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Abstract

He kino tokomaha ki te kai i ngā kai. Tēnā kia tū ki te mahi, ka aha hoki?

When it is time to eat, there are many. When it is time to work, what then?

For Human-Computer Interaction (HCI) practitioners, interacting with people is a fundamental part of our work. When running any kind of user study, it is important to critically consider any ethical or cultural biases that we (or our data or methods) may have. While this is not a new consideration, the introduction of wearable technology has introduced new aspects to user studies which may not have been apparent previously. In this paper, we present a wearable technology-based user study as a case study to highlight cultural and ethical considerations. Cultural considerations centre on both the cultural considerations that should be made towards participants and considerations for their data. Ethical considerations centre on the immediate impact on participants' privacy and agency and the longer-term impact on their mental and physical safety. Finally, we suggest that in situations where cultural and racial disparities affect participant expectations and technical results, it is essential to proactively explore these factors.

1 Introduction

As HCI practitioners, working with people (end-users, stakeholders, co-designers etc.) is central to many of the things we do. The types of engagement we have differs, depending on which part of the design phase we are in and the design processes we are following (e.g. co-design, participatory design, using personas etc.). As the nature of computing has changed and the availability of lightweight and wearable technology has increased, so too have the types of studies we run with potential end-users. Evaluating on-body or wearable systems requires very different types of interactions with users than the types of studies we might have run twenty years ago. In this way, much of the work we do in these studies has brought us closer to those in psychology and health in terms of how and what we investigate. While the roots of the HCI discipline are firmly embedded in psychology, ergonomics and human factors, HCI educators and practitioners are, increasingly, no longer coming from such backgrounds. As such, they may not have experience or training in running studies which have the potential to impact users in ways that studies of more ‘traditional’ computing systems did not.

In this paper, we describe an interdisciplinary project which includes investigating the use of the Muse EEG headband[1] as a benchmark EEG measure for fatigue identification. In order to achieve this, studies are being conducted with end users to capture EEG (for baseline) and other psychometric data to determine how effective commercial wearable technology is for identifying fatigue in everyday (non-laboratory) settings. Structuring and running these studies have highlighted two key factors which we recognise as not being the focus of the “many”, referred to in the whakataukī (Māori proverb) at the beginning of this paper, and which it is now time to work towards: Firstly, the importance of ensuring emerging HCI practitioners are exposed to multi-disciplinary study methods (particularly from psychology and health) in order to gain a better understanding of the potential impacts of their studies from an ethical standpoint; Secondly, in a context where cultural and racial differences impact not just participant expectations but also technical outcomes, these factors must be investigated up front in order to mitigate cultural offence and creating biased data through the removal of outliers, where outlying data is an artefact of racial differences. These reflections provide considerations not only for our own research team but for other practitioners working in similar contexts that can pave a more equitable and ethical way forward.

2 Background and Related Work

Human-Computer Interaction has been a prominent field of research since the late 1900s after Card et al. [2] released his book designed to practicalise the cognitive and behavioural sciences with the use of computer science. However, as early as the 1990s, Hartson [3] argued that while HCI theory was well-grounded in its psychological roots, “the bulk of real-world practice could benefit a great deal more from theory” [3, p.105] and future application areas for HCI “are growing more rapidly than the HCI methods needed for their development” [3, p.110]. Electroencephalography (EEG) has been a cornerstone of cognitive and behavioural science since its inception by Hans Berger in 1929 [4]. Enabling the analysis of synchronous post-synaptic cortical activity, EEG is widely used in the study of cognitive functions such as memory, attention and, in the case of this study, fatigue. Spapé et al. [5] illustrate Hartson’s concerns well in the context of EEG. They postulate that the rise in popularity of EEG has led to naïve neurorealism that uses EEG as a facet to pull the subjective psychological experiences of humanity out of the abstract and into the concrete, misguidedly attributing simplistic data that we do not yet fully comprehend or agree upon to incredibly complex psychological phenomena. This reductionist approach by HCI may be in part due to its intellectual whakapapa (genealogy) of usability inextricably woven into its practice. Card et al. [2] himself aimed to provide psychological scientists and computer scientists alike a way to design “interactive computer systems to be efficient and easy” [2, p.vii]. For example, in EEG

