Te Whare-Tapa-Whā and Te Maramataka in Road Safety

This paper has been peer reviewed

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INTRODUCTION

This project sought to identify ways to reduce inequalities between Māori and non-Māori in road safety outcomes. This paper discusses the use of a shift in approach within the road safety sector from a 'cultural competency' model to a 'cultural safety' model to reduce these inequalities.

Māori are significantly over-represented in road trauma. Waka Kotahi has stated:

> *"For 2013-2017 the average rate of DSIs per 100,000 population for all Māori men was 87.0; much higher than the average rate of 61.5 for all men. For non-Māori men the DSI rate is about average from 30 years onwards but for Māori men the DSI rate remains above average through to 64 years. For all Māori women the rate was 40.5; much higher than the average rate of 29.0 for all women. For Māori women the rate of DSI rate remains above average through to 59 years".* [1]

The proposal of a 'cultural safety' model requires a paradigm shift in the manner in which we carry out road safety activities. A 'cultural competence' model is about road safety engineers seeking to understand and apply Māori values to their projects. Conversely, a 'cultural safety' model requires road safety engineers to step back and to understand *"their assumptions, biases and values, and consider imbalances in power. The aim is to consider ways to transfer power to enable patient-led change and better health outcomes."* [2].

This paper discusses a 'cultural safety' model and gives examples through adopting Mātauranga Māori (intergenerational knowledge) within road safety.

BACKGROUND

Disparities in outcomes between Māori and non-Māori are not only evident in the Transport sector; the Health and Education sectors have also identified similar inequalities. Research in the health sector has recognised that a paradigm shift is needed from a point of 'cultural competency' to 'cultural safety' to break down the inequity in health outcomes [2].

While there has been significant improvement in our understanding of Māori road safety issues [1], we are still building our cultural competency [5]. The health sector research suggests that a narrow understanding of cultural competency may be harmful [3]. When applied to road safety, we may be homogenising Māori and therefore not accurately representing the issues related to crashes.

The research from the health sector recommends a 'Cultural Safety' approach. This approach is a paradigm shift in that it requires road safety engineers to step back and to understand *"their assumptions, biases and values, and consider imbalances in power. The aim is to consider ways to transfer power to enable patient-led change and better health outcomes."* [2]

Māori, as a road user group, are a key part of the Road to Zero strategy. Improving Māori road safety has historically been focussed on driver and vehicle licencing as well as the co-design of projects [6]. To adopt a 'cultural safety' approach within road safety, we are further proposing to enable user-led change through a greater focus on Māori values and Te Tiriti o Waitangi principles [4] [7] in road safety. Te Tiriti o Waitangi principle in road safety includes:

- **Partnership** – partnering with Māori to develop strategies for reducing Māori road trauma
- **Protection** – actively protecting Mātauranga Māori *(Māori knowledge)*, interests, values and other taonga. For example, undertaking studies like that attached in the paper on Maramataka and its influence on road safety
- **Participation** – to emphasise participation and success at all levels of reducing road trauma. [3] [4]

Mātauranga Māori refers to intergenerational knowledge that has been passed down from Māori tūpuna *(ancestors)* as it connects them to their whakapapa *(genealogy)* so that it can be protected and preserved for future generations. This includes a Te Ao Māori world view, perspectives, cultural traditions, and creative practices.

Te Whare-Tapa-Whā and Te Maramataka are two Māori frameworks that can be used to increase Māori participation in road safety.

Te Whare-Tapa-Whā

Te Whare-tapa-whā is an holistic health and well-being framework developed by leading Māori health advocate and researcher, Sir Mason Durie in 1984 [8]. This framework describes the holistic health and well-being represented as a wharenui *(meeting house with four walls)*. These four walls of the wharenui represent the four dimensions of holistic health and well-being and are as follows:

- Taha-Wairua *(spiritual well-being);*
- Taha Hinengaro *(mental and emotional well-being);*
- Taha-Tinana *(physical well-being)*;
- Taha-Whānau *(family and social well-being)*.

