‘Doped’ on kava:

Understanding kava’s impacts on cognition and driving

S. ‘Apo’ Aporosa (PhD.)

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Published by
PACIFIC STUDIES PRESS
Suva, Fiji

Title: 'Doped' on kava: Understanding kava's impacts on cognition and driving

ISBN: 978-982-101-273-7

Subjects: Culture – Pacific area
Indigenous substances – Pacific area
Cognition
Road safety

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Cover design and layout by Jeremy Tritt, 2019.
Cover photographs: Todd M. Henry, 2020.

TO

Aporosa Paula Bainimoli
ni Natokalau, Kadavu, Fiji
(*noqu yaca* [my namesake])

Ni sa yali ga na noda itovo, sa oti sara ga o keda. (Fijian)

Koe taimi 'e mole ai 'ae 'ulungaanga fakafonua 'o ha tangata,

'e mole ai foki moe tangata ko ia. (Tongan)

Afai ole a leiiloa ma galo atu lau tu ma lau aganuu, ole a leai so tatou

faasinomaga mautu e taialaina lou sa. (Samoan)

Taem yu lusum kastom, yu lusum rod. (Bislama)

Me e ngaro poina koe i taau peu, ka puapinga kore koe. (Cook Island Māori)

Pau ka nohona ʻōiwi, pau kākou. (Hawaiian)

Mena ka ngaro to tātou ahure, katahi ka ngaro tātou te tangata. (Māori)

When we lose our culture, we are nothing.

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FORWARD

Anyone who has attended a friendly kava-drinking session has probably noticed the fine balance between seriousness and relaxation. Even the most informal gathering around a kava bowl follows specific rules, but the rules usually make the event more comfortable for people, not less. Drinking kava in casual settings prompts storytelling, joking, and gossip, as well as probing discussion of social issues. Highly ceremonial kava sessions can induce silence, reverence, and even awe, but most sessions slip into a looser groove, which is socially intoxicating (although not physiologically addictive).

This book is like a kava session. I encourage you to read it as if each page were its own cupful. These are not dry words!

For one thing, this book is inherently dialogical, as all kava-drinking sessions are. Just as kava sessions overflow with conversation, so this book engages with many other speakers. Dr Aporosa is deeply versed in the academic literature on kava, and he brings the words and insights of many other researchers into these pages. He has also engaged in long-term conversations with people across the Pacific about the traditions and future of kava drinking. This book is a fresh contribution to longstanding conversations involving many audiences.

For another thing, this book is entirely respectful of kava culture. As many readers will know, kava has its critics: non-drinkers who dismiss or do not understand the deeply ritualised camaraderie of the gatherings; religious fundamentalists who misunderstand the nature of divine gifts; scholars who see the tree clearly, but miss the forest of context. Dr Aporosa's respect is woven into his research design, making this a worthwhile scientific study that effectively recognises the social context in which it takes place.

There are three other ways in which this book is like a kava-drinking session: its movement toward truth; its lightness of touch; and the new discussions it encourages.

By movement toward truth, I mean that the book contributes genuinely new knowledge to the world about what kava affects and what it does not affect, as well as how these findings relate to concerns about driving safety. At kava sessions – among the jokes, banter, and lighthearted talk – there are similar moments when new understandings emerge about who we are and what we are all doing here. Truth does not always emerge at kava-drinking sessions, but when it does, it has the force of the most powerful sermon.

By lightness of touch, I do not mean unserious, for this is a tremendously serious book. But it is enjoyable to read in a way few scientific reports are. Reading about the *faikava* approach, the Fijian *isevusevu* offered to participants, the analysis of the study's data and its implications is a smooth journey for the reader thanks to Dr Aporosa's skills as both researcher and writer.

Finally, the book encourages new discussions. Indeed, new discussions are part of the research design, as readers will see in the description of the trial and evaluation of brochures on kava and driving in Bislama, Fijian, Samoan, and Tongan. Talk at kava sessions never really ends. It continues the next night, and the next. The research Dr Aporosa presents in this book will live on, too, as new researchers and policymakers continue to drink, study, think about, and manage kava in the Pacific and the Pasifika diaspora around the world.

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ACKNOWLEDGEMENTS

This work was generously funded by the Health Research Council of New Zealand (Pacific post-doctoral award No. 19/002) and supported by Te Huataki Waiora School of Health and the School of Psychology's *Traffic and Road Safety Research Group* at the University of Waikato.

I am also grateful to Cortical Metrics for its generous donation of hardware and software, which allowed the collection of the research data.

I wish to acknowledge the support of Associate Professor Kirsten Petrie, founding Dean of Te Huataki Waiora School of Health, who played a strategic role in this study's academic placement. Also, thanks are due to Professor Nicola Starkey and the University of Waikato's *Traffic and Road Safety Research Group*, Associate Professor Brett Langley from Te Huataki Waiora School of Health, Professor Jerome Sarris from the University of Melbourne, Associate Professor 'JD' Baker from Chaminade University of Honolulu, and Dr Jan Prosser (Psychology Worx) for their advice and expertise, which moved this study to a new level following anomalies and inconsistencies in the previous kava drink-driving study.

The author is extremely grateful to Dr Keakaokawai Varner Hemi (Assistant Vice Chancellor Pacific, University of Waikato), Dr David Taufui Mikato Fa'avae (Lecturer, Te Kura Toi Tangata School of Education, University of Waikato), and Jenny Robertson and Bridget Holland (Research Managers, University of Waikato) for their wisdom and guidance; and to Jacinta Ford (PhD student, Anthropology Programme, University of Waikato) and Dr So 'SoSo' Hyun Park (Te Huataki Waiora School of Health, University of Waikato) for their excellent support as research assistants. Also worthy of recognition are Dr Martin Atkins (School of Engineering, University of Waikato), Hakau Ballard (Master's student, Department of Computer Science, University of Waikato) and Dr Ray Littler (Honorary Fellow: Statistics, University of Waikato) for their statistical analysis expertise.

The following people and their kava club connections were also critical to the research project: Associate Professor Malakai Koloamatangi (former Directorate: Pasifika, Massey University) and the Grey Lynn, Auckland, *fofo'anga* (Tongan kava club); Pakilau Manase Lua, Makahokovalu Pailate and the Inasi kava crew; Asaeli Tulagi, Ravulolo Tuikubulau, Ispa Swamy and the Hamilton Fijian kava community, including Sitiveni Sivivatu and the Clarkin Road Kava Niteclub; Troy Wihongi and the Hamilton Dox Brother's *Kalapu*; the University of Waikato's *Fono* at the *Fale* crew; Todd Henry and Anau Mesui-Henry at the Four Shells Kava Lounge, Auckland; and Dr Edmond Fehoko (Research Fellow, University of Auckland). Dr Sione Vaka (Senior Lecturer, Auckland Technical Institute), Pediatric Surgeon Mr Jitoko Cama (Waikato District Health Board) and Professor Rich Masters (Te Huataki Waiora School of Health, University of Waikato) must be acknowledged for their academic insights; *malo 'aupito kei vinaka vakalevu sara*! Special mention is required of Associate Professor Matt 'Maciu' Tomlinson (Australian National University, wrote the 'Forward'), who the author first met in Fiji in the mid-2000's, and who has been an amazing mentor and model of academic excellence. *Vinaa vaalevu sara noqu tauvu!*

Critical to the kava drink-driving brochure production were the translators: Marie-Christine 'Kitty' Wells (Bislama), *Faifekau* (Reverend) Siosaia Sisitoutai (Tongan), *uso* Lance G. Matemate Fuimaono (Samoan) and *tau* Usaia Gaunavou Jr (Fijian; Masters student, University of Waikato).

Additionally, the study was made possible with the following supporters: Arcia Tecun (aka Dr Dan Hernandez, Department of Anthropology, University of Auckland), *kai noqu* Sianiti Nakabea Bulisala (Pacific Student Success Coordinator, University of Waikato), *tokoua* Leni Lolohea (former Future Students Advisor – Pacific, University of Waikato), numerous supporters at ASAOnet, and the author's family, friends and associates in Fiji, particularly, Tevita and Evia Bainimoli (Natolalau, Kadavu), Sekove Bigitibau Degei (Visama, Nakelo and Lecturer, Fijian Studies, University of the South Pacific), Serupepeli Udre (Mau, Namosi and Senior Education Officer), and the staff and students from Richmond Methodist High School, Kadavu.

The author is especially thankful to the following personnel and their relevant law enforcement, road safety and road research units for their support toward the project: Acting Superintendent Gini Welsh and Inspector Pete McKinnie at the New

Zealand Road Policing Unit; Sergeant Mike Morgan, Counties-Manukau Police, Auckland; Sally Fletcher, Otahuhu Police Prosecutions Office, Auckland; Commissioner of Police Fuiavailili Egon Keil, Samoa; Executive Officer Leasi Galuvao, Land Transport, Samoa; Deputy Commissioner of Police, Sālote Grewe, Tonga; Sergeant Edward Kalura, Road Safety Division, Vanuatu Police; Senior Superintendent Mahesh Mishra, Police Traffic Division, Fiji; and Dr Helen Poulsen, Dr Mary-Jane McCarthy and Dr Rishi Pandey from the Motor Vehicle Accident Research Unit, New Zealand Institute of Environmental Science and Research.

Finally, this study would not have been possible without my amazing wife Jan who is the 'real brains' behind the psychometric testing I do, and those who joined the study as research participants. Due to confidentiality, they cannot be named.

1. Kava, not a problem until we got cars...

In 2009, I received a phone call from a Sergeant at the Counties-Manukau Police Prosecutions Section in Aotearoa New Zealand. A few weeks earlier, a night shift patrol had stopped a Pacific Islander who appeared to be driving a little erratically. Following a negative breath-screening test, indicating the driver had not consumed alcohol, the driver admitted he had been drinking kava. This led to the driver being charged with driving under the influence of a drug. At a subsequent court appearance, the driver pleaded not guilty to the charge.

The reason the Sergeant called me is because I am *iTaukei* (indigenous Fijian) by ancestry, and the Sergeant knew that kava is an important part of my *iTaukei* culture and identity, and that I had recently started my doctoral research. While the emphasis of that research was on the importance of (Pacific) culture to academic achievement, it also included a focus on the effects of kava on cognition.[1] The other reason the Sergeant came to me was because I had been a policeman for almost 8 years, had arrested a large number of alcohol drink-drivers, and had given evidence in both the district and high courts on numerous occasions; therefore, I knew the evidentiary process. The Sergeant was looking for an expert witness who could give evidence at the upcoming defended hearing on the impacts of kava consumption on cognition and safe driving.

While I was happy to assist, I had to state the obvious: research aimed at understanding kava psychopharmacology had not been done. In fact, even the simplest of testing had not yet been completed. The Sergeant responded that he had found a lot of research online that suggested otherwise, to which I responded that yes, while there is research, those studies had used tablets (or capsules) containing selected extracted kavalactones.[2] Those tablets are vastly different to kava as drunk over many hours by members of the Pacific community as part of traditionally influenced practice. I also told him that regardless of this extreme difference between tablet-form kava and naturalistic kava – or kava as drunk by

Pacific peoples – research associated with tablet-form kava use is commonly applied to, and overlaid on, kava as used in naturalistic traditionally influenced settings. Such correlations are not correct and cannot be used for evidentiary purposes.

I was then asked how long it was likely to be before we would know the effects of naturalistic kava use on cognition, so that we could better understand kava's interaction with driver safety. I recall saying that such research would be very expensive and require a certain skill set, namely a researcher who could bring together Pacific kava users and then, within a naturalistic kava-use setting, also administer tests to assess cognitive function. This was going to be logistically challenging, not to mention the need for a great deal of research funding.

I also recall saying that kava drink-driving is a relatively new issue, and that while Pacific people may have been drinking kava until the early hours of the morning for almost a hundred generations, it had only been in the last few years that we have stopped walking home; kava was not a problem until we got cars…

Little did I know at the time that 10 years later I would be the one to do that research – a series of investigations funded by the Health Research Council of New Zealand (the Health Research Council).

This book explains that research to reveal new understanding about what kava is and isn't. I have attempted to do this as simply as possible, keeping the language non-technical where appropriate. To assist readability, I have also used the endnote style.[xx] These notes point the reader to referenced material, including page numbers and extra commentary where required.

Throughout this book I will use the term 'kava', which has become the English standard term for both the drink and the plant it is made from, and is the word used in Tongan. Other Oceanic languages have related terms, such as *sakau* in Pohnpei, Federated States of Micronesia, Samoan '*ava* and *yaqona* in Fijian.[3]

Starting in Chapter 2, kava's cultural significance, ethnobotany, traditional use styles, risk assessment and limited psychopharmacological understanding are explained. Chapter 3 details the methodology and methods, or how the study to understand kava's effects on cognition, and in turn driver safety, was done. The

results of the study are explained in Chapter 4. This includes explanations about how kava affects the user's reactions, coordination, attention and sequencing. It also challenges what 'doped', 'intoxicated' and 'drunk' mean when associated with kava use. In Chapter 5, I explain the development, and trial and evaluation, of a kava drink-driving safety brochure, presenting comments from participant evaluators. All studies have limitations, or weaknesses, within the research design that have the potential to influence outcomes and conclusions. I explain those limitations in Chapter 6, before summarising, or presenting, the 'short version' of the study in Chapter 7. For a vastly more condensed and straight-to-the-point version of the study, an executive summary is presented on page 111. This is followed by 'About the Author', which also explains a situation that occurred in rural Fiji in 2003 and led to my career as a health researcher with a focus on kava.

Finally, before I get into the study and an understanding of kava's impacts on cognition, what happened to the Pacific Islander charged with 'driving under the influence of a drug', namely kava, back in 2009? At the defended hearing the judge found him not guilty due to a lack of understanding about how kava affects driving.

I am not suggesting that driver was guilty of unsafe driving following kava use. Rather, the following pages will add to understandings about kava's effects on users to help address the lack of kava psychopharmacology understanding. I hope this knowledge will encourage further *talanoa* (discussion) and research on kava, keep road users safe, and prevent the wrongful arrest and prosecution of kava users who may well be safe to drive.

2. Kava, culture and cars

Kava (*Piper methysticum G. Forst. f*), in both its plant and drink form, is culturally significant to Pacific people.[4] As Pacific people have moved away from their village homes to national urban settings and international diasporic environments, they have taken kava with them. City living has led to a reliance on driving to aid cultural collectivism. Being 'doped' on kava, or the effects resulting from kava drinking, is suspected to interfere with driver safety, which has in turn led to a 'clash of cultures' – between traditional kava use and modern systems of transportation.

Little is understood about the psychopharmacological effects of kava. This chapter draws on the existing cultural and psychopharmacological literature about kava to help readers understand the traditional–contemporary culture clash and provide context for the research described in later chapters.

Kava and drinking *mana*

Ethnobotanical, linguistic and genetic evidence suggests the tropical shrub *Piper methysticum* (Figure 1), which is more commonly known across the Pacific as kava,[5] was originally found by the Austronesian Lapita people when they first arrived in northern Vanuatu around 3000 years ago.[6] That 'finding' is a key driver in traditional narratives, particularly the belief that kava contains, or is imbued with, *mana* (spiritual power). For instance, kava is asexual – without seeds and requiring manual propagation. This has led to its status as a 'plant of the gods'[7]; as kava is believed to have been nurtured by the traditional gods until the arrival of those first Austronesians. This link to the gods is argued to imbue kava with *mana*.[8] *Mana* is also believed to give kava its medicinal efficacy, which includes mild anesthetic, analgesic and anti-inflammatory properties, antifungal, amoebicidal, anticonvulsant, antimicrobial, anticancer and anxiolytic activity.[9]

In *Kava: The Pacific drug*, Lebot, Merlin and Lindstrom's[10] text described by Yale University Press as "the most comprehensive treatment of kava ever written",[11] the authors explain the importance of kava as a "traditional exchange item that also links people with their gods and ancestral spirits". That union – the link between

kava and traditional spiritualism and *mana* – is argued to be a key reason why early Pacific voyagers took kava with them as they spread out and inhabited the islands of Oceania.[12] Vanuatuan anthropologist Kirk Huffman[13] adds: "Well cut and wrapped fresh kava branches can be planted after sea voyages of up to two weeks… Thus, we can attribute the entire distribution of drinkable kava across the Pacific to the earlier maritime explorers of the region, long before the late arrival of European explorers".

In their text, which focuses on the geographical region of Eastern Polynesia, Kirsh and Green[14] concur: "we can be certain it [kava] was introduced from the West [i.e. from the direction of Vanuatu]. Most probably, this occurred with or just after the initial Lapita settlement of Fiji-Tonga-Samoa region".[15] It is speculated that early trading by Lapita people also introduced kava to areas west of Vanuatu, including selected regions of Papua New Guinea.[16]


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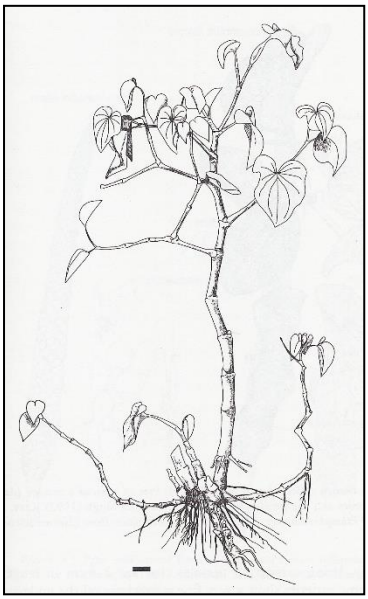
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Figure 1: Piper methysticum *(kava), approximately 3 years of age*.

Kava has not lost its value as a traditional exchange item. Today, Pacific people continue to carry kava with them into contemporary Pacific diasporic spaces when migrating for work and education. However, unlike rural Pacific village life where people mostly walked to the homes of family and neighbours, diasporic living and

suburban sprawl frequently necessitate travel by car if relationships are to be maintained. The use of motor vehicles for this purpose has contributed to the traditional–contemporary cultural clash alluded to earlier; a tension that underpins this book and the study it reports.

Kava: From plant to drink

Kava (*Piper methysticum*) is the name of both the plant and a drink made from its roots and basal stump. Like the plant, kava as a drink plays a significant role in Pacific traditions and cultural practices.[19] Beverage kava is made by steeping the crushed (and in some areas of the Pacific, dried) rhizome from the *Piper methysticum* plant in water to make a drink that looks similar to milky-coffee and tastes slightly peppery with earthy undertones (see Figure 2).

Figure 2: *Mixing kava in a* kumete *(kava bowl) in Auckland, Aotearoa New Zealand.*[20]

Singh[21] points out that those "who are unused to kava or are unsympathetic to it" (with unsympathetic inferring those who lack respect for kava's cultural significance) "have described its taste and effects in fairly negative terms, comparing it to washing-up water, muddy water, 'chalk swimming in body sweat,' etc." Others have suggested that kava is an acquired taste, with Aporosa and Foley[22]

responding, “We don’t drink kava for the taste; it’s about culture, practice and connection, something most non-Pacific Islanders can’t understand.”

In Vanuatu and the kava-using regions to the west, kava is mixed with less water and is therefore more concentrated than the kava typically prepared in Fiji and the islands to the east.[23] Kava produces a tingling in the mouth. This is particularly noticeable on the tongue when the kava is concentrated, as selected kavalactones interact with oral sensory nerves.[24]

Urbanisation has created extremes between traditional and urban contemporary styles of kava consumption. This is particularly the case in Vanuatu.[25] For instance, while rural *niVanuatu* drinkers will “quaff the entire coconut shell of kava at once and in silence … [and] sit down [often on mats on the ground] beside small fires to ‘listen to the song of the kava’ - that is, to feel its effects”[26], urban contemporary kava drinkers tend to meet in bar-type settings called *nakamal*. At these venues, patrons purchase single cups of highly concentrated kava; usually standing near the point of purchase while they drink the contents of that cup in a single action, before heading off and sitting on benches to talk with friends. Patrons returned sporadically to purchase and drink additional cups, with about half a dozen cups of potent kava typically consumed over several hours (see Figure 3).

Figure 3: *Serving and drinking kava in a* nakamal *in Port Vila, Vanuatu.*[27]

Most urban Fijian and Tongan kava users, including those in diaspora, continue to mix the beverage in a *kumete* (traditional wooden kava bowl, for which *tanoa* is another well-known name), from which it is served to those present in *bilo* or *ipu* (cups made from half coconut shells), with users typically sitting cross-legged on mats on the floor.[28] Many of these naturalistic, or traditionally influenced, kava

users also observe cultural etiquette, including following a serving order based on hierarchy, partaking in *cobo* (clapping[29]) before and after drinking (as a sign of respect), and engaging in *talanoa*, or culturally guided discussion underpinned by Pacific respect-based values[30] (see Figure 4). In the past 10 years, there has been a shift by some urban, particularly diasporic kava users to sitting on chairs, with the kava bowl placed on a table; a practice also common among non-Pacific kava drinkers (see Figure 5).

Figure 4: *Kava drinking on mats by participants with mixed ethnicity in a private home (Māori owners) in Waikato, Aotearoa New Zealand.*[31]

Figure 5: *Diasporic Pacific Islanders and non-Pacific kava drinkers seated at tables, as opposed to on mats on the ground.*[32]

While Figures 4 and 5 show participants who are all male, this is not to say women do not, or have not historically, drunk kava. For instance, the Colonial Administrative Head of Fijian Affairs, Basil Thomson, said in 1896, "women are regular [kava] drinkers".[33] In another example, Tomlinson[34] discusses Turner's[35] 1986 comment that, "It is only in recent times that Fijian women have also drunk yaqona [kava]", pointing out that Lester[36] had essentially "said exactly the same thing forty-five years earlier".

While Fijian women may have been drinking kava for generations, contemporary kava drinking by other Pacific women is increasing, with this done in both mixed gender and female only groups. There has also been a marked increase in non-Pacific women attending *faikava*[37] venues (Figure 6).[38] Tecun and colleagues[39] comment,

> … some church-based kava events are integrating co-ed kava to include young women in the youth circles that take place in church halls, demonstrating generational shifts in shared spaces. Additionally, along with women, *fakaleiti*/*fakafefine*, 'in the manner of a lady/woman', *fakatangata*, 'in the manner of a man', and LGBTQIA+[2] folks are also participating alongside their cisgender peers in youth- and student-led *faikava*.

Figure 6: (L) *The Silent Whistle Women's* Kalapu*, Auckland, Aotearoa New Zealand*[40]*;* (R) *Mixed gender kava drinking with staff and students at the University of Waikato.*[41]

Kava drinking by most Pacific people is understood to be vastly more than simply the ingestion of an indigenous substance. It is viewed as a process of exchange; not only between those physically present, but also their ancestors and the chiefly entities they represent.[42] This is illustrated, for instance, in the word *wainivanua*, a term used by *iTaukei* (indigenous Fijians) when speaking about kava during formalities.

Wainivanua (or 'water of the *vanua*') draws its significance from the union of *wai* (water) with the concept of *vanua*. *iTaukei* cultural expert, Professor Asesela Ravuvu[43], explains:

> Vanua literally means land, but also refers to the social and cultural aspects of the physical environment identified with a social group. On the social plane it includes people and how they are socially structured and relate to one another. On the cultural plane it embodies the values, beliefs and the common ways of doing things.

The combining of *vanua* with *waini* "infers to an ingestible representation of the land, people and culture … which is deeply rooted in their [*iTaukei*] sense of identity and customary practices".[44] Once prepared as a drink, kava becomes a sacred and living entity that embodies the *mana* of the *vanua*, which in turn has the ability to enhance a person's *mana*.[45]

Tecun and colleagues[46] describe a similar union between *mana* and *vanua* from the Tongan perspective:

> Kava is mana (potency, authority) because as a metonym of fonua (land), it is the actual land itself and therefore contains the power of place. Fonua is a complex concept of land and ocean, which means placenta, people, ancestors, and traditions.

In a latter section, they explain the significance of the *mana*/*fonua*/*vanua* connection for young Pacific people living in diaspora (although the union applies equally to adults): "Kava, as a transportable fonua, thereby links young people to their ancestral lands and seas, which contain the mana to heal the cultural and temporal dislocations created by diaspora."[47]

Kava's cultural significance for the land, the culture and people has great similarity across the Pacific, prompting Lebot and colleagues[48] to write that kava "plays a unique role in the social life of many Pacific societies ... [as part of] asserting their cultural identity". Cultural anthropologist Dr Nancy Pollock[49] adds: "In Tonga, Samoa, Futuna, Fiji and Pohnpei kava usage persists as an 'external symbol' of both current and past ideologies".