[1]The Muse system has already been used to detect cognitive fatigue, and the design of the Muse lends itself to being accessible and easy to use [1].

research, Hairston et al. [6] conducted usability studies on commercial EEG equipment but only considered user comfort in applying, wearing and using the devices. Similarly, Radüntz et al. [7] conducted a study centred on the effects of appearance and comfort on the desirability of use of consumer-level EEG devices. To the best of our knowledge, there is a gap in the literature regarding participants' perceptions of their experience of taking part in an EEG study or wearing an EEG in general. One study [8] examined, using heart rate variability, only the experience of EEG electrode placement with no significant findings. With ease of use and commercialisation as the frontier for HCI, there are ethical and cultural issues that have been paid little consideration.

Psychology and health, in which HCI has its roots, have had to undergo their own transformations as fields of research in response to the growing concerns that research was not adequately addressing issues that needed attention. Henrich et al. [9], in their seminal paper, coined a now widely used acronym, WEIRD, referring to the large body of psychological knowledge that was procured from studies primarily carried out by and on groups that are from Western, Educated, Industrialised, Rich and Democratic populations. This work has led to vital growth in cultural, community and indigenous psychology, which has enabled the pursuit of research and solutions that are relevant to communities that do not fit within the WEIRD context. Healthcare and health research are still bustling with conversation around the commercialisation and commodification of health. While consumerism persists as a hallmark of the health sector in many Western countries, there is a growing desire for health to be framed by a human rights approach that places greater emphasis on preventative, universal healthcare instead of public-payer, private-provider healthcare that does not view access to adequate healthcare as a right but as a market [10].

Aotearoa, New Zealand, presents a unique opportunity in this context, as it is a place where Western knowledge and mātauranga Māori (indigenous Māori knowledge) coexist. This distinctive environment allows for a shift in focus whereby factors that traditionally are not put in the spotlight can be brought to the forefront of research considerations. Indigenous perspectives, in this case, Māori perspectives, find here a place to be acknowledged by HCI research in a culturally appropriate manner. The signing of Te Tiriti o Waitangi in 1840 established a framework for interactions between the Māori people and government institutions. Te Tiriti embodies principles of active protection, equity, and recognition of Māori self-determination and sovereignty. In the realm of research, Te Tiriti serves as a guiding document to ensure the meaningful inclusion and leadership of Māori in projects that influence Māori outcomes [11]. By recognising mātauranga Māori, we aim to enrich the field of HCI, fostering inclusivity, cultural understanding, and responsiveness to the diverse needs and perspectives of indigenous communities.

3 Method

As part of our work, we are conducting studies investigating the use of EEG for cognitive workload and cognitive fatigue classification. We use one of these studies here as a case study to highlight key ethical and cultural considerations for participatory studies (as discussed in Section 1 (Introduction) and later in Section 5 (Discussion).

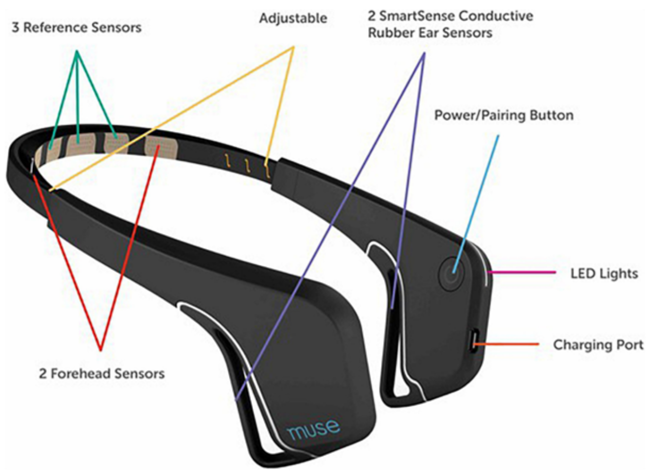

Figure 1: Muse EEG system by InteraXon Inc (adapted from Krigolson et al. [1])

3.1 Participants

The study was run with six participants between the age of 22 and 34. Given the small participant size, gender and cultural background have been excluded from the participant description for anonymisation. Participants were recruited through word of mouth and were all staff or students of the University of Waikato. Approval was provided by the human research ethics committee of the University of Waikato, and all participants gave informed consent with the option to withdraw from the study at any point up to two weeks post-participation. Participants were asked to refrain from caffeine consumption at least three hours before taking part in the study.