Māori have an interconnected relationship with the whenua (land) which builds the foundation of their identity as a people – the wharenui is embedded in the whenua. **If one of the four walls of the wharenui are imbalanced or not embedded within the whenua, the wharenui may become unstable.**

When applying this thinking to road trauma and the impacts of Māori people, Te Whare-Tapa-whā is believed, by those whom practice it, to play a major role in determining other contributing factors that impact an individual's decision making, sensory impairment, and reactive reflexes. This could be due to the following factors:

- Disconnected from whenua which causes an imbalance in the 'wharenui' or holistic health and well-being leading to a loss of identity, sense of place and belonging.
- Lack of knowledge on how to practice Mātauranga Māori so unable to grow, harvest and gather traditional food sources.
- Disconnected from whānau, hapū and iwi – lack of community, intimate relationships that fuel a spiritual-soul-connection with other human-beings.

Te Whare-Tapa-Whā Analysis

WSP has not carried out an analysis for this as there is limited data of each individual's holistic health and well-being. Unfortunately, as a result of colonisation, the practice of

Mātauranga Māori was negatively impacted, leaving many Māori very disconnected from their whenua tūpuna *(ancestral land)* and overall identity as a people [9].

Te Maramataka

Te Maramataka is a lifestyle that Māori tūpuna lived religiously which revolves around the lunar calendar. A lunar calendar is when the moon changes each night of the month and repeats itself for 30 days. The moon has a magnetic pull over the water, oceans, and seas – the human body is made up of 70% of water which is why the moon affects people mentally, emotionally, spiritually, and physically [10]. Māori tūpuna knew how to adapt to the natural changes of lows and highs, living equally with the environment.

Te Maramataka provides knowledge on when and where to harvest and grow food, when to rest, when to be productive and when not to have important meetings. It prepares people for different moods and emotions that whānau *(families),* friends and the environment are experiencing. Te Maramataka starts when the Matariki star cluster *(also known as Pleiades)* reappears in the sky to signal the Māori new year. The impact on every iwi *(tribe)* varies depending on the location in the country. For example, Maramataka suggests not catching eels during Rākaunui *(the full moon)* – this also corresponds to the time eels are less likely to be hunting as their prey are more likely to see them.

In relation to Māori road trauma, This paper explores how Te Maramataka can help to identify whether or not people are more susceptible to road crashes during high, medium of low energy based on different lunar phases of the moon.

Te Maramataka Analysis

WSP carried out an analysis to see if there is correlation between the number of crashes and their period of energy in accordance with Te Maramataka (See Figure 1).

There are different Maramataka calendars across Aotearoa, so we are using the Tāmaki Makaurau calendar (Figure 1) as an example study area. Tāmaki Makaurau area was chosen because of the large number of crashes available to study under one assumed lunar period.

