Similar or Disparate Brain Patterns? EEG Variability in Jaran Kepang Dancers

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Abstract

Electroencephalography (EEG) devices have advanced in recent years such that individuals can now measure their own brain waves and patterns without having to go to a clinical research facility. This paper utilizes the EEG recording consumer device NeuroSky Mindwave Mobile 2 to explore the traditional Jaran Kepang phenomenon. Jaran Kepang is a dance-performance of Indonesian origin where the dancers go into trance and take the form of other 'beings'. This paper questions whether the dancers' brain patterns in trance are different from ours. The aim of this experimental study was to compare intrapersonal EEG variability of three Jaran Kepang dancers between their roles of "host" and "alter" during trance, but also the intrapersonal EEG records of three professional actors who act as the respective "host" and "acted-alter", and the interpersonal EEG variability between two controls. With the approval of the Ethics Review Committee and everything else in place, this study took an unfortunate turn due to the global Covid-19 pandemic. The study was instead conducted both by and on the main-researcher for graduation purposes. The results show no between-subjects significant differences. However, for all participants significant within-subject results were found between baseline and the reading mind state. We hope to continue our research in the future.

1. PREFACE

I try to make sensible and fact-based decisions as I aspire to be a long-term researcher and scientific educator. Despite this, I was born and raised in a strict and religious environment. While I battled the mentioned dogma, I was unable to overlook that a significant number of people around me appeared to easily stay in a delighted, loving space, interminably at ease while displaying a condition of mental serenity that I lack. How could they achieve this? Would I need to quit any pretense of "thinking" to get this new outlook?

These inquiries have concerned me since young, however lately I have seen that these two mentalities may not be as far separated as I originally suspected. Truth be told, these two perspectives may even supplement one another. The area of science can shift suddenly when novel and creative concepts force improved methods of thinking, according to Thomas Kuhn in his book, *The Structure of Scientific Revolutions* [Kuh12]. I think we are now at the beginning of a revolution in brain science that will pave the way for the uncovering of the human psyche's hidden capabilities.

Another fascination of mine is the Jaran Kepang dance rituals which started in my younger years. As Javanese-Surinamese (and part Dutch) within this research, I tried looking at the familiar with fresh eyes. At the same time, this "subject" was also very unknown to me, and I was able to get acquainted with the views and ideas about cultural and biophysical aspects of the Jaran Kepang from the Javanese community. My own origins have made it easier to make contacts within the studied group.

It was specifically not our aim to test the "validity" of Jaran Kepang dancers' personal experiences and interpretations, or its authenticity. Based on my own personal and academic interests, I set out to deepen the understanding of the Jaran Kepang phenomenon. Because of my optimism and trust in the process, I chose to do this daring research involving a physical experiment with in-real-life subjects, while in a global pandemic. Don't get me wrong: writing my thesis during a global pandemic was difficult. It's depleting, exhausting, and perplexing. I was lost and had no idea where the future of this research was heading. And indeed, under unforeseeable Covid-19 circumstances, it went differently than expected. But, even if that's the case, I'm glad I got to study something I love.

2. INTRODUCTION

Behind the gates on the yard of Sana Budaya in Suriname, it's a big party! Gamelan sounds welcome the guests dressed in colorful jarik and klambi shirts. Javanese batik fabrics adorn the stalls in the courtyard. And while one is enjoying his saoto, the other orders another 'bami' (noodles). A sweet, ice-cold dawet, cools down after

eating the sambel tempeh, which is very *pedhes* (spicy) this time, and is also refreshing on a hot day like this. Outside in the street, the group "The Young Riders" prepares for a performance of the traditional "horse dance", or Jaran Kepang.

Jaran Kepang is a traditional Indonesian horse dance. Jaran is the 'spirit' of the horse and Kepang is the horse made of woven bamboo with which the dancers perform *(see Figure 1 for reference)*. In front of the eyes of the public, the dancers (hosts) fall into trance and their bodies become "in possession of other identities" for entertainment purposes. When the dancers come back to reality, they claim that they do not remember anything about the performance [The09].

Figure 1: *'Kepang', the bamboo woven horse which the Jaran Kepang dancers perform with. It is said that this fake horse carries the 'spirits' throughout the performances. This image was taken during our first meeting with the Jaran Kepang group: "The Young Riders".*

Similar experiences are found in the phenomena dissociative identity disorder (DID), a mental disorder that falls under the field of psychiatry/clinical psychology. It was known as multiple personality disorder (MPD), and is a trauma-based illness, unlike Schizophrenia which is largely genetic. According to DSM-5, its characteristics are having at least two unmistakable and relatively enduring character states, and having difficulties recalling certain occasions beyond what might be clarified by normal neglect [Ame13]. Furthermore, "alters" is the term used to describe the personalities.

Recently, researchers {like [LCd*06]; [HCJ*02]; [Sha18]} have used electroencephalogram (EEG) devices to tell the difference between a DID patient and a malingerer, which we will discuss subsequently. In this paper, we will aim to look at the EEG patterns of experienced Jaran Kepang dancers in both host and alter states, using the same approach as the DID cases from existing literature. We want to compare the "within-subject" or intrapersonal EEG data of the Jaran Kepang host and alter during trance, and also compare those to EEG data of control subjects who act out being the 'host' and acted alter. Significant differences in EEG variance between Jaran Kepang dancers' host and alter personalities (during trance) but not between control "hosts" and acted "alters" would provide physiological evidence for Jaran Kepang trance being different from "mere" acting. A substantiated lack of difference (insofar as a statistical lack of effect can be substantiated, which is on logical grounds limited) would suggest physiological similarity between trance and acting. Results of investigations will not be set alongside ideas or perspectives on Jaran Kepang dancing as a spiritual endeavour.

Interlude: But, realize, dear reader, we are amidst a global pandemic, where Covid-19 has a drastic impact on capitalism, life, our global society, different cultures and research. In this paper, you will read about a beautiful research including the appropriate measures, and the approval of the Ethics Review Committee of the Faculty of Science at Leiden University. We also had the immense willingness from the Jaran Kepang community to participate in our original study design. But, unfortunately, we had to pivot and resort to contingency plan 'D' for this graduation study. During this time, the Covid-19 situation in Suriname was no longer manageable and was stated as code purple, indicating the highest risk levels. Also, code black applied to all hospitals alongside a Total Lockdown excluding essential services for at least three weeks (at the time). Due to these unforeseen circumstances, we could not research the aimed study group as we originally had planned. We hope to continue our research in the future.

For the purpose of this graduation thesis, we will begin with a literature review focusing on the Jaran Kepang origins, Dissociative Identity Disorder, and EEG measuring devices. From these insights we will formulate the research question and our approach. We will cover the pilot study, done to select the appropriate procedure for the main study, leading to the final experiment. This will be followed by the results and a discussion on their significance.

