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Impact of Slow Rhythmic Movement on State of Coherence and Integrative Wellbeing

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Abstract

The focus of this paper is the study and evaluation of the effect of a short slow rhythmic movement practice on state of coherence and perceived wellbeing. The practice was made available via video during the Covid-19 pandemic.

An integrative wellbeing model grounded in autopoietic theory of self-organisation in living systems was used to inform the evaluation of impact and ensure the relevance of the data. More specifically, data quality was enhanced by focusing the participants' awareness on their immediate embodied experience of physical, emotional and relational wellbeing, sense of meaning, valence and activation.

The slow movement practice was found to have a positive impact on physical and emotional wellbeing, valence and sense of meaning. The changes that these entrainments produced were measurable and significant with a large size for physical and emotional wellbeing, sense of meaning, and a medium effect size for valence. This suggests there are potential health benefits to slow movement interventions and there is a need for further research into the impact of slow movement on health. Linking the rhythmic slow movement with resonating music is suggested for enhancing impact.

Key Words: consensus, human networks, multi-agent systems, trauma informed care.

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Introduction

Movement therapies have been found to have positive effects on the mind and the body. In a 2016 study in South Africa students completing twice weekly cycling for 6 weeks showed improvements in depressive symptoms (Balchin et al, 2016). Dance positively impacts depression, both acutely (Koch et al, 2007) and long term (Pylvanainen et al, 2015) and also improves cardiovascular fitness (Fong Yan et al, 2018). Tai Chi has been shown to acutely increase heart rate variability (HRV) (Vaananen et al, 2002) and lengthen the pre-ejection period (PEP) of the heart (Motivala et al 2006). HRV is increased via vagal nerve activation (Berntson et al 1997), while PEP is lengthened by dampening down cardiac sympathetic nerve activation (Cacioppo et al. 1994). Yoga improves mood, reduces stress and anxiety (Streeter et al, 2010, Javnbakt et al 2009).

There is limited research into the development and evaluation of interventions on impact of slow movement on wellbeing. The focus of this research is the study and evaluation of the effect of slow rhythmic movement intervention on perceived wellbeing. A variation of a fifteen minutes slow movement qigong practice, initially developed by Dr Bisong Guo (2001), i.e., Energy Brushing Qigong. Qigong originated in China as a means of self-care, i.e., according to the first historical record in China "Shang Shu," 4,000 years ago (Feng et al, 2020). The word Qigong consists of two Chinese characters: Qi and Gong. Qi is often translated to mean life energy, and Gong as work, and also merit (Cohen 1999). The word Qigong in this translation means working with life energy as well as the benefits one has as an outcome of Qigong practice (Cohen, 1999). Cohen (1999) suggests that a good Western definition of Qigong would refer to Qigong as a psychophysiological self-regulation (Cohen, 1999).

The underlying principle of the Energy Brushing Qigong exercise is to manipulate Qi (energy) and direct it to specific areas of the body using mostly slow arm movements and in a standing position, while maintaining sustained focus on the physical movements throughout. Energy Brushing Qigong provides easy to follow moves to empower and invigorate the entire body-mind system, improving circulation, increasing blood flow, enhancing breathing, clearing the mind, reducing stress. The practice was adapted by Dr Laurie Rauch (2020) with emphasis on the elements of the practice, associated with coherence of body and mind, and made available via video during the Covid-19 pandemic (Calming movement videos with Dr Laurie Rauch - Recovery College Online). Laurie Rauch has previously completed and studied a number of successful interventions in

Exercise and Movement and Breathing with top sportsmen (e.g., Olympic athletes, professional soccer players, club rugby players, elite cyclists/runners MMA champion), stressed business /or executives and in Mental Disorders (e.g., Bipolar, PTSD) over a period of 25 years. His research focuses the effects of breathing and/or rhythmic movement on achieving a state of coherence and optimal functioning of the nervous system.

Coherence

The neurobiological process underpinning coherence occurs when a person's heart and breathing rhythms are in coherence with their 10 sec blood pressure rhythm (Prinsloo et al 2011). If a person uses their breathing rhythm to guide their heart rhythm to cohere with their blood pressure rhythm, this beautiful coherent state is best attained in a quiet and contained space. If it is too noisy or there are other distractions, the breathing rhythm becomes an ineffective guide for the heart rhythm.