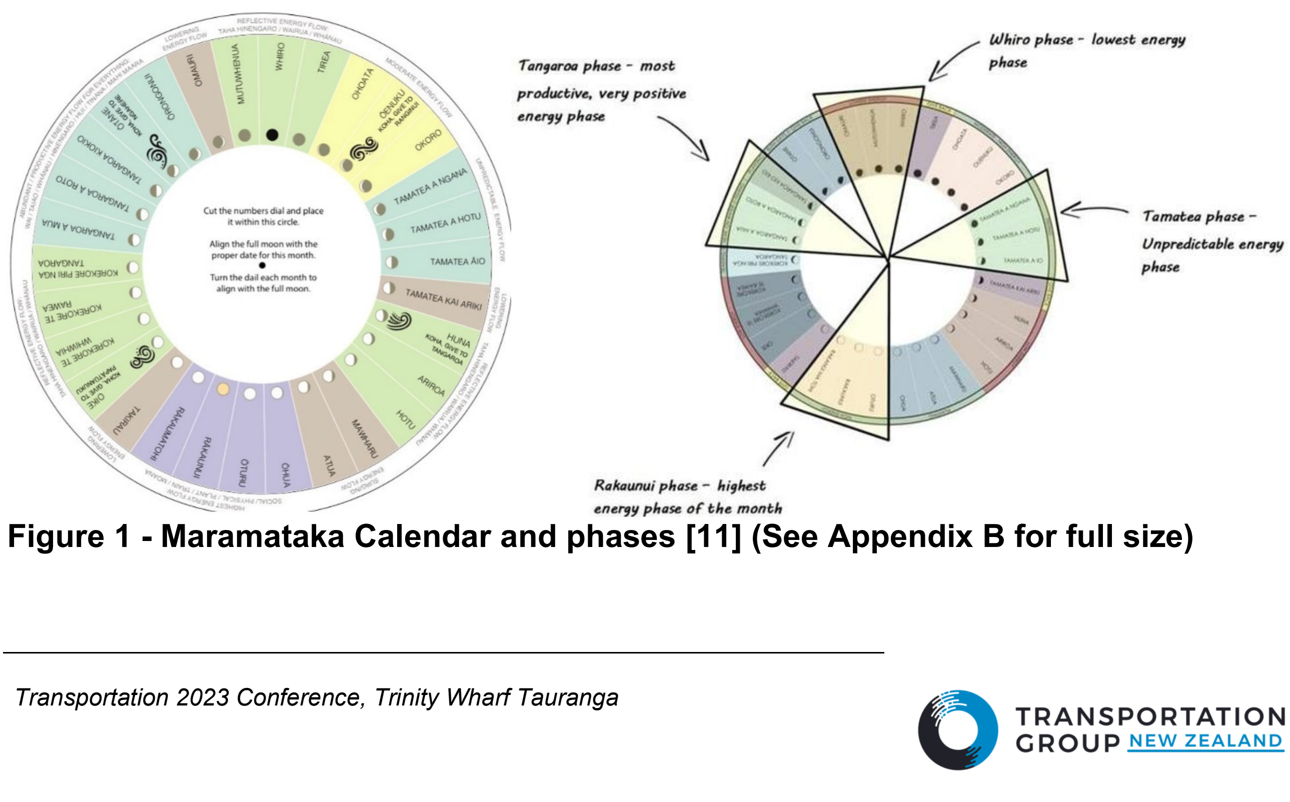

Figure 1 - Maramataka Calendar and phases [11] (See Appendix B for full size)

Process

The process carried out to assess the correlation between crashes and the Maramataka calendar included:

1) *Full Moon* - Determine dates of the full moon over study period,
2) *Te Maramataka* - Consult with Te Maramataka Calendar to align with days following full moon,
3) *Relationship* - Establish cross reference for date of crash to the day past full moon. This then is aligned to Te Maramataka date,
4) *Data Sourcing* - Assess Minor, Serious and Fatal Injury crash total per Te Maramataka period in Tāmaki Makaurau over two time periods (2011-15 and 2016-20),
5) *Expected Crashes* – The expected crashes are not anticipated to be evenly distributed because traffic flows on corridors are not evenly distributed throughout the year. To account of variation and the rotation of weeks in the year, we took 10 years of crash data and;
    a. sorted crashes into corresponding week of the year,
    b. determined the average expected crash number per week of the year over ten-year period,
    c. aligned those expected crashes to the corresponding lunar calendar established in 1 above,
    d. Sum the expected crashes per Maramataka lunar period being assessed
6) *Comparison* - Assess greater / less than expected vs Energy levels to see if high level correlation
7) *Statistical Analysis* - Determine if correlation above is statistically significant using “Goodness of Fit” method over six periods.

Results

The full results of the analysis is shown in Appendix A. A summary is in Table 1.

Table 1 - Summary of results

Energy Category	Phase Name	Correlation	Statistically Significant
Highest Energy	Rakaunui	- No Correlation	N/A
Positive Energy	Tangaroa	- Some Correlation	Yes (needs further analysis to confirm)
Lowest Energy	Whiro	- Some Correlation	No
Unpredictable Energy	Tamatea	- No Correlation	N/A
Lowering Energy Flow		- Some Correlation	No

The “Highest” and “Unpredictable” energy periods showed no or very limited correlation that energy levels may affect crashes.

The “Lowest” and “Lowering” energy periods showed some correlation that energy levels may affect crashes. However, initial statistical analysis did not show the difference in results were statistically significant from that expected.

The “Positive” energy period showed a correlation with reduced crashes than expected. An initial review of the data showed that the difference from the expected crash figures may be statistically significant.

