ethical standards

**Conflict of interest** The Authors declare that there are no conflicts of interest, or competing interests, present in this work.

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## References

- Armstrong, A. (1964). *Māori games and hakas: Instructions, words, and actions*. Wellington: AH & AW Reed.
- Awatere, A. (1975). Review of Mitcalfe (1974), Maori poetry: The singing word. *Journal of the Polynesian Society*, 84(4), 510–519.
- Barsade, S. G., & Gibson, D. E. (2012). Group affect: Its influence on individual and group outcomes. *Current Directions in Psychological Science*, 21(2), 119–123. <https://doi.org/10.1177/0963721412438352>.
- Bartlett, F. C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge: Cambridge University Press.
- Bennett, A., & Eglash, R. (2013). Cultural robotics: On the intersections of identity and autonomy in people and machines. *Revista Teknokultura*, 10(2), 327–350. [https://doi.org/10.5209/rev\\_TK.2013.v10.n2.48254](https://doi.org/10.5209/rev_TK.2013.v10.n2.48254).
- Best, E. (1974). *The Māori as he was: A brief account of Māori life as it was in pre-European days* (Rev). Wellington: Government Printer.

- Booth, W. J. (2006). *Communities of memory: On witness, identity, and justice*. Ithaca: Cornell University Press.
- Brawer, J., Hill, A., Livingston, K., Aaron, E., Bongard, J., & Long, J. H. (2017). Epigenetic operators and the evolution of physically embodied robots. *Frontiers in Robotics and AI*. <https://doi.org/10.3389/frobt.2017.00001>.
- Campbell, S. (2014). *Our faithfulness to the past: The ethics and politics of memory*. New York: Oxford University Press.
- Casey, E. S. (2000). *Remembering: A phenomenological study*. Bloomington: Indiana University Press.
- Chella, A. (2019). Rilkean memories and the self of a robot. *Philosophies*, 4(2), 20. <https://doi.org/10.3390/philosophies4020020>.
- Clark, A. (1997). *Being there: Putting brain, body, and world together again*. Cambridge: MIT Press.
- Clément, V. (2017). Dancing bodies and Indigenous ontology: What does the haka reveal about the Māori relationship with the Earth? *Transactions of the Institute of British Geographers*, 42(2), 317–328. <https://doi.org/10.1111/tran.12157>.
- Cohen, E. E., Ejsmond-Frey, R., Knight, N., & Dunbar, R. I. (2010). Rowers' high: Behavioural synchrony is correlated with elevated pain thresholds. *Biology Letters*, 6(1), 106–108. <https://doi.org/10.1098/rsbl.2009.0670>.
- Colombetti, G., & Krueger, J. (2015). Scaffoldings of the affective mind. *Philosophical Psychology*, 28(8), 1157–1176. <https://doi.org/10.1080/09515089.2014.976334>.
- Colombetti, G., & Roberts, T. (2015). Extending the extended mind: The case for extended affectivity. *Philosophical Studies*, 172(5), 1243–1263. <https://doi.org/10.1007/s11098-014-0347-3>.
- Daniel, Y. (2005). *Dancing wisdom: Embodied knowledge in Haitian vodou, Cuban yoruba, and Bahian candomblé*. Urbana: University of Illinois Press.
- De Jaegher, H. (2019). Loving and knowing: Reflections for an engaged epistemology. *Phenomenology and the Cognitive Sciences*. <https://doi.org/10.1007/s11097-019-09634-5>.
- Donald, M. (1991). *Origins of the modern mind: Three stages in the evolution of culture and cognition*. Cambridge: Harvard University Press.
- Downey, G. (2005). *Learning capoeira: Lessons in cunning from an Afro-Brazilian art*. New York: Oxford University Press.
- D'Urville, D. (1950). *New Zealand 1826–1827: From the French of Durmont D'Urville—An english translation of the voyage de l Astrolabe in NZ waters* (O. Wright, Ed.). Wellington: Wingfield Press.
- Earle, A. (1832). *A narrative of nine months' residence in New Zealand in 1827: Together with a journal of residence in Tristan D'Acunha*. London: Longman Rees.
- Ehrenreich, B. (2007). *Dancing in the streets: A history of collective joy*. New York: Metropolitan Books.
- Fessler, D. M. T., & Holbrook, C. (2016). Synchronized behavior increases assessments of the formidability and cohesion of coalitions. *Evolution and Human Behavior*, 37(6), 502–509. <https://doi.org/10.1016/j.evolhumbehav.2016.05.003>.