Although there are slight changes in how kava is mixed and drunk, particularly in Vanuatu, Western Oceania and some of the Pacific diaspora, 'typical' durations and consumption volumes for kava use have been determined in order to provide a standard and point of measure for research purposes. Based on research and observations from Fiji, Tonga, Samoa, Aotearoa New Zealand, Australia, Hawaii and

the UK, typical naturalistic kava use, or traditionally influenced kava drinking sessions, last (on average) for 6 hours.[50] During this time, each consumer will ingest (on average) 3.6 litres (6.33 pints) of aqueous kava. It is interesting to note at this point that even though kava is typically used at such high volumes, and often on a daily basis, in many communities, its consumption is not associated with health risks or adverse side-effects, a theme that will be discussed shortly.[51]

Kava beverage is not an alcohol and, when consumed, does not cause marked euphoria or hallucination. Rather, it induces a relaxed feeling that facilitates clear-headed discussion and promotes wellbeing.[52] Put simply, kava's effects cannot be used as an excuse for criminal activity, emotional outbursts, raucousness or anti-social behaviour.[53] That lack of effect – regardless of the fact that many nevertheless describe the subtle relaxation associated with kava use as 'kava doped', 'kava drunk' or 'kava intoxication' – prompted Thomson[54] to write, "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".

Yet despite kava's lack of inebriation effect, this has not prevented it being associated by many with other more impactful substances, along with their negative social and health implications.

Fighting kava misinformation and assessing kava harm

Although kava is not fermented and is clearly not an alcohol, the 'kava is alcohol' myth is commonplace.[55]

The myth is believed to have started with Johanne Forster, a naturalist aboard Captain James Cook's *Endeavour*, who gave kava its botanical name *Piper methysticum*; hence the full botanical name, *Piper methysticum G. Forst. f* (underline for emphasis). *Methysticum* is a Greek word meaning 'intoxicating', or according to Forster, 'intoxicating pepper' – *Piper methysticum*.[56] Added to this myth, was a report that masticating kava during preparation, as was common until the early 1900s, "transformed the starch of the root into sugar, and that this by fermentation turned into alcohol".[57] Further, after drawing on an early 1800s report from Fiji, Thurn and Warton[58] were adamant kava was "liquor … [with] its effects being similar to that of laudanum". Norton and Ruze[59] suggest that early European accounts of kava drinking not only associated kava with alcohol, but also opium,

which further maligned kava's reputation. Churchill[60] posits that from the outset, kava's botanical name suggested kava had an "intoxicating quality", and that this made "it more difficult to correct the error".

Other common myths associated with kava are that regular use leads to addiction (which it does not)[61]; that even moderate kava use can cause liver damage evidenced through an increase in gamma-glutamyl transpeptidase levels in the blood (which is a misinterpretation of blood test results)[62]; and that kava abuse leads to *kava dermopathy*, or a "ichthyosiform eruption" of the skin[63]. Elsewhere, I have explained that *kava dermopathy* subsides as kava ingestion is reduced or stopped, leaving no residual effects, and is therefore harmless. I add that: "While this harmless drying of the skin may not look attractive to some, to others it is considered to represent the kava user's enthusiastic engagement with their culture. It comes down to perspectives."[64]

Myths concerning kava are not limited to its health impacts, but also suggest it has negative implications for socio-cultural systems. For instance, evangelical Christians are increasingly calling for a ban on kava use, arguing that it's contemporary use is akin to witchcraft and communing with pre-Christian ancestral gods.[65] New Methodist church minister Atu Vulaono, an outspoken kava critic from Fiji, asserted that kava "is a hold-over from pre-Christian religion and not from God", calling it the "drink of Satan", which he believes is disrupting Fijian lifeways by activating curses on the *vanua*.[66]

Others claim that kava drinking is excessively time consuming and "takes men away from their families"; to which I have responded elsewhere, "that excessive television watching, gaming or involvement with sport can do the same thing". Yet the TV, gaming console or rugby ball, for instance, are not blamed for taking men away from their families; "Kava, as opposed to personal choice, or even poor choice, has become the scape-goat and the point of criticism".[67]

Countering these myths are works by scholars such as Sarris and colleagues[68] who reported kava as a safe, non-addictive and viable alternative to benzodiazepine for the treatment of generalised anxiety disorder. That safe status is also reflected in kava's regulation in Aotearoa New Zealand – falling under the *Food Standards Code 2015*[69] – which classifies kava as a 'food'. Additionally, the World Health

Organization's 2016[70] kava risk assessment states: "On balance, the weight-of-evidence from both a long history of use of kava beverage and from the more recent research findings indicates that it is possible for kava beverage to be consumed with an acceptably low level of health risk".

Finally, kava's level of harm to both the health of the user and socio-cultural systems was assessed in a 2019 drug harm ranking exercise undertaken in Australia. In that study, experts (which included several Australian Government drug advisors) assessed the harm levels of 22 drug substances to both the user and others, using the Multi-Criteria Decision Analysis (MCDA) methodology. When the scores for both the harm to the user (36) and harm to others (41) were combined (77), "alcohol was the drug ranked as causing the greatest overall harm", scoring higher than crystal methamphetamine (42/24: harm to user/others respectively), heroine (45/13), tobacco (18/14), cocaine (22/3) and ecstasy (5/2).[71] Conversely, kava was ranked as the least harmful of the 22 assessed substances, with the harm to the user scored at 2, and harm to others 1 (total harm 3).[72]

Concerning alcohol and harm to others, an estimated 53 million people in the United States – or one in five – are reported to annually experience "secondhand harm" from alcohol use.[73] Similarly, the "wealth of new evidence on the health effects of exposure to secondhand tobacco smoke" led the World Health Organization[74] to make policy recommendations aimed at protecting others from second-hand tobacco smoke.

Yet despite the evidence to the contrary – including the disproportional risk levels of (legal) alcohol and tobacco, when compared with kava; kava's regulation in Aotearoa New Zealand as a food[75]; and the weight and balance comparisons reported by the World Health Organization[76], which present kava in a very favorable light – myths concerning kava's negative impacts on health and socio-cultural process persist. This includes the misrepresentation and misreporting of kava in sensational media reports, peer reviewed academic publications and government health warnings.[77] The latter includes warnings from the Australian Government, which currently has some of the heaviest restrictions on kava importation in the world.[78]

With kava use reported as being of low risk, what is known about its pharmacology?

Kava chemistry

Kava contains a number of active compounds called kavalactones, of which six are reported as being responsible for its psychoactive effect.[79] These six kavalactones have each been allocated a number to aid chemotype classification, and are listed below with their chemotype number and their standard abbreviation (see also Figure 7):

1. *demethoxy-yangonin* (DMY)
2. *dihydro kavain* (DHK)
3. *yangonin* (YAN)
4. *kavain* (KAV)
5. *dihydromethysticin* (DHM)
6. *methysticin* (METH).

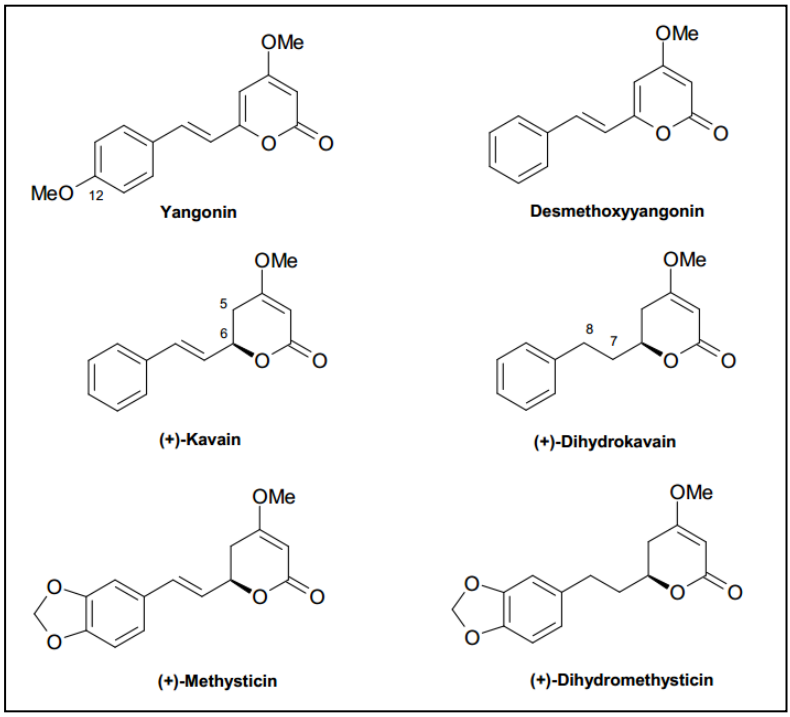

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Figure 7: *Chemical structure of the six major kavalactones present in kava beverage made from the roots and basal stump. Me = methyl group.*

Pharmacologists explain that kava acts on the brain and central nervous system by blocking the calcium ion channels, which leads to a reduction of neurotransmitter release excitation, and the potentiation of *gamma-Aminobutyric acid* ($GABA_A$), through enhanced ligand binding to the GABA receptors. This creates a reduction in the neuronal re-uptake of noradrenaline responders and possibly dopamine, leading to a reversal of monoamine oxidase (MAO) B inhibition.[81] Cairney and colleagues[82] add though, that, "unlike sedatives such as benzodiazepines [to which kava is most commonly likened], barbiturates and anaesthetic steroids, kava lactones do not appear to act on the GABA receptor complexes directly." Put simply, the six kavalactones are reported to act on receptors in the central nervous system, causing a slight numbing and slowing in response time in the muscles, limbs and brain.[83]

Although the explanation in the previous paragraph would suggest there is a high level of knowledge regarding kavalactone psychopharmacology, Kautu and colleagues[84] warn that kavalactone "modes of action are not fully understood", with even less known about "the neurophysiological mechanisms associated with kavalactone metabolism". Likewise, the World Health Organization also admits to large knowledge gaps concerning kava ethnobotany and psychopharmacology, and has requested research on these factors related to "human health effects".[85]

In one of my first attempts to understand kava psychopharmacology, I drew on the work of Saletu and colleagues[86] who in 1989 reported that a single 200mg tablet dose of *kavain* – one of the six key kavalactones found in kava – has an "elimination half-life of 9 hours". Based on this work, I calculated that it took slightly more than 90 hours for kava to be eliminated from the body. [87] Work to further understand kava's elimination half-life has stalled since my 2008 study.[88] However, some commentators have suggested this half-life may be longer than 9 hours, particularly when kava is consumed at traditional high volumes and when all of the kavalactones – currently understood to number 20[89] – are present. Additionally, depending on the age of the kava plant at the time of harvest (lactone levels increase with age) and the concentration of the kava when mixed into the beverage, consumers in naturalistic use settings often ingest more than 8,000mg of kavalactones per sitting, which represents 30 times the pharmacologically recommended daily dose.[90]

The new kava user

Kava's psychotropic properties have also made it increasingly popular among non-Pacific people[91] where, in some countries, kava is served in bar-like settings as an alternative to alcohol.[92] In the United States, there are currently over 180 kava bars[93], some franchised under names such as *Kavasutra*, *The Root of Happiness* and *Island Root.*[94] These environments look very different to traditionally influenced kava-use spaces.[95] Kava's growing popularity has also led to the development of commercially produced flavoured pop-culture kava drinks, available in bottles and cans, and the addition of kava to selected food items, particularly chocolate.

Standing against the bar-type commercial kava space is Four Shells Kava Lounge in Auckland's (Aotearoa New Zealand) central business district.[96] Four Shells is run by Anau Mesui-Henry, who was born in Tonga and has a lengthy family history in kava farming, and her photographer and documentary making husband Todd M Henry. Four Shells focusses on authenticity and education, provided by people who have lived and worked in rural Tonga, and have an intimate knowledge of kava and kava culture. The venue uses traditional utensils to serve kava and provides mats for patrons seeking to sit on the floor.

Authenticity within the commercial kava-bar space is a hotly contested theme, particularly in the United State. It is a topic that Ariana Yetts[97] unpacks with great insight within a chapter in her thesis, commenting that, "What comes to be seen as authentic is instead the outcome of selection processes that emphasizes an overly simplistic, static notion of Pacific kava traditions."

Cornell University in the United States has a student 'bar' called the Sacred Root Kava Lounge, where kava is flavored with chocolate and vanilla to reduce the earthy taste.[98] While this may seem novel, kava use in tertiary settings is not new, particularly in Aotearoa New Zealand. Unlike Cornell University, these Aotearoa New Zealand kava spaces tend to reflect naturalistic kava-use settings, with those in attendance sitting on the floor on mats, using *bilo*/*ipu* and *kumete*, and where kava powder is contributed by attendees for mixing and drinking, as opposed to being purchased by the cup or bowl. These environments offer an "alternative yet safe space grounded on Pacific respect-based values that prioritise *vā* [relational connection] honouring, inclusivity, talanoa and learner wayfinding as integral parts of postgraduate students' research experience, with kava as part, but not the focus,

of the contextual experience"[99]; environments that Fehoko[100] terms "cultural classrooms". Tecun and colleagues[101] add that "university students in Aotearoa [New Zealand] are discussing their studies and community issues in co-ed and gender-inclusive kava circles".

Tecun and colleagues' comment about gender inclusivity in university student-led kava circles is significant. Although kava use among women is common in Fiji, including among women who are pregnant or lactating,[102] this is not the case in all Pacific nations; a restriction that is influenced, in some cases, by cultural taboos around male and female cousin avoidance during socialisation.[103] However, as kava has moved into diasporic spaces, this has led to both a dramatic increase in its use by Pacific women, with women drinking in both mixed gender and women only environments, together with young Pacific adults ignoring cultural avoidance restrictions.[104] In addition, the development of mixed gender kava spaces, together with kava use in tertiary environments, has encouraged kava use among non-Pacific people.[105] This has extended to Māori, the indigenous people of Aotearoa New Zealand, with growing numbers of Māori viewing kava as part of their ancestral connections back to the Pacific Islands, prior to their migration to Aotearoa New Zealand almost a thousand years ago.[106]

This increased use of kava outside of the Pacific Islands by a growing range of people, when taken alongside kava's documented psychoactive properties, has raised questions about its impact on cognitive functions, particularly in relation to driver safety.

Kava use and driver safety

The New Zealand Police report stopping increased numbers of drivers who appear mildly intoxicated, although breath-screening tests return negative results, with officers suspecting kava impairment.[107] Australian police also report a suspected link between kava use and an increased likelihood of serious motor vehicle accidents.[108] Researchers in Iowa in the United States report, "kava impairment was demonstrated through four cases of self-reported kava use … [suggesting kava use] may hinder one's ability to operate a vehicle safely".[109] Further, Wainiqolo and colleagues'[110] ethnographic work from Fiji reports, "driving following the use of kava was associated with a significant excess of serious-injury involved road crashes".[111]

In addition, the New Zealand Institute of Environmental Science and Research (Aotearoa New Zealand's Crown research institute) reports increased detection of kavalactones in the blood of deceased motor vehicle accident victims.[112] However, the institute acknowledges there are large knowledge gaps concerning the interpretation of kavalactones in the blood. For instance, at this stage, it is not possible to determine whether kavalactones detected in the blood of victims result from kava consumed in the previous hour, or previous 24 or even 36 hours.[113] Additionally, with kava not metabolising on the breath in a similar manner to alcohol, and therefore not conducive to breath screening, and with blood testing of suspected kava drink-drivers being ineffectual for evidential purposes, the monitoring and policing of kava-impaired drivers is extremely difficult.

The roadside testing of kava drink-drivers is not unique, with similar limitations also reported for cannabis;

> There is no such thing as a weed Breathalyzer, no biological factor that indicates whether someone is impaired by cannabis at the moment you test them—not blood or urine or hair or breath or spit. While every state prohibits driving under the influence of weed, no state has found a reliable way to sort the stoned from the sober. Like Washington, some states have implemented the 5-nanogram-per-milliliter threshold, but cannabis pharmacokinetics are so variable that even if two people share a joint, one person might dip below that level within two hours and the other might stay above it for the rest of the week. Stoned driving is therefore one of the biggest unresolved sticking points in the long slide toward legalizing marijuana in the US—a Kafkaesque quandary with no clear solution.[114]

The difficulty in monitoring and policing suspected kava-impaired drivers was illustrated in a recent news item by journalist Torika Tokalau.[115] Tokalau reported that shortly after 2am on 14 October 2018, New Zealand Police stopped a driver whose actions led them to believe he was under the influence of alcohol or drugs. The 52-year-old male driver admitted to consuming "about five or six small bowls" of kava and also taking an "unknown prescription medicine" for leg and back issues. After passing a breath-screening test, he was ordered to undergo a roadside coordination test to determine his sobriety. He was subsequently arrested and charged with "driving while incapable", due to a perceived unsteadiness on his feet. The case took 14 months to process through the court system, with the driver eventually found not guilty due to reasonable doubt, as it could not be determined whether the unsteadiness was the result of kava, the prescription medicine, a combination of both, or the leg and back issues.

Although the driver had his charge dismissed due to reasonable doubt, the title of Tokalau's article – "*Auckland man under the influence of kava gets off drug-driving charge"* – nevertheless insinuates he was 'under the influence' of kava and yet 'got off' the drug-driving charge.

This current lack of a suitable evidentiary standard measure, against which to assess driver competency following kava use, not only impedes road policing efficiency and road safety, but also judicial process and the protection of innocents where applicable. That protection of innocents has also been highlighted as a point of concern in a recent cannabis drug-driving study. McCartney and colleagues[116] warned that current testing systems aimed at assessing cannabis-impaired drivers is subjective, leading to "a significant risk of unimpaired individuals being mistakenly identified as 'cannabis-impaired' (and vice-versa)". Further, this lack of a suitable measure is evidenced in the fact that, to date, there have only been three successful kava-use-related driving prosecutions in Aotearoa New Zealand,[117] and a small number overseas.[118]

The prevalence of people driving while under the influence of drugs or alcohol is a significant health and safety issue in Aotearoa New Zealand, with an estimated annual 'social cost' of $564 million.[119] In one recent Aotearoa New Zealand study, 20 per cent of drivers reported taking drugs known to interfere with driver safety within 3 hours of driving.[120] In Australia, research focused specifically on Tongan kava drinkers reported that it was common for 70 per cent of participants to drive home from kava drinking sessions;[121] travel that can include long-distance and inter-city driving.[122]

By applying that Australian estimate to the reported 20,000 people in Aotearoa New Zealand who drink kava on an average Friday or Saturday night,[123] this suggests there could be as many as 14,000 kava users controlling motor vehicles over this time. It is also pertinent to take into account that injury due to road traffic accidents is a leading cause of hospitalisation for Pacific men and women in Aotearoa New Zealand; [124] and that hospitalisation due to drug use is also higher among Pacific people than the general population and increases significantly with age.[125]

Rosekind and colleagues[126] point out the need for more research aimed at understanding the effects that drug substances, notably substances other than

alcohol and cannabis, have on driver safety. They also acknowledge that such studies can be complicated, requiring new and innovative approaches, particularly "in today's world of poly drug-impaired drivers".

It should be noted that although kava is regulated as a 'food' in Aotearoa New Zealand, it is nevertheless a 'drug'. The World Health Organization (2021) explains that any substance, "when taken in or administered into one's system, [which] affect[s] mental processes, e.g., perception, consciousness, cognition or mood and emotions" is a drug. This includes nicotine, coffee, energy drinks (such as Red Bull) and kava. As the World Health Organization goes on to explain, this can be confusing, as the term 'drug' is often incorrectly associated with, "dependence-producing … 'drug use', 'substance use' or 'substance abuse'." Based on this classification, had the 52-year-old male driver in Torika Tokalau's (2020) article been convicted in court, he would indeed have been guilty of drug-driving.

Kava use and cognitive function

LaPorte and colleagues[127] present the first comprehensive literature review on kava's effect on cognitive function. While this is valuable, overall, the findings show inconsistency and subjectivity across the studies surveyed. This was illustrated in a 2017 update of the review, which included only one new study since 2011.

In Sarris and McIntyre's[128] 2017 update, they reported that of 12 clinical trials that assessed the effects of kava on "mental function", four cited "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".

It is important to note that these studies involved participants who had consumed a modified version of kava, taken in tablet (or capsule) form. Administered at a pharmaceutically recommended "daily dose of 60–250mg kavalactones",[129] these tablets contain selected extracted kavalactones, which Bian and colleagues[130] refer to as "designer kava preparations". Such preparations are vastly different to kava consumed in naturalistic traditionally influenced settings. This contrast between modified pill-style kava and naturalistic kava has led some researchers to question whether the former can rightly be called or considered to be actual kava.[131] Moreover, it is common for findings deriving from research that used modified pill-

style kava to be applied to, and overlaid on, naturalistic kava-use psychopharmacology, incorrectly assuming effect correlation.

In an earlier section it was explained that kavalactone "modes of action are not fully understood", with even less understood about "the neurophysiological mechanisms associated with kavalactone metabolism".[132] When this finding is considered alongside the fact that most research into kava's effects on cognitive function has used modified kava in tablet or capsule form, plus the dearth of equivalent research based on naturalistic kava use, these gaps in understanding become even more pronounced.

There is a real need for experimental data that investigates the cognitive effects of kava consumed in naturalistic settings at traditional volumes.[133] Such data will also be valuable for understanding kava's effect on driver safety, which in turn could provide insights into the over-representation of Pacific people in motor vehicle accidents.

Initial research: Kava and cognition linked to driving

The first study that aimed to understand kava's impacts on cognition, and in turn driver safety, both during and following its consumption at traditional volumes, started in 2017 and was funded by a Health Research Council Pacific post-doctoral award (ref. 16/462).

This study, referred to as Experiment 1, was led by the author and used two visual-sensory psychometric measures drawn from the Vienna Test System: Traffic test battery. These were the WAFA[134] Alertness and WAFG Divided Attention measures.[135] The measures 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 to the two specific cognitive functions (alertness/reaction and divided attention) being looked at, between a control (non-kava drinking, *n*=20) and active (kava drinking, *n*=20) group following kava consumption.[136]

This lack of impact on divided attention is particularly interesting when considered against a paper from the United States. Berry and colleagues[137] reported on the

assessment, by drug recognition experts in Iowa,[138] of four drivers who self-reported kava use following police stops. The authors report that: [139]

> Psychophysical impairment in these four cases was measured through four divided attention tasks during the DRE [drug recognition expert] evaluations including the Modified Romberg Balance Test, WAT, OLS, and the Finger-to-Nose test. The psychophysical impairment observed in all four DRE [drug recognition expert] evaluations indicates that kava can hinder one's ability to perform divided attention tasks such as operating a vehicle.

This conclusion is interesting considering Experiment 1 used a specific divided attention test (WAFG[140]), drawn from an industry standard test battery for drug driving, with sufficient participant numbers to provide statistical power and significance, and with participants who attended a lengthy kava session.[141] Yet Experiment 1 produced very different results to those reported by Berry and colleagues.

Having said that, I (together with two research assistants, in Experiment 1), did observe 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 3 hours of kava consumption.[142]

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.[143] 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 assessed in a feasibility study also funded by the Health Research Council's Pacific post-doctoral award (ref. 16/462). That feasibility study is discussed in detail in a recently published paper in *Pacific Dynamics: Journal of Interdisciplinary Research*,[144] where it is argued that the methodology and methods used in the study, "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 traditional kava session."[145]

Learning from the feasibility study was then used to inform a new application to the Health Research Council. This resulted in me receiving the 2019 Health Research Council: Pacific Sir Thomas Davis Te Patu Kite Rangi Ariki Award (ref. 19/002), thereby enabling the feasibility study to be replicated in a full research study. This book is chiefly dedicated to explaining that full study.

Study aims and hypothesis

The study described in the following pages of this book ***aimed to measure aspects of participants' neurological functioning during, and immediately following, traditionally influenced kava consumption, and to apply those results to driver functionality***.

The purpose was to build better understanding of kava-related cognition, driver safety and coordination issues. It is anticipated this information will improve road safety; reduce injury and hospitalisation rates, and the related economic and social costs; have a positive impact on the health of Pacific people and other road users, both in Aotearoa New Zealand and internationally; and contribute to the World Health Organization's call for more research on kava when used in its naturalistic form.[146]

The hypothesis being tested was that the participants consuming kava in the active kava-using group would show changes in their neurological functioning (namely speed, focus, fatigue, accuracy, sequencing, timing perception, plasticity and connectivity), when compared with the participants who were not consuming kava in the control group.

A traditional–contemporary tension

This chapter started by describing kava's cultural importance as an ingestible representation, manifestation and embedded symbol of ethno-cultural identity in Oceania. As Pacific people have migrated, they have taken kava, the kava culture, and its associated respect-based practices with them. Kava's introduction to the Pacific diaspora has also encouraged the use of the beverage among non-Pacific people, resulting in the burgeoning growth of franchised kava bar-styled venues

and alternative forms of consumption. Corresponding with kava's increased popularity among this new user group has been the manufacture of tablets and capsules containing kava extracts.

Although major differences in how kava is used exist between many in the new kava-use group and Pacific people, in the most part, traditional users – even when in diaspora – have maintained consumption styles influenced by their culture. Often referred to as naturalistic kava use, these consumption styles include sitting cross-legged on the floor on mats and serving the mixed kava beverage from a centrally located *kumete* in *bilo* and *ipu*.