It should be noted that this study does not utilise enough data to make a definitive conclusion. However, we believe that the results are significant enough to warrant further study on a larger data set, e.g. Nationwide over more years with Te Maramataka experts.

It should also be noted that this study does not take into consideration an individual's Whare-tapa-whā which may have contributed to decision making, sensory impairment, and reactive reflexes during a crash/ road trauma.

International Literature Review
Literature reviews of international studies found multiple sources where lunar cycles have been studied for their effect on sleep, road crashes, suicide rates and hospital room visits. The theme of these studies is that there are some examples of statistical correlation between full moon phases and incident rates. However, as the studies are regional based, they have not been matched to Te Maramataka phases.

Full moon and traffic crashes –

Japan - This study examined nationwide Japanese data of ambulance transport from 2010 to 2014. This assessment utilised 842,554 cases to determine the correlation between full moon and traffic crashes. Onozuka (2018) found that…"*study findings demonstrate a significant increase in the risk of traffic accident-related emergency transport on full moon nights. Specifically, a significant increase in emergency transport due to traffic accidents on full moon nights was observed for males, people aged 40 years or older, on both weekends and weekdays, and before midnight."* [12]

Australia – This study examined crash data in Victoria, Australia from 2000 to mid 2019. The study could not find any statistical correlation between moon phase and crash number [13].

United States – This study examined 13,029 fatal motorcycle crashes in the United States. The crashes occurred at night time between 1975 and 2014. Redelmeier and Shafir (2017) stated that…*"the full moon is associated with an increased risk of fatal motorcycle crashes, although potential confounders cannot be excluded"* [14].

Full moon and Emergency Department patients – This American study looked at 15099 patient visits to an emergency department over four years. The study found no correlation between the full moon and the number of patients in emergency departments, ambulance call outs, admissions to hospitals or admissions to a monitored unit [15]

Lunar Cycle and Psychiatric Admissions – This study analysed 17,966 cases of people treated as a psychiatric inpatient. The study examined admission and discharge data and correlated to moon phases. No statistical connection was found with moon phase and admission date, length of stay or discharge dates. [16]

Full moon and different aspects of Human Health – This study referenced other studies that dispelled some myths about the moon affecting birth rates, sleep patterns, menstrual cycle and behaviour change. [17]

Moon phase and sleep

Surrey – This study carried out research into the lunar period and sleep of 91 males and 114 females. While they did find some correlation between sleep times and lunar period, it was not statistically significant enough to draw a conclusion. [18]

Switzerland – This study carried out research on 2125 individual to do a subjective at home study of sleep quality (self-rating scale). Sleep EEG spectral analysis and cortisol level assessments were performed on 759 participants. Overall, there was no significant difference in the lunar phase and sleep quality. [19]

What further research opportunities are there?
To further examine the correlation of Te Maramataka requires specialist input from Māori scholars. There are also further opportunities to incorporate Te Whare-Tapa-Whā into other road safety studies.

Another belief is that there are specific areas where road deaths are more suspectable because of the history of the site. There is an opportunity to identify and examine these to identify correlation with road crash locations.

It is important to note that we are examining correlation, rather than causation, at this early stage. Although this study found some correlation in Tāmaki Makaurau between the lowest and lowering energy periods in the Te Maramataka calendar, further study is required to research this and other contributing factors which may cause this correlation.

Conclusion
Research from health and education sectors suggest that a ‘cultural safety’ model is an appropriate method to reduce inequalities in outcomes between Māori and Non-Māori. In moving towards this model, the road safety industry has an opportunity to incorporate Te Whare-Tapa-Whā into road safety studies. This work will seek to protect Mātauranga Māori, as obligated within Te Tiriti o Waitangi, and include Māori cultural practices in our industry’s approach to road safety.

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References

[1] Waka Kotahi, He Pūrongo Whakahaumaru Huarahi Mō Ngā Iwi Māori., Wellington: NZTA, 2021.

[2] E. J. R. T.-L. D. W. C. L. B. P. S. a. R. P. Curtis, "Why Cultural Safety rather than Cultural Compency is required to achieve health equity," UoA; Faculty of Medical and Health Sciences, Auckland, 2019.