3.2 Location and equipment

The study was conducted in a well-lit office on the University of Waikato Hamilton campus. Participants engaged in the experiment using a laptop computer and a joystick. This study is part of a larger research project, investigating the use of lower cost commercial-grade wearable devices for use with cognitive workload and cognitive fatigue studies. As such, this study was conducted using the Muse EEG system – a commercially available EEG headband (see Figure 1). The Muse headband sits across the forehead and the ears, containing five dry electrodes. It provides four channels (AF7, AF8, TP9 and TP10) and one reference electrode (FpZ), recording data from the frontal and temporal regions of the cerebral cortex through the Mind Monitor app[2] via Bluetooth on an Android phone.

3.3 Study protocol

The experimental protocol is carried out in three phases: Pre-task, task, and post-task. In the pre-task phase, participants completed the Stanford Sleepiness

[2] https://mind-monitor.com

Scale (SSS) and Victoria Stroop Test (VST) before closing their eyes for five minutes. During that time, the EEG recording began. In the post-task phase, participants once again had a five-minute resting state with their eyes closed, after which the EEG recording was stopped, and they completed the SSS and VST again. In the task phase, participants operated the OpenMATB flight task simulator for 90 minutes. EEG measurements were recorded continuously for the whole of the task.

The Stanford Sleepiness Scale [12] is a one-item, Likert scale self-report for assessing participants' subjective level of fatigue. Participants circle a rank number from 1 to 7 to indicate their level of fatigue. The higher the number, the higher the level of fatigue. Two to three statements accompany each rank. For example, 1 is accompanied by "feeling active and vital; alert; wide awake", and 7 is accompanied by "no longer fighting sleep; sleep onset soon; having dream-like thoughts".

The Victoria Stroop Test (VST) was developed by Spreen and Strauss [13] to provide a more brief alternative to the original Stroop test [14]. The VST consists of three trials, each of which contains 24 items. For each item, participants must press a key corresponding to its colour. The three trials consist of dots, words and colour names, respectively. It is expected that it will take longer to do and that there will be more errors in the third trial due to a semantic interference between the colour of the word and the word itself being the name of a colour. The VST is hence a test of cognitive inhibition, one's ability to ignore stimuli that are irrelevant to a task, the control of which is inhibited when participants are fatigued [15, 16].

Real and simulated piloting tasks successfully induce cognitive fatigue, as measured by EEG [17, 18]. This study used the Open Multi-Attribute Task Battery [19], an open-source program designed for behavioural research, to induce cognitive fatigue. The software presents four tasks that collectively simulate a piloting task which can be used to test various behavioural and cognitive domains in participants, such as multitasking, vigilance, mental workload, and so on (as shown in Figure 2. OpenMATB is highly customisable and has been modified for this study. One of the four tasks was removed, as was the scheduling view that displayed upcoming task events to participants. This left three tasks for participants to carry out for 90 minutes: the system monitoring task, the tracking task and the resource management task

The system monitoring task consists of four gauges labelled Temp1, Pres1, Temp2 and Pres2. Each gauge has an arrow that oscillates around the midline but will eventually move to the very top or very bottom of the gauge. When this happens, participants must press the corresponding key (F1, F2, F3 and F4, respectively) to bring the arrow back to the midline. If the participant is successful, a small yellow bar will light up at the bottom of the gauge, but if they do not press the key in time, then the bar will light up red. The tracking task requires participants to use a joystick to manoeuvre a crosshair such that it remains inside a blue dotted box in the centre of the screen. Finally, the resource management task requires participants to control the flow of fuel between several fuel tanks and reserves. The aim is to keep two specific tanks filled to halfway throughout the task.