- Fischer, R., Callander, R., Reddish, P., & Bulbulia, J. (2013). How do rituals affect cooperation? An experimental field study comparing nine ritual types. *Human Nature*, 24(2), 115–125. <https://doi.org/10.1007/s12110-013-9167-y>.
- Gemeinboeck, P. (2019). Dancing with the nonhuman. In J. Bennett & M. Zournazi (Eds.), *Thinking in the world*. London: Bloomsbury Academic.
- Goodwin, C. (2013). The co-operative, transformative organization of human action and knowledge. *Journal of Pragmatics*, 46(1), 8–23. <https://doi.org/10.1016/j.pragma.2012.09.003>.
- Griffiths, P., & Scarantino, A. (2009). Emotions in the wild. In P. Robbins & M. Aydede (Eds.), *The Cambridge handbook of situated cognition* (pp. 437–453). Cambridge: Cambridge University Press.
- Hanks, W. F. (1991). Foreword. In J. Lave & E. Wenger (Eds.), *Situated learning: Legitimate peripheral participation* (pp. 13–24). Cambridge: Cambridge University Press.
- Hapeta, J., Palmer, F., & Kuroda, Y. (2018). Ka Mate: A commodity to trade or taonga to treasure? *MAI Journal: A New Zealand Journal of Indigenous Scholarship*. <https://doi.org/10.20507/maijournal.2018.7.2.5>.
- Henare, M. (2001). Tapu, Mana, Mauri, Hau, Wairua. In J. A. Grim (Ed.), *Indigenous traditions and ecology: The interbeing of cosmology and community* (pp. 197–221). Cambridge: Harvard University Press.
- Hokowhitu, B. (2009). Māori rugby and subversion: Creativity, domestication, oppression and decolonization. *The International Journal of the History of Sport*, 26(16), 2314–2334. <https://doi.org/10.1080/09523360903457023>.

- Hokowhitu, B. (2014). Haka: Colonized physicality, body-logic, and embodied sovereignty. In L. Graham & G. Penny (Eds.), *Performing indigeneity: Global histories and contemporary experiences* (pp. 273–304). Lincoln: University of Nebraska Press.
- Hove, M. J., & Risen, J. L. (2009). It's all in the timing: Interpersonal synchrony increases affiliation. *Social Cognition*, 27(6), 949–960.
- Hufendiek, R. (2020). Emotions, habits, and skills: Action-oriented bodily responses and social affordances. In I. Testa & F. Caruana (Eds.), *Habits: Pragmatist approaches from cognitive neurosciences to social sciences* (pp. 100–119). Cambridge: Cambridge University Press.
- Hutchins, E. (1995). *Cognition in the wild*. Cambridge: MIT Press.
- Hutchins, E. (2010). Cognitive ecology. *Topics in Cognitive Science*, 2(4), 705–715. <https://doi.org/10.1111/j.1756-8765.2010.01089.x>.
- Hyland, N. (2015). Beyoncé's response (eh?): Feeling the *ihi* of spontaneous haka performance in Aotearoa/New Zealand. *TDR/The Drama Review*, 59(1), 67–82.
- Hyland, N. (2019). The message is Māori: The politics of Haka in performance. In P. Eckersall & H. Graham (Eds.), *The Routledge companion to theatre and politics* (pp. 257–260). London: Routledge.
- Ingold, T. (2000). *The perception of the environment: Essays on livelihood, dwelling and skill*. London: Routledge.
- Jackson, S. J., & Hokowhitu, B. (2002). Sport, tribes, and technology: The New Zealand All Blacks' haka and the politics of identity. *Journal of Sport and Social Issues*, 26(2), 125–139. <https://doi.org/10.1177/0193723502262002>.
- Ka'ai-Mahuta, R. (2012). The use of digital technology in the preservation of Māori song. *Te Kaharoa*. <https://doi.org/10.24135/tekaharoa.v5i1.98>.
- Kāretu, T. (1993). *Haka: The dance of noble people*. Auckland: Reed.
- Kelly, L. (2015). *Knowledge and power in prehistoric societies: Orality, memory and the transmission of culture*. Cambridge: Cambridge University Press.
