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Decolonising quantitative methods within a Pacific research space to explore cognitive effects following kava use

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Abstract

Work that challenges Western hegemonic research traditions, through use of innovative and alternative approaches as part of 'decolonising methodologies', is increasingly being validated by research funding bodies, post-graduate research and large-scale projects. This paper explains a feasibility study that combined a Pacific respect-based cultural methodology with a counter-hegemonic development theory to create a post-development methodological framework (PDMF). The framework was then used to guide the culturally ethical use of Western psychometric measures at a naturalistic kava-use setting. Not only does the study demonstrate the viability of the PDMF and the naturalistic kava use setting—or *faikava* methodology—as a valid tool for collecting data in a study conducted pursuant to a major research award, it also builds on a growing body of work aimed at decolonising Pacific methodologies.

Keywords: research frameworks, Pacific, feasibility study, kava, cognition, safety, driving

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Introduction

With kava use increasingly extending beyond the Pacific Islands, including into Pacific diasporic environments and among non-Pacific people (Aporosa, 2015; Aporosa and Forde, 2019), the need to better understand kava's effects on cognition has been signalled by both health professionals and law enforcement agencies, particularly in relation to driver safety.

This paper reports on a feasibility study that collected quantitative data within a naturalistic kava-use setting. The study was completed in Aotearoa (New Zealand) and guided by a post-development methodological framework (PDMF). The feasibility study explored the viability of conducting a future full study into the impact of kava use on driver safety, to be conducted among both Pacific and non-Pacific peoples. It is worth noting that definitions vary as to what amounts to a feasibility study, particularly as feasibility studies can be confused with pilot studies. Eldridge and colleagues (2016) define a feasibility study as a trial run "in which investigators attempt to answer a question about whether some element of the future trial can be done" (p. 15).

This paper draws on that definition and reports on the usefulness of the Brain Gauge tool (a somatosensory psychometric measure) when used in a naturalistic test setting and with a *faikava* methodology (which will be explained in detail in a later section). Although a Tongan word literally meaning 'to do kava', *faikava* has been adopted widely by Pacific diasporic kava users to refer to venues used for kava drinking and to ceremonies that are guided by traditional values and influence (Tecun, 2017).

The results of the feasibility study identified several areas of concern and where kava psychopharmacology knowledge was lacking. They also helped build greater methodological rigor (aided by the PDMF) and added to the growing body of literature that seeks to decolonise methodologies. The feasibility study resulted in the award of a substantial research grant to undertake a full study, which commenced in 2019.

The creation of a post-development methodological framework

Although there is a plethora of writings on the Pacific, a great deal of this comprises observations and interpretation by non-Pacific people. It has only been more recently that Pacific research by Pacific people, framed around Pacific ways of knowing and doing and accommodating the diversity of cultures, practices and languages that exist within Pacific ethnicities, has been articulated (McFall-McCaffery, 2010).

This change has been largely influenced and driven by scholars such as Professor Konai Helu-Thaman (2003), who called for the decolonisation of Pacific studies by acknowledging and legitimising indigenous people's interpretations and presentations of their histories, knowledge and traditions. As part of this decolonisation process, "culturally appropriate practices" have been promoted (Helu-Thaman, 2003, p. 4), leading to the use of Pacific research frameworks such as "Kakala, Vaka, Ta Va, Teu La Va and Tivaevae" (McFall-McCaffery, 2010) and the Fijian *vanua* research framework (Nabobo-Baba, 2006). Professor Linda Tuhiwai Smith (2012), an expert on decolonising methodologies, states that it is through combining "existing methodological approaches and indigenous practices" that "indigenous methodologies" are created (p. 144).

As research by Pacific academics with Pacific peoples increasingly seeks to understand wider societal complexities, so too the challenge of maintaining methodological decolonisation grows (Ponton, 2018). For example, when the Fiji Ministry of Education called for research to understand the impacts that nightly kava use has on teacher cognition (including the experience of kava 'hangover' and suggested interference with teaching ability) (Aporosa, 2014, p. 88), this created a methodological challenge. Pacific-specific psychometric tests do not exist, leaving researchers with the issue of how to use Western-developed, -standardised and -normed assessment measures in an ethical and decolonising manner to assess the brain function of Fijian teachers, without disadvantaging them due to the measure's Eurocentric design.

To address this issue, Fijian researcher Apo Aporosa (2014, 2021) combined *vanua* research with post-development theory to guide the use of psychometric tests. *Vanua* research ensured indigenous Fijian cultural protocols and respect-based interactions were adhered to, while post-development theory drew attention to likely power imbalances arising from the use of Western-developed cognitive assessment tools. Post-development theory is a relatively new development theory, concerned with local level empowerment, self-determination and decision-making and aimed at countering hegemony and power inequities (Anacleti, 2002, p. 168; Peet and Hartwick, 2009, p. 197–8).

Combining *vanua* research with post-development theory led to the creation of a post-development methodological framework (PDMF), which could then be used to guide the use of psychometric measures in a manner that was both culturally ethical and helped decolonise Pacific methodological practice (Aporosa, 2014, p. 102). Also relevant was the study's approach to data analysis, which assessed participants against their baseline

score, rather than standardised (external) Eurocentric norms. This provided equity for participants, particularly those with non-European or mixed Pacific-European ancestry.