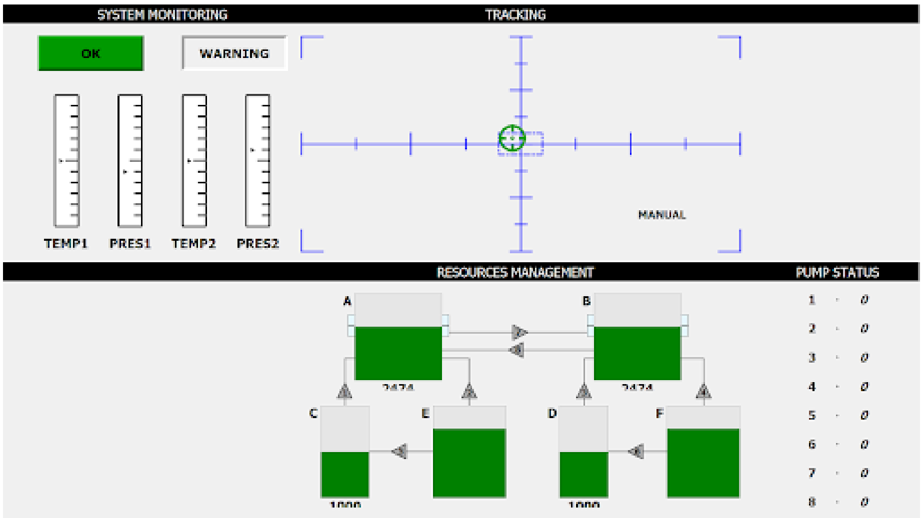

Figure 2: OpenMATB

4 Results: identifying areas where cultural and/or ethical considerations are beneficial

The study outlined above has been used as a case study to establish areas where identifying and understanding cultural and/or ethical considerations were or may have been beneficial. This includes the use of EEG headsets on participants (the use of wearable technology), the practice of inducing fatigue, regulating caffeine consumption, and the tracking of participant performance.

4.1 The use of wearable technology

As described in Section 3 (Method), our study involves the use of the Muse EEG headset. The Muse headband sits across the forehead and the ears, containing five dry electrodes. The use of wearable technology, such as this, requires the study coordinator to make physical contact with each participant. While Muse is a non-invasive wearable device, this physical contact can have other connotations for participants. We recognise the importance of this, for example, for Māori participants. We believe that there are important cultural considerations that should be made when working with wearable technology (as discussed in more detail in Section 5 (Discussion)).

4.2 Study-induced fatigue

As discussed earlier in Section 3.3, participants in our study were asked to perform the Stanford Sleepiness Scale (SSS), both before and after undertaking a cognitively fatiguing task. Within our study, one participant reported a score of 7 (“no longer fighting sleep; sleep onset soon; having dream-like thoughts”) on their post-test SSS. The participant noted that they briefly had a dream that the experimenter asked them to open their eyes and take off the EEG before the experimenter asked them to do so. Furthermore, this participant expressed that they were so fatigued that they felt they might not be able to continue with their own work for the rest of the day after the experiment. With only a small sample size pilot study (n=6), a Wilcoxon signed-rank test[3] already showed a strong trend toward the task impacting SSS scores that is close to statistical significance, with a difference in pre-task SSS scores and post-task SSS scores, $Z = -1.84$, $p = 0.066$. Regardless of the statistical significance of these results, statements from participants regarding their subjective experience of fatigue elicit an ethical conversation with regard to fatigue research.

4.3 Regulating caffeine consumption

To accurately account for confounding variables, our cognitive fatigue study requires participants to abstain from caffeine for three hours before the experiment. While this is a common undertaking in clinical studies and studies that measure fatigue, it may be less common in HCI practices. Here, we suggest that this additional regulation three hours prior to the study commencing constitutes an ethical consideration – i.e. the three hours should be considered as they sit outside of the allotted two-hour study duration (discussed more generally in Section 5 (Discussion)).

4.4 Participation and performance

Within our study, participants' performance in the OpenMATB task (described in Section 3.3 (Study Protocols)) was logged by the programme. Still, their performance has not been used as a variable in this study, and participants were not given the impression that maintaining a high level of performance was important. One participant noted that there were no consequences to poor performance in the task and that, if they felt like it, they could have simply not done the task at all and sat in their seat for the whole 90 minutes. This poses a problem to this study and others like it as, even though the current participants did carry out the task, we must now consider the implications of this for future participants and similar studies.[4].