Research has identified typical naturalistic kava use as equating to 3.6 litres (6.33 pints) of kava per drinker consumed over a 6-hour period. This average consumption volume is vastly greater than the pharmacologically recommended doses of tablet-form kava. Irrespective that some kava drinkers consume these high volumes on several evenings each week, and contrary to a great deal of misinformation about kava's negative impacts on health and socio-cultural stability, kava is reported as safe and lacking adverse side-effects.

Kava psychopharmacology, or how kava affects the user when consumed, can be confusing. For instance, while there has been a great deal of research using tablet-form kava, very little is understood about the psychopharmacological effects of kava when consumed in its traditionally influenced form over many hours in naturalistic settings.

As kava has shift away from Pacific rural village settings – where kava users mostly travel on foot – and into cities in which family and friends are often spread over large distances, this has led to a greater reliance on vehicle transportation. Additionally, with kava now being consumed by highly mobile non-Pacific people, this has resulted in a traditional–contemporary tension, with kava use suspected as contributing to unsafe driving.

With kava not being an alcohol, and therefore preventing the use of standard breath-screening tests, accurate roadside detection and assessment measures for kava in the context of driver safety are not currently available. Additionally, with large knowledge gaps around how naturalistic kava is metabolised in the body,

together with limited understanding about kava drug half-life, standard blood screening to inform road safety and police evidential processes is also unavailable.

This book reports on a Health Research Council-funded study that aimed to shed light on the effects that naturalistic kava drinking has on driving safety. In the next chapter, the methodology and study methods, or the processes and systems used to undertake the research, will be explained.

3. How the study was done

The previous chapter explained the traditional–contemporary tension that has arisen around kava use; namely, the potential impact that traditionally influenced kava use is having on kava drinkers who then drive home. Several knowledge gaps hinder our understanding of that potential tension; gaps which the research study described in this book aimed to help address. This current chapter explains the methodology and methods in the research, or how the study was done.

Situating the study and the guiding principles

The study was based at the University of Waikato's Te Huataki Waiora School of Health and linked to Te Kura Whatu Oho Mauri School of Psychology's *Traffic and Road Safety Research Group*. Ethics approval was granted by the Health and Disability Ethics Committee within the Aotearoa New Zealand Ministry of Health (reference number 19/NTB/44).

The study was guided by the Pacific Post-development Methodological Framework and the *faikava* methodology.

The Pacific Post-development Methodological Framework combines the Fijian *vanua* research framework with post-development theory, to guide the ethical and equitable use of Western-developed, -standardised and -normed psychometric measures among Pacific people.[147] It is also argued that the framework has broader applicability for all ethnicities, as it is underpinned by ideals and values based on respect; ensuring research participants are treated with dignity and respect at all times, and that the guests (participants) and their needs are treated as superior to those of the host (or research team).

The *faikava* methodology uses a naturalistic kava-use environment to collect both quantitative and qualitative research data. This approach to data collection has only recently been termed the *faikava* methodology, although these types of naturalistic settings have been used for research purposes for more than 20 years. The *faikava* methodology is recognised by the Health Research Council, which has funded nine

research projects over the past seven years in which this data collection methodology has been used.[148]

The status of the *faikava* methodology has been commented on elsewhere:[149]

> The lengthy use of the *faikava* methodology in research, together with kava's recognition as a safe, non-addictive substance that facilitates quality *talanoa* and its endorsement by the HRC [Health Research Council] 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 naturalistic kava-use environment used in the methodology is explained further in an upcoming section entitled 'Location and testing'.

Determining participant numbers

Dr Ray Littler, a biostatistician at the University of Waikato, was consulted about the number of participants required for the results to achieve statistical significance.

Dr Littler used power calculations (based on the overall cortical metric values obtained from the use of the Brain Gauge tool during the feasibility study) to determine the minimum number of participants required for the study to produce statistically significant results: *n*=15. However, it was considered that increasing the number of participants to *n*=20 would substantially increase the statistical significance to a 98 per cent probability level, and allow for dropouts. Dr Littler's calculations are represented in Figure 8.

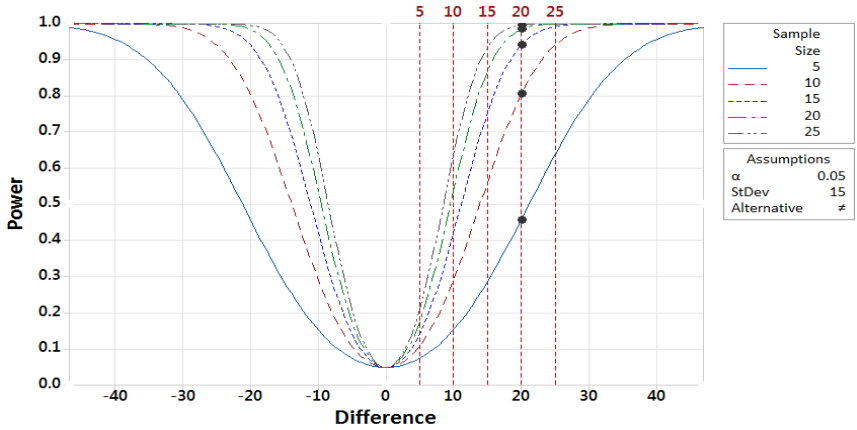

Figure 8: *Power calculations (using Power Curve 2-sample t-test) used to determine minimum participant numbers required to ensure the statistical significance of the data.*[150]

Participant recruitment and eligibility

Initial recruitment was for male participants over 18 years of age who held a full (unrestricted) driver's license. Males were targeted, as historically they have been the dominant kava-consuming gender,[151] although as discussed earlier (see page 10 and 18), many women do, and have, drunk kava for some time. It is anticipated future kava cognition testing will include both a female active and control cohort.

Through the recruitment process, 26 kava-using participants were identified, all of whom were recruited from *faikava* venues in Hamilton and Auckland. In the study, this group is referred to as the 'active' group. In addition, 25 non-kava drinking participants were recruited by word of mouth, and through online advertisements and noticeboards at the University of Waikato. This group is referred to as the 'control' group.

All recruits completed an eligibility screening form to ensure they were in good health, free of neurological or psychological conditions (for example, previous head injury, concussion or psychotic disorders), and were not taking any anxiolytic, antipsychotic or sleep medication. The form required recruits to answer a range of simple questions related to these matters by ticking either 'yes' or 'no'.

Recruits in the active group were also questioned about their kava use; allowing novice kava users to be identified and excluded, as the study required participants who regularly consumed kava at high volumes over multiple hours.

Eligibility screening for the control group asked whether the recruits had ever consumed kava, and if so, how recently. For those who indicated they had previously used kava, that use had mostly occurred as part of a cultural experience at the University of Waikato or while on holiday in Fiji.

The eligibility screening reduced the number of participants to n=20 in each group, complying with the 98 per cent statistical significance probability level identified from the power calculations.

Participants were given an information sheet explaining the research aims, procedures, expected time commitment, and the requirement not to consume any alcohol in the 24 hours before testing, and no coffee, energy drinks or Coca-Cola in

the 6 hours before testing. Control participants were also reminded that they must not consume any kava at all in the period prior to testing. Active participants were requested not to consume any kava in the 4 days prior to testing. This 4-day washout period is based on current understandings of kava elimination half-life, as explained in the earlier chapter under the heading 'Kava chemistry'.[152]

Just before testing started, control participant number 18, a 38-year-old man of Māori ancestry, was forced to withdraw due to an unexpected incident at home. Due to time limitations, he was unable to be replaced.

Participant demographics

The age and ethnic breakdown of the 39 participants who completed the testing is presented in Table 1. Participants were numbered from 1 to 20 in each group.

Table 1: Age and ethnicity of active and control participants

ACTIVE (kava using)		Participant number	CONTROL (non-kava using)	
AGE	ETHNICITY		AGE	ETHNICITY
34	Guatemalan	1	24	Tongan
34	Tongan	2	32	Vietnamese
31	Hawaiian	3	49	Māori
41	NZ European	4	49	Māori
27	NZ European	5	34	Vietnamese
30	Fijian	6	31	Fijian
51	Fijian	7	49	NZ European
48	Fijian	8	50	Māori
27	Tongan	9	21	Māori
29	Tongan	10	36	NZ European
31	Fijian	11	44	Māori
36	Fijian	12	30	Samoan
48	Fijian	13	49	Fijian
30	Fijian	14	24	Fijian
23	Tongan	15	25	NZ European
28	Tongan	16	31	Māori
22	Tongan	17	18	Māori
37	American	18	Withdrew	
27	Samoan	19	39	Māori
22	Samoan	20	41	Māori

Participants were all males and included people of Pacific Island and other ethnicities, to reflect the increasing use of kava by non-Pacific people.[153] The average age of the participants was 34.12 years (SD = 9.61); with the average age of those in the active group being 32.75 years (SD = 8.59) and in the control group 35.57 years (SD = 8.58).

Fijians represented the greatest number of active participants in the study (eight), with two in the control group. Tongans were the next largest active participant group, with five, and one control participant. All of the eight Māori participants were in the control group. Although this number of Māori control participants was similar to Experiment 1, that earlier investigation also had three active Māori participants.[154] Aotearoa New Zealand European representation totaled five participants: three active and two control. Interestingly, the study also included one active participant of Guatemalan ancestry who has been drinking kava for many years, and two Vietnamese control participants who accompanied an active participant.

Briefing and preparing participants for the test

The total participant group was split in two for the testing; with testing carried out on two separate occasions, and each occasion hosting 10 active and 10 (or 9) control participants. This number allowed for appropriate management and observation of participants during the tests.

On both test-days, research assistants transported the participants from their homes to a large meeting room adjacent to a computer lab at the University of Waikato, which would serve as the *faikava* venue during the test.

Participants arrived at 6pm, allowing them time to be briefed on the study procedures, sign consent forms (including an explanation of their ethical rights as a research participant) and complete a short questionnaire. The questionnaire replicated some of the questions asked during the eligibly screening phase, to ensure participants had refrained from using kava for the designated period before the test, were still in good health, had not started taking new medicines, and had not consumed alcohol in the past 24 hours or caffeine, energy drinks or Coca-Cola in the past 6 hours.

Participants were advised that if they had any questions at any point they were free to ask and an open and transparent answer would be given; and that should they wish to withdraw from the study, they were free to do so, and a taxi would be ordered to take them home. With the exception of the control participant who needed to leave for family reasons, no other participants withdrew from the study.

After the consent forms were signed, participants attended a nearby lecture theater where they viewed a short video explaining the Brain Gauge test and were given a full explanation of the test procedures (as detailed in the next sections). Participants were advised that their kava intake, and any other liquid or food consumed during the test period, would be recorded by a research assistant, who would also note any unusual behaviour among the participants, as the test proceeded. The participants were then given time to ask questions.

Following this, the participants were taken to the computer lab to complete the first psychometric test session, using the Brain Gauge, to provide baseline data. Once baseline testing was complete, all participants returned to the *faikava* venue and were invited to sit on woven mats, where *isevusevu* was presented.

iSevusevu is a Fijian-influenced cultural practice in which attendees are acknowledged and the purpose of the *isevusevu* explained.[155] In this case, the participants were thanked for their time and participation. All Pacific people have cultural practices similar to *isevusevu,* including Māori whose equivalent practices are known as *pōwhiri* and *whakatau*.[156] Conducting *isevusevu*, as part of the *faikava* methodology, complies with and upholds Pacific cultural expectations and obligations, as guided by the Pacific Post-development Methodological Framework.[157]

Over the following 6 hours, the participants drank kava (if they were members of the active group), engaged in *talanoa*, consumed chasers (which are explained in an upcoming section) and occasionally left the room to use the toilet. The control participants did not consume kava at any point during the testing phase.

Preparing the kava

Dried powdered kava root and basal stump, originating in Fiji and sold under the Green Gold brand, was purchased from a reputable kava retailer in Hamilton,

Aotearoa New Zealand. Green Gold kava powder is sold in sealed bags, as shown in Figure 9.

A sufficient quantity of kava was sourced for both test-day sessions to aid standardisation. Kava powder, retained for the second testing session, was compressed into heavy-duty plastic bags and stored in an airtight container in a dry dark cupboard at approximately 18°C, to maintain its freshness.[158]

Figure 9: *Green Gold kava powder, used to mix the kava beverage used during testing.*

Approximately 1 hour before each test session, the author mixed 36 litres (9.51 gallons) of kava for consumption during the test. The author has over 20 years' kava-use experience, and the mixing procedure used a standard recipe to produce a kava beverage with a similar concentration to that usually consumed in *faikava* environments in Aotearoa New Zealand. The recipe used was also chosen for its ease of duplication.

The prepared kava was served to the participants in the active group from a *kumete*, in *bilo*/*ipu* (cups made from coconut shells), at 100ml (equivalent to 0.2 pint) portions (see Figures 10 and 11). Portions were served at the rate of six serves per hour, throughout the 6-hour test session; meaning that each active participant consumed 3.6 litres (6.33 pints) of kava during the session.

Location and testing

The room where the kava was consumed during the study was set up to reflect a *faikava* space, or a typical kava session venue. To replicate that naturalistic environment, woven mats were placed on the floor, which the participants sat on cross-legged while consuming the kava (see Figures 10, 11 and 12).

Figure 10: *Kava being poured into the* kumete *for serving to study participants.*[159]

Figure 11: *Kava being served, in* bilo/ipu *from a* kumete*, during the test session.*[160]

I ensured that all cultural kava consumption protocols were adhered to throughout the session.[161] This adherence to protocol, together with the naturalistic setting, encapsulated the *faikava* methodology, as used in the two previous kava cognition studies.

All of the participants were invited to partake of snack foods, at their leisure, during the test period. These foods were typical kava 'chasers', or food items consumed during a regular kava session,[162] and included salted potato chips and peanuts, apples, pears, bananas and sweets (see Figure 12). The sweets provided were sugar-free to limit any potential cognitive stimulant effect; this was done purely as a precautionary measure, contrary to research that argues "that the idea of a positive CHO–mood relationship is unsubstantiated".[163]

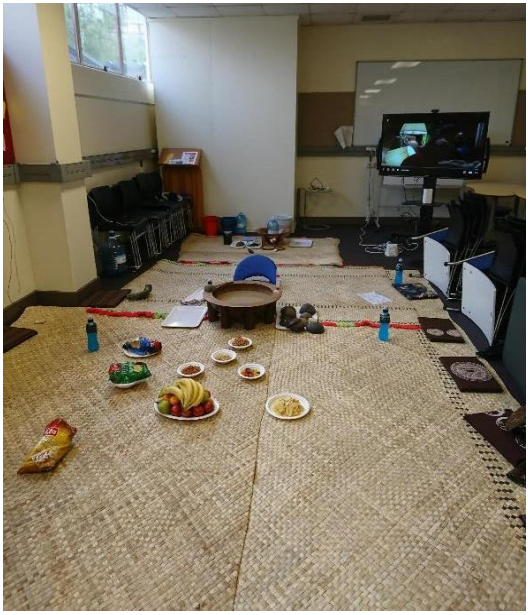

Figure 12: *The* faikava *environment used during the study*.[164]

The drinks offered (in addition to kava) were water and sports rehydration drinks, as participants had been asked to avoid any Coco-Cola, energy drinks or caffeine. Participants were free to move about the venue and leave it to use the toilet throughout the testing session, although members of the active group were advised to be in the room at kava serving times, and all participants were required to be available for testing in the computer lab at designated times.

Although the study adhered to some strict conditions, flexibility around the consumption of chasers, along with the freedom to move about were allowed, so

as to create a naturalistic kava consumption setting and to comply with the structure of the *faikava* methodology.[165]

Psychometric tests

Cognitive assessment of participants during the study was conducted using the Brain Gauge testing tool.[166] 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.[167]

Shaped like a typical computer mouse, the Brain Gauge device has two probes (each 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 13.

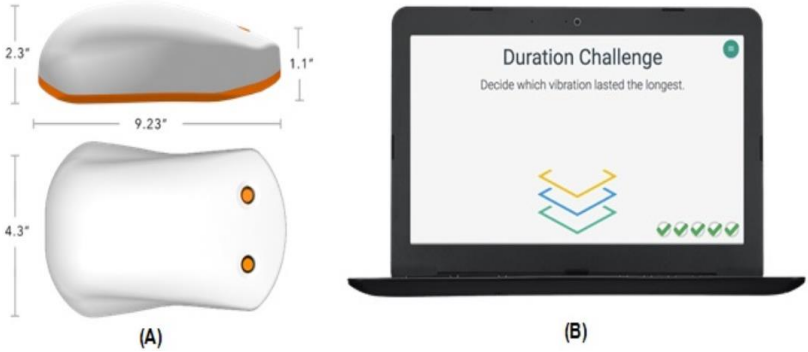

Figure 13: "*The 'Brain Gauge' (A) two-digit vibro-tactile stimulation handheld device and (B) example of visual cueing test screen".*[168]

During the test, the Brain Gauge probes deliver a vibratory stimulus (with a flutter range of 25 to 50Hz) 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 six domains[169]:

- 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 sequencing and 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
- Focus – associated with motivation, attention span, determining similarities and differences between objects or events, and the ability to predict future consequences.[170]

Brain Gauge also calculates an overall composite score (cortical metric), together with individual task scores, which are presented alongside normative scores (see also Figure 14).[171] These performance measures can be applied to the strategic, tactical and operational cognitive aspects needed to understand driver capacity and performance.[172]

Brain Gauge has test–retest functionality (meaning results are not compromised with repeated use) and has been used in more than 60 major studies measuring traumatic brain injury, drug use and autism, resulting in 45 peer-reviewed publications. In addition, Brain Gauge is increasingly being used (in the United States and, more recently, Aotearoa New Zealand) as a field-side neurosensory measure to assess concussion in professional sport (chiefly American football and rugby union).

For this study, testing was completed in a computer lab adjacent to the *faikava* venue, where each Brain Gauge device, together with a standard computer mouse, was connected to a Dell Optiplex (9020) desktop computer running the Brain Gauge application. 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 asked to read the test instructions 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 1 and 3 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 on the actual tests. The total test battery took between 10 and 20 minutes to complete.

Each participant was allocated to one of several research assistants who monitored their progress and addressed any issues during their use of the Brain Gauge tool. Once participants had completed the test battery, they were redirected to the Brain Gauge home page. Once at the Brain Gauge homepage, the research assistants then directed them back to the *faikava* venue. Participants were not made aware of their scores or performance at any time during the testing.

Testing intervals

The study's 6-hour duration was selected to represent the period of a typical traditional kava session,[173] and was consistent with the two earlier kava-cognition studies I had undertaken.[174]

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

- T1: baseline prior to any kava consumption
- T2: halfway through the kava session (when participants had been drinking for 3 hours)
- T3: when the kava session had ended, 6 hours after the consumption of the first *bilo* of kava.

The participants were given 5-minute warnings before each test session. Brain Gauge baseline testing (T1) commenced at 6.30pm, and as explained earlier, was

followed by *isevusevu*. The final Brain Gauge testing (T3) was undertaken following the sixth hour of kava consumption at 12.30am.

On return to the *faikava* space, after the final testing, the participants were acknowledged with *tatau*. *Tatau* is similar to *isevusevu*, and in this case thanked participants for their time and participation. It also complies with Pacific cultural expectations and obligations, and the Pacific Post-development Methodological Framework and *faikava* methodology used in the study.[175]

The *tatau* provided an opportunity for some of the control participants to consume kava for the first time, and was followed by a substantial meal, and presentation of a $100 gift voucher to thank each of the participants for their time. All participants were provided with a ride home. The test session took approximately 7.5 hours to complete.

Analysis of the test data

Brain Gauge test results are presented in both illustrative and numerical format, with the latter easily exported to a variety of software options for data analysis.

Figure 14 shows a typical data output in illustrative form, as produced by the Brain Gauge application. The figure was produced following the feasibility study and shows the test results for participant AA at baseline (T1), the midpoint at 3 hours (T2) and the completion of kava drinking at 6 hours (T3).[176]

Although this mode of illustration is extremely valuable for interpreting the data of individuals, it is less clear for presenting group data.

In the study, instead of generating Brain Gauge illustrations, the numerical data was exported and analysed using Student's *t*-test (Normal), a nonparametric statistical test that comes in two versions – the Wilcoxon signed-rank test and the Mann-Whitney U test (rank sum) – together with Bayesian inference techniques.

Student's *t*-test and non-parametric analysis compares and measures the significance of differences between paired groups: in this study, that was the difference between the active and control groups. Bayesian analysis produces a 'Bayes factor', which is used for comparative analysis. A Bayes factor represents a

ratio of the likelihood of a specified hypothesis (e.g. the effect of a treatment) compared to a second hypothesis (e.g. the treatment having no effect).

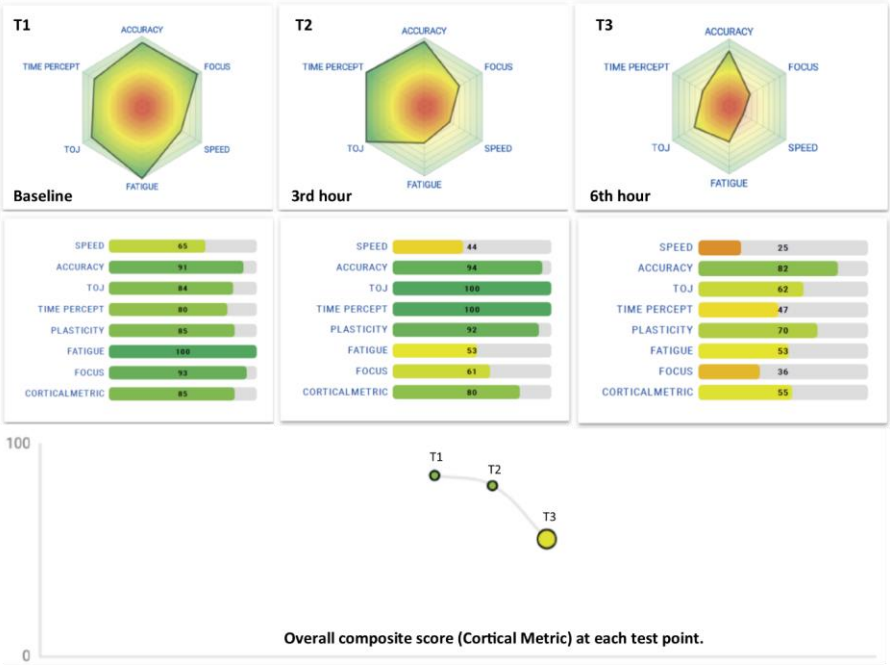

Figure 14: *Brain Gauge output data: at baseline (T1); the 3-hour midpoint (T2); and at the conclusion of kava consumption at 6 hours (T3) for participant AA.*[177]

In summary

This chapter presented the study design; the instruments and guiding methodology, which are critical to the success of the overall study.[178]

The Pacific Post-development Methodological Framework and the *faikava* methodology guided the data collection in which 20 active (kava drinking) and 19 control (non-kava using) participants were tested with the Brain Gauge at three test points (T1, T2 and T3). This was followed by analysis of both the kava used during the testing and the output data from the Brain Gauge measure.

The results of the analysis are presented in the following chapter, together with commentary to add interpretation and explanation.

4. Temporal order judgment

Chapter 2 explained growing concerns by road policing that drivers 'doped' on kava may be a hazard to safe driving.[179] This is a recently new concern linked to the increased mobility of kava users, one that has created a clash of cultures – between traditional kava use and modern systems of transportation. That chapter also explained the large knowledge gap concerning psychopharmacology when kava is used in its naturalistic form.[180]

These concerns and shortfalls in understanding led to a first of its kind, kava drink-driving study (called Experiment 1), which used an industry standard measure of drug driving – the Vienna Test System – to assess the reaction and divided attention of kava users during and following a naturalistic 6-hour kava session. Although no statistically significant differences were identified between the control and active participants in Experiment 1,[181] the active participants were observed to have slowed movement and slight speech slurring.[182] This led to the identification and feasibility testing of a new psychometric test – the Brain Gauge – and the subsequent funding, by the Health Research Council, of a new full study; the focus of this book.

Chapter 3 explained the methodology and methods used to undertake the new full study. In a similar manner to Experiment 1 and the feasibility study, the new full study was also underpinned by the Pacific Post-development Methodological Framework and *faikava* methodology, and tested a control and active group who attended a 6-hour naturalistic kava-use session. Baseline (T1), mid-point (T2) and end-point (T3) testing was completed using the Brain Gauge tool and application, with the kava subsequently chemically profiled through analytical fingerprinting and the data collected during testing statistically analysed.

This chapter presents the results, interpretation and discussion from those analyses.

Kava analysis and chemical fingerprinting

Several weeks after completion of testing, the author took a 200gm (7.05 ounce) sample of the Green Gold kava powder used in the testing to the New Zealand Institute of Environmental Science and Research in Wellington for analysis. While there, the author also mixed a sample of kava using the same recipe as used for testing.