When combined with cultural systems and processes, Aporosa (2014) argued the PDMF approach counters subjugation of research participants by external systems of power or hegemonic influence, thus contributing to methodological decolonisation. In addition, combining cognitive measures with post-development theory was argued, at the time, to be a first, pushing both post-development and research decolonisation practice in a new direction (ibid, p. 176).

Aporosa (2014) also points out the multi-cultural and multi-ethnic use applicability of the PDMF by drawing on Nabobo-Baba (2006) who explains that her *vanua* research framework is underpinned by the Fijian cultural respect-based values and ideal of *vakaturaga* (p. 25; also see Ravuvu, 1987, p. 18-19, 319-320). *Vakaturaga* has similarities with many other Pacific respect-based value systems and ideals including *gudfala tingting mo fasin* in Papua New Guinea, the Solomon Islands and Vanuatu; *anga fakaTonga* in Tonga; *fa'aSamoa* and *tautua fatama'ali* in Samoa; *kauraro Rarotonga* in Te Au Maohi (or the greater Rarotonga island group); *ke'ano pono* in Hawai'i and Aotearoa Māori *tikanga* (Aporosa and Forde, 2019, p. 77). Respect is also an important driver to the Kakala, Vaka, Ta Va, Teu La Va, Tivaevae and kaupapa Māori methodologies (Naepi, 2015; Ponton, 2018; Taufa, 2010; Tuhiwai Smith, 2012). With respect being a universal expression of ideal behavior (Dillon, 2003), Aporosa (2014) argues the PDMF "has multi-ethnic application" beyond Pacific-specific spaces to include non-Pacific environments (p. 86). He has used both the PDMF and *faikava* methodology among a variety of ethnic people groups ranging from village communities in the Pacific and "a garage in Hamilton, New Zealand", to teaching settings with tertiary students through to a ski lodge in the Swiss Alps and a military base in the UK (Tecun et al, 2020a, describe similar multi-ethnic environments in which they have used *faikava* methodology).

Kava—its effects and use

Kava (*Piper methysticum*) is the name of a plant and of a drink made from the ground rhizome of the shrub. Both the drink and plant play an integral role in Pacific traditions and cultural practices (Aporosa, 2014; 2019b). Kava is not an alcohol and, when consumed, does not cause marked euphoria or hallucination, but rather a relaxed feeling that facilitates clear-headed discussion (Aporosa, 2019a). Kava is also a safe substance, lacking any major health concerns or addictive properties (Aporosa, 2019a; Bian et al. 2020).

Lipid-soluble kavalactones within kava (Sarris, LaPorte, and Schweitzer, 2011) produce analgesic (Singh, 1992), antithrombotic, hypnotic, sedative (Cairney, Maruff, and Clough, 2002), anxiolytic (Pittler and Ernst, 2003; Singh and Singh, 2002) and muscle relaxant (Duffield and Jamieson, 1988) psychoactive/psychotropic effects. That psychoactivity is attributed to kava's action in the central nervous system, where it is understood to decrease neurotransmitter function (Ligresti et al. 2012; Lim, 2016).

In 1998, Saletu and colleagues reported that a single 200 mg tablet dose of *kavain*—one of the six key kavalactones—has an "elimination half-life of 9 hours" (p. 188). Based on this work, Aporosa (2008) calculated that it took slightly more than 90 hours for kava to be eliminated from the body (p. 46). Work to update understanding of kava's elimination half-life has stalled since Aporosa's work (NS, 2010), with some suggesting this half-life is longer than 9 hours, particularly when kava is consumed at high traditionally influenced volumes in which all kavalactones—currently understood to number more than 20 (Bian et al. 2020)—are present.

Elsewhere, kava has been reported as a safe, non-addictive viable alternative to benzodiazapam in the treatment of generalised anxiety disorder (Sarris et al. 2013). Kava's psychotropic properties have led to its increasing popularity among non-Pacific peoples outside of the Pacific islands and within Pacific diasporic communities where, in some countries, kava is served in bar-like settings as an alternative to alcohol (Blackwood, 2019; Showman et al. 2015; Wolinski, 2018).

The increased use of kava outside of Pacific communities and kava's documented psychoactive properties have raised questions regarding its impact on cognitive functions, particularly in relation to driver safety. For instance, the New Zealand Police report stopping increased numbers of drivers who appear mildly intoxicated, although show negative results on breath-screening tests, with officers suspecting kava impairment (Morgan, 2014; 2017; Welsh, 2017). Australian police also report a suspected link between naturalistic kava use and increased likelihood of serious motor vehicle accidents (Fu et al. 2019). In addition, the Institute of

Environmental Science and Research (Aotearoa's Crown research institute) reports increased detection of kavalactones in the blood of deceased motor vehicle accident victims (Poulsen et al. 2012).

LaPorte and colleagues (2011) present the first comprehensive literature review on the effects of kava on cognitive function. While this is valuable, overall, the findings show inconsistency and subjectivity across studies. This is best summarised in a 2017 update, which included a single new study since 2011. Sarris and McIntyre (2017) report that of the "12 clinical trials" that assessed the effects of kava on "mental function", four reported "improved accuracy and performance on visual attention and working memory", five showed "kava to have little or no negative effect on cognitive processes", while another "reported kava to impair reaction time" (p. 16).