3. JARAN KEPANG: A BRIEF OVERVIEW

In this segment, the theoretical foundation is based on using personal observation, interviews with locals, and experts in the field of Jaran Kepang dance. Where possible, academic work is referred to, and conflicts between the different articles is discussed.

Terminology, Word Usage and Meanings

Before going further in discussion, we will go over the relevant components for understanding this trance-type phenomenon. Subsequently, we will describe some of the key figures and other significant terms in this type of ritual. Likewise, old and new perspectives of the scientific community toward trancing, possessing and shamanism, will be discussed. In this paper, non-prejudicial definitions are used to best reflect the topic from its original perspective. It is described in such a way where local language is mixed with English. This, because the purpose of this paper is explicitly not to assess the "legitimacy" or genuineness of Jaran Kepang dancers' own encounters and beliefs. This will form the premise of our discussions of Jaran Kepang performances. Furthermore, the expressed terminology introduced in this paper will hopefully be important in later conversations of Western, religious, and scholarly contemplations and perspectives in managing the particular phenomenon of Jaran Kepang in Suriname.

Inside the setting of altered states of consciousness (ASC), the words trance and possession have frequently been utilized interchangeably [Hal96]. However, like others, we decided to separate these two terms following Halperin his lead. Daniel Halperin refers to the Penguin Dictionary of Psychology which characterizes trance as "a condition of dissociation, characterized by the lack of voluntary movement, and frequently by automatisms in act and

thought, illustrated by hypnotic and mediumistic conditions". Furthermore, we characterized 'possession' as the apparent presence of another entity in a person with or without the observation of a type of trance. It is not the goal of this study to further investigate these two terms.

Another confusion in terminology is that shamanic people would all be categorized together into one term of shaman. This is generally utilized as an elucidating mark for people whether their abilities are to restore, spiritually heal, master the mystical arts, or be a midwife [Mau02]. A shaman in the Jaran Kepang is called a *dukun*[†], which is passed down the generations from father to child. The *dukun* is seen as a beneficiary and provider of power.

Also frequently used in talk of religions is *soul* or *spirits*. Since its many implications, this term is general and vague. Miriam-Webster's Unabridged Dictionary [MW21] records twenty-eight English definitions containing the word 'soul', thirteen of which imply religion. For the end-goal of this paper, we will refer to soul as "man's moral and emotional nature as distinguished from his mind or intellect" as cited from the aforementioned dictionary. This 'man's moral and emotional nature' is referred to as *endang* in our study group. The *endang* can take the form of an animal or even a (beloved) human from the dead. They describe this as 'something' beyond the soul, from another dimension; supernatural. The *endang* then inhabits and exits the human body by control of the *dukun*. As per our own *dukun* (direct source), there are different types of *endang* that the *dukun* can call upon for different ceremonies, like the *endang manteng* for wedding ceremonies, or the *endang majet* for funerals. A lot of different types are associated with negative mysticism. However, the Jaran Kepang, which we study, is meant for entertainment purposes (like a performing brass band on occasions) that brings positive energy to the ceremonies.

Ancient Jaranan

The old practice of the horse trance dance in Central and East Java stems from a larger custom that can be referred to as *Jaranan*[‡]. It incorporates a wide scope of rituals from the supposed horse worshipping individuals of the Riau area of Sumatra to the shamanistic practices of Southern Bali known as Sanghyang Jaran, which date back to the Stone Age and the hunter-gatherers [Mau02]. Nonetheless, this paper will selectively discuss *Jaranan* exhibitions which transplanted into Suriname, South America.

Historical Fieldwork

Papers on Jaran Kepang are rare and restricted to references in passing on different themes managing ethnomusicology or cultural anthropology studies of Java and Sumatra. Most writings are very emic, outdated and are written as it is seen by the audiences. Kathy Foley [Fol85] depicts a West Java ritual that she saw in 1978 named 'Dabus'. Artists dance to the music from *Wayang Golek*. She clarifies that the *dukun* calls upon Allah, His prophets and the "companions of the prophets" to help the dancers. They, then, drive drills into or cut open their stomachs, legs or tongue with blades, and boil eggs with fire on of their heads. The dancers all acknowledged that Allah's power protects them from harm indefinitely, and several even claimed that they were "entered" by the "companions of the prophets".

Like Foley's research dates before 1986 [Fol85], all of Kartomi's papers were also built upon research preceding 1976 [Kar76]. However, she tells us that oral accounts of trance dances in the Ponogoro area deny any trance element in the current and early form of the dance. In 1961, the Burridge paper [Bur61] was about the relocation of a Jaran Kepang adaptation from Indonesia to Malaysia. From the mentioned papers, it is safe to conclude that each time the dance relocates to somewhere else, the exhibition gets reshaped and more secularized. Another example is the Reog, an adaptation that is completely secularized and only performed on special festivals, occasions, and celebrations [Mau02]. The generalized Jaran Kepang is likely the most secular as the exhibitions are only for entertainment purposes, but still contain trance, possession and protection components.

Jaran Kepang: The Adaptation

The typical Jaran Kepang performing group (usually low-class people) comprises of (1) a *dukun*, (2) three performers animating the tiger-like mythological creature Barong, (3) Pentul (a masked clown), and (4) an average of twenty trance dancers riding hobby-horses [Bea99]. The performances are held outside on the grass, and are attended by big numbers - almost the entire 'community'. According to [Mau02], there are three original methods of going into trance. The first one is by repeatedly dancing in circles and rolling onto the ground until they receive the *endang*. The second method has the dancers stand and literally fall into trance; their body gets stiff for awhile and falls to the ground as the *endang* gets used to the 'new vessel'. And lastly, a trance induced by rhythmic *Gamelan* (drumbeat/percussive sound). Every type of *endang* has their own dance ritual and musical rhythm by the *Gamelan* where they are called upon. To remove the *endang* from the 'human vessel', yet, another song is played.

All this was corroborated by our own *dukun* (direct source), who further claimed that the reason the *endang* demanded to see the sky above and grass beneath their feet was to be close in contact with nature and "the other dimension". He also stated that you couldn't sit on the raised stands to watch the performance, because you would then be "above" the *endang* which would make it angry. However, like many adaptations, our study group "the Young Riders" discarded the old-fashion ways and provides a safe performance for the public on raised stands, while the trance-dancers dance on cement with a roof tent above their head. For the trance experience, this group does not look at race, color or gender, but rather at physical, mental and spiritual strengths to become a trance-dancer.

4. RELATED WORK

In this section, research related to DID and EEG studies are presented. Academic work overlapping Jaran Kepang and EEG, and/or

[†] Kartomi, Foley and Burridge alternately use the words *dalang* and *pawang*, and only mention a *dukun* as the leader of the trance groups.