Dr Rishi Pandey, a scientist at the institute, analysed the sample using targeted high-performance liquid chromatography in tandem mass spectrometry (HPLC-MS), in order to determine the fingerprint of kavalactones in the kava beverage. Dr Pandey provided the following explanation of the analysis, including the analysis shown in Figures 16, 17 and 18. Although highly technical, the explanation has been included here in full to enable the analysis to be replicated by analytical chemists, if required.

> Individual fingerprints for each of the six dominant kavalactones was obtained by direct infusion with standards sourced from Sigma-Aldrich, New Zealand. HPLC-MS/MS analysis and MS/MS Quantitation was performed on an AB SCIEX triple quad 5500 LC-MS/MS coupled to a Sciex Exion liquid chromatography system.
>
> Briefly, 10 mL of each of the samples was sub-sampled, centrifuged at 4500 rpm for 10 minutes to pellet down the debris or undissolved matter. 50 microL of the clear aqueous layer was further diluted 1 in 20 with SQ water and 50 microL of internal standard diazepam-d5 was added to the mix. This was followed by the Chromatographic separation of 1 µL of extracted sample on a Phenomenex Luna C18 column (dimension 150 x 2.1 mm, 3 µm particle size, 100 Å) maintained at 40°C throughout the gradient run of 10 minutes with mobile phase A; 0.1% formic acid in water and mobile phase B; 0.1% formic acid in methanol at a flow of 0.5 mL/min.
>
> The gradient time course followed was: 0.00-5.00 minutes 40% mobile phase B; 5.00-6.0 minutes a linear increase in a gradient to 95% mobile phase B at a flow rate of 0.6 mL/min; 6.00-8.00 minutes a hold with 95% mobile phase B; 8.00-10.00 minutes a linear decrease in gradient to 40% mobile phase B and hold from 10.00-10.05 minutes at 40% mobile phase B, to equilibrate the column. The mass analyzer was an AB SCIEX 5500 Triple-Quad operated in positive ion mode, using electrospray ionisation (ESI) operated at the following conditions: gas 1, nitrogen (60 psi); gas 2, nitrogen (50 psi); ion-spray voltage, 5000 V in positive mode; ion-source temperature, 450°C; curtain gas, nitrogen (30 psi). Nitrogen collision gas was set at medium for all experiments. The dwell times were optimised using the scheduled MRM algorithm incorporated in the AB Sciex Analyst® software and flexible window widths functionality was applied. All data processing is performed using Sciex MultiQuant® 3.0.2 software with the SignalFinder1 algorithm.

The reconstructed ion chromatograms and product ion spectra were found to be consistent with the spectra acquired by direct infusion of individual pure kavalactone standard (Figure 15 and 16). The observed mass spectra and MRMs (quantitative and qualifier ions) for each of the six kavalactones in the aqueous kava extract agreed with those identified in the unextracted kavalactone standard mix (Figure 17). The quantitation of the kavalactones was performed using a six-point standard calibration curve constructed with diazepam-d5 (IS) in 10% methanol (0.12, 0.26, 0.55, 1.1, 2.2 mg/L) developed using a set of six-point calibration at different dilutions. The standard curve was fitted to a Hill's regression curve. The fresh aqueous kava extract exhibited clear fingerprint for each of the six kavalactones, with kavain (34.7 mg/L) and dihydrokavain (30.6 mg/L) being the most abundant kavalactones, followed by dihyromethysticin (15.4 mg/L), methysticin (8.4 mg/L), desmethoxyyangonin (6.2mg/L), and yangonin (2.0 mg/L). Overall, the results demonstrated clear fingerprint of the six kavalactones in traditionally prepared fresh kava extract.[183]

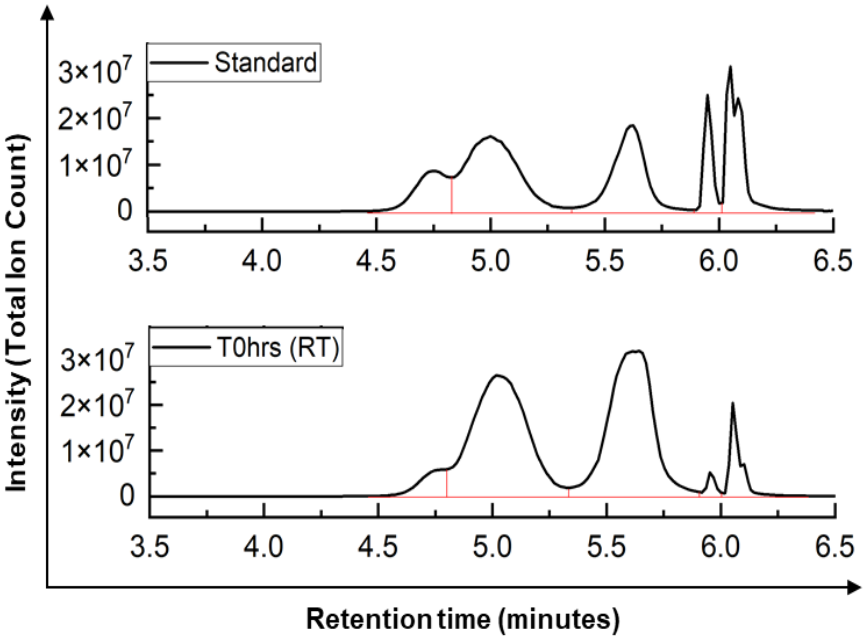

Figure 15: *Targeted UPLC-MS/MS analysis of kavalactone standard mix containing the six kavalactones (Kavain (1.18 mg/L), Dihydrokavain (1.00 mg/L), Yangonin (1.01 mg/L), Desmethoxyyangonin (1.14 mg/L), Methysticin (1.02 mg/L), and Dihydromethysticin (1.00 mg/L)) and fresh kava extract. Reconstructed total ion count (TIC) chromatograms of kavalactone standard mix (standard) and fresh aqueous kava extracts show the different peaks corresponding to the six kavalactones.*

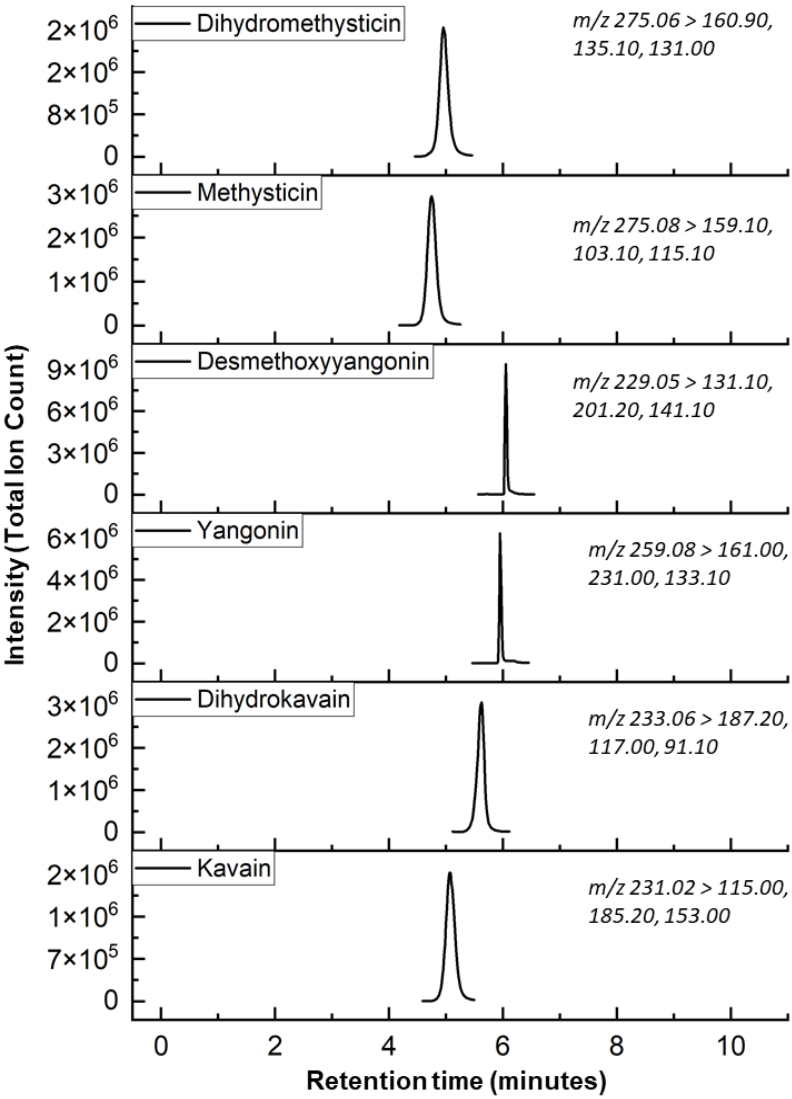

Figure 16. *Mass spectra fingerprint for kavalactones obtained by direct infusion of each of the six pure kavalactone standards prepared in methanol on the AB SCIEX 5500 Triple-Quad mass analyzer. MRM transitions identified for each of the kavalactones is shown as the m/z in the of standard stacked plot. The MRM detection windows were set at 12 seconds and 30 seconds as determined by the density of MRM concurrency in chromatography, target scan time was 0.4 seconds, resulting in at least 15 points across the peak baseline. At least 3 MRMs per analyte were monitored, with one quantitative MRM (based on the maximum intensity of the analyte) and two qualifier ions.*

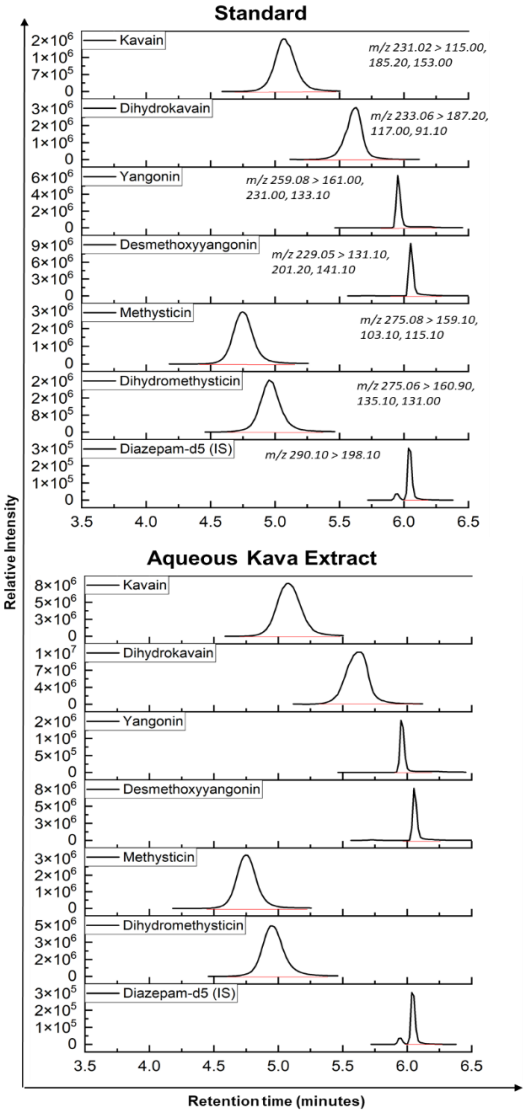

Figure 17: *Mass spectra for each of the six kavalactones and Internal standard (IS) diazepam-d5 as extracted and identified by targeted multiple reaction monitoring (MRM), for the unextracted kavalactone standard mix solution (Standard), and aqueous kava extract. MRM transitions monitored for each of the kavalactones is shown as the m/z in the of standard stacked plot. The MRM detection windows were set at 12 seconds and 30 seconds as determined by the density of MRM concurrency in chromatography, target scan time was 0.4 seconds, resulting in at least 15 points across the peak baseline. At least 3 MRMs per analyte were monitored, with one quantitative MRM (based on the maximum intensity of the analyte) and two qualifier ions.*

In short, the kava used during testing was found to contain no adulterants, with a strength rating of 5 per cent total kavalactones by dry weight, a chemotype of 462531, and a mean kavalactone content of 115mg per 100ml of kava beverage.

Kavalactone ingestion volumes

All 20 of the active participants consumed the maximum of 3.6 litres (7.6 pints) of kava over the 6-hour test period, drinking the full 100ml of kava at each serving.

With the HPLC-MS analysis showing the presence of 115mg of kavalactones per 100ml of kava beverage, this equates to each active participant having consumed 1,840mg of kavalactones by the time of the T2 Brain Gauge test after 3 hours of kava drinking; and 3,680mg after 6 hours of kava consumption, just prior to the final test (T3).

This level of consumption is almost 15 times greater than the pharmacologically recommended dose. The kava used during this testing was not as strong as that used during Experiment 1, in which participants each ingested 4,426.145mg of kavalactones over the 6-hour test period.[184]

Psychometric test data

As explained in Chapter 3 in the section on 'Psychometric tests' (page 36), the Brain Gauge test battery comprises nine tasks which measure six cognitive attributes or domains: Speed (with Fatigue as a variable), Accuracy, Temporal Order Judgement, Timing Perception, Plasticity and Focus.

Additionally, in Chapter 3 in the section on 'Analysis of the test data' (page 39), it was explained that while the Brain Gauge application presents the test data of individuals in a user-friendly illustrative format, as shown in Figure 14, this is not the case with group data. Therefore, the data analysis in this study will, in the first instance, be presented in Tables 2, 3 and 4. These will be followed by specific points of discussion, accompanied by simple box-plots (and in one case violin-plots).

Within the tables, *p*-values for *t*-test and nonparametric statistical test data meeting statistical significance (≤ 0.05), and Bayesian analysis data greater than a cutoff of

2.5, are either highlighted in **bold** text or underlined. This will aid discussion in the following sections.

Tables 2.1, 3.1 and 4.1 present within-cohort data (comparing control group data with control group data; and active kava-using group data with active kava-using group data) at the three test points (T1, T2 and T3, as explained on page 38). Although some of that within-cohort data is statistically significant (≤ 0.05) (for instance, the control group shows a marked regression in Plasticity, or how well the "brain is integrating, processing, and adapting to information from [the] external environment"[185] between their T1 baseline and T2 mid-point third-hour test [W[186]=0.002838; t[187]=0.001382; BF[188]=27.93537], whereas no change is evident among the active participants for the same period), only one data set (active group Focus) will be discussed here.

Table 2: Non-parametric analysis of Brain Gauge output data

2.1 Group-wise (analysed with the Wilcoxon signed-rank test [*W*])

Test	Focus	Accuracy	Temporal Order Judgement	Timing Perception	Plasticity	Fatigue
Control-T1 v Control-T2	0.06491	0.003521	0.2361	0.6024	0.002838	0.02874
Control-T1 v Control-T3	0.04377	0.6699	0.09922	0.3058	0.1688	0.07028
Active-T1 v Active-T2	0.03315	0.3801	0.7798	0.08502	0.5958	0.3636
Active-T1 v Active-T3	0.08003	0.07013	0.2572	0.0908	0.2943	0.9687

2.2 Test-wise (analysed using the Mann-Whitney U test (rank sum) [*MW*])

Test	Focus	Accuracy	Temporal Order Judgement	Timing Perception	Plasticity	Fatigue
Control-T1 v Active-T1	0.09256	0.2154	0.6432	0.3264	0.3049	0.9146
Control-T2 v Active-T2	0.5669	0.5174	0.556	0.1969	0.4478	0.3381
Control-T3 v Active-T3	0.1284	0.4218	**0.01199**	0.4986	0.2111	0.1534

Table 3: *t*-test analysis of Brain Gauge output data

3.1 Group-wise [*t*]

Test	Focus	Accuracy	Temporal Order Judgement	Timing Perception	Plasticity	Fatigue
Control-T1 v Control-T2	0.03943	0.003769	0.2057	0.7241	0.001382	0.0267
Control-T1 v Control-T3	0.04786	0.6725	0.08645	0.2126	0.1324	0.05641
Active-T1 v Active-T2	0.02225	0.6374	0.8907	0.09863	0.9972	0.3301
Active-T1 v Active-T3	0.0599	0.07084	0.2512	0.1242	0.2446	0.8949

3.2 Test-wise [*t*]

Test	Focus	Accuracy	Temporal Order Judgement	Timing Perception	Plasticity	Fatigue
Control-T1 v Active-T1	0.1056	0.353	0.7854	0.3471	0.4133	0.7914
Control-T2 v Active-T2	0.2257	0.2664	0.5427	0.07599	0.3003	0.3568
Control-T3 v Active-T3	0.1243	0.6883	**0.007301**	0.4068	0.3207	0.3074

Table 4: Bayesian analysis of Brain Gauge output data represented as Bayes Factor [*BF*]

4.1 Group-wise [*BF*]

Test	Focus	Accuracy	Temporal Order Judgement	Timing Perception	Plasticity	Fatigue
Control-T1 v Control-T2	1.705228	11.82067	0.4995444	0.2516297	27.93537	2.327754
Control-T1 v Control-T3	1.464235	0.2580279	0.9301191	0.4885296	0.6795536	1.288536
Active-T1 v Active-T2	2.651865	0.2576112	0.2343741	0.8267202	0.2323277	0.3611313
Active-T1 v Active-T3	1.207349	1.061227	0.4286033	0.6976325	0.4361348	0.2342181

4.2 Test-wise [*BF*]

Test	Focus	Accuracy	Temporal Order Judgement	Timing Perception	Plasticity	Fatigue
Control-T1 v Active-T1	0.9029292	0.4422151	0.321491	0.4458265	0.4095644	0.3207528
Control-T2 v Active-T2	0.5596713	0.5227868	0.3621285	1.114496	0.484628	0.4419345
Control-T3 v Active-T3	0.8067667	0.3327489	**6.193058**	0.4108801	0.4634306	0.4753166

Concerning the within-active-cohort Focus data, Table 2.1, 3.1 and 4.1 show a statistically significant level of impairment to the Focus of the active participants at T2 (or following 3 hours of kava use): [*W*=0.03315; *t*=0.02225; *BF*=2.651865]. However, at T3, and following 6 hours of kava drinking, the Focus of the active participants shows a (non-statistically significant) level of improvement: [*W*=0.08003; *t*=0.0599; *BF*=0.1243]. That change in a positive direction (as opposed to a regression) can be seen in Figure 18, which is a simple box-plot showing the results of the group statistics *t*-test analysis. Together with an upcoming observational comment, this positive change in Focus will be discussed shortly in relation to driving.

Of greater interest are Tables 2.2, 3.2 and 4.2, which present the between-cohort data (comparing data from the control group and the active kava-using group) at the three test points (T1, T2 and T3).

At odds with the hypothesis (page 24), the results show no statistically significant level of impairment to the following five cognitive attributes or domains for the active participants (when compared with the control participants) over the course of the 6-hour kava-use session.

- Focus – or how well the "brain is able to concentrate on the task at hand", which is "associated with motivation, attention span, determining similarities and differences between objects or events, and the ability to predict future consequences".[189]
- Accuracy – or how well the "brain is able to differentiate between similar sensations or stimuli", which is "responsible for integrating sensations that are detected by different parts of the body".[190] A simple box-plot showing the Accuracy data is presented in Appendix A (page 103).
- Timing Perception – or how well the "brain is able to keep track of time", which is linked to "motor learning, balance and coordination, and timing accuracy".[191] A simple box-plot showing the Timing Perception data is presented in Appendix B (page 104).
- Plasticity – or how well the "brain is able to react and adapt to changes in [the test subjects] surroundings", which allows response adjustments to new situations and environmental change.[192] A simple box-plot showing the Plasticity data is presented in Appendix C (page 105).

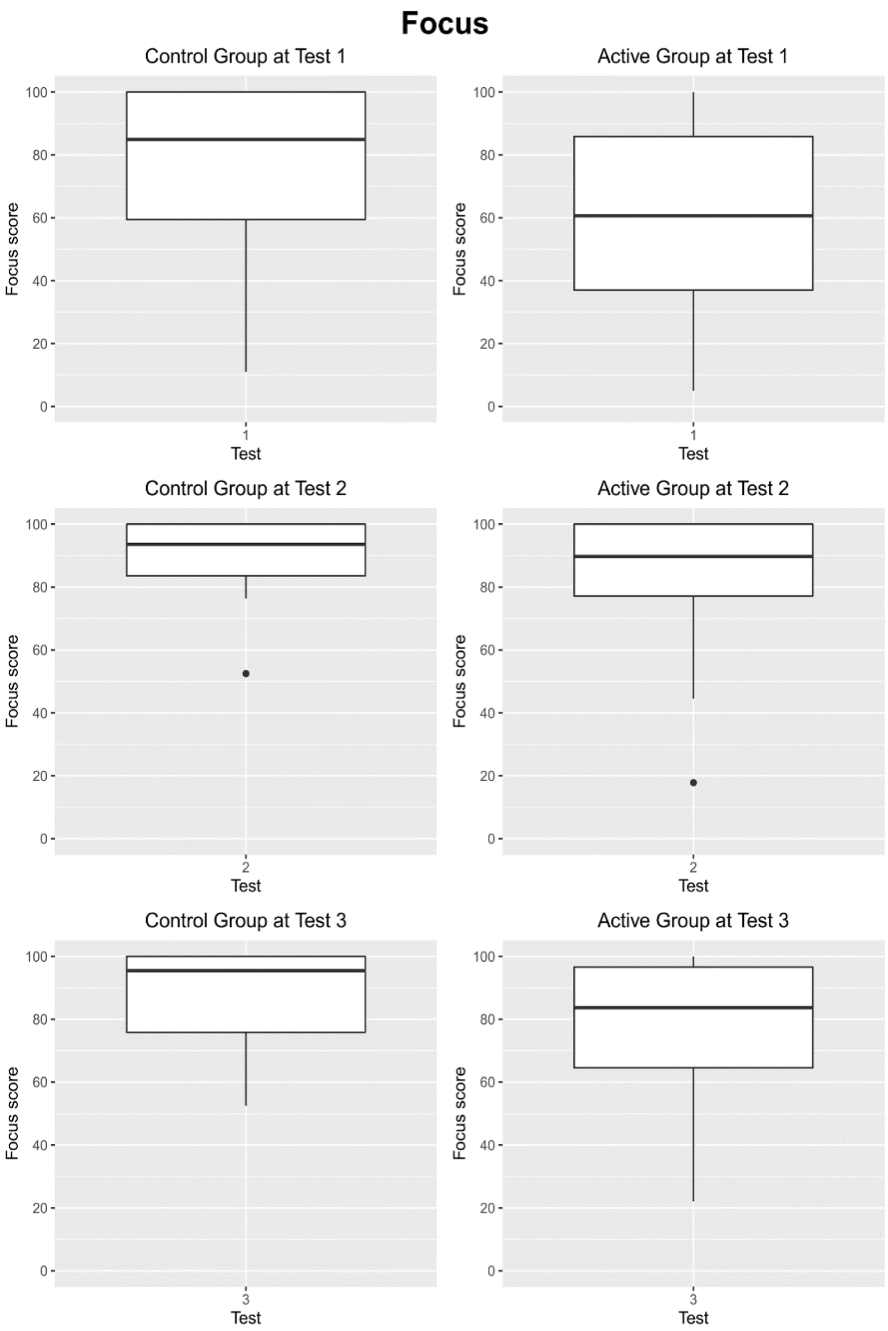

Figure 18: *Simple box-plot showing the Focus data.*

- Fatigue – or how the "brain tires during a mentally demanding task", which has an impact on reaction time.[193] A simple box-plot showing the Fatigue data is presented in Appendix D (page 106).

Although the data described above shows no statistically significant changes for five of the domains measured by the Brain Gauge, there are nevertheless two points of interest.

The first point of interest relates to Timing Perception. Tables 2.2, 3.2 and 4.2 (and Appendix B, page 104) show no statistically significant change in Timing Perception for the active group, when compared with the control group over the 6-hour period ([*MW*=0.4986; *t*=0.4068; *BF*=0.4108801]). Within the Brain Gauge test definitions, Timing Perception includes "balance and coordination". Therefore, the data suggests kava use over 6-hours has no negative impact on the drinker's ability to maintain body position control during the execution of a task. This finding supports a recent pilot study[194] in which participants (*n*=6), who also attended a 6-hour kava-use session employing the Pacific Post-development Methodological Framework and *faikava* methodology, had their balance assessed using a force-plate. The results of the study suggest that kava does not impair postural control, as measured using a 30-second eyes-closed static-stance balance task. That study is currently under review for publication.[195]

The second point, which is of greatest interest, is the Temporal Order Judgement test scores. Data in Tables 2.2, 3.2 and 4.2, which compares the Temporal Order Judgement scores of the active kava users with those of the control group, shows a significant level of regression in active participants' Temporal Order Judgement at T3: [*MW*=**0.0119**; *t*=**0.007301**; *BF*=**6.193058**]. Figure 19 presents a simple box-plot of the results of this data. Figure 20 shows the same data presented as a violin-plot, to provide alternative illustration.