It is important to point out that these studies involved participants who had consumed a 'modified' version of kava. Administered at a pharmaceutically recommended "daily dose of 60–250 mgs kavalactones" (Bian et al. 2020, p. 13), these tablets (or capsules) contain selected extracted kavalactones which Bian and colleagues (2020) referred to as "designer kava preparations" (p. 23). Those designer kava preparations are vastly different to kava consumed in naturalistic traditionally influenced settings. This contrast between modified pill-styled kava and naturalist kava has led some researchers to question whether the former can rightly be called or considered to be actual kava (Aporosa, 2019a).

Research into kava consumed in traditionally influenced settings

Kava, when consumed in traditionally influenced settings—also referred to in this paper as 'naturalistic kava use settings' or the '*faikava* methodology' (and explained further shortly)—is made by steeping dried and pounded kava rhizome in water in a *kumete* (a traditional wooden kava bowl). The resulting drink is then served to those present in *bilo* or *ipu* (cups made from half coconut shells) (see Figures 1 and 2). Drinkers typically sit cross-legged on the floor on woven mats and engage in *talanoa*—culturally guided discussion (Aporosa, 2014).

Aporosa and Tomlinson (2014) report that traditionally influenced Fijian kava drinking sessions last, on average, for over six hours. During this time, consumers will frequently ingest 3.6 litres (6.33 pints) of aqueous kava, equating to more than 8,000 mg of kavalactones, or thirty times the pharmacologically recommended daily dose.

Figure 1 Dry pounded kava root being mixed for drinking in a *kumete* (photographer: Todd M. Henry, 2019).

Bwarenaba et al. (2017) report that kavalactone "modes of action are not fully understood" (p. 1) and that even less is understood regarding "the neurophysiological mechanisms associated with kavalactone metabolism" (p. 5). When it is taken into account that most research into kava's effects on cognitive function has used modified kava in tablet or capsule form, and considering the dearth of equivalent research based on naturalistic kava use, these gaps in understanding become even more pronounced. In particular, there is a real need for experimental data investigating the cognitive effects of kava at traditional consumption volumes.

These gaps in current understanding and data have led the World Health Organisation (WHO) to call for more research on all areas of kava psychopharmacology, particularly during, following and related to naturalistic kava use (Abbott, 2016, p. viii; also see Bian et al. 2020, p. 23).

In response to this call, Aporosa and colleagues (2017; 2020; Aporosa, Atkins, and Brunton, 2020) investigated the impacts of traditionally consumed volumes of kava on the cognitive faculties of reaction and divided attention, with the aim of understanding kava's effects on driver safety. The study (referred to as experiment 1) was funded by a Health Research Council of New Zealand (HRC) Pacific post-doctoral award (ref. 16/462) and was the first of its kind. It used two visual-sensory psychometric measures drawn from the Vienna Test System: Traffic's test battery. These were the WAFA Alertness and WAFG Divided Attention (Strum, 2011a; 2011b). WAFA and WAFG are test labels and not acronyms. These are industry standard assessments of driver safety and have been used extensively to assess the impacts of drugs and alcohol on driving.

The results of experiment 1 failed to identify statistically significant differences in cognitive function between a control (non-kava drinking) and active (kava using) group following kava consumption. However, the study investigators observed that most of the active participants exhibited a slowed motor response and a slight slurring of speech, which started around the mid-point of testing, or after three hours of kava consumption (Aporosa, 2020; Aporosa et al. 2020).

This anomaly—between the lack of a test-identified impairment in cognitive function and the observed deterioration—was discussed with several psychopharmacology experts. The experts postulated that the experiment's failure to detect a significant difference in cognitive function was potentially due to the Vienna Test System measures using visual-sensory assessment, whereas kava's dominant action is to decrease neurotransmitter function in the central nervous system (Aporosa, 2020; Aporosa et al. 2020). They suggested an alternative assessment tool could be used, one capable of measuring subtle changes in cognition via the central nervous system.

This alternative testing system—named the Brain Gauge—was subsequently used in the feasibility study reported on in this paper.

Methodology and methods

The feasibility study involved small-scale testing of the Brain Gauge testing tool with two participants. The study aimed to investigate potential challenges with the testing equipment and proposed methods, particularly within a naturalistic kava use test setting. The intention was that if successful, the test methods used could then be replicated (with any required modifications) in a full study.

The feasibility study was underpinned by the PDMF. As explained earlier, this framework combines the indigenous Fijian *vanua* research framework with post-development theory to guide the use of Western-developed, -standardised and -normed psychometric measures with Pacific people, in order to ensure equity and decolonise research practice (Aporosa, 2014, p. 102; 175). The *faikava* methodology, used alongside the PDMF, guided the collection of this data.

Participants

The feasibility study involved only two participants: AA and MA. Both participants are male, as this is the dominant kava using gender, and both are regular kava consumers.

AA, of Fijian ancestry, has been the principal investigator on several kava studies attached to this project. He has over 20 years' experience in kava preparation and consumption and the related cultural aspects, including kava consumption protocols.

MA is Aotearoa born, of English ancestry, has been drinking kava in naturalistic settings for over 10 years and is a research fellow at the University of Waikato with AA. He was chosen as the second participant to provide representation of non-Pacific people, as people from this demographic are increasingly using kava as part of their social activities (Aporosa, 2015).

Preparation of the kava

The kava beverage used in the study was prepared by primary investigator AA, following the same 'recipe' as that used in experiment 1. In total, 7.2 litres (1.9 gallons) of kava was mixed using kava powder originating from Tonga and purchased through a popular supplier (*Kava World International*) in Hamilton, New Zealand.