- Konvalinka, I., Xygalatas, D., Bulbulia, J., Schjødt, U., Jegindø, E.-M., Wallot, S., & Roepstorff, A. (2011). Synchronized arousal between performers and related spectators in a fire-walking ritual. *Proceedings of the National Academy of Sciences*, 108(20), 8514–8519. <https://doi.org/10.1073/pnas.1016955108>.
- Krueger, J. (2014). Emotions and the social niche. In C. von Scheve & M. Salmela (Eds.), *Collective emotions: Perspectives from psychology, philosophy, and sociology* (pp. 156–171). New York: Oxford University Press.
- Krueger, J. (2015). Musicing, materiality, and the emotional niche. *Action, Criticism, and Theory for Music Education*, 14(3), 43–62.
- Krueger, J. (2016). Extended mind and religious cognition. In N. K. Clements (Ed.), *Religion: Mental religion* (pp. 237–254). Farnington Hills: Macmillan Reference USA.
- Lakens, D. (2010). Movement synchrony and perceived entitativity. *Journal of Experimental Social Psychology*, 46(5), 701–708. <https://doi.org/10.1016/j.jesp.2010.03.015>.
- Lakens, D., & Stel, M. (2011). If they move in sync, they must feel in sync: Movement synchrony leads to attributions of rapport and entitativity. *Social Cognition*, 29(1), 1–14. <https://doi.org/10.1521/soco.2011.29.1.1>.
- Lara, B., Astorga, D., Mendoza-Bock, E., Pardo, M., Escobar, E., & Ciria, A. (2018). Embodied cognitive robotics and the learning of sensorimotor schemes. *Adaptive Behavior*, 26(5), 225–238. <https://doi.org/10.1177/1059712318780679>.
- Legare, C. H. (2019). The development of cumulative cultural learning. *Annual Review of Developmental Psychology*, 1, 119–147. <https://doi.org/10.1146/annurev-devpsych-121318>.
- MacDonald, S., Uesiliana, K., & Hayne, H. (2000). Cross-cultural and gender differences in childhood amnesia. *Memory*, 8, 365–376. <https://doi.org/10.1080/09658210050156822>.
- Macrae, C. N., Duffy, O. K., Miles, L. K., & Lawrence, J. (2008). A case of hand waving: Action synchrony and person perception. *Cognition*, 109(1), 152–156. <https://doi.org/10.1016/j.cognition.2008.07.007>.
- Matthews, N. (2004). The physicality of Māori message transmission—Ko te tinana, he waka tuku kōrero. *Junctures: The Journal for Thematic Dialogue*, (3), 9–18. Retrieved from <https://ourarchive.otago.ac.nz/handle/10523/5157>.
- Mazer, S. (2011). Performing Māori: Kapa Haka on the stage and on the ground. *Popular Entertainment Studies*, 2(1), 41–53. Retrieved from <https://novaajs.newcastle.edu.au/ojs/index.php/pes/article/view/44/30>.

- McGeer, V. (2018). Intelligent capacities. *Proceedings of the Aristotelian Society*, 118(3), 4–29. <https://doi.org/10.1093/arisoc/aoy017>.
- McKay, J. (2013). ‘We didn’t want to do a dial-a-haka’: Performing New Zealand nationhood in Turkey. *Journal of Sport and Tourism*, 18(2), 117–135. <https://doi.org/10.1080/14775085.2013.846229>.
- McNeill, W. H. (1997). *Keeping together in time: Dance and drill in human history*. Cambridge: Harvard University Press.
- McRae, J. (2017). *Māori oral tradition: He Kōrero nō te Ao Tawhito*. Auckland: Auckland University Press.
- Menary, R. (2007). *Cognitive integration: Mind and cognition unbounded*. Basingstoke: Palgrave Macmillan.
- Miles, L. K., Nind, L. K., & Macrae, C. N. (2009). The rhythm of rapport: Interpersonal synchrony and social perception. *Journal of Experimental Social Psychology*, 45(3), 585–589. <https://doi.org/10.1016/j.jesp.2009.02.002>.
- Mogan, R., Fischer, R., & Bulbulia, J. A. (2017). To be in synchrony or not? A meta-analysis of synchrony’s effects on behavior, perception, cognition and affect. *Journal of Experimental Social Psychology*, 72, 13–20. <https://doi.org/10.1016/j.jesp.2017.03.009>.
- Moorfield, J., Ka’ai, T., & Ka’ai-Mahuta, R. (Eds.). (2013). *Kia Rōnaki: The Māori Performing Arts* (1st ed.). Auckland: Pearson New Zealand.