Temporal Order Judgement includes sequencing and is associated with "how well [the] brain is able to keep track of the order of events".[196] King, Hume and Tommerdahl[197] add that Temporal Order Judgement, as assessed by the Brain Gauge, is a "metric associated with the 'when' pathway (frontal-striatal)". With "frontal-striatal pathways control[ing] many of the brain's executive functions, including decision making, behavioral control, and information processing",[198] this

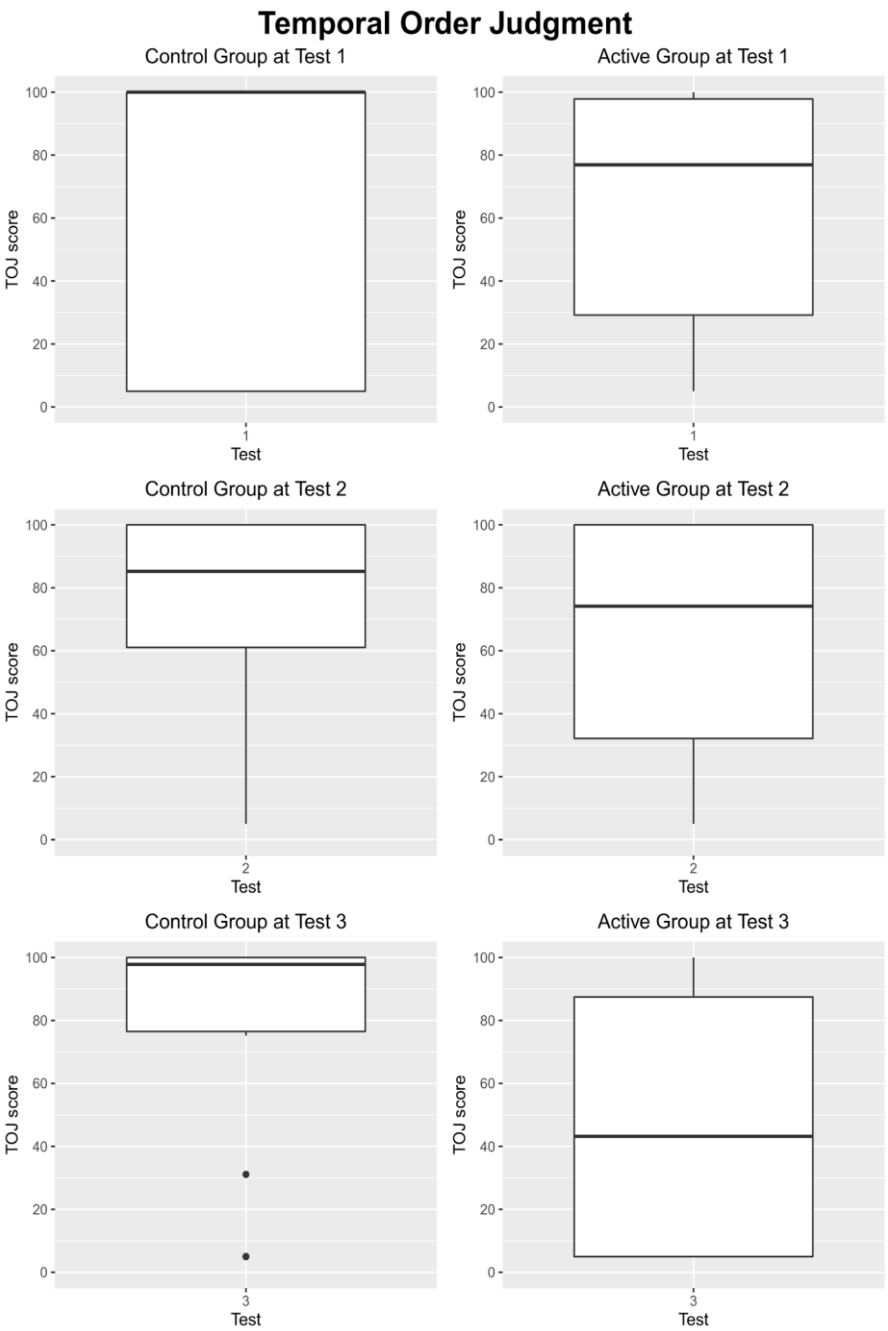

Figure 19: *Simple box-plot showing the results of the Temporal Order Judgement data.*

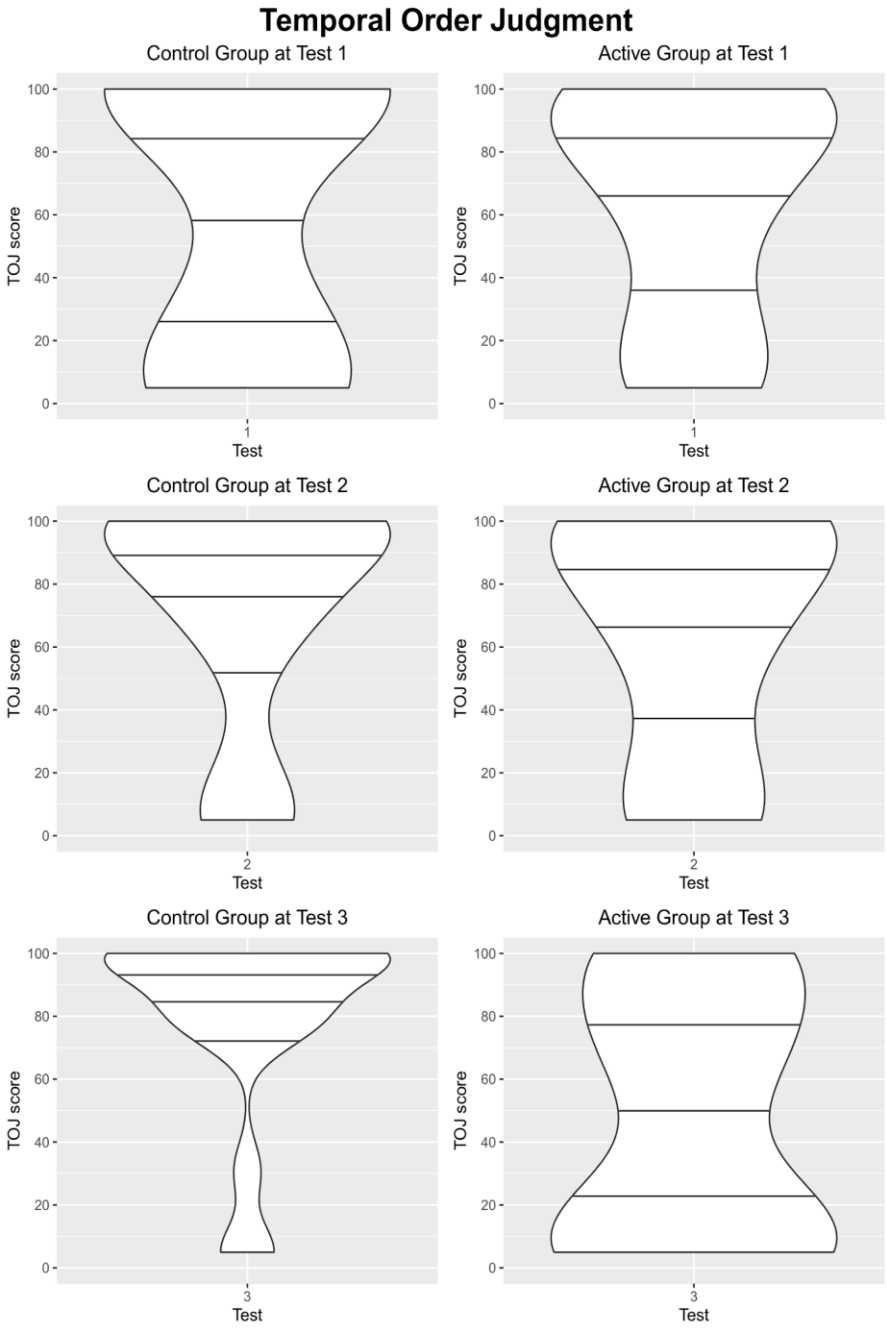

Figure 20: *Violin-plot showing the results of the Temporal Order Judgement data.*

is argued to have implications for safe driving, a theme that will be discussed shortly.

This finding of regression in active participants' Temporal Order Judgement supports, to some extent, the study hypothesis (page 24), with the acknowledged limitation that kava appears to impact only one of the six domains measured by the Brain Gauge. Due to the large knowledge gaps concerning kava neuroscience and neuro-psychopharmacology, which are exacerbated when associated with naturalistic kava use,[199] no reasoning or speculation will be offered here concerning the apparent lack of impact on the other five domains.

Observations

Following the approach adopted in Experiment 1, the research assistants and I discussed any observations we made during the test period regarding changes in the participants' behaviour.

As with Experiment 1, we noted subtle changes in many of the active participants, with these changes often becoming more noticeable after 4 hours of kava use.[200] Changes noted included slowed psychomotor response, a somnolent-like state, slightly altered word pronunciation and a slowed speech rate.

These observations align with reports from both Aotearoa New Zealand and Pacific-based police, who state that kava drink-drivers observed during road-side stops typically exhibit decelerated body movement and slurred or slowed speech.[201] Additionally, Berry and colleagues recorded a similar observation with one of the four drivers stopped and assessed by drug recognition experts in Iowa, with the driver observed to be "cooperative but slow to answer questions and had slurred speech."[202]

Observationally, there is an additional point of interest. At T1 baseline testing, the control participants generally appeared a lot more focused on the computer screen than the average active participant. For instance, the control participants appeared to lean further forward in their chairs, allowing closer proximity to the computer screen and suggesting an increase in concentration when undertaking the Brain Gauge task. At T2, the control participants appeared slightly less intent and focused, adopting a slightly more relaxed posture, when compared with T1. At T3, the control

participants were vastly more relaxed, giving the appearance they either 'knew' the test and were comfortable with it and their surroundings, or they were tired.

However, the possibility of tiredness must be treated with caution; particularly as the data does not support this idea. For instance, at T2, the data shows the control participants as having a statistically significant level of Fatigue [*W*=0.02874; *t*=0.0267; *BF*=2.327754], whereas at T3 the data shows an improvement in Fatigue [*W*=0.07028; *t*=0.05641; *BF*=1.288536].

Conversely, the active participants appeared more relaxed than the control group at T1, although at T2 and T3 there appeared to be an incremental increase in how they sat in their chairs, and focused and interacted with the Brain Gauge task. For instance, at T1, the active participants appeared relaxed and 'laid-back' in their seated position, engaging with the Brain Gauge task in a more relaxed manner than their control counterparts. However, at T2, they appeared to lean forward more in their chairs, moving slightly closer towards the computer screen, suggesting a greater level of concentration on the task when compared with T1. That increased level of perceived vigilance, though, did not appear to be carried back into the *faikava* environment, following the T2 test. The active participants appeared to relax back into the kava-use session after the test, exhibiting early stages of somnolence and a slight slowing of speech rate, as already described.

At T3, most of the active participants appeared even more focused on the Brain Gauge task than they did at T2. This included moving further forward towards the computer screen, and bodily assuming a subtle, yet greater, degree of postural rigidity (with less body movement) than at T2. On return to the *faikava* space following the final T3 test, the active participants appeared to return to their pre-T3-test relaxed state, with some stating it was 'good to be able to *now* relax and enjoy the kava', suggesting testing had been demanding.

Admittedly these comments are based on speculation linked to observation. However, this change in demeanor by the active participants from T1 to T3 – from a relaxed state to a more focused and intent presence – also appears to be reflected in the active participant Focus scores, and the shift from a statistically significant level of regressed Focus at T2 [*W*=0.03315; *t*=0.02225; *BF*=2.651865] to an improved level of Focus at T3 [*W*=0.08003; *t*=0.0599; *BF*=0.1243].

This improved level of Focus is also reflected in the Fatigue data, showing a non-statistically significant level of Fatigue improvement from T2 [*W*=0.03636; *t*=0.03301; *BF*=0.3611313] to T3 [*W*=0.9687; *t*=0.8949; *BF*=0.2342181].

Focus, Temporal Order Judgement and driver safety

The data shows an improvement in the Focus (and Fatigue) of the active participants between T2 and T3, despite the fact that the participants had been at the test venue for over 6 hours and the final T3 test was conducted at 12.30am. With kava's dominant effects reported as soporific, anxiolytic and relaxant,[203] it would be expected that the data would show a regression in both the Focus and Fatigue scores as the testing progressed. Due to large gaps in kava neurophysiological, metabolism, drug half-life and neuro-psychopharmacology understanding, it is not currently possible to provide a physiological reason for this Focus and Fatigue score improvement on the part of the active participants.

Taken at face-value, what the results currently suggest is that kava may have a small positive effect on Focus; that following 6 hours of traditionally influenced kava use, this potentially improves how well the "brain is able to concentrate on the task at hand", as well as enhancing "motivation, attention span … and the ability to predict future consequences".[204] This in turn would slightly enhance a driver's alertness and therefore improve driving safety. However, it is argued that this statement should be treated with caution, as the data shows a very different effect on Temporal Order Judgement.

At T3, at a time when each active participant had consumed 3,680mg of kavalactones, data shows a significant level of impairment to participants' Temporal Order Judgement [*MW*=**0.0119**; *t*=**0.007301**; *BF*=**6.193058**]. As a reminder, the Brain Gauge measure of Temporal Order Judgement is associated with the "integrity of the frontal-striatal cortex … the frontal-striatal pathways control[ing] many of the brain's executive functions, including decision making, behavioral control, and information processing".[205]

In their comprehensive literature review evaluating measures of executive function, Asimakopulos and colleagues[206] report that executive function plays a vital role in safe driving. To assist their claim, they define the operational components of executive function as:

Decision-making / judgment - The assessment and 'ordering of various competing actions and goals'.

Impulse control / inhibition - 'The ability to suppress automatic actions that are inappropriate in a given context that interfere with a certain behaviour'.

Self-awareness / insight - The 'ability to critically appraise our own actions and the actions of those around us'.

Cognitive flexibility - 'The ability to shift between response sets, learn from mistakes, devise alternative strategies, divide attention, and process multiple sources of information concurrently'.

Planning - 'The ability to envision both the ideas contained in a strategy and the steps involved in a tactical approach to realising the strategy'.

Working memory - Executive process responsible for the temporary storage and manipulation of information in both simple (e.g. recalling a series of digits, such as a phone number) and complex cognitive tasks (e.g. coordinating two tasks simultaneously).

Anstey and colleagues[207] add that "executive function is necessary for integrating information and planning a response". They illustrate the importance of the connection between information integration and response planning on the one hand, and safe driving on the other, by stating that as we age our faculties of executive function decrease. They then hypothesise that the over-representation of elderly drivers involved in motor vehicle accidents at intersections (noted to be driving situations that involve complexity ("i.e., the planning and decision-making part of the driving task") correlates with that decline. [208]

What is confusing in the current study is that although the data shows an improvement in Focus scores for the active kava drinking participants from the T2 to T3 tests, it also shows a significant decline in Temporal Order Judgement, and therefore a negative impact on executive function, over the same period. Put another way, the data suggests that while the active kava drinking participants showed improvements in concentration "motivation, attention span … and the ability to predict future consequences"[209] from T2 to T3, they equally showed a significant decline in their ability to coordinate complex tasks and in "planning and decision-making".[210]

This confound was discussed with several psychopharmacology experts who, although unable to explain the anomaly, recognised that understanding of the effect of kava on cognition when consumed at traditionally influenced volumes (as opposed to modified pill-style kava) is still new and evolving.

What also needs to be recognised is that "[Executive function] is a complex construct to both understand and assess", [211] suggesting that the confound cannot be solely explained by reference to the kava-science knowledge gap. Where this anomaly may have application is in clarifying comparisons between kava and benzodiazepine, particularly as kava is often compared to this prescription anxiolytic.[212] For instance, when benzodiazepine dose is markedly increased, effects commonly include interference with reasoning or judgement, over-sedation, loss of coordination, marked euphoria, excitability, aggression and loss of consciousness.[213] This does not occur when kava is consumed at high volumes. Put simply, kava and benzodiazepine have similar effects at low dose. However, at high dose they are very different, with the consumption of high kava volumes not leading to a marked loss of thinking clarity, control or consciousness.

An additional factor worthy of consideration is the potential effects resulting from a lack of sleep. It is common for traditionally influenced kava sessions to finish after midnight on weeknights (nights during the working week) and with 3am and 4am not uncommon during the weekend. Additionally, consecutive nights of kava use are also common, including on weeknights. In a Fiji-based study that utilized psychometric tests to assess *lomaloma ca*, or 'kava hangover', which found that the kava drinking participant group "displayed [on average] a 16.5 per cent deficit in processing speed" when compared to control, some participants argued the results were more-so a reflection of "sleep deprivation as opposed to the effects of *yaqona* [kava]."[214] That is an interesting observation when Prichard's work is considered.

In a recent interview with investigative journalist Johann Hari, Professor of neuroscience and psychology, Roxanne Prichard, from the University of Minneapolis, stated, "it only takes a small amount of sleep loss for … negative effects to kick in… if you stay awake for eighteen hours—so you woke up at 6 a.m. and went to sleep at midnight—by the end of the day, your reactions are equivalent to if you had 0.05 percent blood alcohol." Prichard added: "Stay up another three hours, and you're [the equivalent of being] legally drunk."[215]

Although the test data shows a slight (non-statistical) improvement in the Focus scores of the active participants between the mid-point and final Brain Gauge test, it is worth considering the potential of sleep deprivation when combined with kava use as a contributing factor to the significant negative Temporal Order Judgement

scores. This suggests the value of research aimed at understanding lengthy late night traditional kava use and limited sleep. That research would also protect innocents who may have consumed very small amounts of kava although be "mistakenly identified as '…[kava]-impaired'",[216] to quote the concerns of McCartney and colleagues regarding cannabis-impaired drivers (as discussed earlier) and applying their comment to kava.

'Kava doped' and 'kava intoxication' reconsidered

It is valuable at this point to further consider kava's effects in comparison to other drug substances, particularly as the effect of kava has been compared with alcohol intoxication (leading to the commonly used term 'kava intoxication'), as well as to laudanum, cannabis, opiates (narcotics) and hallucinogens.[217] In an earlier section, it was stated that unlike alcohol and most other recreational drugs, kava drink does not cause marked euphoria or hallucination, instead inducing relaxed feelings and clear-headedness (see page 12). Much of that understanding is based on ethnographic commentary.

These current findings add quantitative support to that qualitative data, demonstrating that kava's effects are not only different to high-dose benzodiazepine use (as described above), but also vastly different to many of the drug substances kava is often compared with.

For instance, in their chapter on the 'Influence of drugs on cognitive functions', Juárez-Portilla and colleagues[218] explain how a selection of depressant and stimulant drugs impact cognitive faculties. Stimulant drugs, which include methamphetamine and cocaine, are not discussed here, as kava has not (to my knowledge) been compared with these drugs. Instead, this discussion focuses solely on two key depressant drugs: alcohol and cannabis.

Juárez-Portilla and peers[219] note that alcohol has a "biphasic effect on brain activity, causing excitation and euphoria … confusion, loss of awareness and selective attention begin to occur, significantly diminishing the execution of working memory and its long-term consolidation." Cannabis is also noted to induce mild euphoria, leading to impaired basic motor coordination, disrupted planning, organisation and problem-solving ability, and interference with decision making and emotional and behavioural control.[220] The authors point out, though, that the severity of any

impairment depends upon the cannabis cultivar strain, use quantity and frequency, with habitual use playing "an important role in the diminution of gray matter".[221]

As the findings of this study show, while kava has a significant impact on Temporal Order Judgement, no interference occurs to most of the cognitive faculties disrupted by alcohol and cannabis use. This also shows that kava's effect cannot be described as hallucinogenic; with drugs that do fall under this category typically causing hallucinations and anomalies in perception, together with considerable change in subjective thought, consciousness and emotion.[222] Additionally, this study shows that kava's effects cannot be described as narcotic, also a common effect descriptor applied to kava.[223] As the United States Drug Enforcement Administration[224] explains, "the term 'narcotic' comes from the Greek word for 'stupor'" and is linked to high opiate use, an effect clearly lacking in high-volume kava use.

Finally, the present discussion demonstrates that the common terms used to capture kava's effects following high-volume use – 'kava doped' and 'kava intoxication' – are misleading and incorrect. This is particularly the case when 'intoxication' is commonly defined as "having physical or mental control markedly diminished".[225]

By drawing on the study findings, and comparing these with the literature that explains how selected drugs impact cognitive faculties, this study clearly shows that kava, when consumed in naturalistic settings over many hours, has unique but subtle effects. These are vastly less impactful on cognitive faculties, and very different to the effects of alcohol, cannabis, hallucinogens and narcotics. However, it must by noted that although this present discussion explores differences in effect between differing substances, it is not suggesting that kava has no impact on driver safety.

Kava and driver safety

In the early chapters of this book, I explained that naturalistic traditionally influenced kava consumption typically occurs in communal environments, over many hours, with some users drinking more than 20 times the pharmaceutically recommended daily dose; and an estimated 70 per cent of those users then driving home, some long distance and inter-city. I also explained that police are stopping

what they suspect are increasing numbers of kava-impaired drivers, but lack suitable evidential-standard measures to assess these drivers' competency; for example, blood or breath-screening tests, which "research has shown … is the most effective way to deter drink-driving".[226]

Findings from this study show that high traditionally influenced volumes of kava consumption can significantly impair decision making, behavioural control and information processing linked specifically to Temporal Order Judgement.[227] Yet, it is important to point out that while this sentence makes a bold and concerning statement, Temporal Order Judgement has a specific definition in the Brain Gauge descriptor: "how well [the] brain is able to keep track of the order of events".[228] This needs to be balanced against the other five faculties measured during testing, namely Focus, Accuracy, Timing Perception, Plasticity or Fatigue, which were not impacted, although they also play various roles in decision making, behavioural control and information processing.

However, accepting that kava does have some negative impact on driver safety, this raises the question of how best to modify driver behaviour when kava consumption interferes with safe driving. This challenge will be the focus of the next chapter.

5. Encouraging behaviour change

The fact that kava has psychoactive properties has never been in question. Exactly how that psychoactivity interacts with cognition, and particularly driver safety, has been of interest to police and road safety for over a decade. The previous chapter explained the findings from cognitive testing during and following kava use at traditionally influenced use volumes. Those finding were surprising. What was not expected was the significant level of impact that kava has on Temporal Order Judgement, or sequencing, when no impairment was detected for Focus, Accuracy, Timing Perception, Plasticity or Fatigue. This was particularly surprising, given there is some cross-over between these faculties and Temporal Order Judgement.

With kava not having the same level of impact on cognitive faculties as alcohol or cannabis, although nevertheless significantly disrupting a cognitive faculty that is important for safe driving; and with kava lacking detectability through breath and blood tests to dissuade impaired driving, how then can behaviour change be encouraged to assist road safety?

Harm reduction to address drug-impaired driving

In relation to drug-impaired driving, Watson and Mann[229] explain that, unlike alcohol drink-driving, research shows:

> relatively high degrees of willingness or intent to engage in [drug impaired driving … as] many users do not view their driving as impaired … In some contexts, [drug impaired driving], therefore, appears to be a fairly 'normalised' behaviour among people who use drugs, particularly if it is common among one's peer group.

With 70 per cent of kava users reportedly driving home following kava use, and some of that driving being long distance (Auckland to Hamilton [in Aotearoa New Zealand; a journey of approximately 100km] and vice-versa being common, for instance),[230] this would suggest driving following kava use is also a fairly normalised behaviour.

Watson and Mann[231] suggest a harm-reduction approach to address drug-impaired driving. The central theme of harm-reduction theory acknowledges that societies

will never be drug free, yet "recognizes that the [substance] user has the ability to act responsibly and to make choices to stop or modify risky behavior".[232] A key aspect of modifying risky driver behaviour, including drug-impaired driving, is education that takes into account the cultural and social norms of the target audience.[233] In their paper focused on designing and evaluating road safety messaging and campaigns, Lewis and colleagues[234] explain the "transforming approach", a harm reduction measure that "aims to influence community-wide attitudes, values, and norms relating to risky and/or illegal road user behaviors … [which] is intended to motivate people to align their behavior with perceived community expectations, values, and norms."

Across the Pacific, community expectations, values and norms are associated with cultural respect-based ideals linked to what are inferred as 'chiefly behaviours'. These ideals are encapsulated in (although are not limited to) *rispeck* in the Bislama-speaking nations of the Western Pacific (Papua New Guinea, the Solomon islands and Vanuatu); *vakaturaga* in Fiji[235]; *faka'apa'apa* and *anga fakaTonga* in Tonga; *tautua fatama'ali* and *fa'aaloalo* in Samoa; *kauraro Rarotonga* in Te Au Maohi (or the greater Rarotonga island group); *ke'ano pono* in Hawai'i; and Māori *tikanga* in Aotearoa New Zealand.[236]

Drawing on these Pacific-wide ideals, and with the aim of using respect (together with education, harm reduction and a transforming approach) to reach readers and reduce risky driving following lengthy kava use, I produced a three-fold A4 (DL size) user-friendly brochure (see Figure 21a and 21b: for a link to download the brochure, see[237]). The brochures included a simple summary of police concerns about the effects of kava on safe driving; together with an explanation of the research and its findings, in particular kava's impacts on Temporal Order Judgement (explained, for simplicity's sake, in the brochure as *slowed thinking and decision making*). This information was combined with a challenge to kava-using drivers to reconsider whether they should drive after consuming kava, and if they choose to do so, whether this would align with their Pacific values of respect for other road users.