[‡] The Javanese utilization of the word *Jaranan* can be confounding. They use it as a word for the exhibition structure, but it is also regularly used to portray the horse trance artists themselves instead of different words, for example, *Jathilan*. In different locations, it is utilized as a particular kind of Jaran Kepang. This paper will distinctly use the word as the name of the generalized horse trance dance, with the exception of where explicitly noted.

Jaran Kepang and DID do not exist according to our findings. However, research regarding EEG and the trance-like state 'meditation' was found and will be discussed subsequently. Still, to our knowledge, this paper is the pioneer in connecting Jaran Kepang, DID and EEG together as topics.

4.1. EEG and Dissociative Identity Disorder

To scientifically establish the existence of DID and better understand the physiological concomitants of this condition, researchers have used neurophysiological technology to investigate changes in DID host personalities compared to alter identities and controls. EEG patterns are known to change more between participants than they do within a single person across time. However, a study [LCd*06] found that the intrapersonal EEG variability between two alters was more different than the intrapersonal EEG variability between host and acted-alter, but less different from one another than the interpersonal EEG records of two healthy controls. It was found that even if a patient's EEG changed due to another alter, it retained its specificity. Also during task stimulation events, another two-group by two-state study involving DID patients managed to record EEG signals [HCJ*02]. Six of the twenty-one tests comparing host and alter revealed significant differences, but none of the tests comparing control and acting alter did.

The first-mentioned study [LCd*06] recorded the subjects with eyes closed sitting in a reclining chair. All of the subjects' actions were recorded using a video camera system. The individuals were given an intravenous injection ([99mTc]-HMPAO) during the EEG recording which was then used to perform a brain SPECT scan. Furthermore, all patients were tested with a urine analysis (UA) before recording EEG. For analysis, independent t-tests were employed to discover statistically significant variations in relative power per 1 Hz with frequency bands ranging from 1 - 30 Hz. Another study by Shanmugam [Sha18], made use of a lie detector (P300), EEG and ECG measurements as a 3-step approach to diagnose a DID patient. The study by Hopper [HCJ*02] also utilized typical medical devices, like the 64-channel electrode cap with extra electrodes evenly distributed in between the international ten-to-twenty electrodes [Jas58]. Signals were referenced to linked-earlobes with a vertex electrode as ground, and EEGs were recorded continuously for five minutes while doing task stimulus events.

None of the research, however, required participants to score their mood while in various personality states or in-between sessions. As a result, determining the extent to which mood affects EEG is difficult. Also, their reliance on single case studies is making it difficult to compare neurophysiological parameters between DID hosts, alters, and controls using statistical methods. This is then difficult to identify in a single case study, especially if minor changes in neurophysiological variables indeed exist.

4.2. EEG and Meditation

Another topic looked into, is how EEG technology could measure other trance-like states like meditation. Many people still regard meditation as a "new age treatment" with no scientific backing. Goleman and Davidson believed that meditation could help people develop traits like empathy and compassion, which they had seen in yogis and Buddhist monks [GD17]. They found that yogis' Gamma oscillations were higher (25 times greater to be precise) not only throughout the meditation rituals, but also during baseline assessments before any meditation was done. This electric pattern occurred in the highest, most powerful type of the EEG frequency known as high-amplitude *Gamma*. In another study [ACS61], four Yogis who practiced *samadhi*, a type of meditation, showed continuous alpha activity with greater amplitude modulation during rest. Furthermore, various sensory stimuli had little effect on the Alpha activity during their meditation. Increasingly, meditation's health benefits are being thoroughly documented. More recently, a paper by Thomson published in Nature [Tho18], illustrates that the release of Gamma waves can help to alleviate Alzheimer's symptoms. Perhaps a Gamma-wave-producing meditation practice can achieve the same outcomes. So, there is some evidence that distinguishes meditation from 'mere drowsing' based on available EEG methods.

4.3. EEG Devices

A well-known approach to measure brain patterns, is the usage of functional magnetic resonance imaging (fMRI) [LP09]. However, for the purpose of this study, fMRI and other medical neuroimaging techniques were out of our reach and not feasible. Moreover, it would not fit the goal of our study, as those neuroimaging techniques are wired and do not allow for any movement during recording. Most EEG studies, like [HCJ*02] and [LCd*06], are measured with an EEG cap with 21-electrodes, based on the ten-to-twenty worldwide electrode placement system [Jas58]. However, these experiments were still very limited because the subjects could also not be free in bodily movements.

But, recent research [RHG*14] proposed various methodological approaches that have been developed to evaluate body and brain dynamics while moving. These descriptions provide strategies for recording EMG, EEG, kinetics, kinematics and eye movements in real time during movement. They also suggest how to prevent and eliminate motion artifacts, as well as hardware and software. Furthermore, they presented different chronicle frameworks, EEG terminals, covers and strategies for determining custom electrode locations. They reasoned that it is feasible to obtain and evaluate data of the body and brain in synchronicity during exercise assignments. This, however, is a too elaborate mathematical tackle to take on for our investigation.

More recently, the average person can also monitor their own brain activity and patterns at home without the usage of fancy equipment. In a study by Permana and colleagues [PWP19], they make use of NeuroSky's MindWave Mobile 2 (MWM2). This deivce is more portable than traditional EEG data acquiring systems, which are bulky and consume a lot of channels. This headset can wirelessly record and send data via Bluetooth, allowing the signal to be analysed and categorized on a computer. They replaced an electric wheelchair's default joystick with a self-made control system that used brain waves signals collected from the headset to control the wheelchair's motor. According to their research, the Neurosky MWM2 headset could be a viable option for this type

of application. Furthermore, another study uses machine learning techniques to analyse EEG data in order to develop smart applications that can recognize various mental operations [Aln17]. Thus, our paper will use the MWM2 in attempt to detect EEG variability in Jaran Kepang dancers.

5. METHODS AND MATERIALS

5.1. NeuroSky Mindwave Mobile 2

In this study, we utilized NeuroSky's MWM2 for capturing EEG data. The MWM2 is a consumer electronic device worn as a headband. It is intended for basic brain-computer interfacing applications, education, wellness, and gaming. This compact EEG sensor has a contact node that is placed on the forehead above the left eyebrow and measures voltage fluctuations as the ionic currents, which are flowing through the neurons in the frontal lobe. The sensor is placed at FP1, as that is a hairless part of the forehead to provide EEG clarity for correct RAW and powerband transmission. This area is also perfect for measuring higher cognitive processes such as attention and meditation. Because of its proximity to the eye, FP1 allows for blink detection. Also, you have to clip the reference contacts on the left earlobe which measures the heart rate at location A1.