This same beautifully coherent 10 sec rhythm in a person's heart during a stressful situation can be attained via rhythmic locomotor movement (Rauch et al 2013; Rauch, 2020). Coherence during a stressful situation occurs when the heart and blood pressure rhythms align, but not the breathing rhythm[1].

Of crucial importance for the establishment of the coherent 10 sec rhythm in the heart is that there must be no mental interference. This requires the person to stop thinking about anything else and keep a single-minded awareness on their breathing rate or locomotor movement depending on whether the breath or locomotor movement is being used to guide their heart rhythm to be in coherence with their 10 sec blood pressure rhythm. This will ensure that all mental activity aligns with the 10 sec rhythm in the heart. If everyone in a group of people is in a 10 sec coherent state then the social coherence amongst the group members will be optimal.

The essential characteristics of the rhythmic slow movement are outlined in Figure 1.

[1] Locomotor movement is co-ordinated by the basal ganglia located in the ventral frontal cerebrum. The coherent 10 sec rhythm in the heart occurs via activation of the vagal nerve, the parasympathetic arm of the baroreflex (van de Vooren et al., 2007), which is under modulatory control of the vmPFC (Resstel and Correa, 2006). Presumably the sympathetic vasomotor arm of the baroreflex is up regulated during locomotor movement.

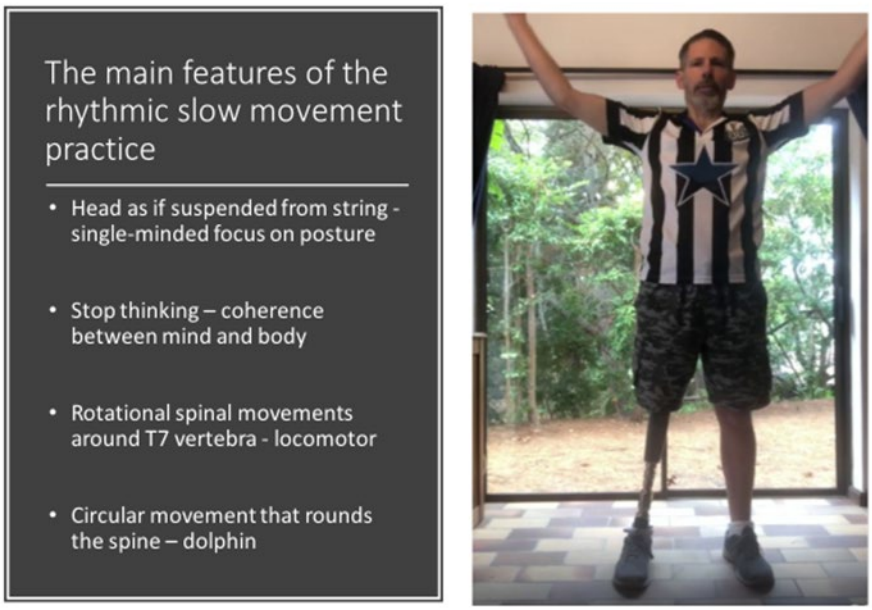

Figure 1. Essential Feature of the Slow Rhythmic Movement

Due to the pandemic the practice was offered strictly online, via a recorded video. There was no opportunity to collect reliable heart rate, respiration and blood pressure data. The impact of the practice on wellbeing was conducted through self-evaluation, based on an integrative model (Sice et al, 2020a, 2020b).

Integrative Model of Wellbeing:

"Our personal knowing of the world is our way of experiencing it, of bringing forth a world. It is personal but not private as it arises in a continuous coupling with the environment." Francisco Varela

This section articulates the wellbeing model used in the self-evaluation (Figure 2) of the practice. It is grounded in the understanding of living systems and human cognition from the perspective of autopoiesis. The theory of autopoiesis defines and describes the dynamics of living as an autopoietic system, i.e., a network of processes of production of components that: (i) through their interaction and transformations continuously regenerate the network of processes that produced

them; and, (ii) constitute the entity as a concrete by specifying the topological domain of its realisation as such a network (Maturana and Varela, 2012).