This kava powder was the same as that used in experiment 1 and had been stored under recommended conditions to limit degradation and maintain its freshness (AECOM-Kalang, 2017). Therefore, it was assumed the kavalactone levels were the same as those measured in experiment 1, namely 145 mg per 100 mls of kava beverage (see the certificate of analysis from T. K. Group Labs, Iowa, USA, in Aporosa 2020, p. 39–40). No further testing to determine the kavalactone levels of the kava consumed on the date of the feasibility study took place.

After mixing, the 7.2 litres of kava was poured into a *kumete*.

Location of the kava session

The room where the kava was consumed during the feasibility study was organised to reflect a *faikava* space, or a traditionally influenced kava use venue.

To replicate that naturalistic environment, woven mats were placed on the floor, and the participants sat cross-legged on these while they consumed kava (see Figure 2). Following a short culturally informed ceremony in which words were spoken in the Fijian language, AA measured and served 100ml quantities of kava from the *kumete* into *bilo* (coconut shell cups, also known as *ipu*). AA ensured that all cultural kava consumption protocols were adhered to throughout the session (Aporosa, 2014).

To maintain the naturalistic setting, AA invited colleagues and friends from the community to join the kava session. Invited individuals were served kava from a separate batch to that of the two individuals taking part in the study.

This setting, in a similar manner to the previous kava cognition studies, comprised and encapsulates the *faikava* methodology.

Figure 2 Serving kava from a *kumete* (kava bowl) in *bilo/ipu* (cups made from half coconut shells) to drinkers sitting on woven mats on the floor (photographer: Todd M. Henry, 2020).

The Brain Gauge somatosensory assessment

Cognitive assessment was undertaken at intervals during the kava session, using the Brain Gauge testing tool (www.corticalmetrics.com). Brain Gauge is an innovative tool that measures slight changes in strategic, tactical and operational cognitive faculties, including fine motor skills and fatigue, to assess neurological functioning (King et al. 2018). Shaped like a typical computer mouse, the Brain Gauge device has two probes (5mm in diameter) on which the participant rests the index and middle finger of their non-dominant hand. The participant also controls a standard computer mouse using the dominant hand. This standard computer mouse is used to register responses delivered by the Brain Gauge probes.

The Brain Gauge tool is paired with a Brain Gauge application, which delivers the test battery via a computer screen. This set-up is shown in Figure 3.

Figure 3 "The 'Brain Gauge' (A) two-digit vibro-tactile stimulation handheld device and (B) example of visual cueing test screen" (King et al. 2018, p. 3).

During the test, the Brain Gauge probes deliver a vibratory stimulus (flutter range of 25–50 Hz) to the participant's non-dominant index and middle fingers, and the application presents the participant with a range of nine tasks related to this stimulus. For example, the participant may be asked to click the mouse key (using the dominant hand) as quickly as possible when they feel a vibratory stimulus delivered through the probes, in order to record the reaction time between when the stimulus is delivered and the participant's response.

The nine tasks delivered by the application measure:

- speed—reaction time and reaction time variability, with fatigue as a variable
- accuracy—sequential amplitude discrimination and simultaneous amplitude discrimination
- temporal order judgement and connectivity—to measure how well brain cells are communicating with each other
- timing perception—duration discrimination
- plasticity—to measure how well the brain is integrating, processing and adapting to information from the external environment (King et al. 2018; Tommerdahl, 2017).

Brain Gauge also calculates an overall composite score (cortical metric), and individual scores are presented alongside normative scores (Corticalmetrics, 2017). These performance measures can be applied to the strategic, tactical and operational cognitive aspects necessary in understanding driver capacity and performance (Barkley and Cox, 2007).

Brain Gauge has test-retest functionality (meaning results are not compromised with repeated use) and has been used tens of thousands of times in over sixty major studies measuring traumatic brain injury, drug use and autism, resulting in forty-five peer-reviewed publications. In addition, Brain Gauge is increasingly being used (in the United States of America and, more recently, Aotearoa) as a field-side neurosensory measure to assess concussion in professional sport (chiefly American football and rugby union).

In this feasibility study, each Brain Gauge device, together with a standard computer mouse, were connected to a Dell Latitude 36530 laptop running the Brain Gauge application. The two participants were seated at these laptops and positioned so they could not see the other participant or view what part of the testing the other participant was on.

Participants were instructed to place their non-dominant hand on the Brain Gauge mouse in such a way that their index and middle fingers were in contact with the probes and their dominant hand on the standard computer mouse. If participants pressed too hard, the Brain Gauge application would instruct them to loosen their grip.

Participants were requested to read the test instructions presented on the computer monitor carefully and to focus, while at the same time staying relaxed and answering each question to the best of their ability. The Brain Gauge application presented participants with a brief demonstration of what vibrations would feel like on their fingers. It then led the participants through the test battery, with each test taking between one to three minutes. The participants had to complete three practice trials at the beginning of most tests and were required to answer all three trials correctly before they could progress. Feedback was given on the practice trials, but not task trials. The total test battery took between ten and twenty minutes to complete.

Once participants had completed the test battery, they were redirected to the Brain Gauge home page. They were not made aware of their scores or performance at any time during the testing.

Procedure

Testing with the Brain Gauge tool occurred at three points during the feasibility study:

- T1: baseline prior to any kava consumption
- T2: halfway through the kava session (when participants had been drinking for three hours)
- T3: when the kava session had ended, six hours after the consumption of the first *bilo* of kava.