To ensure the greatest possible reach and comprehension for the brochure's message, it was translated into (standard) Bislama, Fijian, Tongan and Samoan (see Appendices E to H, respectively, page 107-110). This arguably provided language accessibility for the dominant kava-using nationalities.

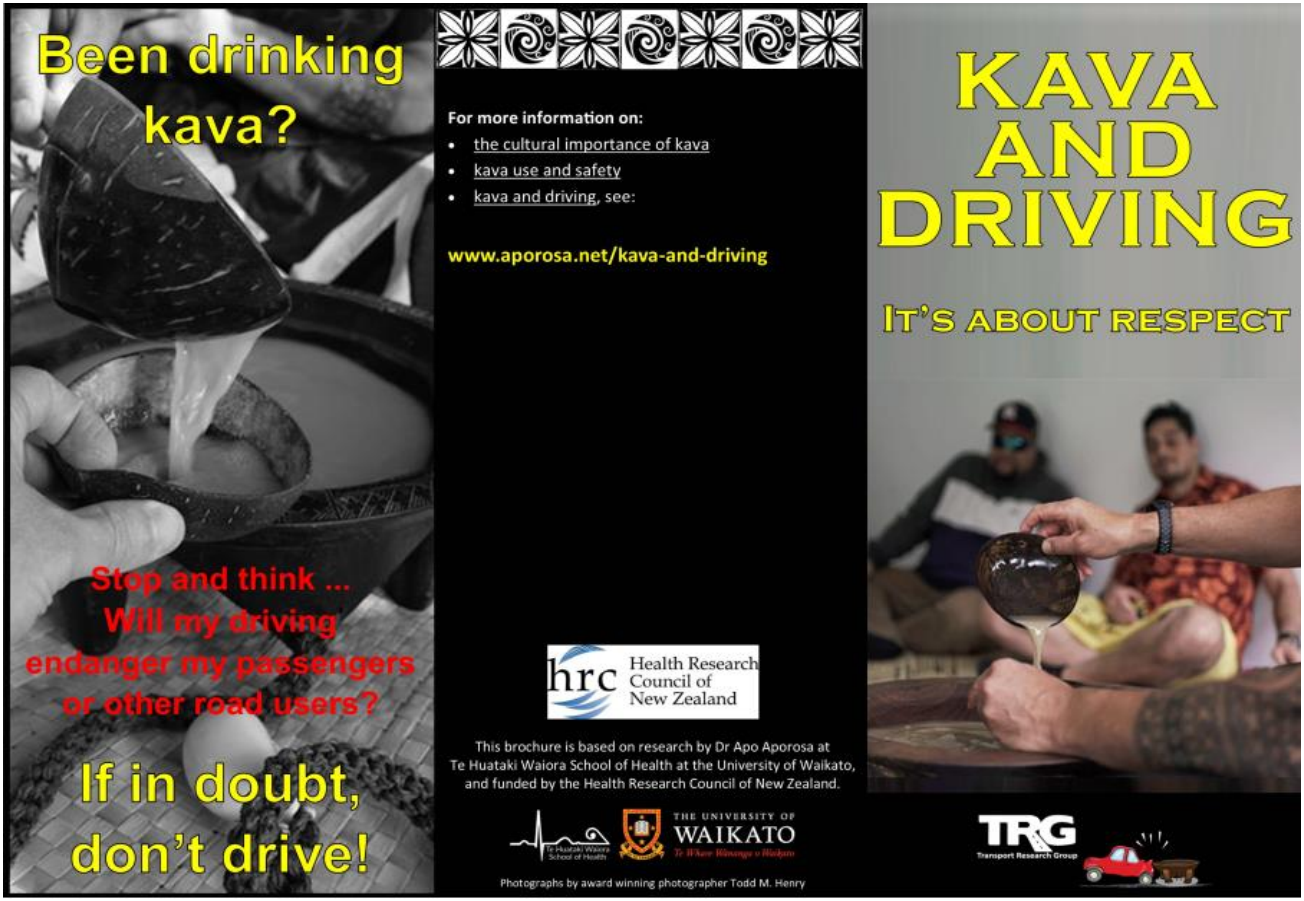

Figure 21a: *Cover of English language kava drink-driving brochure.*

Figure 21b: *Inside of English language kava drink-driving brochure.*

Trialling and evaluating the kava drink-driving brochure

Before distribution, the brochures were trialled and evaluated in several *kalapu* (kava-use venues) in Auckland, Hamilton and Canberra, Australia. COVID-19 travel restrictions prevented travel to, and testing of the brochures in the Pacific Islands, as had been originally planned.

In total, 62 people (male and female, representing a wide range of Pacific nationalities, together with some non-Pacific participants) took part in the evaluation. Initially, the brochures (in all five languages) were simply placed on the floor at each *kalapu*, unaccompanied by any commentary, to assess interest. At all *kalapu*, the people nearest the brochures immediately picked them up, with some drawing the attention of others present who then asked for a brochure.

At the Canberra *kalapu*, a Tongan man in his thirties was asked why he had picked up the brochure so quickly. He replied, "The picture [indicating the cover of the brochure], it's about kava. I want to know."

During this initial period, attendees showed enthusiastic interest, with some asking for a brochure in their own language when they became aware these were available. There appeared a great deal of interest in the translated versions of the brochure, demonstrated in *talanoa* (discussion) about word comparisons across the various languages.

The simple placement of the brochures on the floor at *kalapu* (without commentary) also led to unprompted *talanoa* about kava's effects on cognition. This *talanoa* related to the brochure's statement that: "Studies have shown that drinking kava can slow thinking and decision-making. This, in turn, affects how safely people drive."

Reading this comment prompted several people to describe their experience of driving following kava use. For instance, a Fijian man in his forties explained how he had to stop and sleep while driving from South Auckland to Hamilton in the early hours of the morning after drinking kava. He asserted that his driving was fine, and that he had only stopped due to tiredness. Conversely, another man, also Fijian and in his forties, commented that, "One time, I was so dope I drove over the Dinsdale roundabout"; prompting a laugh from many in attendance.

At a different venue, a Fijian woman in her late thirties, whose husband was also present at the *faikava*, recalled a late-night trip home with her husband, who was driving, after drinking kava. She explained that her two children where in the back of the vehicle asleep, and that as they drove into a small rural town, she noticed the vehicle was slowly moving to the right and into the oncoming lane. She stated that if she had not been awake, and had it not been for the streetlights, which enabled her to see that her husband's eyes were closed, or had there been an oncoming car, it was likely they would have died. The husband responded that it wasn't the kava that had caused him to nod-off, but, "we got called out and I was working [the night before]. It was family, so we had to go up"; meaning that following an overnight work shift, he drove to another city for a family commitment, which involved kava use. The woman followed with, "Yes, he was tired. He only drinks [meaning 'drank'] a little bit [of kava]".

At a separate venue, at which Temporal Order Judgement was explained after a participant asked the author for more information on what was meant by "slow thinking and decision-making", another participant (a Tongan man in his early thirties) explained that when driving following kava use, and particularly when approaching intersections, he went through (what was described as) a ritual: double-checking the colour of the traffic lights, and even triple-checking for approaching cars to ensure the way was clear. He commented that, "I know that when I drive after grog [a common colloquialism for kava, particularly in Fiji], I have to be more careful, so I go through *the* system".

Another participant (a male European in his thirties) who was also present added, "True. You have to concentrate more. But I can drive OK, but you have to concentrate." Later in the discussion, the same participant warned, "… and never text when you drive after kava. It's like you get fixed on the screen [of the mobile phone] and don't know time is passing. I almost ran up a car in front"; a comment that prompted some teasing from others about the dangers of texting and driving.

When participants were asked what they thought of the brochure, there was overwhelming agreement on the value of providing a research summary in a Pacific-flavoured and Pacific-language-friendly medium. This value has also been recognised by academics. For instance, Dr Keakaokawai Varner Hemi and I[238] explain

that translating research "into their own [Pacific] languages" provides opportunity for dialogue, accountability and correction. We also argue research translation is both necessary and ensure compliance with ethical standards and research ethic requirements; [239] "We envision opportunities to check inaccuracies, to corroborate and bear testimony and to find consensus, to validate histories and experiences, knowledges and truths. We hope to challenge and address histories of assimilation, discrimination and colonisation by education—and by research." [240] The reaction of the participants to the Pacific-flavoured and translated brochures supports the work Keakaokawai Varner Hemi and I have undertaken in this space.

A 33-year-old Fijian male commented that, "This [the brochure] is good. You know us, we don't read things when they long"; suggesting brevity was necessary. Similarly, a Samoan male in his mid-twenties typified the comments of several participants when he said, "… people will read this coz it's in the language"; meaning the translated Samoan language. A Tongan male in his late-twenties asked if he could have some to take to the *kalapu* he typically attended on a Friday night, "for the boys".

While the aesthetics of the brochures, the content and language friendliness were well received and praised by some, their value in prompting immediate behaviour change was not as encouraging. Participants were asked if they felt the brochures would make them reconsider driving following high kava use, or defer them from driving. Initially most said 'yes', indicating the brochures would encourage them to reconsider. However, as the *talanoa* unfolded, it was clear the initial reaction lacked substance. For instance, a Tongan male in his early thirties commented:

> Most of the *faikava* boys are uneducated so they won't care, they will just drive. Some might listen to the *Faifakau* [the Minister], just a small percent, so that would be good. And some who know someone who dies after driving and *faikava* might listen. Like me; my cousin died in a crash in Tonga after drinking kava. So I know my limit and go home when I'm still safe to drive. That brochure is only for a small percent, because most people been driving after kava for years and they will keep doing it.

Another Tongan male of similar age added:

> Many of the *faikava* boys come because they have turned away from alcohol [drink kava instead of alcohol]. Some of them used to drive after alcohol. They know kava is nothing like alcohol; it doesn't affect driving like alcohol, so they say they are safe to drive.

A Tongan male in his forties stated:

> You can't teach old dogs new tricks; they will still drive. The way that some might be encouraged to think about driving after kava is if you use the Church, get the *Faife'au* [Minister] to give the message and some will listen. I think the hook is the Church. I planned a sports event and the registrations were low, so I asked the *Faife'au* to promote, and we got plenty of people. I think that will be the only way, but then some don't go to Church.

A Tongan male in his early fifties at a *kalapu* in Canberra stated:

> These [brochures] are good for the young boys no good in driving [inferring a lack of driving experience]. I live over … [a town approximately an hour's drive away]. I always come here [to the *kalapu*] and drink [kava] then drive. Sometimes the sun is coming [meaning daybreak] and I drive. I know the way [home]. I am good, never have a accident, coz I know the way and I can drive [inferring experience].

A Samoan male in his mid-twenties stated:

> This is good information, I understand it [meaning both the content and Samoan language]. But some of the younger people won't understand it coz some of the language is a bit formal. But then that's the only way you can properly give the message. We Samoans don't drink as much [kava] as Fijians and Tongans, its mostly the older generation [who drink], like the ones in their sixties and then they drive. So this is good for them [inferring the language translation for older Samoan kava drinkers].

The same Samoan male was asked about the value of using Pacific respect-based values, and the suggestion in the brochure that driving after using kava was likely to endanger other road users and hence be counter to those values. He responded:

> Yes, it will make them think. I don't think there will be magic [inferring dramatic] change, but they will be more aware. When the older people see this [brochure written in Samoan], they will pick it up straight away, they will like it. They will like the values. But the younger people probably won't read past the first few sentences coz that's young people, they don't read much, and they aren't connected to the traditional values the same as the older people.

Exploring alternatives to the brochures

A group of kava drinkers, of mixed Pacific ethnicities and in their early twenties were asked what they felt would be the most impactful way to get the kava drink-driving message across to those in their age group. A Fijian female suggested:

> I think short videos would be the best, about 30 seconds long, coz that's what they [the younger generation] go for. And if you could have influencers in the videos, like rugby heroes, I think that would get the message across.

A Rarotongan female followed with:

> I think, you need to come up with something real simple, but a clear message. Like in Rarotonga they ran this STD [sexually transmitted disease] campaign, very simple: '*Did you remember: car keys, wallet, condom*'. People remembered it and would even say it to each other. Short, simple, good.

Although the brochures appeared to have limited effect in prompting immediate behaviour change – evidenced in the fact that most of the attendees at the *kalapu* where the brochures were trialled, having consumed kava for 6 hours or more, then drove home – the brochures are nevertheless argued to have some value. For example, they led to lengthy *talanoa* on the effects of kava on cognition and driver safety; *talanoa* that I noticed continued over subsequent *faikava* I attended. In addition, the brochures have been requested by *kalapu* attendees and when provided, then sparked further *talanoa*.

Following the trial, a large number of brochures were commercially printed[241] and distributed to a variety of Pacific-focussed community services, as well as being given to kava users to leave at their various *kalapu*.

Road safety campaign design and evaluation experts Lewis and colleagues[242] caution about the need to "dispel the notions of the 'silver bullet' and 'one-size-fits-all' approach" when it comes to promoting driver safety. In the case of this study, the focus need not simply be on the value of the brochures in curbing problematic kava drink-driving behaviour. The *talanoa* associated with the brochures, and the subsequent unpacking of related themes that they stimulate (such as discussion around kava's effects on cognition) are also valuable. As Lewis et al. [243] state:

> To change unsafe behavior is usually a long-term process. It is therefore unrealistic to expect that road users will suddenly change their behavior after being exposed to one campaign, especially if the behavior has become habitual or if they continue to believe that they will escape any penalty.

Again, in the case of this study, with its goal of curbing unsafe driving after kava use, ongoing exposure to the brochures is necessary, together with the associated *talanoa*, as is "the need to assess effects over time, including longer-term exposure (i.e., beyond immediate post-exposure measures)."[244] Work aimed at assessing those 'effects over time' is currently underway. Aided by a Health Research Council Pacific Knowledge Translation Award (ref. 22/024), the findings of this study have been published in summary form[245], with that summary translated to the four dominant Pacific languages: Bislama, Fijian, Tongan and Samoan in a similar manner

to the language-friendly brochures. Those summary translations will shortly be published in *In Our Language: Journal of Pacific Research* and interviews undertaken in 2023 to understanding any behavior change linked to driving post kava use.

Pacific concerns about the study

There is an additional matter, linked to participant and stakeholder feedback on this study, that is worth consideration.

In October 2021, some months after the brochures had been in circulation and the technical report on the research project circulated,[246] a lengthy post, written in the Tongan language, appeared on a Facebook page entitled *Fofo'anga NZ*.[247] The post questioned the validity of the study and its findings, and asked several questions, most of which were addressed in the technical report (and now also this book).

This led me to discuss the post with several people who occasionally attend a *kalapu* to which *Fofo'anga NZ* is linked (with one of those people also having been a participant in the data collection for the study). What appeared to underlie the questions and comments in the post was concern that the study findings, namely that kava when consumed at traditionally influenced volumes can negatively impact driving, could raise a red flag with law enforcement, policy makers and the government in Aotearoa New Zealand; and that this in turn may lead to restrictions on kava's availability and use, as has happened in Australia. The chief concern by some within *Fofo'anga NZ* was the likely implications for Tongan (and Pacific) cultural expression and practice in Aotearoa New Zealand.

With kava use and its related practices being central to my identity and ancestry as a Fijian, I completely understand the concerns of *Fofo'anga NZ*. In a response, translated to Tongan by a friend, I spoke about the background to the study (as explained in Chapter 1), addressed some of the questions regarding the methodology and findings, provided a link to the technical report, and stated my intention to travel to the *Fofo'anga NZ* base in Auckland, Aotearoa New Zealand, and meet with the members to discuss this matter further.[248] I finished my response by posing the following question:

> Na ikai loto fiemalie kiai ae potungaue polisi o NZ, pea nae fuu fie ma'u ha taha kene fakatotolo ae palopelma ni. Mei he kamata, na ikai keu fie kau ki he fekumi koeni koe uhi oku ou inu kava mo au kae pehe foki ki hoku famili moe kaunga maheni. Ka I he taimi tatau, nau ilo fakapapau koe fakatotolo koeni e pau ke fekumi ke ma'u ha ola. He koe

> taha peia oe ngaue ae polisi, ke tauhi ae lao mo fakamamafa ki he lelei fakalukufua oe sosaieti. (I want to leave you with a question: Police have wanted this research for some time. The research was going to be done whether Pacific people wanted that or not. So, do you want a non-Pacific person, who does not know kava, to do the research, or do you want an islander who knows kava, drinks kava, understands how important kava is to Pacific identity, to do the research?)

That response prompted a large number of comments, mostly in Tongan, with the majority in support of the research, particularly in that the study had been done by a kava using Pacific Islander.[249] This tension is further discussed in a recent summary article published by *Research Outreach*[250] linked to a prompt question:

> *How receptive have kava-drinkers been to your leaflet informing them of the risks involved in driving after attending kava sessions?*
>
> The reaction has been mixed, ranging from exceptionally positive through to highly critical of both the brochures and research. Many critics felt kava effects were almost non-existent, especially when compared with alcohol, and therefore they felt safe to drive. Others felt the research findings could draw unnecessary attention to kava, and lead to regulatory controls that would have a huge impact on our culture and practices, not to mention push people toward alcohol and its socio-cultural impacts; disruptions not caused by kava. Yet others felt that suggesting kava caused harm vicariously criticised our culture and practices. As I said earlier [in the publication], this is a sensitive issue, one I also understand as a Fijian and a kava user.

In summary

This chapter explained the development and evaluation of kava brochures, aimed at encouraging driver safety following kava use, which stemmed from the research study, and were translated into the dominant Pacific languages.

While these brochures were clearly popular, they had little immediate effect, although they did encourage a great deal of *talanoa* (discussion), as did the study itself, in a subsequent post on the *Fofo'anga NZ* Facebook page.

While the concerns of some at *Fofo'anga NZ* were not directly related to the trial and evaluation of the brochures, they did highlight the sensitive nature of conducting research associated with cultural icons and practices, when the findings could be perceived as threatening those practices. This is a topic Associate Professor Maciu Tomlinson and I discussed in a 2014 paper[251] concerning the difficulties of conducting 'gold standard' research in naturalistic settings, a theme discussed in the next chapter in association with the study's limitations.

6. Limitations

Theofanidis and Fountouki write that:

> as much as researchers may carefully plan and design their study, it is inevitable they will face some limitations which are not always identified at the beginning, before conducting the research … [However, an] unbiased and frank discussion and detailed presentation of a study's limitations are the core part of scientific integrity.[252]

That observation is the focus of this short chapter, which surveys the limitations of the current study, as well those noted in the two previous kava drink-driving research projects.[253]

'Gold standard' research design in naturalistic kava studies

The limitations associated with conducting double-blind placebo-driven research within naturalistic kava-use settings have been discussed in several publications.[254] For instance, Associate Professor Maciu Tomlinson and I[255] comment that, "randomized controlled trials … considered the 'gold standard' for health research … [are] next to impossible under the conditions in which kava is normally consumed". The reasons for this judgement include the cultural significance of kava, and the Pacific values associated with its use, which prevent deception by inferring that a substance is kava when it is not. To do so would be culturally disingenuous and therefore contrary to Pacific respect-based values and ideals.[256]

In addition, kava research requires experienced kava drinkers who can consume typical average kava volumes over 6 hours. Such experienced kava drinkers would immediately recognise a placebo, as kava not only has a unique taste, but also produces tingling in the mouth as a result of selected kavalactones interacting with oral sensory nerves; sensations that are difficult to replicate in an inactive substance.[257]

Knowledge gaps in kava ethnobotany and lactone consistency and distribution[258] add further complications, creating additional gaps in current kava understanding. These include gaps in understanding about:

- kava metabolism and dose relationship[259]
- kava half-life and elimination[260]
- how kavalactones interact with neurophysiological mechanisms[261]
- kava reverse tolerance and sensitisation[262]
- how to interpret kavalactone levels and elimination in blood samples[263]
- the role of "set, and setting"[264]; or how social and environmental influences, when combined with how a drug user feels at the time, affect kava use across differing environments.[265]

It is likely to be a number of years before many of these limitations have been mitigated, and it is for this reason that the World Health Organization has called for more research into all areas of kava psychopharmacology, particularly during, following and related to naturalistic kava use.[266]

Ideally, the use of a driving simulator would have provided a true representation of the actual impact of kava use at traditional consumption volumes on driving. However, time constraints related to simulator test procedures and the use of a naturalistic test setting did not allow for this.[267]

An additional concern results from my own experience in a driving simulator following kava use. Although day-simulated driving was pleasant, switching to night-mode very quickly led to feelings of intense nausea. It is suspected this may be linked to kava's psycho-activity in the optical nerves, leading to sensory disruption. This condition is also common among some kava users who, after several hours of kava drinking, report feeling nauseous when watching fast moving television, particularly when glancing at the screen from the corner of their eyes, as opposed to looking at it directly. For driving simulator testing to reflect real-world conditions as closely as possible, this would necessitate night driving simulation, which could potentially cause intense nausea, contributing to yet another study limitation.

I would argue, though, that these limitations do not invalidate the learnings from this or previous kava drink-driving studies. Kamboj and colleagues[268] support this claim when they comment:

> '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.

The following final chapter will summarise the study, providing the *short version* of what was involved and found.

7. The short version

This final chapter summarises the key points of the research, providing a *short version* of what has proceeded.

The study and understanding of kava psychopharmacology can be confusing. This is because of a plethora of misinformation about kava's impacts on health, together with terminology used in ethnographic studies and the media that exaggerates kava's effects at high dose. Additionally, most research aimed at understanding how kava affects cognition and behaviour has used tablets or capsules (containing selected extracted kavalactones administered at a maximum daily dose of 250mg kavalactones) as part of its methodology.[269]

Studies such as Sarris and colleagues'[270] double-blind, randomised, placebo-controlled work, which highlighted the efficacy of small daily doses of tablet-form kava (containing either 120, 240, or 250mg of kavalactones) in reducing generalised anxiety disorder, have encouraged interest in kava's potential for helping users who ingest a single-tablet dose with a glass of water and assert they are taking 'literal kava'.

As has been explained elsewhere, extracted tablet-form kava is vastly different to kava consumed in *faikava* settings.[271] To date, very little research aimed at understanding kava psychopharmacology has been completed using kava as it is typically consumed in these traditionally influenced settings.[272]

In *faikava*, users typically sit cross-legged on mats on the floor, often for long periods of time, and engage in *talanoa* (discussion). *Faikava* attendees usually follow traditionally influenced use protocols, in which they prepare a beverage using the dried and pounded rhizome of the kava plant, and where each drinker routinely consumes 3.6 litres (7.6 pints) of kava over a 6-hour period, while engaging in *talanoa* and observing (to varying degrees) cultural practices based on Pacific respect values. Kavalactone ingestion volumes at *faikava* frequently exceed 15 times the kavalactone potency administered in kava tablet clinical trials or when

kava is given as a medicinal aid to reduce anxiety.[273] Moreover, kava consumed in these traditionally influenced settings contains all the kavalactones, currently believed to number more than 20, together with the four main flavokavains, some fiber and additional minerals from the plant. [274]

Also of significance is that an often-overlooked aspect of any substance use is the associated influences and impacts of 'set and setting', or a person's mindset related to the social and physical environment of the substance used.[275]

Yet despite these factors, kava psychopharmacology understanding continues to be chiefly viewed through the lens of inaccurate effect descriptors and research associated with tablet-form kava use, with that latter understanding often applied to, or overlaid on, kava users who drink in naturalistic traditionally influenced settings.

Further contributing to kava psychopharmacology confusion is the inconsistency and subjectivity across studies reporting kava's impacts on cognition, with some research suggesting that kava improves mental function, while other studies state "kava to have little or no negative effect on cognitive processes".[276] Again, most of these studies used tablet-kava, although the findings have often been interpreted as applying to naturalistic traditionally influenced kava users.

Add to this the increasing reports from police of stopping drivers, mostly of Pacific ethnicity, who they believe are impaired by kava use, and their limited ability to measure and deal with this; and the also increasing anecdotal reports linking kava use with Pacific people's over-representation in motor vehicle accident statistics, and it becomes apparent why both the police and the New Zealand Institute of Environmental Science and Research have called for research to understand the effects of naturalist high-volume kava use on driver safety.