Applying the MWM2 is very non-invasive. No scalp-electrodes need to be applied (other than those that are part of the device). No abrasion of the skin is required for contact, nor is it expected to occur by using the device. The total weight is very low (approx. 90 grams). Ears and eyes are not covered, nor affected. The device is cordless and powered by a single AAA battery. It outputs 12-bit raw brainwaves (3 - 100Hz) with a 512 Hz sampling rate, according to its guidelines. Furthermore, the EEG band frequencies are grouped and generated by the headset into Delta (1 - 3 Hz), Theta (4 - 7 Hz), Alpha1 (8 - 9 Hz), Alpha2 (10 - 12 Hz), Beta1 (13 - 17 Hz), Beta2 (18 - 30 Hz), Gamma1 (31 - 40 Hz), Gamma2 (41 - 50 Hz). This is a very basic consumer device.

5.2. NeuroExperimenter (NEx)

We utilized the application NeuroExperimenter (NEx) which receives raw data from the NeuroSky's MWM2 device. Before sending the data to NEx, the headset filters away noise and artifacts. The NEx application functions as a user interface for the MWM2. NEx explores brainwave activity while the user attempts various "mind states" like mindfulness, relaxing, and attentiveness. Consumers can figure out what mixture of brainwaves characterizes a particular mental state. However, data between sessions is difficult to compare according to the NeuroSky guidelines. This is due to the fact that the interaction between both the device and the subject will alter as the surroundings changes. Also, the total power output (i.e. the summation of the eight standard waveforms' power) fluctuates from sample to sample. At the same time, all eight power data (one for each wave type) are generated. Data on meditation and attention is also recorded during each second, though not simultaneously with the power data, according to the NeuroSky guidelines. The headset calculates 'Attention' and 'Mediation' data ("eSense" data) in an unknown way (possibly from the power data and/or the raw data). However, it is not necessary to know the algorithms as we do not make use of those measurements in our study.

To compare data within and between sessions, we applied a normalizing technique. To get "total power" for the sample, we first summed all of the power data (i.e. meditation and attention are not included in the sum). Then, each variable in the sample was then divided by this total power. The square root of the result was then calculated. Each normalized item in the sample was thus the square root of that variable's proportion to the sample's overall power. This ranged from 0.0 to 1.0. Taking the square root caused the power data to become (almost) regularly distributed. This permitted us to do a two-tailed test for significance of the difference between different sessions.

5.3. Breath Analyser

Before each task condition, the participants were required to do a non-invasive breath analyser (from TIKKENS) to ensure they were not intoxicated. The subject had to blow slowly and continuously into the mouth tube for five seconds. Being under influence can affect the EEG results, which was taken into account and will be discussed in this study. In the previous-mentioned EEG study by Lapointe et al. [LCd*06], all subjects were screened with a urine analysis (UA) before recording EEG. This revealed that one out of six patients tested was positive for benzodiazepine (session 1) and barbiturate (session 1 and 2). Due to the small sample size and difficulty in screening patients with DID, this individual was not eliminated from the study. Our breath analyser only tests whether under the influence of alcohol, however, screening for anti-depressant drugs for example was out of boundaries for our exploratory research. In any case we also decided, beforehand, not to exclude any participants from our study, but to take positive intoxication results into account.

5.4. POMS-SF Questionnaire

The same individual might produce different brain waves or patterns at different strengths depending on their current brain chemistry. Perhaps tiredness, ingestion of alcohol or caffeine produces different measurements from the same mind state [FBH*99]. Therefore, it was decided to use a questionnaire to determine ones mood before each session, which the previous mentioned studies did not do. POMS questionnaire measures six different dimensions of mood swings. In 1983, the short version of POMS was introduced [Sha83], namely POMS-SF (profile of mood states - short form). The number of questions was reduced from 65 to 37. For our study purposes, the abbreviated form still includes all components and properly depicts the mood states of individuals. All questions utilized in this online questionnaire can be found in *appendix A*.

5.5. Pilot Studies

We had a total of four pilot studies over a period of five weeks. These experiments were intended to help choose the appropriate procedure for our main test in section 5.6. The goal of this setup was to learn how to utilize the MWM2, NEx application, and to analyse the preliminary results. The design consisted of two

sessions per participant in order to measure inter- and intrapersonal EEG results. Each subject was continuously recorded for one minute per session. The timing between the two sessions and the order of the procedure differed in each pilot study. This enabled a comparison of different outcomes and the exploration of possible sequence effect. It also allowed us to stay aware of any software discrepancies. The total participants in this study included three family members of the same household. The subjects stayed the same throughout all pilot studies and will be referred to as subject A, B and C. All participants gave informed consent.

Pilot Study 1: During the first pilot, we ran a couple of tests in emulation mode to understand the program. The NEx program has the option to pause and resume a recording, making it possible to record two sessions in one recorded file. The program, then, automatically statistically compares the intrapersonal EEG records between the two sessions. However, it was apparent that the resume button was unreliable as the headset completely disconnected from the program. This happened whenever the headset was either removed from the subject's head or turned off between the sessions. This would not be practical for the Jaran Kepang dancers, as they need time to prepare for the second session after doing the first measurements. Thus in this scenario, we would have to export the raw data from session 1 and manually compare it to the raw data from session 2.

With the headset data, we conducted the pilot with two subjects who were tested as follows: Subject A did session 1 directly followed by session 2, whereafter subject B was measured idem dito. Note that between the sessions the headset was removed from the head, turned off, and then turned on again before placing it back on the head for session two. The participants were asked to sit quietly with their eyes closed (baseline) in both sessions.

Results: After analysis from the headset data, we found that subject B always had approximately 1.6 times more total power than subject A in both sessions. Table 1 depicts these results. Furthermore, we did a two-tailed test for significance (at the level p= .01) of the intrapersonal EEG differences between the two conditions for both subjects. As expected, we found no significant intrapersonal EEG differences between the two sessions, as both conditions were the same (i.e. baseline) for both subjects. No further analyses were done for this first test.

Table 1: *Normalised average EEG results of Subject A (sA) and Subject B (sB) from Session 1 (s1) and Session 2 (s2) per wave-type and Total Power*

wave-type	sA-s1	sA-s2	sB-s1	sB-s2
Delta	0.51	0.49	0.54	0.51
Theta	0.4	0.46	0.42	0.44
Alpha-1	0.39	0.41	0.39	0.42
Alpha-2	0.48	0.44	0.42	0.44
Beta-1	0.21	0.21	0.21	0.2
Beta-2	0.19	0.17	0.18	0.18
Gamma-1	0.12	0.12	0.11	0.11
Gamma-2	0.1	0.1	0.1	0.1
Total Power	159192	165890	256694	262793

Pilot Study 2: In the first pilot, we noticed a unique difference with the amount of total power in subject B vs. subject A. This could be because the sessions were conducted directly after each other with very little time (approx. five minutes) in between. Thus, pilot 2 was designed such that there were 24-hours between the two sessions. In Session 1, Subject A went first followed by Subject B, and then 24 hours later, session 2 was measured in the same order. Both sessions had the baseline condition. Because the sessions were 24-hours apart, we required the subjects to rate their mood before each session.