[3] E.-L. L. a. P. N, "Improving Access to Health Care Among New Zealand's Maori Population," *American Journal of Public Health,* vol. 96, no. 4, pp. 612-617, 2006.

[4] SchoolNews NZ, Te Tiriti o Waitangi - living the values, Wellington: MOE, 2016.

[5] M. Philip, "TE TŪTURUTANGA Ō TE TAUMAUTANGA KI TE MĀORI," 8 September 2021. [Online]. Available: https://www.engineeringnz.org/news-insights/te-t%C5%ABturutanga-%C5%8D-te-taumautanga-ki-te-m%C4%81ori/. [Accessed 10 1 2023].

[6] Ministry of Transport, "Road to Zero: New Zealand's Road Safety Strategy 2020 - 2030," Ministry of Transport, Wellington, 2019.

[7] National Advisory Committee on Health and Disability (NHC), "A framework to improve Maori health policy," Ministry of Health, Wellington, 2002.

[8] S. M. Durie, "Te Whare Tapa Whā," Mental Health Foundation of NZ, 11 2021. [Online]. Available: https://mentalhealth.org.nz/te-whare-tapa-wha. [Accessed 20 11 2021].

[9] Maipi-Clarke, "Maahina," Maahina, 2021. [Online]. Available: https://www.maahina.com. [Accessed 20 11 2021].

[10] M. H, "A Discourse on the Nature of Indigenous Architecture," Researchgate, 2018.

[11] The Spinoff, "Expert Feature: Maramataka - living by the moon," Radio New Zealand, 30 March 2020. [Online]. Available: https://www.rnz.co.nz/national/programmes/afternoons/audio/2018740762/expert-feature-maramataka-living-by-the-moon. [Accessed 14 November 2021].

[12] D. N. K. H. A. Onozuka, "Full moon and traffic accident related emergency ambulance transport: A nationwide case-crossover study," *Science of the Total Environment,* pp. 801-805, 2018.

[13] A. D, "The Influence of the Moon on the river Behaviour," Melbourne, 2019.

[14] D. S. E. Redelmeier, "The full moon and motorcycle related mortality: population based double control study," *BMJ,* vol. 5367, p. 359, 2017.

[15] A. S. Thomspson D, "The Full Moon and ED Patient Volumes: Unearthing a myth," *American Journal of Emergency Medicine,* 1996.

[16] "Is it the moon? Effects of the lunar cycle on psychiatric admissions, discharges and length of stay," *Swiss Medical Weekly,* vol. 20070, p. 149, 2019.

[17] B. T. a. R. A. Roy A, "A structured review of relation between full moon and different aspects of human health," *SM Journal of Biometrics and Biostatistics,* vol. 1007, p. 1(2), 2017.

[18] A. G. a. D. D. Monica C, "Effects of lunar phase on sleep in men and wormen in Surrey," *J Sleep Research ,* vol. 24, pp. 687-694, 2015.

[19] e. a. Haba-Rubio J, "Bad Sleep? Don't blame the moon! A population based study," *Sleep Medicine,* vol. 16, pp. 1321-1326, 2015.

[20] Te Papa, What is Maramataka | The Maori lunar calendar?, Wellington: Te Papa,

2021.

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Ngā mihi nui ki a koe to Troy Brockbank for helping develop the idea for this paper, Tal Rogoff from WSP Info Centre for the literature research and Dr Fergus Tate for reviewing and providing advice.