5 Discussion

While Section 4 (Results) outlined areas in our case study where cultural and/or ethical considerations were or may have been beneficial, these factors and others can be considered for wearable participatory studies more generally. As such, here we discuss an extension of these considerations and how they may affect a wider range of participatory studies.

[3]Please note, a sample size of six is too small to draw conclusions from a Wilcoxon signed-rank test. This test is used here only as an indication.

[4]It is important to clarify that the primary concern here is not participant retention. If a participant is no longer comfortable with participating at any point during the study or until two weeks after participating, they are free to withdraw from the study and have any information provided by them removed. The key challenge here is the homogeneity of effort put in by participants when performing the OpenMATB task

5.1 Cultural considerations

As kairangahau Māori (Māori researchers) here in Aotearoa, New Zealand, some of us in this study find ourselves oriented toward viewing the nature of science and research through a different lens than the rest of the academic community. In studies such as this, it is important to pay particular consideration to our Māori participants, as the head, and more specifically hair, is largely considered one of the most tapu (sacred) parts of the human body, and careless treatment of Māori participants may instil in them some trepidation around participating in such studies. Tapu is often translated to the word sacred and denotes a spiritual quality that is inherent in people, places and even objects [20]. Traditional Māori belief is that people are inherently born with tapu and that its maintenance retains a sense of personal safety and health. Hair is so tapu that burying a lock of a chieftain's hair (who, as a chieftain, was considered to have even greater tapu) in a wāhī tapu (sacred place) would suffice to protect the land in which the wāhī tapu was located as well as the people who resided on that land [21]. Understanding the importance of tapu is vital to the research process, as Western knowledge, particularly in the sciences, presupposes its own validity and places itself as a reference point around which other epistemologies orient themselves and has historically led to great distrust of academia by indigenous communities [22, 23]. Recognising and respecting the centrality of mātauranga Māori to Māori participants by implementing it into the research process aids in the recruitment and retention of Māori participants, allowing for the collection of data that is more representative of the population in Aotearoa, New Zealand [24]. Touching or damaging another person's hair or passing something over another person's head is an extreme affront to someone's tapu. It was recounted to Best [25, p.38-39] by Māori kaumātua (elders) that the damage or loss of tapu posed an immediate threat to physical health and that it was the destruction of tapu by European colonists that had left Māori "in a defenceless and helpless condition". In this study, participants were forewarned that the placement of an EEG on the head was a necessary part of the study and were asked at the time of the experiment if it was okay for the experimenter to place the EEG on their head. While asking permission is a simple act, it may be one more step towards building trust between Māori participants and researchers.

Here, it should be noted that there is a risk in the application of cultural safety frameworks. This risk is the tendency of individuals to perceive members of groups that are different to them as having less variability than members of groups of which they are part, a phenomenon well-known in social psychology as the out-group homogeneity effect [26]. Again it is important that we, as researchers, do not emulate the "many" who eat the food prepared for them at the table and merely rely upon the work of others to provide us with checklists and guidelines with which we can claim cultural safety. Work into the conceptualisation of Māori identity has revealed the striking diversity with which Māori perceive themselves as such. Greaves et al. [27] found that most Māori in their latent profile analyses were in the middle two out of six ordinal categories, falling neatly between those classed as "traditional essentialists" and "disassociated". Furthermore, there was an increase in the rate of Māori concurrently identifying as NZ European from "traditional essentialists" to "disassociated". It is vital that we recognise this as a time to work, ascertaining and clarifying the wishes of our Māori participants, as "Māori" is often not the sole part of their identity. Whether by choice or by historical dispossession of mātauranga, they may not be practitioners of tikanga Māori, and we must be cognizant that no one Māori identity is more or less authentic than another [28].