Autopoiesis is basic to the living individual. What happens to the individual is subservient to its autopoietic organisation, for as long as it exists the autopoietic organisation remains invariant. What this means, is that its identity, and therefore its emergent global processes, are generated through a process of self-organisation (Sice et al, 2004). Figure 2 attempts to give a 'holistic view' of what we discern as global processes in a human system. We have bodies comprised of cells working together, self-organising with in what we call 'nervous system', 'immune system', 'cardio-vascular system', etc., all dynamically integrated. We have mental activity experiences: thoughts, images, feelings, concepts, narratives, etc. and these are organised by a process of managing attention and intention, which Siegel (2010) refers to as 'mind'. We are conscious beings and have the capability to be both aware of what we may perceive as external environment and also self-aware of how we are as a being as well as aware of our internal system dynamics (Damasio et al, 2016). We continuously make choices and act. These actions in turn impact our state of being and becoming. Porges (2009) suggests that humans and indeed mammals, first orient themselves and then act (Porges, 2009). This is interpreted in the model in Figure 2 as valence, i.e., positive or negative evaluation of the internal and/or external environment, that arises from the complex processes of body, mind, awareness in the context of the environment of the human system. In a sense the body, mind, awareness and valence/action systems contain information of the whole human system, and the whole system in turn impacts the processes that produce it. There is a local to global and global to local dynamics of the living system, that through self-organisation and self-production maintains living (Varela 1996, 1997; Sice et al, 2004). Thus, from an autopoietic perspective, the wellbeing could be defined as maintaining body, mind, and awareness coherence, i.e., homeostasis and adaptation within environment (Damasio et al, 2016; Sice et al., 2020). This definition is different from the hedonic (positive feeling) (Kahneman et al, 1999) and eudemonic (positive functioning) (Keyes et al., 2002), (Ryan et al., 2001) definitions of wellbeing. However, it encompasses their meaning, within a dynamic model of being acknowledging both positive feeling and orientation (valence), and homeostatic functioning (Figure 2).

Awareness of experiences as they unfold includes: witnessing present moment sensations, bodily states (alert, quiet, pleasant, unpleasant), mental activity (thoughts, feelings, memory, intentions, beliefs, attitudes, etc.) and

relational/environment experience (connectedness to others, nature, etc.), sense of meaning and purpose (Rauch et al, 2019; Levine 2010), and compassionate attitude to self (Maturana, 2008; Siegel, 2010; Neff, 2012; Gilbert, 2017), ensuring observation nurtures wellbeing as it is carried out with gentle kindness (Sice et al., 2020; Thompson and Varela, 2001, Varela et al., 2016). This has important implications for understanding and evaluation and measurement of human experience. As the living (autopoietic) system is embodied and situated, measuring and monitoring for wellbeing, requires an enquiry into the physical, mental and relational domains, interpreted from the perspective of the living system itself (Sice et al, 2019).