Results: Similarly to the first pilot, subject B displayed a much higher (approximately 1.75 times) total power across both sessions, despite the 24-hour difference. The POMS-SF questionnaire did not indicate major mood differences between the two subjects nor between the (24-hours apart) sessions. The differences (Δx) between subject A and B in each of the six dimensions is displayed in Figure 2. For example, subject A scored 7 out of 24 (29%), while subject B scored 9 out of 24 (38%) for Tension-Anxiety. Maybe, this indicates that the higher amount of total power is because subject B found it more exciting or scary than subject A. More research on how ones mood affects the total power is needed. Also, it is important to keep in mind that subjects objectively rated their subjective mind states. Still, it was important to figure out if these total power differences were perhaps due to a sequence effect.

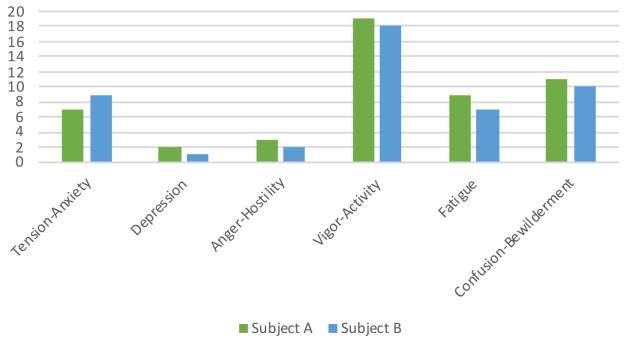

Figure 2: *POMS-SF Results of subject A vs. subject B from session 1 in pilot study 2. Each dimension has its own amount of questions and total score.*

Pilot Study 3: The third design tested the sequence effect by changing the order of participants. The order sequence of this pilot can be found in Table 2. Furthermore, we also investigated if the total power was influenced by gender. For the latter, we recruited another participant: Subject C. Subject B and C identified male, while subject A identified as female. All participants were right-handed, and in their early-20's.

Table 2: *Note: Session 1 and Session 2 were 24-hours apart. Session 2 data was not acquired for Subject C.*

	Sequence Order		
Session 1	subject A	subject B	subject C
Session 2	subject B	subject A	

Results: The total power (TotPwr) per session and participant is depicted in Table 3. In session 1, the TotPwr of the male subject C was only 1.15 times higher than female subject A, compared to male subject B's 2.89 times more total power than subject A. We conclude that gender has no role in the number of total power. Hence, we excluded subject C from the second session, which was aimed to explore the possibility of a sequence effect. In session 2, subject B was measured first and still had 1.22 times more TotPwr than subject A, who was measured second. This revealed that there was no sequence effect, and that it was not the cause of a higher TotPwr data seen every time in subject B. Neither the mood scores or the sequence order seemed to (directly) affect the TotPwr.

Table 3: *TotPwr Results of Pilot Study 3 with female A, male B male C*

	Subject A	Subject B	Subject C
TotPwr Session 1	412611	1194109	476332
TotPwr Session 2	281091	341895	

Pilot Study 4: Participants found it difficult to sit still and think of absolutely nothing during the previous pilots. Naturally, the mind wanders off. But, even if the subject would just think about food, our somatosensory system would get activated. Or, if one is thinking about playing tennis, we would observe brain activity in the motor cortex. This is known as the human mirror neuron system (hMNS), which consist of neurons that react to both perceived and self-produced activities [PFF*92]. This type of "mind wandering" would result in higher relative power in wave forms from certain brain areas. This is seen as a limitation considered that the measurements will not be identical in the baseline sessions. And more strongly, this could be the reason that the 'total power' of subject B was always higher in the previous pilots. It is possible that subject B tended to 'think more' during baseline so that certain brainwaves appeared more strongly.

For this reason, we conducted a fourth pilot to explore the maximum EEG variability within a participant and the maximum capabilities of the MWM2 device. In this study, we maximized the sensory stimulation of the brain to activate different regions. Subject A and B were asked to watch and listen to a video, smell and eat food, and get their body massaged simultaneously in one session.

Results: Opposite to the previous baseline measurements, results showed low Alpha and high Gamma waveform activity in relative power. But, most strikingly was the amount of total power within the session. This was approximately 8.98 times greater than the average total power in any previous session. These results suggest an EEG variability range from baseline to "all out" in relative strength compared to the outputs of other subjects. It is suggested to include this condition type when comparing baseline to an activity. Then, we would be able to analyse if the EEG records of the activity condition is within or outside the full EEG variability range of a certain individual. However, when comparing two baseline sessions, the researcher just has to take into consideration that brain activity might differ greatly as some subjects' minds wander relatively more.

5.6. Final Experiment Design

Our final experiment had a 2 x 2 within/between subject design, consisting of two groups (adult (>18 years) Jaran Kepang dancers, and adult non-dancer controls) and two task conditions (rest-, and acted-/alter state). For, the control group we recruited professional actors that could really "live in" the respective character and age. The design of the experiment is depicted in the table below *(Table 4)*.

Table 4: *2 x 2 Study Design*

Subject	Session 1	Session 2
Jaran Kepang Dancer 1	Baseline	Alter
Jaran Kepang Dancer 2	Baseline	Alter
Jaran Kepang Dancer 3	Baseline	Alter
Control 1	Baseline	Acted-Alter
Control 2	Baseline	Acted-Alter
Control 3	Baseline	Acted-Alter

Procedure: The final procedure was derived from pilot study two. This, because our study group would need to prepare for the trance performance, thus a 24-hours between the two sessions was logical. Pilot study 3 was not chosen, due to our observations that a sequence-effect did not occur nor that the total power was affected by it. Lastly, the suggestion of pilot study four was not applied as both sessions in our main study require the person to sit completely still.

Prior to the experiment, the subjects were screened for intoxication, and had to score their mood. This was done with the breath analyzer and POMS-SF, as mentioned earlier. While the experiment was conducted, the individuals sat in a chair with their eyes closed for one minute (the duration of each session). The subjects' actions were not videotaped. Approximately 24-hours later, the second test for all subjects were conducted, either as themselves or while in trance.

5.7. Covid-19 Considerations

All experimentation adhered to local rules, legislation, and guidelines concerning spreading of Covid-19. If either the experimenter or subject had any Covid-19 symptoms, the experiment would be postponed or that subject would not participate. When distances between people involved was less than the required distance (expected only during placing/removal of the EEG capturing device), then face-masks/-shields were worn by all involved alongside PPE gloves by the experimenter.

5.8. Analysis

Two factors were assigned to the sample data: Condition (alter & acted-alter) and Wave-type (Delta, Theta, ALpha1, Alpha2, Beta1, Beta2, Gamma1 and Gamma2). A two (group) by two (condition) analysis of variance (ANOVA) was used, with repeated measurements on the Condition and Wave-type variables. The between subject analyses was divided by the factor: Group (Jaran Kepang Control Group). Also, post-hoc t-tests were utilized to analyse the significance of intrapersonal differences between Jaran Kepang (JK) host and alter, as well as between control and acted-alter.