Appendix A – Results

Phase	Phase No.	2016 - 2020 Actual	2016 - 2020 Expected	2016 - 2020 Difference	2016 - 2020 %	2011 - 2015 Actual	2011 - 2015 Expected	2011 - 2015 Difference	2011 - 2015 %	Energy Levels (Appendix B)
Ariroa	24	565	571	-6	-1%	522	497	25	5%	
Atua	27	515	571	-56	-10%	480	497	-17	-3%	
Hotu	25	579	571	8	1%	466	497	-31	-6%	
Huna	23	569	571	-2	0%	478	497	-19	-4%	
Korekore te piri ki Tangaroa	6	534	571	-37	-6%	466	497	-31	-6%	
Korekore te rawea	5	551	571	-20	-4%	486	497	-11	-2%	
Korekore te whiwhia	4	552	571	-19	-3%	480	497	-17	-3%	
Mawharu	26	553	571	-18	-3%	468	497	-29	-6%	
Mutuwhenua	13	588	571	17	3%	522	497	25	5%	Lowest
Oenuku	17	531	571	-40	-7%	472	497	-25	-5%	
Ohoata	16	535	571	-36	-6%	525	497	28	6%	
Ohua	28	558	571	-13	-2%	509	497	12	2%	
Oike	3	567	571	-4	-1%	490	497	-7	-1%	
Okoro	18	539	571	-32	-6%	482	497	-15	-3%	
Omauri	12	614	571	43	8%	515	497	18	4%	Lowest and lowering
Orongonui	11	544	571	-27	-5%	489	497	-8	-2%	
Otane	10	544	571	-27	-5%	443	497	-54	-11%	
Oturu	29	287	571	-284	-50%	247	497	-250	-50%	Highest
Rakaumatohi	1	578	571	7	1%	515	497	18	4%	Highest
Rakaunui	0	562	571	-9	-2%	475	497	-22	-4%	Highest
Takirau	2	604	571	33	6%	495	497	-2	0%	Lowering Energy Flow
Tamatea a Hotu	20	567	571	-4	-1%	497	497	0	0%	Unpredictable
Tamatea a Nganaa	19	574	571	3	1%	501	497	4	1%	Unpredictable
Tamatea Aio	21	565	571	-6	-1%	484	497	-13	-3%	Unpredictable
Tamatea Kai Ariki	22	582	571	11	2%	490	497	-7	-1%	Lowering Energy Flow
Tangaroa-a-kiokio	9	546	571	-25	-4%	468	497	-29	-6%	Positive
Tangaroa-a-mua	7	578	571	7	1%	448	497	-49	-10%	Positive
Tangaroa-a-roto	8	552	571	-19	-3%	553	497	56	11%	Positive
Tirea	15	527	571	-44	-8%	486	497	-11	-2%	
Whiro	14	585	571	14	2%	472	497	-25	-5%	Lowest