The study's six-hour duration was agreed upon to represent the period of a typical traditionally influenced kava session (Aporosa and Tomlinson, 2014).

The study commenced at 10am, with participants AA and MA welcomed and briefed on the procedure for the day by JL (the psychometrician). Once questions had been answered, the participants were seated at their respective laptops and commenced the Brain Gauge test battery (T1). Once the baseline testing was complete, the participants were invited to take a seat on the mats and begin consuming kava. At this point, the other individuals taking part in the kava session were invited to enter the room.

The participants consumed six 100ml serves of kava per hour, replicating typical traditionally influenced kava consumption volumes (Aporosa and Tomlinson, 2014). This equated to the participants consuming one serve every nine minutes and thirty seconds, with JL using a stopwatch to alert participants when it was time to consume their next serve.

JL recorded the participants' kava intake at every serve. Any food consumed by the participants during the study was also recorded. This consumption of food (commonly referred to as 'chaser'), combined with sitting cross-legged on mats, using traditional kava utensils such as *kumete* and *bilo* or *ipu*, having the company of other guests engaging in *talanoa*, and the serving of kava at typical volumes and time intervals, all contributed to creating a naturalistic test setting and encapsulated the *faikava* methodology. The participants were also free to move around the room and use the bathroom throughout the study, adding to a relaxed atmosphere.

The participants were given a five-minute warning before the second test (T2). At this point, the other individuals left the room so that the participants could complete the Brain Gauge test battery uninterrupted. The participants then resumed drinking kava, and the other individuals were invited back into the room.

Prior to T3, the participants were given another five-minute warning. As at T2, the other individuals left the room for the duration of testing. Once the participants had completed the test battery for the third time, they were thanked by JL and the study concluded.

Data analysis

Data analysis was not undertaken, as the study was concerned purely with the feasibility of the testing methods.

Results from the feasibility study and recommendations for future trials

As demonstrated in previous similar studies (Aporosa, 2017; 2020; Aporosa, Atkins, and Brunton, 2020), the PDMF, *faikava* methodology and methods detailed above provide a robust procedure for examining the effects of kava on cognitive function in the context of a full study, while maintaining the naturalistic setting of a traditionally influenced kava session.

This claim would no doubt raise concerns among quantitative research purists. For instance, Hammarberg and colleagues (2016) state quantitative research is expected to conform to "complex theoretical or philosophical framework[s and follow] … rigorous analysis" processes guided by "straightforward mathematical rules" (p. 500). This contrasts with the flexibilities often associated with the "research characteristics … [of] Pacific standards, values … responsiveness and reciprocity" (DeSouza, 2007, p. 14), which Anae (2019) argues favour "qualitative research methods rather than quantitative" (p. 9). However, Kamboj and colleagues (2018) point out that although:

> 'naturalistic studies' (i.e. those conducted in ecological settings) … [may lack the] high levels of experimental control afforded by double-blind laboratory studies … [they] are nonetheless potentially valuable in allowing efficient preliminary hypothesis testing … [as] these can then pave the way for more tightly controlled studies if promising effects are observed. Previous naturalistic drug studies have yielded novel findings that were subsequently independently replicated in double-blind laboratory experiments. (p. 1135)

Therefore, we (the authors) stand by the assertion that the methodology used in this feasibility study provides authoritative direction for a full study, while also contributing to the growing body of work that challenges hegemonic discourse and legitimises indigenous research approaches.

The collection of research data, both qualitative and quantitative, during traditionally influenced kava use, when united with the cultural values, respect-based practices and reciprocity associated with Pacific methodologies such as Kakala, Vaka, Ta Va, Teu La Va, Tivaevae, *vanua* research framework and PDMF, has been a regular practice for over twenty years. It has, however, only been in the past few years that this practice has been termed the *faikava* methodology. For instance, Nabobo-Baba (2006)—who developed the *vanua* research framework—does not specifically use this term. She does though mention the methodological significance of kava when she writes:

> Appropriate preparation for interviews is essential. It needs to take into account vanua custom [local practices] and be open to change as required. For my research project, preparation involved me buying sufficient yaqona [kava] and sulus [also known as a sarong or lava], to give each interviewee (p. 26).

Toren and Tomlinson, two non-Pacific cultural anthropologists with many years of research experience in Fiji, both used kava environments as key settings for research data collection. As early as 1988, Toren commented that "kava-drinking is virtually obligatory; a refusal to drink effectively constitutes a denial of society and a rejection of the status quo" (p. 704). In a similar manner to Nabobo-Baba, Toren also did not explicitly call for a *faikava* methodology, although her statement makes it clear that to do social research in a place like Fiji, one simply has to be part of the kava environments. During his doctoral research, Tomlinson (2004) spent up to 40 hours a week collecting data in kava settings in Fiji, commenting: "Not to drink kava is not to acknowledge others, not to recognize the value of social relationships that are affirmed in the kava circle" (p. 113). He has since collected research data using the *faikava* methodology in Samoa, the USA and Australia.

Faikava settings and the use of the *faikava* methodology played a key role in Fehoko's work in which he described these settings as a "cultural classroom" (2014, p.62–4; 2015, p. 136). Similarly, Vaka and colleagues (2014; 2016a; 2016b; 2020) report the use of the *faikava* methodology in several research projects investigating Pacific mental health. Tecun and colleagues (2017; 2018; 2020a; 2020b; Bell and Hernandez, 2017) and Hernandez (2019) have also used this methodology in a variety of settings, including Tonga and the USA, with

Tecun stating his "primary method of gathering ethnographic data has been talanoa in person, over food, or at faikava" (2017, p. 53).