6. RESULTS

This section does not describe the results of the proposed study above. As mentioned in the introduction, we could not measure our preferred study group due to Covid-19 circumstances. Data acquired for the results in this section were necessary for graduating purposes.

The 2 x 2 setup of the main experiment described in section 5.6 was followed as closely as possible to obtain data. We did twelve measurements (two conditions per six subjects) in total, all acquired from only one participant. This participant was the principal experimenter herself, as we were not even able to utilize six different subjects due to the Covid-19 circumstances. Thus, the studied group consisted of one female (aged 22) instead of six different subjects. She is referred to as subject A, B, C, D, E and F throughout the rest of this paper. The two groups are referred to as group JK (Jaran Kepang Dancers) and group CG (Control Group). Group JK consisted of subject A, B and C, while group CG had subject D, E and F (each with $n=3$).
The whole experiment was conducted in two days. Both sessions for all ($n=3$) JK subjects were recorded in one day, while subject D, E and F were measured in both conditions on the next day. The conditions are referred to as S1 (session 1) and S2 (session 2) with a slight deviation from the original study design. Respectively session 1 was the baseline and session 2 was a "reading mind state". In session 2, both groups actively read out of a part of a dummy text (a *Lorem Ipsum* version) for one minute. This type of text was chosen in order to eliminate any Theory of Mind effects which could influence the mirror neurons (see [Mit11] for the Theory of Mind perspective). Note that any activity could have been chosen for the second session. These results do not aim to answer our research question, nor "prove" what has already been studied.

Because the measurements of the digital breath-analyser might occasionally deviate, we took two readings per subject per session, as suggested by the manufacturer's guidelines. Group JK (subjects A, B, and C) took the average of two tests all-together, and so did the control group (subjects D, E and F). For both groups, the average out of the two measurements was 0.00 %BAC. The different types of measurements: ‰BAC, ‰Prom, g/L, mg/100ml, and mg/L also resulted in 0.00 for all readings.

The results of the POMS-SF questionnaire are presented in Table 5. The 37 items were rated on a 5-point scale that ranged from "Not At All" (zero) to "Extremely" (four). The scale's means ranged from $\bar{x} = 0.67$ for Tension-Anxiety to $\bar{x} = .0$ for Depression. In Figure 3, the total scores in each of the six dimensions of Group Jaran Kepang (JK) and the Control Group (CG) is displayed. The differences (Δx) between group JK and CG, is 16.67% decrease in tension-anxiety; Anger-Hostility has a 4.17% increase; Vigor-Activity has a 11.11% increase; and a 15% decrease in Fatigue. The other subscales depression and confusion-bewilderment were scored the same with $\Delta x = 0.00\%$.

Interpersonal EEG Records. The ANOVA revealed in the between-subject analysis that none of the six participants exhibited statistically significant interpersonal variations in wave-form relative power at $p \leq .01$. Table 6 showcases the between subject effects ($F = 16.18;\ p = 0.02;\ n = 6$) from the ANOVA Repeated Measures analysis. So, significant interpersonal EEG variability between subjects ($n = 6$) were not found.

	Short Form Scales		
	Nr. of Items	Mean Score	SD
Tension-Anxiety	6	0.67	0.89
Depression	7	0	0
Anger-Hostility	6	0.25	0.45
Vigor-Activity	9	2.67	0.49
Fatigue	5	0.5	0.53
Confusion-Bewilderment	4	0	0
Total Number of Items	37		

Table 5: *Results of the POMS-SF Questionnaire over all (n=6) subjects, based on a total of 37 question items. Each item was scored on a scale of 0-4.*

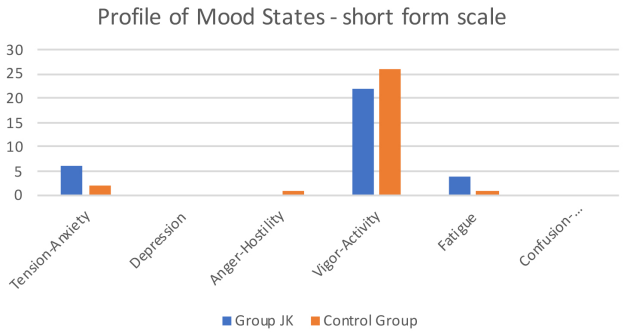

Figure 3: *POMS-SF Results from Group JK and CG. The POMS-SF Questionnaire with six different dimensions consisting of 37 questions of mood states. These six subscales include: Tension-Anxiety, Depression, Anger-Hostility, Vigor-Activity, Fatigue, Confusion-Bewilderment.*

Table 6: *Between Subjects Effects from the ANOVA Repeated Measures (n=6)*

Cases	Sum Squares	df	Mean Square	F	p
Group	0.00	1	0.00	16.18	0.02
Residuals	7.7e-4	4	1.9e-4		

Note. Type III Sum of Squares

Intrapersonal EEG Records. The within-subject ANOVA analysis ($n = 6$) is depicted in Table 7. It reveals significant main effects between the factors Condition and Group ($F = 36.29;\ p = 0.004$) and between Condition and Wave-type ($F = 55.68;\ p < .001$). There was no significant difference between factors Wave-type and Group ($F = 2.17;\ p = 0.07$). A significant three-way interaction between Condition, Wave-type and Group ($F = 3.92;\ p = 0.004$) was also found. It was expected that the two factors Wave-types and Condition would individually be statistically significant as they respectively have eleven and two different levels.

The most interesting analyses in our study now, is the interaction between Condition and Wave-type, as we want to see how the different wave-forms behave across two different sessions. (In the study with real JK and control subjects, we would be more interested to see how the two conditions, which are both in rest (although one as a host vs. as (acted-)alter), compares between the two different groups). Figure 4 depicts the normalised averages across the different wave-types between session 1 (in rest) and session 2 (reading). The black horizontal line at value 1 indicates where all individual Wave-types would be seen in the graph, if the two conditions would completely be identical. This would mean that they had the same normalised average data across all Wave-types. The Wave-types in the summary graph with an asterisk (*), indicate that the difference between the average (normalised) data from session 1 and 2 is statistically significant (to p=.01 level; two-tailed test). Thus, each subject could have eleven (total wave-forms) intrapersonal significant differences in total.
When all the intrapersonal EEG records for the control group *(n=3)* were examined (by counting the number of asterisks per Wave-type), there were 18 out of 33 (55%) significant differences ($p \leq .01$) in the frequency groups relative power. Similarly, for group JK (*n=3*) the number of significant differences were 19 out of 33 (58%). The relative power of Theta, Alpha1, Alpha2, Attention and Meditation varied the most between subjects, as seen in Figure 5. Beta1, Beta2, Gamma1, Gamma2, and totPwr varied the least between all subjects.