In this second study of its kind, a somatosensory psychometric tool (Brain Gauge) was used to measure slight changes in six specific neurological functions – namely Focus, Accuracy, Temporal Order Judgement, Timing Perception, Plasticity and Fatigue – during and following *faikava*. This testing found that following the sixth hour of kava use, at which time each research participant (*n*=20) had consumed 3.6 litres of beverage kava equating to 3,680mg of kavalactones (or 14 times the

pharmacologically recommended dose), there was no statistically significant impact on the Focus, Accuracy, Timing Perception, Plasticity or Fatigue of the active kava users, when compared against the control group (*n*=19).[277]

However, analysis of within group data (which compared active kava users with each other) found that between the third and sixth hour of testing, these kava drinking participants showed a small improvement in their Focus (and Fatigue), despite being at the test venue for over 6 hours and the final test not being conducted until 12.30am.[278] This slight improvement was unexpected, particularly as kava's dominant effects are reported as soporific, anxiolytic and relaxant. Additionally, while this finding would suggest increased driver alertness overall, and therefore improved driving safety, the data showed a very different effect on participants' Temporal Order Judgement.

Temporal Order Judgement, or "how well [the] brain is able to keep track of the order of events",[279] which is associated with a person's executive function, was shown to be (strongly) statistically impaired when compare with the control group.[280] This is both a unique and new finding, and suggests kava at traditionally consumed volumes compromises driver safety, although the nature of this impairment is vastly different to alcohol, cannabis, and other euphoric and hallucinogenic substances.[281] The findings also add quantitative understanding to ethnographic data on kava effects, suggesting often-used terms such as 'kava doped' and 'kava intoxication' are misleading and incorrect.

Although this study generated new neurophysiological understanding concerning kava use, it also further highlights the huge knowledge gap that exists concerning kava psychopharmacology. That knowledge gap is demonstrated in the lack of interpretation of much of the study data, particularly around how kava impacts on selected cognitive facilities, but not others. That understanding is not likely to advance until, at a minimum, "the neurophysiological mechanisms associated with kavalactone metabolism"[282] when consumed at traditionally influenced use volumes, are understood. That lack of understanding essentially hampers further kava drink-driving research, except for learnings likely to derive from testing kava users in a driving simulator, although this would necessitate overcoming potential nausea that could prevent participants from completing the test.

That lack of understanding also hampers road policing, particularly as the interpretation of kavalactones in blood tests, and therefore the ability to use blood samples for evidentiary purposes, is linked to understanding of the "neurophysiological mechanisms associated with kavalactone metabolism".[283] Further, with kava not metabolising on the breath in a similar manner to alcohol, therefore excluding current breath-test measures, it is likely to be some time before road policing has suitable evidential-standard measures to assess kava drink-driver competency. When it comes to alcohol, such measures are considered "the most effective way to deter drink-driving".[284]

The study also tested the value of a Pacific-flavoured, valued and language-friendly brochure aimed at providing kava drink-driving education to curb unsafe post-kava driving. While the brochure was well received and prompted a lot of *talanoa* about the effects of kava on cognition, including recounts of participants' experiences of post-kava-drink driving, immediate changes to participants' behaviour appeared limited. Drawing on road campaign design and evaluation work by Lewis and colleagues,[285] long-term exposure to this brochure and its associated information is recommended before noticeable behavioural change is likely.

This study has nevertheless made a major contribution to kava neuroscientific understanding, particularly in relation to neuro-psychopharmacology.[286] The study has highlighted the need for more research in understanding the effects of kava when consumed at traditionally influenced volumes. The study also responds to the World Health Organization's call for more understanding on kava psychopharmacology in relation to traditionally influenced use volumes[287]; and to Watson and Mann's[288] request for more research and understanding on the "social [and] cultural … patterns of [drug impaired driving … and the] many types of psychoactive substance use (licit and illicit, recreational and therapeutic) that can impair driving".

Last weekend I was drinking kava with a group of Pacific Islanders in Hamilton, Aotearoa New Zealand. The *talanoa* turned to what I do and my research. That prompted a visitor, who I had not previously met, to ask, "how long before the police can breathe test us for kava". I had to admit I did not know, as there was still a lot about the science of kava we do not understand. I added, though, that kava is one of our most important icons of identity; a plant and drink that underpins our

cultural and *talanoa* practices, with these practices driven by respect values. Therefore, are we being respectful to kava, our passengers and other road users if we drive in a condition that could endanger those others? This then opened a new level of *talanoa* and one of the locals asking me if I had any of “those kava driving papers you made” (inferring the brochures). I had some in my car, which were then distributed to a new group of kava drinkers. And so, the learning continues.

Notes

Chapter 1

[1] Aporosa, 2014a.

[2] Bian, Corral, Wang, Botello, Kingston, Daniels, ... & Xing, 2020, p. 13; Singh, Singh & Singh, 2004, p. 142.

[3] Aporosa, 2014a, pp. 35-38.

Chapter 2

[4] Aporosa, 2019c; Aporosa & Gaunavou, 2021.

[5] For commentary on kava and its linguistic equivalents across the Pacific, see Lebot, Merlin & Lindstrom, 1992, pp. 27-28.

[6] Lebot, Merlin & Lindstrom, 1992, p. 6, 23.

[7] Singh, 2004b, p. 29.

[8] Aporosa, 2014, p. 34; 2019c, p. 98.

[9] Lebot & Cabalion, 1988, pp. 23-29; Lim, 2016, pp. 155-158.

[10] Lebot, Merlin & Lindstrom, 1992, p. 120.

[11] https://yalebooks.yale.edu/book/9780300052138/kava

[12] Aporosa, 2019c, pp. 97-98.

[13] Huffman, 2012, p. 25.

[14] Kirsh & Green, 2001, p. 256.

[15] Also see Lebot, Merlin & Lindstrom, 1992, p. 6.

[16] Lebot, Merlin & Lindstrom, 1992, p. 26

[17] Aporosa, 2008, p. 21.

[18] Singh, 2004b, p. 61.

[19] Aporosa, 2014a, pp. 35-39; 2014b; 2019c.

[20] Photographer: Todd M. Henry, 2019.

[21] Singh, 2004a, p. 7.

[22] Aporosa & Foley, 2020, p. 107-108.

[23] Aalbersberg & Sotheeswaran, 1991, p. 555; Aporosa, 2019c, p. 98.

[24] Aalbersberg & Sotheeswaran, 1991, p. 557; Singh, 2009, p. 110.

[25] Corcuran & Brynjolffssen, 2008.

[26] Lebot, Merlin & Lindstrom, 1992, p. 110-111.

[27] Photographer: Todd M. Henry, 2019.

[28] For a visual understanding of traditionally influenced kava use by Pacific people in diaspora (Hamilton, Aotearoa New Zealand), see Tarek Bazley's (2016) story screened on Al Jazeera and Max Molyneux and colleagues' Newshub item (Molyneux, Thompson & Aporosa, 2017).

[29] Arno, 2005, p. 48.

[30] Aporosa, 2014a, p. 117,165,168; Aporosa & Forde, 2019, p. 77,82.

[31] Photographer: Author, 2009.

[32] Photographer: Todd M. Henry, (L) 2019, (R) 2018.

[33] Thomson quoted by Geraghty, 2008.

[34] Tomlinson, 2004, p. 662.

[35] Turner, 1986, p. 205.

[36] Lester, 1941, p. 98.

[37] Although increasingly being used by all Pacific Islanders to mean a kava venue or kava use space, *faikava*, or 'doing kava', is a Tongan word.
[38] Lolohea, 2021; Henry & Aporosa, 2021, pp. 188-189.
[39] Tecun, Reeves & Wolfgramm, 2020, p. 184.
[40] Photographer, Todd M. Henry, Nov. 2020.
[41] Photographer, Author, Sept. 2020.
[42] Aporosa & Fa'avae, 2021, pp. 36-37. Also see additional comments on this theme in 'About the Author'.
[43] Ravuvu, 1983, p. 76.
[44] Aporosa, 2014, p. 68; also see Yeo, Hinze, Vanderschantz, Aporosa & Paruru, 2022, pp. 244-245.
[45] Tomlinson, 2004, p. 669; Turner, 1986, p. 203.
[46] Tecun, Fehoko & Hafoka, 2021, pp. 228-229.
[47] Tecun, Fehoko & Hafoka, 2021, p. 230.
[48] Lebot, Merlin & Lindstrom, 1992, p. 198.
[49] Pollock, 1995, p. 2.
[50] Aporosa, 2008, p. 77; Aporosa, Atkins & Brunton, 2020, p. 1; Aporosa & Tomlinson, 2014, p. 165.
[51] Abbott, 2016, p. 26.
[52] Aporosa, 2019b, pp. 3-4; Carlini, 2003, p. 508; Keltner & Folkes, 2005, p. 522; Lewin, 1964, pp. 223-224.
[53] Aporosa, 2019b, pp. 3-4; D'Abbs, 1995, p. 169; Lemert, 1967, p. 333.
[54] Thomson, 2008, p. 72.
[55] Aporosa, 2019b, p. 3.
[56] Singh & Blumenthal, 1997, p. 36; Steinmetz, 1960, p. 6.
[57] Lewin, 1998, p. 185.
[58] Thurn & Warton, 1925, p. 102.
[59] Norton & Ruze, 1994, p. 93.
[60] Churchill, 2010, p. 57.
[61] Aporosa, 2019b, pp. 4-5; Singh (2004c, p. 132) states categorically that "there was no evidence in the literature to suggest that kava used leads to addiction or dependency." Singh, Singh & Singh (2004, p. 159) add, "In general, when compared to benzodiazepines and alcohol, kava compares most favorably in terms of risk for abuse and addiction."
[62] Aporosa, 2019b, pp. 5-6.
[63] Norton & Ruze, 1994, p. 98.
[64] Aporosa & Foley, 2020, p. 108.
[65] Aporosa, 2019d.
[66] Aporosa, 2019c, p. 97.
[67] Aporosa & Foley, 2020, p. 108.
[68] Sarris, Stough, Teschke, Wahid, Bousman, Murray, … & Schweitzer, 2013, p. 1727; also see Teschke, Sarris & Lebot, 2011, p. 102.
[69] New Zealand Government, 2015.
[70] Abbott, 2016, p. 26.
[71] Bonomo, Norman, Biondo, Bruno, Daglish, Dawe, … & Castle, 2019, p. 763.
[72] Bonomo, Norman, Biondo, Bruno, Daglish, Dawe, … & Castle, 2019, p. 764.
[73] Nayak, Patterson, Wilsnack, Karriker-Jaffe & Greenfield, 2019, p. 275.
[74] World Health Organization, 2007, p. 3.
[75] New Zealand Government, 2015.
[76] Abbott, 2016, p. 26.
[77] Aporosa, 2016, pp. 45-46; 2019b; Aporosa & Foley, 2020.

[78] Aporosa, 2019a; also see Aporosa, 2014a, pp. 161-162 and footnote 81. At the time of writing, the Australian Government was calling for submissions to support a proposed pilot programme aimed at allowing the commercial importation of kava. In a *NZ Herald* interview in which I was interviewed about the submission process and the proposed liberalisation of kava regulation in Australia, I commented, "I can post a box of 12 40oz bottles of Jack Daniels – enough to kill [referring to the Australian drug ranking study] – into Australia from Aotearoa New Zealand but cannot send 100 grams of safe kava [a limitation that would remain with the new pilot program]. The entire situation is ludicrous, beyond ridiculous, health bureaucracy gone mad." (Marriner & Aporosa, 2021).
[79] Jackson, 2006, p. 16; Lebot & Levesque, 1996, p. 397; Singh, 2004c, pp. 105-110.
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[87] Aporosa, 2008, p. 46.
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[92] Wolinski, 2018.
[93] Kalm with Kava, 2021.
[94] Blackwood, 2019; NPI Productions, 2021; Rabang, 2019a, 2019b; Showman, Baker, Linares, Naeole, Borris, Johnston, … & Turner, 2015, p. 58; Tecun, Reeves & Wolfgramm, 2020, p. 185.
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[100] Fehoko, 2015, p. 136.
[101] Tecun, Reeves & Wolfgramm, 2020, p. 184.
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[106] Aporosa & Forde, 2019.
[107] Hart, 2021; Morgan, 2014; 2017; Tokalau, 2020; Welsh, 2017.
[108] Fu, Perl, Jennings & Hepburn, 2019, p. 147.
[109] Berry, Gilbert & Grodnitzky, 2019, p. 1948.
[110] Wainiqolo, Kafoa, Kool, Robinson, Herman, McCaig & Ameratunga, 2016, p. 1.
[111] Also see Wainiqolo, Kafoa, McCaig, Kool, McIntyre & Ameratunga, 2013; Wainiqolo, Kool, Nosa & Ameratunga, 2015.
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[113] Poulsen & McCarthy, 2020.
[114] Lewis, 2022.
[115] Tokalau, 2020.
[116] McCartney, Arkell, Irwin, Kevin, & McGregor, 2021, p. 8.

[117] DCNZ, 2000; Hart, 2021; Tokalau, 2020.
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[130] Bian, Corral, Wang, Botello, Kingston, Daniels, … & Xing, 2020, p. 23.
[131] Aporosa, 2019a, p. 1; Lebot in Blades, 2018; Procyk & Lebot, 2013.
[132] Kautu, Juliana, Kellie, Mengarelli & Eric, 2017, p. 1,5.
[133] Abbott, 2016, p. viii; Bian, Corral, Wang, Botello, Kingston, Daniels, … & Xing, 2020, p. 23.
[134] WAFA and WAFG are test labels and not acronyms.
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[136] Aporosa, 2017, p. A84; 2018a, p. 30; Aporosa, Atkins & Brunton, 2020, pp. 6-8.
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[160] Photographer: Todd M. Henry, 2019.
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[165] Aporosa, Atkins & Brunton, 2020, p. 5.
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[168] King, Hume & Tommerdahl, 2018, p. 3.
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[171] Cortical Metrics, 2017.
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[183] Tang & Fields, 2019, p. 14; Aporosa, Ballard, Pandey, & McCarthy, 2022, p.6-7.
[184] Aporosa, 2018a, p. 23.
[185] King, Hume & Tommerdahl, 2018, p. 4.
[186] *W* indicates the value results from analysis with the Wilcoxon signed-rank test.
[187] *t* indicates the value results from analysis with the Student's *t*-test–Mann-Whitney U test (rank sum).
[188] *BF* indicates the Bayes Factor and results from analysis using Bayesian inference.
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[190] Pawluk, 2018a.
[191] Pawluk, 2018f.
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[210] Anstey, Wood, Lord & Walker, 2005, p. 46.
[211] Asimakopulos, Boychuck, Sondergaard, Poulin, Ménard & Korner-Bitensky, 2012, p. 423.
[212] Although kava's action is frequently compared with that of benzodiazepines, there is a difference in how benzodiazepines act on the GABA receptors, as explained earlier (see page 16; Cairney, Maruff & Clough, 2002, p. 660).
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[215] Hari, 2022, p. 68.
[216] McCartney, Arkell, Irwin, Kevin, & McGregor, 2021, p. 8.
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[219] Juárez-Portilla, Molina-Jiménez, Morin, Gabriel & Zepeda, 2018, p. 63.
[220] Juárez-Portilla, Molina-Jiménez, Morin, Gabriel & Zepeda, 2018, p. 65.
[221] Juárez-Portilla, Molina-Jiménez, Morin, Gabriel & Zepeda, 2018, p. 64.
[222] Goldberg & Dillon, 2005, p. 3.
[223] A search of the author's Endnote library lists 57 books, published papers and news items describing kava as a 'narcotic'. Of interest is that Lebot, Merlin & Lindstrom, in their 1992 book, *Kava: The Pacific drug*, state on page 1, "Rather, the drug [kava] is a mild narcotic, a soporific, a diuretic, and a major muscle relaxant." (Underline added by author for emphasis.)
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[226] Smith, 2013, p. 24.
[227] Aporosa, Ballard, Pandey, & McCarthy, 2022, p.11.
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[238] Hemi & Aporosa, 2021, p. 58.
[239] Hemi & Aporosa, 2021, p. 57.
[240] Hemi & Aporosa, 2021, p. 58.
[241] Brochures, in all five languages, can be downloaded from https://hdl.handle.net/10289/14570
[242] Lewis, Forward, Elliott, Kaye, Fleiter & Watson, 2019, p. 299.
[243] Lewis, Forward, Elliott, Kaye, Fleiter & Watson, 2019, p. 312.
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[245] Aporosa & Pathe, 2022.

[246] Aporosa, 2021a.
[247] https://www.facebook.com/Makatekina/posts/6284391181631106
[248] The following URL provides a direct link to my response to the *Fofo'anga NZ* post: https://tinyurl.com/mzt8jk5z
[249] The responses to my comment can be viewed here: https://tinyurl.com/mvayvfw8
[250] Aporosa & Pathe, 2022, p. 73.
[251] Aporosa & Tomlinson, 2014, p. 164.

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[254] Aporosa, 2018a, pp. 27-30; Aporosa, Atkins & Brunton, 2020, pp. 8-9; Aporosa, Atkins & Leov, 2021, p. 86; Aporosa & Tomlinson, 2014, p. 170.
[255] Aporosa & Tomlinson, 2014, p. 164.
[256] Aporosa, Atkins & Brunton, 2020, p. 9.
[257] Aalbersberg & Sotheeswaran, 1991, p. 557; Aporosa, Atkins & Brunton, 2020, p. 9; Aporosa, Atkins & Leov, 2021, pp. 83-84.
[258] AECOM-Kalang, 2017, p. 15; Bian, Corral, Wang, Botello, Kingston, Daniels, ... & Xing, 2020, p. 23.
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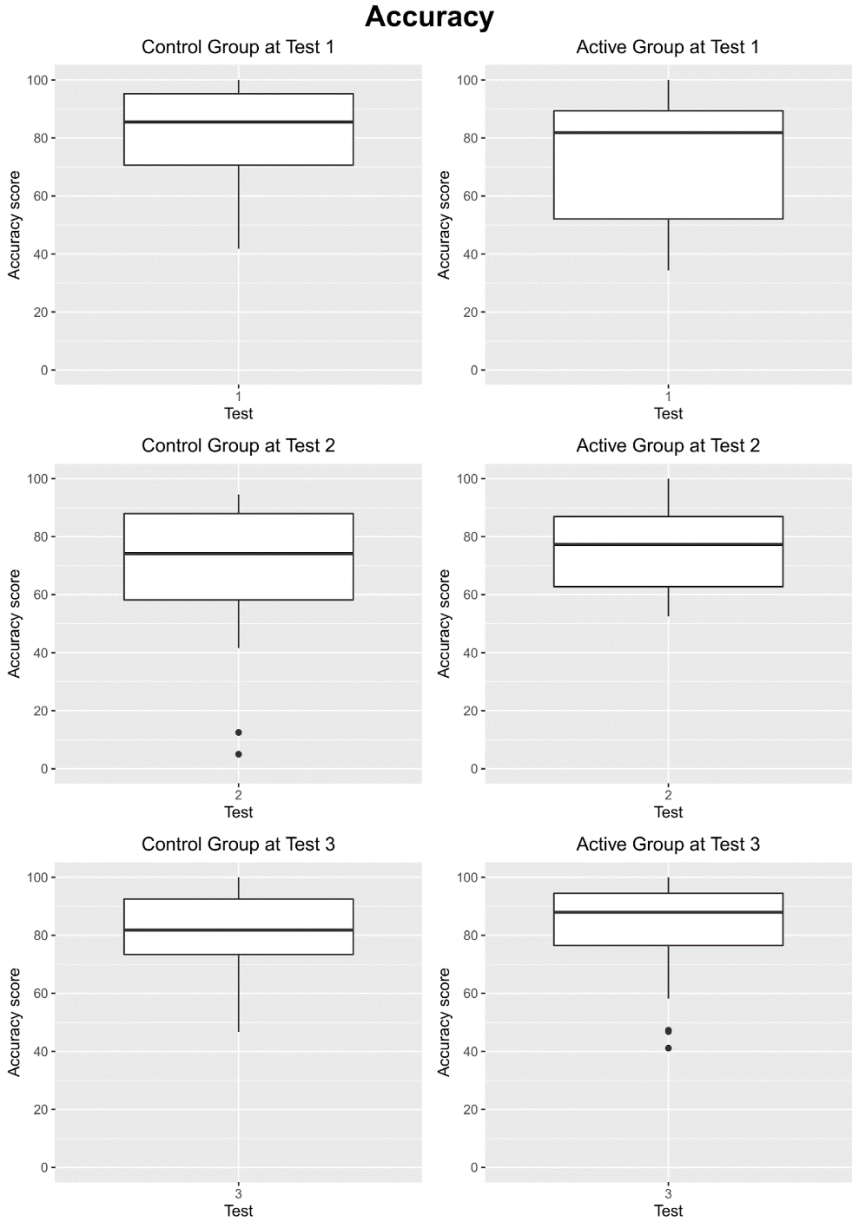
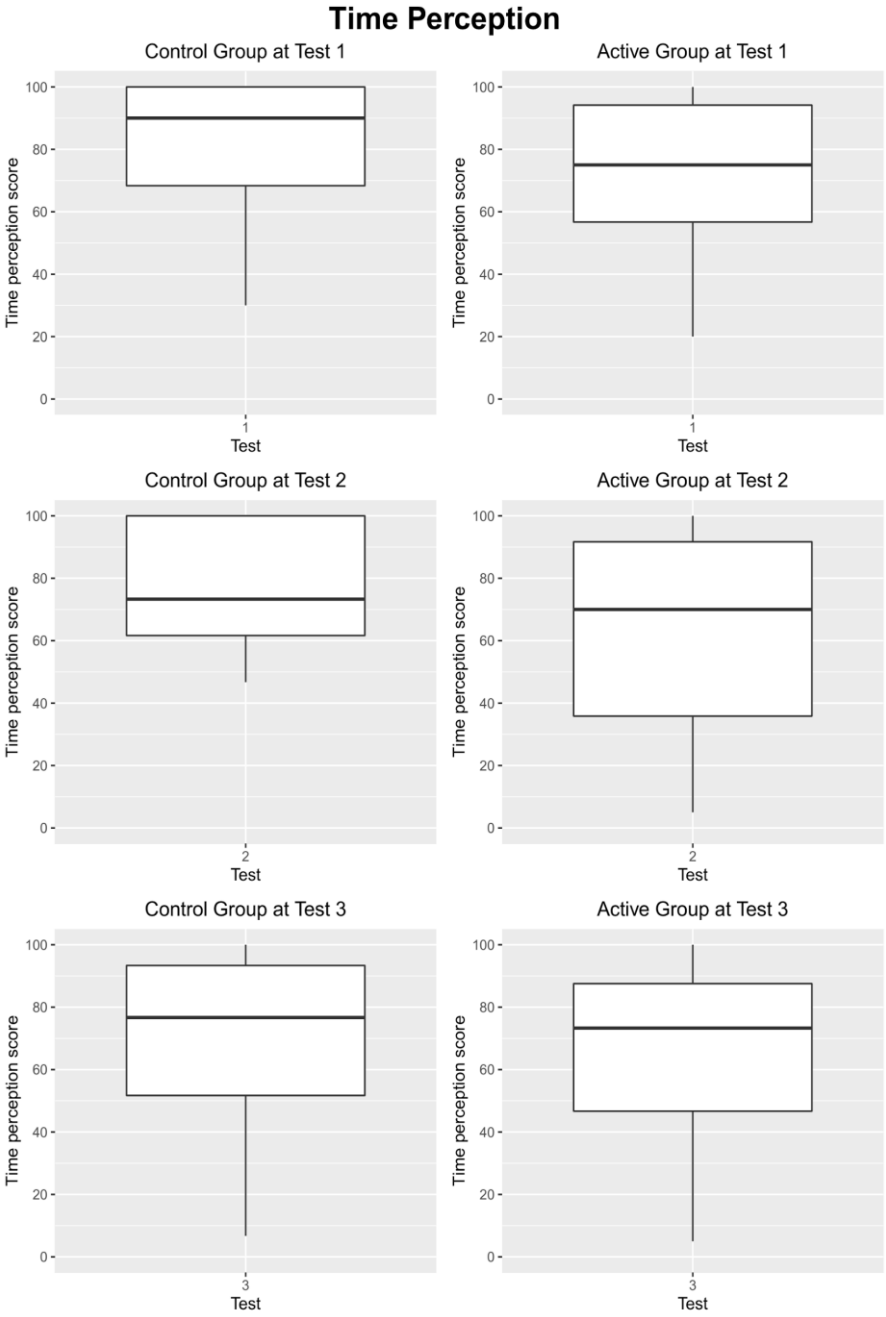
Appendices