Cultural safety can apply not only to the physical form of a participant but also to their data. An important factor in determining the quality of EEG data is the signal-to-noise ratio (SNR). Maintaining a clear threshold between task-related brain activity (the signal) and spontaneous brain activity and other task-unrelated interference (noise) is paramount, and any factor that reduces the amplitude of the signal relative to the background noise reduces data quality [29]. Impedance is the measure of opposition to electrical flow in an alternating current circuit like that in EEG. An increase in impedance results in a decrease in the amplitude of the signal and hence a decrease in SNR, muddying the data and affecting one's ability to find trends in that data. It then stands that factors which increase impedance should be mitigated, or if such factors are not mitigated, the poor-quality data set should be excluded as an outlier from the data analysis. However, what if one such impedance factor belonged only to certain participant demographics? Hair is well known as a poor conductor of electricity, providing resistance, and hence impedance, to circuits such as the EEG [30]. To overcome this, a conductive hydrogel can be applied to help with the transduction of the electrical signal from the cortex to the EEG. However, there is evidence that different types of hair still provide varying levels of impedance even with the application of hydrogel, particularly African hair, which leads to the exclusion of poor-quality data and, in a clinical setting, even misdiagnosis [31]. This issue is grounded in a difference in phenotype which, at first glance, shifts the discussion away from cultural safety because phenotypes can remain consistent in spite of cultural variations. However, we cannot exclude this issue from discussions of cultural safety, as indigenous cultures will be disproportionately affected if this issue is ignored. Although there is an absence of literature surrounding the physical and mechanical properties of hair belonging to the indigenous peoples of the Pacific, there are stark phenotypic similarities to African hair types, particularly throughout Melanesia and Australia. This begs the question, could this outworking of systemic racism through EEG also be happening here in the Pacific?

5.2 Ethical considerations

In Section 4 (Results), we discussed considerations around the ethics of wearable participatory studies based on our experience with our case study. This includes the practice of inducing fatigue, regulating caffeine consumption, and the tracking of participant performance.

Principle 2.6 of the New Zealand Psychological Society's (NZPsS) code of ethics [32, p.19] stipulates that psychological research must, at a minimum, do no harm. Principle 2.6.4 elaborates on this, requiring that all reasonable steps must be made to "protect participants from physical and mental discomfort or danger" or minimise the risk of such discomfort or danger occurring in the event that participants provide informed consent to take part in research that is known to come with those risks. Cognitive fatigue is known to impair emotion regulation [33], so it is essential to consider if a protocol designed to increase cognitive workload and fatigue is overexerting the minds of participants to the point that they experience a level of emotional dysregulation and mental distress or discomfort. Furthermore, principle 2.6.3 of the NZPsS code of ethics [32, p.19] stipulates that psychological research should not “cause serious or lasting harm to participants”. Smith et al. [34] found that induced mental fatigue lasts for varying amounts of time based on the type of task administered to participants, with the 45-minute psychomotor vigilance task used in their study inducing fatigue that lasted for 10 to 20 minutes. In this study and similar studies, which use a continuous vigilance task that also requires multi-tasking, there may be a substantial increase in the duration of fatigue post-experiment that could hamper their ability to carry out any other activities. For example, if a participant drove to where the study was being conducted, could induced fatigue endure such that the participant could not drive home safely? While we initially aimed to ensure that our task would elicit measurable cognitive fatigue in participants and required a 90-minute task to ensure that we could observe these physiological markers of cognitive fatigue, further reading and our data show that we may now be able to reduce the duration of the task to the minimum duration required to observe statistically significant signs of cognitive fatigue, thus minimising risk and discomfort for participants.

Section 4.3 identified an example affecting the privacy and agency of our participants – i.e. that of regulating their caffeine consumption. In regards to individual privacy, this may be impacted significantly also, not only by the regulation of caffeine consumption, but also due to exclusion criteria which require potential participants to disclose if they suffer from a neuropsychiatric or similar disorder that is impacted by fatigue, thus impacting their privacy. Similarly, one of the biggest predictors of cognitive fatigue, and a potential confounding variable, is how much sleep a participant has had in the last 24 hours, and how long they have been awake for at the time of the study [35]. Ideally, we want to minimise impact on participants' privacy and agency, and this can be supported by informing prospective participants of the total expected impact of the study. As is common when working with participatory studies, to help preserve participant privacy, researchers can provide a participant information sheet (PIS) before participants have agreed to contribute to the study. This will ensure that they have an informed opportunity not to agree to participate in a study where it impacts their agency beyond what they are comfortable with or where they might have to disclose personal health information that they may feel uncomfortable sharing, as it impacts their privacy.