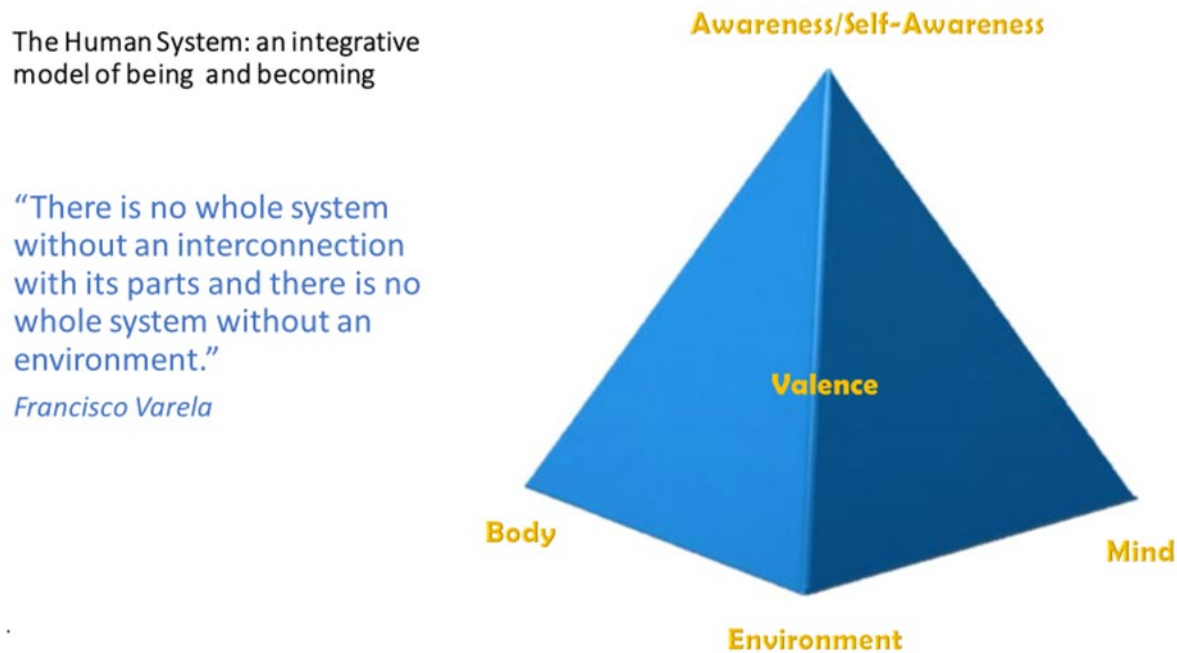

Figure 2. Wellbeing Pyramid: Integrative Model of (Well)

The model of being and its use are described in detail in assessing the impact of Music listening on perceived wellbeing, valence and activation (Sice et al 2020) and the impact of Lung benefitting qigong on wellbeing (Sice et al, 2020). In July 2020, the model was adopted by the Tees, Esk and Wear Valleys NHS Foundation Trust to inform the design of a staff wellbeing screening tool.

In the context of this study, the model implementation requires creating the conditions for encouraging introspection, i.e. accessing individual awareness and

interpretation of personal experience in the present moment in the physical, emotional and relational domains (Price et al, 2018). The perceived benefits of this approach are collecting data with immediate reference to the embodied experience, interpreted by the participants themselves.

Data was collected from online 'wellbeing diaries'. Subjects were in some sense their own controls, an aspect of the study made possible by measurement "before and after" the intervention. The autopoietic perspective adopted in this study (Sice et al, 2020), suggests that our experience of the world is born in our interactions with the environment and is validated by our embodiment. It was thus of utmost importance that the method of enquiry created conditions for paying attention and accessing immediate personal experience through a disciplined act of cultivating capacity 'of becoming aware' of the sources of this experience (Depraz et al., Varela et al. 2016; Sice et al, 2018). Stowell (2020) asserts that everything that "exists" is the result of personal experience, thus, a subjective (phenomenological) account shapes the experiencer's capacity to observe and learn.

Thus, a diary method was considered appropriate for this study (Bartlett, 2015, McDuff et al; Pavel et al). It was designed to collect both quantitative and qualitative data. The quantitative data consisted of participants rating their own interpretation of their experience of wellbeing, before and after the exercise. The diary required the participant to reflect on their present experience, rating their perception of wellbeing according to the four dimensions of the wellbeing model in Figure 2 and according to valence (pleasant/unpleasant experience) on a scale from -5 (poor) to 5 (excellent) and to leave short comments if they choose to do so. Participants were also encouraged to consider their state of being in the moment to promote greater clarity of their inner emotional landscape. They were then asked to rate the intensity of the positive/negative emotions they might be experiencing (Appendix A). The ratings are associated with emotions felt by the individuals.

The mapping of emotions takes into account valence (Watson, 1985). The mapping of emotions in the pleasant (positive) / unpleasant(negative) categories is coherent with David Hawkins scale of experience and literature on categorisation of basic emotions (Zara et al., 2007; Levenson, 2011; Hawkins, 2013). Positive emotions included: -low arousal level emotions: peace, love, safety; - high arousal level emotions: joy, motivation and enthusiasm. Negative emotions included: - low arousal level emotions: apathy, guilt, sadness; -high arousal level emotions: - anxiety, fear and anger (Schriewer, 2016).