Aporosa has been using the *faikava* methodology to collect both qualitative and quantitative data for almost twenty years in numerous settings and nations, including Vanuatu, Fiji, Rarotonga, Tonga, Samoa, Australia, the USA and Europe. More recently, this has included Māori kava use environments in Aotearoa (Aporosa and Forde, 2019) and as part of two major HRC-funded projects (2017; 2020; Aporosa et al. 2020). Moreover, the use of the *faikava* methodology in HRC-funded projects is increasing, with six additional HRC-funded projects using this approach over the past seven years (awardees: Vaka and Fehoko). The lengthy use of the *faikava* methodology in research, together with kava's recognition as a safe, non-addictive substance that facilitates quality *talanoa* (Aporosa, 2019a) and its endorsement by the HRC due to its inclusion in stringently assessed and subsequently funded projects, has led to a recognised and authenticated Pacific-based research data collection mechanism.

The following discussion presents information about the study design, interwoven with methodological considerations and limitations, as opposed to drawing conclusions from the study results.

Study design

The feasibility study participants, AA and MA, are long-term kava users and active in kava research. Therefore, they were significantly invested in the outcomes of the project and were aware of the study aims.

This raises the possibility that they could have consciously or unconsciously affected their performance on the cognitive tasks. This possibility is a common criticism of studies using kava in naturalistic settings. Ideally, to mitigate any demand characteristics, all participants should be blinded to the aims and hypotheses of the study. However, this would be counter to the cultural respect-based protocols that guide kava use within naturalistic settings: protocols that prohibit deception, therefore preventing study blinding (Aporosa et al. 2020, p. 9).

It could be argued that using a control condition and double blinding would be valuable for any future experiments to help control for experimenter effects and demand characteristics. However, these approaches create a challenge, particularly as Aporosa and Tomlinson (2014) explain, because conducting "randomized controlled trials … considered the 'gold standard' for health research … is next to impossible under the conditions in which kava is normally consumed" (p. 164).

The factors contributing to this impossibility include inconsistency in kavalactone strength between kava powders, due to variations in the age of the kava plant at the time of harvest, and differences in the kava cultivars used (not only across the Pacific, but within Pacific nations) and how they mature (which itself depends on variations in soil fertility, humidity, annual rainfall, wind exposure and topography (AECOM-Kalang, 2017, p. 13)). Bian and colleagues (2020) assert :

> It is important to keep in mind that not all kava is equal ... Many factors, ranging from cultivars, parts of the plant used ... One main factor contributing to kava product variation is the cultivar type. There are over 150 different cultivars. Different regions have different and often unique cultivars and/or chemotypes. These different cultivars have varying levels of kavalactones and flavokavains" (p. 4).

When these factors are combined with variations in kava mixing (which is based on kava powder-to-water ratio estimates and preferences for concentration, as opposed to standardised ingredients and a rigid recipe), this places limitations on the ability to duplicate studies over lengthy time periods or across multiple environments. In the case of this feasibility study, the same kava was used as in experiment 1, with a similar estimated kava concentration strength.

Kava's union with cultural values and respect also creates several additional limitations. For instance, cultural values prevent a kava substitute or placebo from being represented as 'real' kava, particularly when the kava is presented as part of a naturalistic, culturally informed and guided test environment. Constraints relating to deception, as mentioned previously, would apply equally to any placebo. Furthermore, because experiment 1, the feasibility and the full study require experienced kava use participants, who were capable of drinking large

volumes of kava (up to 3.6 litres) over six hours, this also negates the possibility of using a kava placebo to drive 'gold standard' testing. Kava produces a tingling in the mouth as selected kavalactones interact with oral sensory nerves (Aalbersberg and Sotheeswaran, 1991), a sensation that an experienced kava drinker would immediately recognise and question if absent (Aporosa et al. 2020, p. 9).

At this stage, overcoming such limitations to allow for a double-blind placebo-driven 'gold standard' testing regime remains a challenge and is beyond the immediate future study scope.

A further consideration concerning the study design is the duration of the feasibility study, which at six hours, is a long time period. Although such time periods are typical of traditionally influenced kava drinking sessions, it is possible that any observed changes in cognitive function could be the result of fatigue and not kava consumption. However, the Brain Gauge's capacity to capture fatigue, as a variable affecting reaction testing, is expected to identify this confound.

Levels of kavalactones in kava preparation

As explained earlier, this study did not reanalyse the kava powder to assess kavalactone levels in the kava beverage consumed throughout the test session. Instead, it was presumed these levels would be the same as that cited on the certificate of analysis issued for experiment 1.

Future studies using this methodology could test random samples from the kava mixture being consumed at the time of the experiment, with these immediately frozen and stored for later analysis to ascertain precise levels of kavalactones.

Knowing individual participant's rates of kavalactone metabolism, together with the dose relationship of kavalactones with cognitive impact, would be extremely valuable to the methodology and subsequent data analysis. However, at present there are large knowledge gaps concerning the psychoactive/psychotropic and psychopharmacological effects of kava (Singh et al. 2004, p. 150–152; Bian et al. 2020, p. 23).