Table 7: *Within Subjects Effects (n = 6) Repeated Measures ANOVA*

Cases	df	F	p
Condition	1	36.290	0.004
Condition * Group	1	32.523	0.005
Residuals	4		
Wave-type	7	159.388	< .001
Wave-type * Group	7	2.172	0.068
Residuals	28		
Condition * Wave-type	7	55.682	< .001
Condition * Wave-type * Group	7	3.920	0.004
Residuals	28		

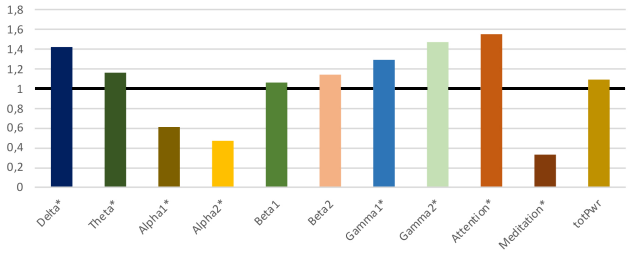

Figure 4: *The normalised ratio of average of reading over baseline (in rest) of Subject B (Group JK). The asterisks (*) indicate significant ($p \leq .01$; n = 1) differences between the two sessions.*

Post-hoc tests. We observed in Figure 4, that in all 'reading' conditions the average Gamma1 and Gamma2 output was significantly higher during reading (as a percent of total power output). Furthermore, Alpha1 and Alpha2 were significantly lower compared to the baseline session. This pattern is similar to the measurements found in pilot study four. However, the total power was on average 1.55 times (*n= 6; SD= 0.72*) greater in every session 2 compared to session 1. This amount of total power is relatively low compared to the 8.98 times (*n= 1*) greater total power in session 2 compared to session 1 in pilot study four. Thus, the total power in rest vs. while reading stayed relatively the same.

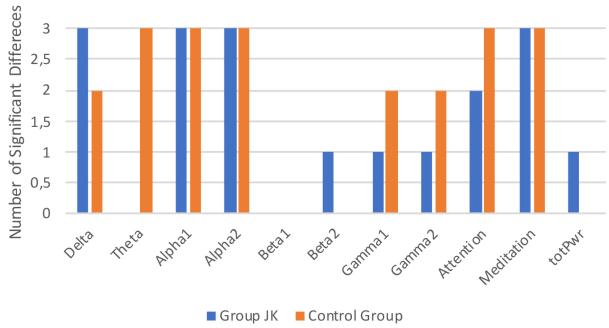

Figure 5: *The vertical axis shows the total number of statistically significant findings ($p \leq .01$; n = 6) from the two-tailed t-tests results on frequency band groups between 1 Hz and 50 Hz for (a) Group JK, and (b) CG. Each group has n=3, so every group can have a maximum of three statistically significances per wave-type.*

So, the hallmarks of reading (vs. baseline) would then be low Alpha and high Gamma. This implies that the formula (Gamma1 + Gamma2)/(Alpha1+Alpha2) can be utilized to distinguish between a baseline and reading mind state. If the outcome of this formula is high, it suggests strong attentive reading. Out of curiosity, we ran the log created during the two sessions of subject B through NEx to test the effectiveness of our proposed formula.

The average output of our derived formula is 2.51 times that of the baseline of subject B, which demonstrates that our method is good at discriminating the baseline from reading. The grading logic to classify 'a reading mind state' was set to a minimum of 0.4. When the output of the formula is less than minimum, the sample is said to "fail" (non-reading). It "passes" if it is larger than or equal to the minimum (i.e. the subject is reading). The box-plot below (Figure 6) indicates that 11% from the 'In rest' session *(n= 58)* and 90% from the 'Reading' session *(n= 59)* "passed", and are classified as 'reading' samples.

7. DISCUSSION

In this section, we will discuss the above-presented results and place them in broader context. Remember, dear reader, that these results will not try to answer our research question, as the actual experiment with real subjects did not occur due to unforeseen Covid-19 circumstances in Suriname.

The POMS-SF questionnaire showed that all participants were

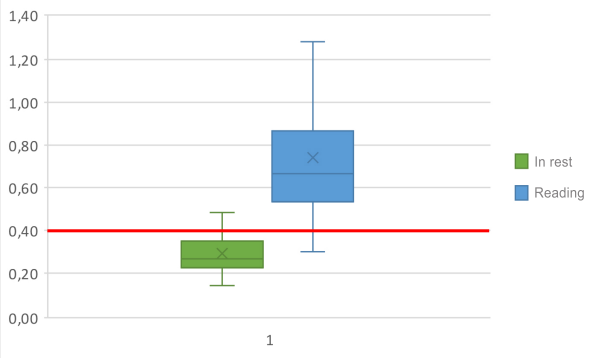

Figure 6: *Box-plot of sessions 'In Rest' (n= 58) and 'Reading' (n= 59) from subject B, group JK. Data above the red horizontal line represents all samples classified as 'reading mind state' by our derived formula: avg(Gamma1 + Gamma2)/(Alpha1+Alpha2).*

relatively similar throughout all sessions. Also, the breath analyzer indicated a safe state with no intoxication. This excludes these external factors from having influence on the results.

All subjects from the control group and the Jaran Kepang group recorded similar EEG patterns of variability between-subjects. This is logical, as all data come from one subject. No (significant) differences between the twelve measurements of the *same* subject were expected. Furthermore, the (adjusted study's) hypothesis that there would be within-subject changes in EEG variability between being in rest (baseline) and reading mind state was confirmed. There were significant differences in intrapersonal EEG variability between the two sessions for all participants in both groups. We were able to discriminate most EEG patterns for reading from baseline. Specifically, we found low Alpha and high Gamma as indicators for the reading state. Note that trying for a 100% distinction would be a matter of overfitting, as it is unlikely that all of the mind state in the sessions were solely thinking of nothing while in rest or reading.

However, this brain pattern study was an attempt to convert subjective mental states/feelings into objective measurements. At least two problems exist from this. One is that the brain chemistry of the individual might change and effect the brainwaves at different strengths. Furthermore, individuals differ in their interpretation of words like "baseline" and "rest state". One might be good in thinking about nothing while the other still has a busy mind state. These effects can be seen back in EEG studies for a meditative state. For example, some researchers believe that meditation states produce Alpha waves [KH66], while others believe it produces Gamma waves [LGR*04]. The variance is most likely due to the subject's personal judgment of what meditation entails. There may also be variances in the brains of the subjects (due to heredity or experience) that will lead to differences. Lastly, our experiments were conducted six times on one person. As such they are hardly conclusive.

8. LIMITATIONS

Apart from the fact that we were not able to conduct the experiment with our actual study group, there might be a few limitations of the (proposed) main study design, used consumer device and the Jaran Kepang culture.