Section 4.4 highlighted a scenario where ethical considerations should be taken into account around participant performance. Multi-tasking, as in OpenMATB, increases cognitive workload and produces cognitive fatigue, but the degree of cognitive fatigue due to multitasking increases with an increase in the number of tasks or items participants must attend to [36]. This aligns well with the motivation control theory of fatigue, which presents fatigue as a culmination of subjective responses that function to indicate when the cost of an activity outweighs the value of that activity [37]. In this way, the risk that participants may lose the motivation to engage with OpenMATB fully is made evident. Conversely, if the value of a task is made abundantly greater than its cost, then it is anticipated that very little fatigue would be elicited. A predicament, therefore, has arisen in the present study. Participants must be motivated enough to engage with all the tasks presented in OpenMATB because participants disregarding one or more tasks in favour of reducing their cognitive workload would result in unreliable data. Yet participants must not be so dramatically motivated so as to avoid eliciting cognitive fatigue.

5.3 Tēnā kia tū ki te mahi, ka aha hoki? - When it is time to work, what then?

To bring to fruition the whakataukī at the beginning of this paper, "When there is food, there are many. When it is time to work, what then?" we should consider what more is there that requires the care and attention of HCI that is being disregarded or avoided in favour of new innovations? Mātauranga Māori encompasses a holistic view of the world, including social, mental and spiritual aspects that bring novel perspectives to the academic community. Here in Aotearoa, mātauranga Māori and science are able to be woven together to create solutions that benefit both Māori and non-Māori. An example of this is found in pūrākau (traditional Māori narratives) surrounding Māori cosmogony.

Nā te kune te pupuke	*From the conception to the increase*
Nā te pupuke te hihiri	*From the increase the thought*
Nā te hihiri te mahara	*From the thought the remembrance*
Nā te mahara te hinengaro	*From the remembrance the consciousness*
Nā te hinengaro te manako	*From the consciousness the desire*
Ka hua te wānanga	*Knowledge became fruitful*

Table 1: *
(Taylor [38, p.14-15])

This chant illustrates the birth of mātauranga Māori and cognition. Preceding the formation of the gods and the physical world, this pūrākau stipulates that the formation of knowledge is inherently spiritual. This view of knowledge has already served as the foundation for frameworks such as Te Hihiri [39], a Māori methodological framework which recognises that research cannot fully hold itself as objective because researchers' subjective experiences influence the motivational energy (hihiri) driving what and how they research. Epistemological contentions are not the only barriers to engagement with Māori. For example, whakawhanaungata (forming relationships with people) is essential to the Māori world, where whakapapa (genealogy; spiritual ancestral connections) is the foundation for everything. While setting aside time to form these relationships may seem bureaucratic and unnecessarily costly, it does help to ensure the recruitment and retention of Māori and ensure that the research goals are of relevance to Māori. New Zealand is in an opportune situation for leading the consideration of cultural factors in HCI. Future directions in HCI, particularly with EEG, should explore Māori views on the mind, well-being and identity. With Te Tiriti as a guiding document, HCI in Aotearoa, New Zealand, should see an increase in engagement and cooperation with Māori so that Māori aspirations and sovereignty are realised. While hindering the development of technologies is undesirable, rampancy in a technological age does nothing to ensure the ethical and efficacious use of modern innovations. Perhaps what the HCI community requires is a reprieve from the lustre of usability and commodification, returning to the theories upon which it has built itself. There are many of us eating at the table of innovation and advancement, but now it is time to work for more equitable HCI research.

6 Conclusion

This paper introduces a participatory case study using an EEG headset to identify cognitive fatigue and uses the researchers' experiences during this study (and supporting literature) to elicit a set of cultural and ethical considerations. In this paper, we first identified areas within our case study where cultural and/or ethical considerations were, or may have been beneficial: the use of EEG headsets on participants (the use of wearable technology), the practice of inducing fatigue, regulating caffeine consumption, and the tracking of participant performance. After this, we expanded these considerations to consider a broader scope of HCI-centred wearable participatory studies: considering cultural safety, considering cultural biases in participatory studies and data collection, and considering the immediate impact on participants' privacy and agency, and the longer-term impact on their mental and physical safety. Finally, we discuss how, in situations where cultural and racial disparities affect participant expectations and technical results, it's essential to proactively explore these factors.

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