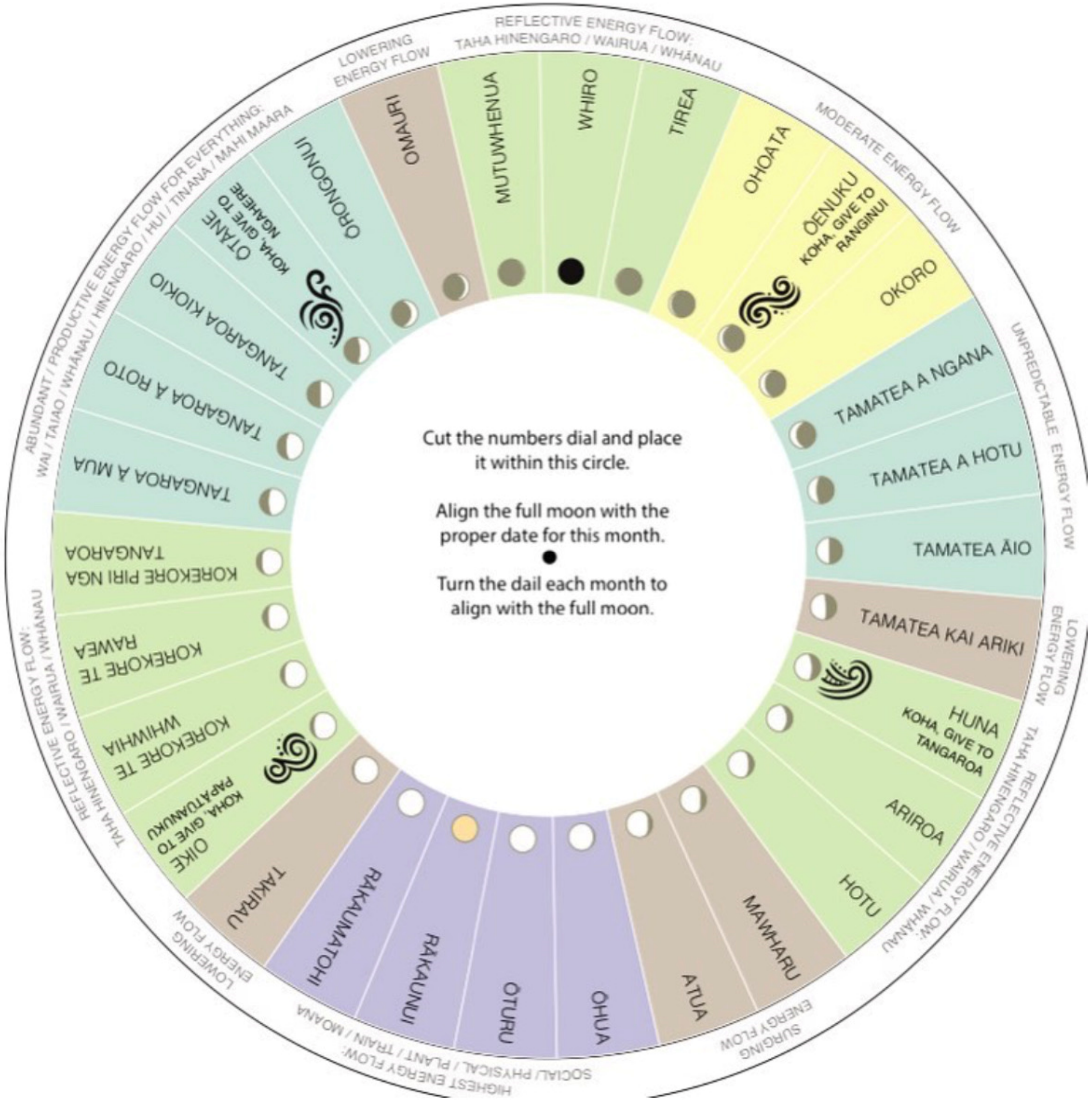
* Oturu phase is last phase in lunar calendar and the negative 50% is likely associated with number of phases rather than other effects.