The 2016 WHO kava risk assessment lists twenty-eight "data gaps" relating to kava and requests further data on kava ethnobotany, psychotropy, psychopharmacology and mechanisms of action related to "human health effects" (Abbott, 2016, p. viii; also see Bian et al. 2020, p. 23). To repeat the assertion made by Bwarenaba and colleagues (2017), cited earlier in this paper, kavalactone "modes of action are not fully understood" (p. 1), with even less known about "the neurophysiological mechanisms associated with kavalactone metabolism" (p. 5). Additionally, questions were raised in an early section of this paper regarding Saletu et al.'s (1998) report of kava's nine-hour elimination half-life, particularly when kava is consumed at high traditionally influenced volumes in which all kavalactones in addition to *kavain* are ingested.

These multiple knowledge gaps have also created limitations for Aotearoa's Institute of Environmental Science and Research, which reports difficulties in understanding the kavalactone levels detected in the blood of deceased motor vehicle accident victims (Poulsen and McCarthy, 2017). Moreover, the current paucity of understanding impacts the methodology and places limitations on the possible ways in which the data analysis from the feasibility study and any subsequent full studies can be applied.

Two additional lines of research inquiry (linked to the topic of levels of kavalactones in kava preparation) would greatly assist the application of data gained from any future investigations that followed the feasibility study. The first would be to explore reverse tolerance in relation to kava consumption, in particular as it related to cognitive impact. Also known as drug sensitisation, reverse tolerance is "an increase in sensitivity to a drug with repeated administrations" (Reber et al. 2009, p. 821). Kava reverse tolerance is documented anecdotally (Hamilton, 2017; LoveKava, 2016) and discussed among kava users. It is also the reason why Thomson (2008) stated "most people who drink kava for the first time … expend too much effort analysing its effects on them and can be heard muttering that they don't feel a thing" (p. 72).

A second area of kava research valuable to any future investigations would be the difference between aqueous kava versus pill kava/'designer kava preparations' in terms of their impacts on cognition. As explained earlier, naturalistic kava is mixed and consumed as an aqueous beverage. The consumption of kava as a supplement or in modified pill form—some containing kava powder or extracted selected kavalactones—is increasing in popularity. An experiment comparing cognitive effects of aqueous kava beverages with that of pill varieties would be valuable, not only for testing whether water-mixed kava impacts cognition differently to pill-

form kava, but also for providing insights into the influence that '*set and setting*' have on kava use and whether these two factors influence cognitive performance differently.

In his book *Drug, set, and setting*, Zinberg (1986) explains that a person's mindset (shortened to 'set') and their social and physical environment ('setting') can be just as influential on a substance user as their drug of choice. McElrath and McEvoy (2002), who studied *set and setting* in relation to the use of Ecstasy (methylenedioxymethamphetamine), note "the suggestive power of reports of drug effects" by users, together with the need to understand the "perceived effects of the drug, rests with the notion of expectation" (p. 206). An understanding of the influence of *set and setting* for kava users could assist in determining the psychopharmacological effects of kava, as opposed to the suggestive or perceived effects.

Timing of the cognitive testing

Having three time points (T1, T2 and T3) for cognitive testing worked well in the feasibility study. Testing with the Brain Gauge test battery was quick to complete and non-invasive. Having three time points had minimal disruptive impact on the flow of the kava session and appeared to work well in providing a snapshot of any changes in cognitive function over the time of the study. Both participants in this study had taken part in an earlier experiment concerning kava and cognition in which the testing was completed every hour. Both participants commented on how they preferred to be tested once every three hours, as it allowed them to relax into the kava session.

Future studies could consider incorporating cognitive testing at additional time periods post-kava consumption—at say, six, twelve and twenty-four hours. Results from such testing may provide a clearer picture about the lasting effects (if any) of kava. It would also aid in making practical recommendations on appropriate stand-down periods between kava consumption and safe driving.

Use of the Brain Gauge

The Brain Gauge proved an efficient, effective and user-friendly device. The participants completed the test battery in under fifteen minutes at each testing point. The Brain Gauge desktop application was navigated easily and intuitively designed. Minimal input and technical expertise was required from the research assistant to operate and gather the data.

Raw data was also easily extracted from the Brain Gauge to an Excel spreadsheet, with the data also presented in illustrative format, as shown in Figure 4. The figure shows the data for participant AA at baseline (T1), the midpoint at three hours (T2) and the completion of kava drinking at six hours (T3). The figures are for illustrative purposes only and will not be analysed or interpreted.