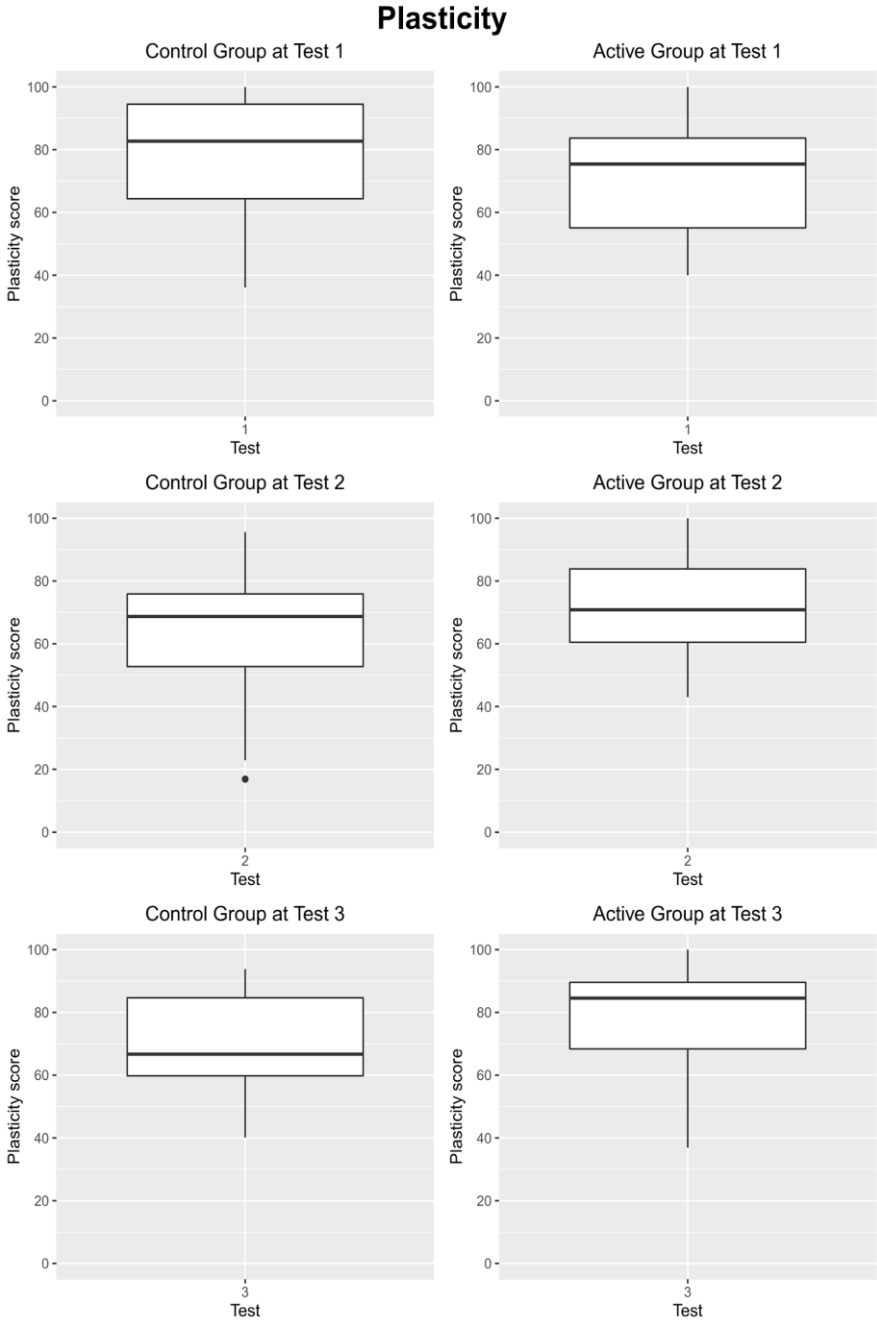
Appendix A: Simple box-plot showing the results of the Accuracy data



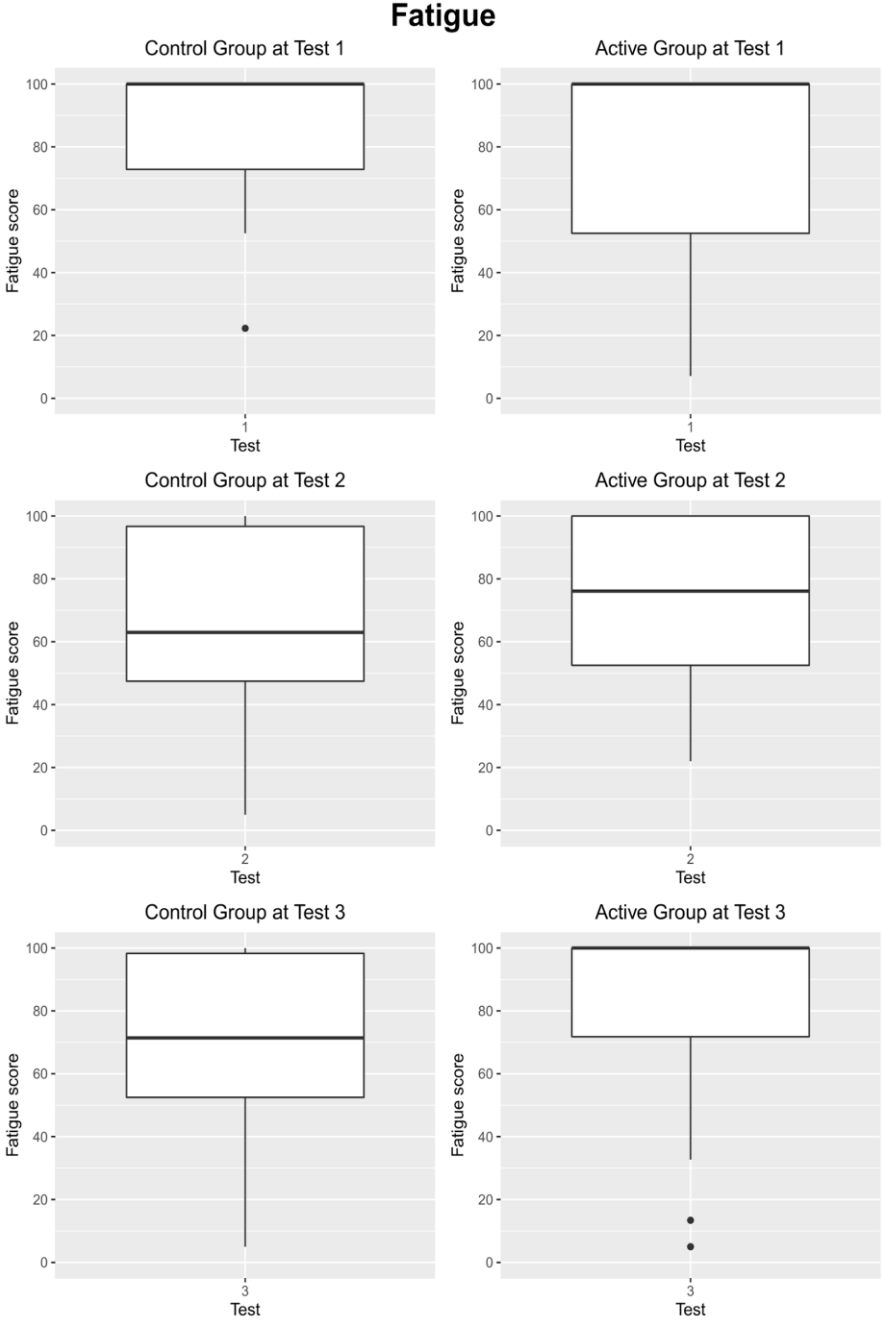
Appendix B: Simple box-plot showing the results of the Timing Perception data



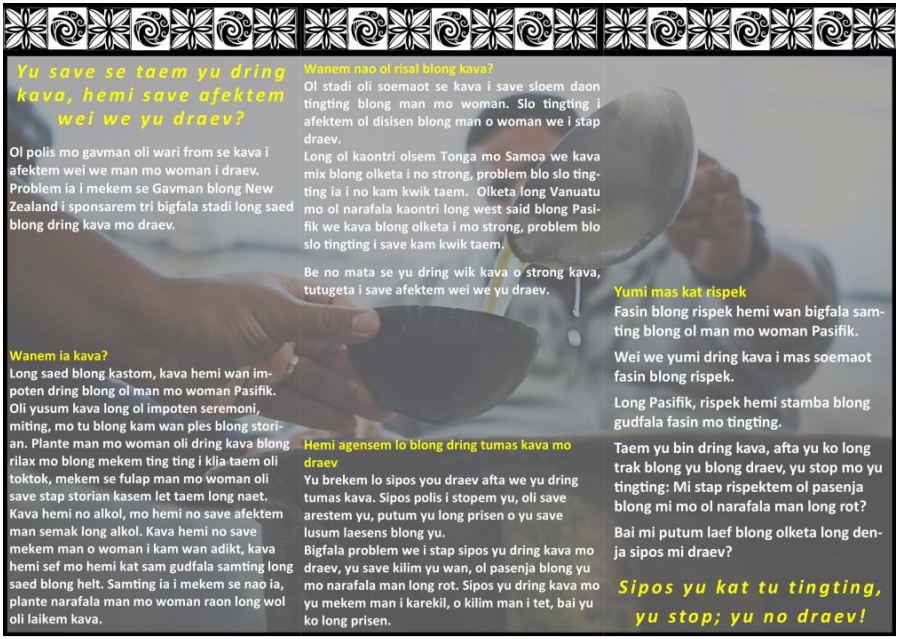
Appendix C: Simple box-plot showing the results of the Plasticity data



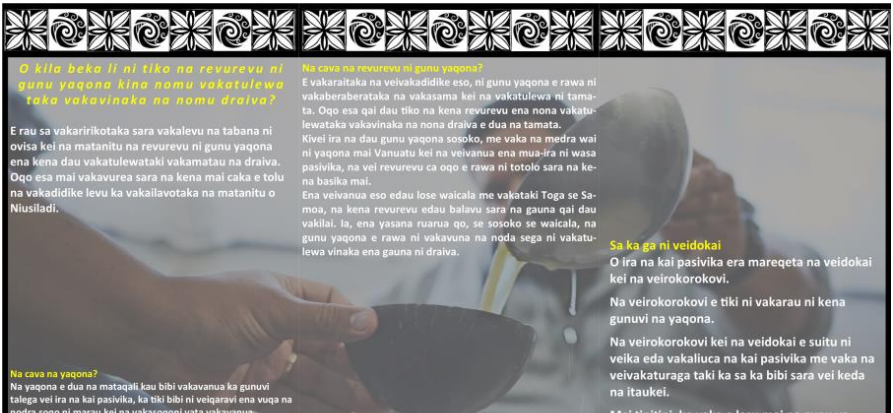
Appendix D: Simple box-plot showing the results of the Fatigue data



Appendix E: Cover and inside of Bislama language kava drink-driving brochure



Appendix F: Cover and inside of Fijian language kava drink-driving brochure



Appendix G: Cover and inside of Tongan language drink-driving brochure

Appendix H: Cover and inside of Samoan language kava drink-driving brochure

Executive summary

Kava (*Piper methysticum*) is a traditional and culturally significant Pacific Island beverage that produces soporific relaxant effects. Kava use is increasing in the Pacific Islands, and among Pacific diasporic and non-Pacific people.

Users often consume the kava drink at much higher volumes than pharmacologically recommended doses (as much as 20 times greater is not unusual), with some users then driving home from kava-use venues.

While there has been a great deal of research using tablets (or capsules) containing selected extracted kavalactones, very little is understood about the psychopharmacological effects of kava when consumed in its natural traditionally influenced form over many hours, as is typical in the Pacific community.

Prompted by concerns over potential driver impairment as a result of kava use, this research involved testing the brain function of kava users over the course of a typical kava session (in terms of its duration and kava consumption volumes). The aim was to understand the effects that drinking kava had on driving safety.

Participants in the active group (n=20) attended a 6-hour kava session, each drinking 3.6 litres (6.33 pints) of kava. A non-kava consuming control group (n=19) was also included in the study. At baseline, all participants were assessed with the Brain Gauge, a somatosensory tool that measures strategic, tactical and operational aspects of brain function. Re-testing was conducted after 3 hours of kava consumption, and again at the conclusion of the test period following the sixth hour of kava drinking.

Analysis of the results compared changes in brain function, both between individuals and the two groups (active and control), before and after the kava drinking session. Statistical modelling was based on t-tests, Wilcoxon signed-rank test [W] and the Mann-Whitney U test (rank sum) [MW], and Bayesian analysis [BF].

The results showed that, for the active participants, the kava consumed had no statistically significant negative impact on their Focus, Accuracy, Timing Perception, Plasticity or Fatigue, when compared with the control group. When active participants (kava drinkers) were compared with other kava users in their group, a slight positive increase in the kava users' Focus and Fatigue was noted, which could infer increased driver alertness and improved driver safety. However, the negative impact of the kava on the active participants' Temporal Order Judgement ("how well [the] brain is able to keep track of the order of events", which is linked to a participant's executive function) was (strongly) significant at the sixth hour: [*MW*=0.0119; *t*=0.007301; *BF*=6.193058].

This finding – as to the effect of kava on a person's Temporal Order Judgement (and hence executive function) – is new, and suggests kava at traditionally consumed volumes compromises driver safety, although the nature of this impairment is vastly different to alcohol, cannabis, and other euphoric and hallucinogenic substances.

Because executive function is also linked to Focus, Accuracy, Timing Perception, Plasticity and Fatigue, the finding was discussed with several psychopharmacologists, who were unable to provide an explanation for the anomaly, but noted that understanding of the effects of traditionally influenced kava consumption on cognition is still in its infancy.

This study makes a new and significant contribution to understanding kava's impacts, when consumed at traditional use volumes, on cognition, while also highlighting the huge knowledge gap that exists concerning kava psychopharmacology. The study has highlighted the need for more research to build understanding in this area, which would also assist road policing, particularly from an evidentiary perspective. The study also responded to national and international calls for research to fill the current gaps in understanding. Additionally, the study investigated the use of a Pacific language-friendly brochure-based driver awareness campaign aimed at curbing potentially unsafe post-kava drink-driving. Although well received, the brochure appeared to have minimal immediate impact on participants' behaviour. However, its value in prompting *talanoa* (discussion) on the subject was noted, as was the long-term nature of driver safety awareness campaigns.

About the author

Na yacaqa o Aporosa, sucu i Niusiladi, vasu ni koro i Naduri, Macuata, Fiji. Noqu bubu e luvei Adi Maimalaga. O Adi Maimalaga e luvei Tui Macuata Naerevono.

I was born in Aotearoa New Zealand. My father is of English ancestry, with his great-great grandfather coming to Aotearoa New Zealand with the British colonial army to fight in the New Zealand Wars of the 1800s. My father was an exceptionally hard-working man, but appeared driven by what I now understand was a need to please his father, an obsession that manifested in regular bouts of anger and frustration, and which I believe was the cause of his repeated heart attacks and early death. I feel it was my father's unpredictability and anxiety provoking behaviour that encouraged me toward my *iTaukei* (indigenous Fijian) maternal ancestry and relatives, and what I perceived as stability and security. I am not ashamed of my *palagi* (European) side, but I identify as *iTaukei*.

My maternal great-great-great grandfather, Tui Macuata Naerevono, was the paramount chief of Caumatalevu in Vanua Levu in northern Fiji. His daughter, Adi Maimalaga, is my great-great grandmother. Adi Maimalaga's mother was not the wife of Tui Macuata, but rather his wife's handmaiden from Udu Point in the northeast of Vanua Levu. This is the reason why our family village of Naduri and Udu Point have a special relationship.

According to my late uncle, Tomasi Chute from Udu Point, and the carrier of our family history, in the mid-1800s Benjamin Thomas Robinson came to Vanua Levu from Glasgow, Scotland. Uncle Tomasi said Benjamin Robinson "helped the Tui Macuata in the Fiji wars". Exactly what that *help* was is unknown, although it did result in Tui Macuata agreeing to Benjamin Robinson marrying his daughter Adi Maimalaga. Their daughter, my great grandmother, is Matalita Robinson. I have a photograph of Matalita at 16 years of age, taken in 1903, when she was a student

at the Marist Convent School in Fiji's original capital of Levuka. Today, the Robinson lineage is one of the largest *kai loma* (mixed *iTaukei palagi*) families in Fiji.

My *kai loma* grandfather was a huge influence on me. He was the antithesis of my father; calm and considered, reflecting the traditional Fijian respect-based ethos of *vakaturaga*.[289] I never once saw grandad angry or heard him cuss. Having moved to Aotearoa New Zealand in his teens, so he could join the Royal New Zealand Artillery and then serving in the Korean War, grandad was the reason I joined the Royal New Zealand Artillery on leaving school, before shifting to the New Zealand Police 5 years later. Sadly, grandad passed away before we could follow our plan of travelling together to Fiji.

Like most *iTaukei*, and particularly those from chiefly lineage, my ancestry has a deep connection to kava and its associated practices, not to mention kava farming as a contemporary commodity. When I drink kava, no matter whether it's with a single other or at a mass gathering, I feel as though the practices and processes involved are a combination of me, my ancestors and my Creator, the Author of cultural expression and identity. I do not believe I can ever fully articulate this with the exception of saying that kava, and the cultural practices associated with it, are vastly more than simply lifting a *bilo* full of kava to my mouth and drinking. When I hear people say they attended a kava bar and had a traditional experience, I feel for them, knowing they have barely scratched the surface of traditional.

After leaving the police, I went to Fiji in 2000 where I spent long periods over the following 10 years assisting with development projects, teaching and farming kava in Kadavu (island) at Richmond Methodist High School (a day student and boarding school) and the nearby village of Natokalau. I am related to Natokalau through my aunty Nora Robinson, who married Tomasi Vasu from Natokalau. Uncle Tomasi is the namesake of Tui Rauni Ratu Tomasi Vasu (subdistrict chief of Rauni and the villages of Natokalau, Korovou and Busa), who is also the great grandfather of my namesake, Aporosa Bainimoli (who this book is dedicated to).

One afternoon in 2003, I was drinking kava in the school hall at Richmond Methodist High School with some family members, friends and school teaching mates. Also present was a senior education officer from the Fiji Ministry of Education in Suva. He told us that there were several at the Ministry who were

pushing to have kava banned from school campuses, arguing that late-night kava drinking by teachers was negatively impacting productivity and leading to student underachievement. One of the teachers turned to me and said, “You have to fix this. You can tell them that this is our culture. They cannot take it [kava] away.”

Regardless that we were at a school, and students do not drink kava, kava nevertheless plays a critical role in the cultural expressions, systems and functions of school life (which are explained at length in some of my work). For those in rurally isolated schools like Richmond and in villages like Natokalau, where there was no television and minimal electricity until recently, daily kava sessions were the norm. These kava venues doubled as staff and school board meeting venues, and were the spaces where parents staying at the school undertaking volunteer labour were hosted, or where village planning meetings were held. They were, and continue to be, spaces of socialisation, which includes catching up on national and world events repeated by those who had listened to the radio that day or had returned from the ‘mainland’.

When told I was expected to *fix* the proposed school kava ban issue, I recall feeling slightly panicky for two reasons. Firstly, I too felt as though my *iTaukei* identity was under threat; that who I was and embodied was about to be taken away, like having an arm hacked off. Additionally, if kava was banned from schools, could it be banned completely, removed from my culture? Secondly, I felt like I was being handed sole responsibility for saving the Fijian kava culture, which included all of the significance and *mana* (spiritual power) that stood behind it.

Shortly after this incident, I returned to Aotearoa New Zealand. In a discussion with Jan, my wife, about my work and the proposed kava ban, she suggested I go to university and study; and that this would support the work I was doing in Fiji, as well as provide greater understanding of the social and cultural challenges being faced by people in developing nations, such as Fiji. As an ex-soldier and policeman, with no school qualifications and substandard reading and writing, this was a daunting prospect I wanted to run from, but equally knew I had to do.

That suggestion by Jan was the catalyst for me enrolling as a development studies student at Massey University, and eventually resulting (after a great deal of frustration navigating tertiary-level study) in a Master’s degree. That Master’s

investigated the role of kava within the Fijian schooling system and was aimed at addressing the concerns about late-night kava drinking by teachers and impacts to productivity and student underachievement.[290] I undertook that research while continuing my work in Fiji. That Master's led to an invitation by the Fiji Ministry of Education to expand the study into a PhD to consider the importance of culture to educational achievement, with a focus on kava.[291] That research was presented to the Ministry in 2013.

While the research has not prevented a small number of people at the Ministry of Education criticising the ongoing use of kava by teachers, it has also not led to the banning of kava from school campuses. In the coming months, a new paper will be published in the *Australian Journal of Indigenous Education* aimed at reminding the Ministry about the important role of culture, and vicariously kava, to the academic achievement of students, together with the processes and systems of education in Fiji.[292]

The theme of my doctoral research led to my first academic role in 2013 as a research fellow at the *Waikato–Tainui College for Research and Development* (Hopuhopu, Aotearoa New Zealand), where I was tasked with writing the scoping report for the tribe's education strategy. This role drew heavily on the importance of culture to educational achievement,[293] while also providing me the opportunity to work on two Health Research Council: Māori-funded projects. That exposure to the work of the Health Research Council led me to apply for the 2016 Pacific Post-doctoral Award, and provided me with the means to start investigating the kava drink-driving research, which this book discusses.

That kava driving research has been based at the University of Waikato where I currently work across two schools: Te Huataki Waiora School of Health and Te Kura Whatu Oho Mauri School of Psychology. I now convene a 200-level health paper, and teach Pacific content across several papers and disciplines, as well as supervising Pacific students who I am hoping will step into my role in the future. I am also a member of the university's Pacific leadership team, led by our Assistant Vice Chancellor, *kaihuahine* (my Hawaiian sister) Dr Keakaokawai Varner Hemi.

In the Acknowledgements to this book, I mention the plethora of people who have been instrumental in my journey. I cannot thank them enough. I have been

privileged to have some amazing role models, such as my grandad, ex-policeman and now *kaumatua* at the Aotearoa New Zealand Rugby Union Luke Mikaire Crawford, Serupepeli Udre and Tui Rauni Tomasi Vasu, to name a few. I have also had people make sacrifices for me, including my Fijian family and those who left their home to make a new life in Aotearoa New Zealand, including my mum. I have also had others see academic potential in me when I felt illiterate and a fraud; it was only recently that I was telling Associate Professor Maciu Tomlinson, who did his doctoral research at Tavuki near Richmond, and who invited me to my first academic conference in 2008, that I frequently struggle with impostor syndrome.

However, I want to finish with two special mentions: In 2013, I returned to Natokalau and during *isevusevu* (presentation of kava) I also presented them with a copy of my doctoral thesis. I apologised that the thesis and my degree were solely in my name when the knowledge they contained were the product of so many, including those present in the village hall that day. Therefore, this made the thesis and doctoral degree 'ours'. 'Ours' includes those mentioned above and in the Acknowledgements at the start of this book. What a strange system academia is; experts privilege me with their knowledge, and in turn I am perceived to be the expert and awarded 'doctor' status.

One of the biggest 'ours' in my journey is Jan, my amazing wife, who I first met at eight years of age. Jan has stood by me through good and a lot of bad, being particularly supportive, tolerant and loving after I left the police with post-traumatic stress disorder (PTSD), then giving me the freedom to spend lengthy periods of time in Fiji. Jan saw promise when I didn't, encouraged me when I wanted to give up, and acted as my personal academic support tutor during my early years of university. My research has expanded to include cognitive assessment because of Jan (Dr.ClinPsych; PGDipAppNeuro), allowing me to do the kava driving research and therefore this book. Jan is the 'real brains' behind the cognitive testing I do. Just like all the other 'ours', I will never be able to repay Jan, but look forward to the adventures we are still to have together.

As this book goes to print, I have received a Fulbright Scholar award to investigate the potential of traditionally influenced kava spaces to reducing PTSD symptomology among post-combat soldiers and first responders. For more details, please see the article in the New Zealand Herald.[294]

Index

This study considers the effect of kava (yaqona) on cognitive functioning when consumed traditionally.

Kava drinking continues to play a dominant role in the cultural practices of many Pacific peoples, whether in their home environments or new diasporic communities. The relaxant and soporific effects resulting from lengthy kava use make it popular among non-Pacific users, too, as a 'social lubricant' and alternative to alcohol. Driving between kava venues after lengthy kava use has become routine among both traditional and new kava users.

The deterioration of cognitive function, including kava's potential impacts on driver performance, has not been researched in depth until now. Funded by a New Zealand Health Research Council award, this first–of-its-kind study assessed kava users' cognitive abilities during and after traditional kava use, producing unexpected results and new research possibilities. This study comes at a timely moment when high numbers of traffic accidents involving Pacific peoples are being recorded.

'Apo' Aporosa is maternally related to the village of Naduri in Macuata, Fiji. Although based in New Zealand, he regularly visits his ancestral homeland where he teaches secondary school students, farms kava, assists with grassroots development projects and conducts research. He has a Doctorate in Development Studies from Massey University, New Zealand. In 2016, Aporosa was awarded the New Zealand Health Research Council (HRC) Pasifika Post-Doctoral Award and in 2019 the HRC Sir Thomas Davis Te Patu Kite Rangi Ariki Award to investigate the impacts of traditionally influenced kava use on cognition and driver safety. Based at Te Huataki Waiora (Faculty of Health, Sport and Human Performance) at the University of Waikato, Aporosa teaches and conducts research in Pacific Studies, psychopharmacology and health - areas that are strongly influenced and informed by traditional knowledge systems. He also carries out his research in association with the School of Psychology's Traffic and Road Safety Research Group (TARS) and is active in the Pacific community and in support of Pacific students.

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