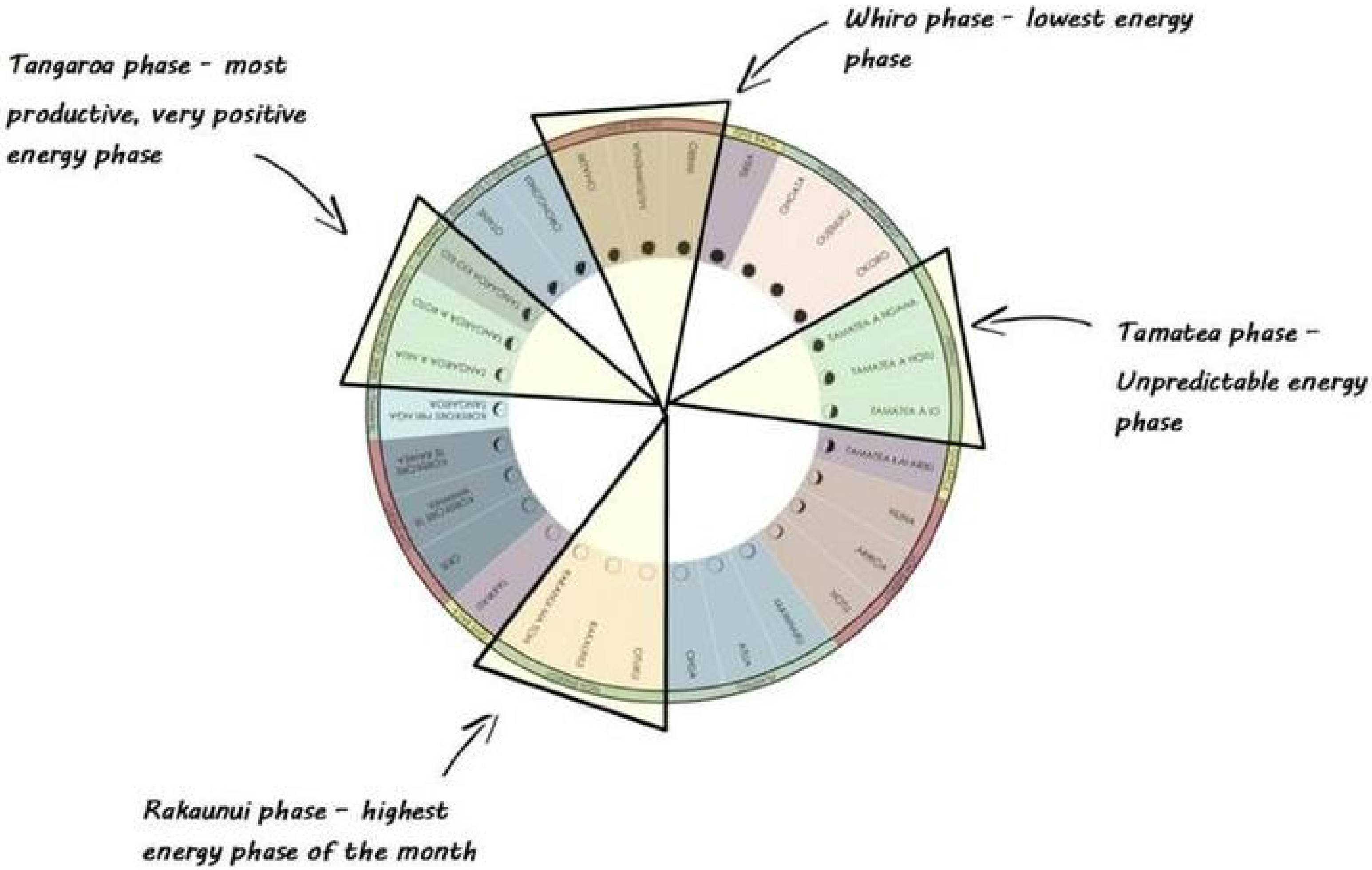
A summary of the correlation of phases is shown below.

Energy Category	Phase Name	Correlation	Statistically Significant
Highest Energy	Rakaunui	- No Correlation	N/A
Positive Energy	Tangaroa	- Some Correlation	Yes (needs further analysis to confirm)
Lowest Energy	Whiro	- Some Correlation	No
Unpredictable Energy	Tamatea	- No Correlation	N/A
Lowering Energy Flow		- Some Correlation	No

GOODNESS OF FIT TEST							
Lowering Energy Levels							
Ho =	Lowering Energy values meet the historic crash weekly pattern						
Actual	614	604	582	515	495	490	
Expected	521.5857143	522.0143	524.2286	521.5857	522.0143	524.2286	
Difference	92.41428571	81.98571	57.77143	-6.58571	-27.0143	-34.2286	
Xc=	16.3739151	12.87639	6.36657	0.083153	1.397992	2.234894	
Xc=	39.33290979						
Df =	5	6					
alpha =	0.05	0.05		Assume 5 degrees but really could be 6 as last is non dependent on rest.			
Cv =	11.07	12.59					
Xc > Cv	Therefore reject Ho						
Therefore Lowering Energy Level times does not match expected							
Lowest Energy Levels							
Ho =	Lowest Energy values meet the historic crash weekly pattern						
Actual	588	614	585	522	515	472	
Expected	520.6285714	521.5857	521.7286	520.6286	521.5857	521.7286	
Difference =	67.37142857	92.41429	63.27143	1.371429	-6.58571	-49.7286	
Xc=	8.718133496	16.37392	7.673096	0.003613	0.083153	4.73988	
Xc=	37.59179109						
Df =	5	6					
alpha =	0.05	0.05		Assume 5 degrees but really could be 6 as last is non dependent on rest.			
Cv =	11.07	12.59					
Xc > Cv	Therefore reject Ho						
Therefore Lowering Energy Level data does not match expected (significantly)							

Appendix B – Calendars




Whiro phase - lowest energy phase
Tangaroa phase - most productive, very positive energy phase
Tamatea phase - Unpredictable energy phase
Rakaunui phase - highest energy phase of the month