- Newen, A., De Bruin, L., & Gallagher, S. (Eds.). (2018). *The Oxford handbook of 4E cognition*. Oxford: Oxford University Press.
- Palmer, F. R. (2017). Stories of Haka and women’s rugby in Aotearoa New Zealand: Weaving identities and ideologies together. *The International Journal of the History of Sport*, 33(17), 2169–2184. <https://doi.org/10.1080/09523367.2017.1330263>.
- Pihama, L., Tipene, J., & Skipper, H. (2014). *Nga Hua a Tane Rore: The benefits of kapa haka*. (Report). Wellington: Manatū Taonga, Ministry for Culture and Heritage. <https://hdl.handle.net/10289/12603>.
- Prescott, T. J., Camilleri, D., Martinez-Hernandez, U., Damianou, A., & Lawrence, N. D. (2019). Memory and mental time travel in humans and social robots. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 374(1771), 20180025. <https://doi.org/10.1098/rstb.2018.0025>.
- Reddish, P., Fischer, R., & Bulbulia, J. (2013). Let’s dance together: Synchrony, shared intentionality and cooperation. *PLoS ONE*, 8(8), e71182. <https://doi.org/10.1371/journal.pone.0071182>.
- Reese, E., & Neha, T. (2015). Let’s korero (talk): The practice and functions of reminiscing among mothers and children in Māori families. *Memory*, 23(1), 99–110. <https://doi.org/10.1080/09658211.2014.929705>.
- Rudhru, O., Ser, Q. M., & Sandoval, E. (2016). Robot Māori Haka: Robots as cultural preservationists. In *The eleventh ACM/IEEE international conference on human robot interaction* (p. 569). Christchurch, New Zealand: IEEE Press. <https://doi.org/10.1109/HRI.2016.7451860>.
- Salmond, A. (2012). Ontological quarrels: Indigeneity, exclusion and citizenship in a relational world. *Anthropological Theory*, 12(2), 115–141. <https://doi.org/10.1177/1463499612454119>.
- Salmond, A. (2017). *Tears of Rangī: Experiments across worlds*. Auckland: Auckland University Press.
- Sandoval, E. B., Rudhru, O., & Ser, Q. M. (2016). The birth of a new discipline: Robotology. A first robotologist study over a robot Māori Haka. In *The eleventh ACM/IEEE international conference on human robot interaction*, (pp. 511–512). Christchurch, New Zealand: IEEE Press. <https://doi.org/10.1109/HRI.2016.7451831>.
- Schmidt, R. C., Fitzpatrick, P., Caron, R., & Mergeche, J. (2011). Understanding social motor coordination. *Human Movement Science*, 30(5), 834–845. <https://doi.org/10.1016/j.humov.2010.05.014>.
- Ser, Q. M., Rudhru, O., & Sandoval, E. B. (2016). Robot Māori haka. In *The eleventh ACM/IEEE international conference on human robot interaction* (p. 549). Christchurch, New Zealand: IEEE Press. <https://doi.org/10.1111/j.1835-9310.2000.tb00049.x/epdf>.
- Simon, H. (2015). Me haka i te haka a Tānerore? Māori ‘post-war culture and the place of haka in commemoration at Gallipoli. *Australasian Canadian Studies*, 32(1–2), 83–137. Retrieved from <http://ro.uow.edu.au/lhapapers/2971/>.
- Slaby, J. (2016). Mind invasion: Situated affectivity and the corporate life hack. *Frontiers in Psychology*, 7, 266. <https://doi.org/10.3389/fpsyg.2016.00266>.
- Smith, L. T. (2012). *Decolonizing methodologies: Research and indigenous peoples* (2nd ed.). London: Zed Books.
- Smith, V. (2017). Energizing everyday practices through the indigenous spirituality of haka. *Journal of Occupational Science*, 24(1), 9–18. <https://doi.org/10.1080/14427591.2017.1280838>.

- Sterelny, K. (2012). *The evolved apprentice: How evolution made humans unique*. Cambridge: MIT Press.
- Sullivan, P., Gagnon, M., Gammage, K., & Peters, S. (2015). Is the effect of behavioral synchrony on cooperative behavior mediated by pain threshold? *Journal of Social Psychology*, 155(6), 650–660. <https://doi.org/10.1080/00224545.2015.1071766>.