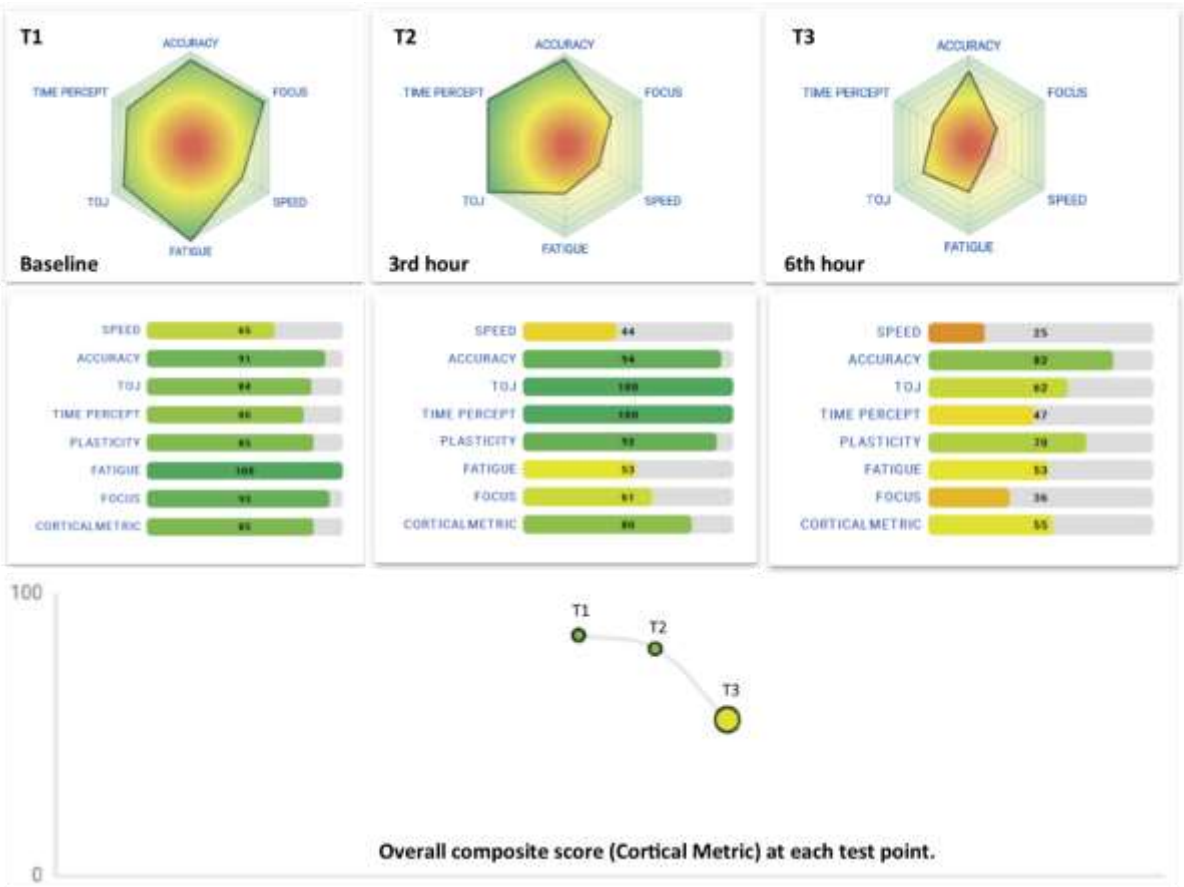

Figure 4 Brain Gauge output data at baseline (T1), the 3-hour midpoint (T2) and at the conclusion of kava consumption at 6 hours (T3) for participant AA.

Future studies using the Brain Gauge tool could consider its use in conjunction with other measures of cognitive function. This would provide validation of the Brain Gauge, while also contributing wider understanding to kava's impacts on cognition.

Controlling for other ingested substances

One participant consumed caffeine, a known stimulant, two hours before starting the baseline testing; the second participant did not.

Future research should present participants with a list of foods and substances they are not to ingest within a specific period prior to testing. These items should include, but not be limited to, known stimulants (e.g. caffeine) and depressants (e.g. alcohol). All prescribed medications being taken by participants should also be recorded. These steps will help to ensure that the results of the test are a direct response to the consumption of kava.

All food that participants consumed for the duration of the kava session was recorded. During a six-hour session, it would be unreasonable to expect participants not to consume anything, and this approach would not sit within the naturalistic context desired for testing. Where possible, future research should provide a standardised range of food for participants to consume and accurately record all food that is consumed during that period.

Conclusions

Balancing the naturalistic setting of a traditional kava session with the demands of a rigid experimental protocol can be a challenging task. We argue that the methods proposed in this paper for future studies would strike a good balance between these two competing demands.

Minor improvements to the experimental design would enable the methods detailed in this paper to explore the effect of kava on cognition in a naturalistic setting. The discussion, methodological considerations and study limitations canvassed here all respond to the WHO's request for greater understanding of kava psychopharmacology, particularly during and following naturalistic kava use (Abbott, 2016, p. viii), together with addressing several of the research challenges identified by Bian and colleagues (2020) in their recent paper.

Kava consumption at traditional use volumes and its resulting psychological effects is an area with huge scope for well-designed empirical experiments. Moreover, the cultural impact of this research should not be underestimated. Research investigating the effect of kava on cognition serves not only the scientific, but also the wider Pacific community, while informing the development of recommendations for safe and beneficial use for all.

As with earlier data collection studies using kava and cognitive measures, this study further validated the use of the PDMF and *faikava* methodology as a viable culturally influenced research process: a process that can be used to guide the use of a quantitative method, while also countering hegemonic methodological process (Aporosa, 2017; 2020; Aporosa, Atkins, and Brunton, 2020). This in turn strengthens and expands the existing body of research on decolonising methodologies, which challenge indigenous deficit discourses, while building theoretical frameworks for, and by, Pacific people (Naepi, 2015; Ponton, 2018).

This feasibility study resulted in the award of a substantial research grant from the HRC Pacific division (ref. 19/002) to undertake a full study which commenced in 2019. This was the second project to investigate the impacts of naturalistic kava use on cognition to be assessed and subsequently funded by the council (the first being experiment 1). Both studies were underpinned by the PDMF and *faikava* methodology and utilised a naturalistic kava use setting for the collection of both quantitative and qualitative data. Both studies, accordingly, validated and authenticated these Pacific research methodological approaches and strengthen Pacific methodological decolonisation.

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