Current Study Design: Due to various shortcomings in the study's design and the utilized EEG technology, the findings should be regarded with caution. The biggest, is that the setting of measuring EEG was not in a usual dark environment nor soundproof so that no outside factors would influence the brain chemistry.

Obviously, the limited sample size of this study would limit the generalizability of the findings to wider groups. As a result, it is suggested that this study be produced with a significantly larger sample size. Furthermore, it would be possible that the restrictive experimental settings required for obtaining clean EEG (siting still with closed eyes) will be insufficient for generating full personality alterations. However, the *dukun* from the population that we study, assured us that professional dancers, like any other performing act, may dance without their costumes or a large stage — thus the Jaran Kepang dancers may reach a trance condition with only mental exertion under his guidance. The dancing is really a gimmick to make the ritual more appealing for entertainment purposes.

EEG device: The importance of specific brain waves is determined by their location in the brain. Medical EEGs can tell us this, but because the MWM2 headset only has one contact node on the frontal lobe, it can't tell us the location of origin. Even if our EEG consumer device provides us with relevant data, discriminating factors may be buried so deeply in the data that our Excel and Jasp analyses fail to uncover them.

Jaran Kepang Community: Although most people in the Javanese culture are willing to talk about Jaranan with anyone who is more than a tourist, only few will acknowledge those aspects that they believe are associated old-fashioned illiterates. The interviewees, even the *dukun*, were hesitant to admit to knowledge old healing methods and rituals. The pressure from religious leaders to suppress animistic performance art, which are still seen as anti-Islamic, unchristian, and paganistic, adds to the barriers to open discussion. Most religions, including Catholicism, Islam, and Protestantism, in some manner and to some degree prohibit such "primitive religious" behaviors. As a result, the Jaran Kepang's continuance is seen as "medicinal" and "spiritual," rather than religious. This type of "spiritualism" is analogous to how the trance-like states yoga and meditation (from Buddhist/Hindu origins) are practiced without jeopardizing Westerners' core beliefs.
Some of these religious leaders have historically and continuously deemed ancestral rituals as incompatible with monotheism and thus heretical. This stance contributed to Jaranan's near extinction during the Dutch colonial period of both Indonesia and Suriname, and, more recently, in the age of an Indonesian Islamic majority (in both countries). Due to the Covid-19 pandemic and economic factors in Suriname, continued performance of these practices is steadily disappearing. Because of these concerns, many *dukuns* and dancers who were interviewed did not openly speak about their roles and beliefs in the Jaran Kepang in full honesty. As a result, the barrier between profane and sacred has become increasingly blurred, with the sacred being obliged to redefine itself in order to be recognized as secular. Luckily, the purpose of this study was not to ascertain whether or not sacred *Jaranan* and its many adaptations are still practiced today.

9. FUTURE DIRECTIONS

To fully understand the importance of alter-specific alterations in EEG, more exploration on the stability of EEG in normal and psychiatric populations is required. Future research should focus on the extent to which subjects can modify their own EEG by completing cognitive tasks while mimicking numerous trance-like states. Furthermore, obtaining multiple EEGs from the same alter might also be interesting to measure the test-retest reliability of that alter's EEG, just as we did in this paper. The lack of consistency across several EEG recordings will indicate that the alter does not have a distinct brain wave pattern, or that our EEG device can not detect it. Lastly, the extent to which variables not relating to dissociation (e.g., medication and anxiety) can influence these individuals' EEGs will require further research.

10. CONCLUSIONS

In conclusion, there were no significant interpersonal EEG variability between the two groups from our investigation. Because the final experiment was conducted on just one person, no significant differences between the subjects were discovered. However, there were significant intrapersonal variances between the two sessions (baseline vs. reading) in all subjects. Furthermore, the findings of this early investigation suggest that variability may be an objective measure of the neuronal cortical connection. A bigger group study covering all spectral bands and all electrode pairs is suggested as a viable avenue for future research with real subjects. The differences in EEG variability between Jaran Kepang dancers, their alters, control hosts and their acted alters is yet to be adequately studied.

As you have read, all precautions, methods, materials, and the recruited subjects are ready, including the approval of the Ethics Review Committee of the Faculty of Science at Leiden University. Unfortunately, due to the Covid-19 situation in Suriname we could not conduct this research. We hope to continue this research in the future.

Importantly, the findings of our 'real' study may pave the way for more precise ideas concerning brain variability and trance-like states to be tested in the future. Jaran Kepang rituals can enrich the DID myth and either support it, help as hypnotic-treatment or debunk it. All in all with the unfortunate turn of events, I would like to close off with this quote as we have gathered no 'real' data for our 'real' study of interest as presented above: "An absence of evidence is not evidence of absence" [Alt95].

11. ACKNOWLEDGMENTS

I could not have written this thesis without the help of the residents of Kwarasan, Wanica. In many respects, I was able to learn a lot from them. The older Javanese Surinamese's recollections, experiences, expertise, and beliefs have challenged my preconceptions and shattered my preconceived notions. I was able to observe how they perservere the Javanese culture up close, and I am in awe of how they each give meaning to life in their own unique way. As a result, I want to express my gratitude to the residents of the Javanese villages, particularly those I interviewed, for their hospitality and willingness to share their stories with me. I hope Mr. Soemiran and his son Poelong will continue the Jaran Kepang performances, and will remain open-hearted for future collaborations and experiments. I am also grateful to everyone who assisted me with my study. Many thanks to Leiden University's Ethics Committee of Science for giving permission to do this experimental study. Furthermore, I'd want to express my gratitude to my parents for all of the information, time, IT-stuff, and work they provided, particularly for all of the Javanese and Surinamese translations during interviews and meetings. Nonetheless, I thank friends and family who willingly participated to test my experimental procedure and the technological device for me. My thanks go to Drs. Harvey Kort, who gave me the opportunity to critically analyze this study with his support as my second supervisor. Finally, I want to express my gratitude to Dr. Maarten H. Lamers for his excellent supervision.

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Appendix A: POMS-SF Questionnaire.

"On a scale of 0-4, how do you feel?"

Items for the POMS-SF Questionnaire include:

1. Tense
2. On edge
3. Uneasy
4. Restless
5. Nervous
6. Anxious
7. Unhappy
8. Sad
9. Blue
10. Hopeless
11. Discouraged
12. Miserable
13. Helpless
14. Worthless
15. Angry
16. Peeved
17. Grovely
18. Annoyed
19. Resentful
20. Bitter
21. Furious
22. Lively
23. Active
24. Energetic
25. Cheerful
26. Full of pep
27. Vigorous
28. Worn-out
29. Fatigued
30. Exhausted
31. Weary
32. Bushed
33. Confused
34. Unable to concentrate
35. Bewildered
36. Forgetful
37. Uncertain about things