- Sullivan, P., & Rickers, K. (2013). The effect of behavioral synchrony in groups of teammates and strangers. *International Journal of Sport and Exercise Psychology*, 11(3), 286–291. <https://doi.org/10.1080/1612197x.2013.750139>.
- Sutton, J. (2007). Battering, habit and memory: The embodied mind and the nature of skill. *Sport in Society*, 10(5), 763–786. <https://doi.org/10.1080/17430430701442462>.
- Sutton, J. (2015). Remembering as public practice: Wittgenstein, memory, and distributed cognitive ecologies. In D. Moyal-Sharrock, A. Coliva, & V. Munz (Eds.), *Mind, language, and action: Proceedings of the 36th international Wittgenstein symposium* (pp. 409–443). Berlin: Walter de Gruyter.
- Sutton, J. (2018). Shared remembering and distributed affect: Varieties of psychological interdependence. In K. Michaelian, D. Debus, & D. Perrin (Eds.), *New directions in the philosophy of memory* (pp. 181–199). London: Taylor and Francis.
- Sutton, J., & Keene, N. (2017). Cognitive history and material culture. In C. Richardson, T. Hamling, & D. Gaimster (Eds.), *The Routledge handbook of material culture in early modern Europe* (pp. 46–58). London: Routledge.
- Sutton, J., & Tribble, E. B. (2012). Materialists are not merchants of vanishing. In *Early modern culture: An electronic seminar*, 9.
- Sutton, J., & Williamson, K. (2014). Embodied remembering. In L. Shaprio (Ed.), *The Routledge handbook of embodied cognition* (pp. 315–325). Abingdon: Taylor and Francis Group. <https://doi.org/10.4324/9781315775845>.
- Sweetman, L. E., & Zemke, K. (2019). Claiming Ka Mate: Māori cultural property and the nation's stake. In F. Gunderson, R. C. Lancefield, & B. Woods (Eds.), *The Oxford handbook of musical repatriation* (pp. 700–722). Oxford: Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780190659806.013.38>.
- Tamminen, K. A., Palmateer, T. M., Denton, M., Sabiston, C., Crocker, P. R. E., Eys, M., & Smith, B. (2016). Exploring emotions as social phenomena among Canadian varsity athletes. *Psychology of Sport and Exercise*, 27, 28–38. <https://doi.org/10.1016/j.psychsport.2016.07.010>.
- Tarr, B., Launay, J., Cohen, E., & Dunbar, R. (2015). Synchrony and exertion during dance independently raise pain threshold and encourage social bonding. *Biology Letters*. <https://doi.org/10.1098/rsbl.2015.0767>.
- Taylor, D. (2003). *The archive and the repertoire: Performing cultural memory in the Americas*. Durham: Duke University Press.
- Turetzky, P. (2002). Rhythm: Assemblage and event. *Strategies*, 15(1), 54–78. <https://doi.org/10.1080/1040213022012788>.
- United Nations Educational, Scientific and Cultural Organisation. (2018). *Basic texts of the 2003 convention for the safeguarding of the intangible cultural heritage*. France: UNESCO.
- von Scheve, C., & Salmela, M. (Eds.). (2014). *Collective emotions: Perspectives from psychology, philosophy, and sociology*. New York: Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780199659180.001.0001>.
- von Zimmermann, J., & Richardson, D. C. (2016). Verbal synchrony and action dynamics in large groups. *Frontiers in Psychology*, 7, 1–10. <https://doi.org/10.3389/fpsyg.2016.02034>.
- Waitoki, W., Dudgeon, P., & Nikora, L. W. (2018). Indigenous psychology in Aotearoa/New Zealand and Australia. In S. Fernando & R. Moodley (Eds.), *Global psychologies: Mental health and the global South* (pp. 163–184). London: Palgrave Macmillan.
- Wenger, E. (2010). Communities of practice and social learning systems: The career of a concept. In C. Blackmore (Ed.), *Social learning systems and communities of practice* (pp. 179–198). London: Springer.
- Williams, J. (2016). Do no harm: The extended mind model and the problem of delayed damage. *Sophia*, 55(1), 71–82. <https://doi.org/10.1007/s11841-016-0515-3>.
- Ziemke, T. (2016). The body of knowledge: On the role of the living body in grounding embodied cognition. *BioSystems*, 148, 4–11. <https://doi.org/10.1016/j.biosystems.2016.08.005>.

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