Statistical Analysis

There were 60 participants in total, out of which 38 completed both the pre and post diaries. After cleaning the data to account for a minimum duration of 10 min, entries for 24 participants were considered. The mean scores for the four wellbeing dimensions and the valence before and after the exercise are shown in Table 1. They reflect an increase for all the values post-intervention ranging from 0.04 for relational wellbeing to 1.58 for physical wellbeing. These values are also shown in the radar chart in Figure 3.

Kolmogorov-Smirnov and Shapiro-Wilk tests are employed to test the data for normality. The results are shown in Table 2. Both tests show that none of the variables is normally distributed ($P<0.05$). Therefore, the non-parametric one-tailed Wilcoxon signed rank test is applied to detect any statistically significant increases. The threshold for statistical significance is set to $P=0.05$. The effect size r is also computed. A small effect is associated with an r threshold of 0.10, a medium effect for $r=0.30$, and a large effect for $r=0.50$. The results are shown in Table 3.

The Wilcoxon signed rank test reveals statistically significant differences for physical wellbeing with a large effect size ($P<0.001$, $r= 0.545$), emotional wellbeing with a large effect size ($P<0.001$, $r= 0.528$), sense of meaning with a large effect size ($P<0.001$, $r= 0.504$), and valence with a medium effect size ($P=0.003$, $r=0.393$). The differences in relational wellbeing (connectedness) are not significant ($P=0.354$, $r=0.054$).

Table 1 Mean scores before and after the intervention.

	Before	After	Change
Physical	1.50	3.08	1.58
Emotional	1.71	3.21	1.50
Relationships	1.88	1.92	0.04
Sense of Meaning	1.63	2.46	0.83
Valence	2.00	3.13	1.13

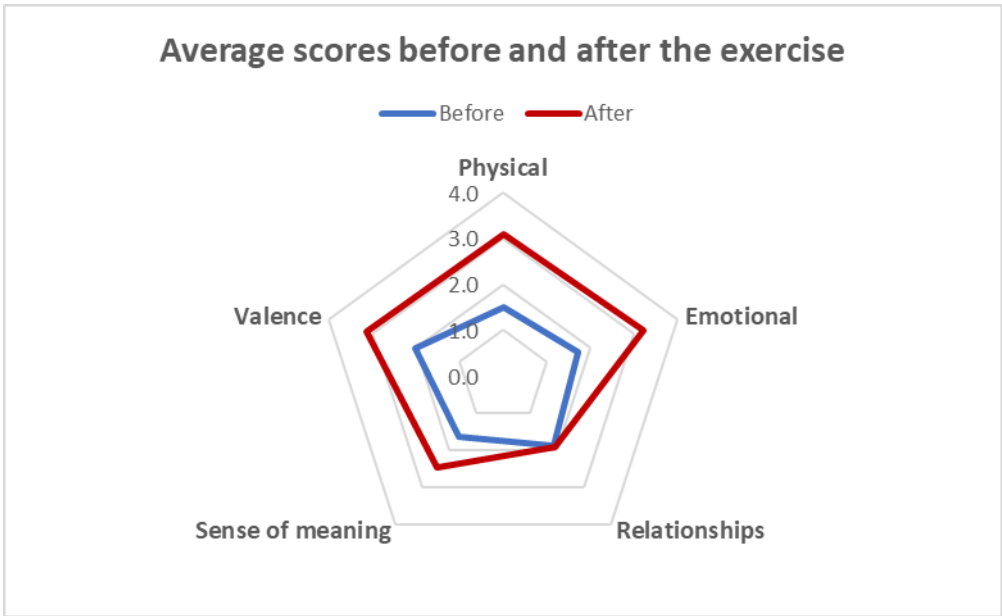

Figure 3. Mean scores before and after the exercise.

Table 2 Normality tests: test statistic and p-values. P-values less than 0.05 are in bold.

Music group	Kolmogorov-Smirnov		Shapiro-Wilk	
	Test statistic	*P*	Test statistic	*P*
Physical	0.222	**0.003**	0.852	**0.002**
Emotional	0.183	**0.037**	0.889	**0.012**
Relationships	0.199	**0.015**	0.907	**0.030**
Meaning	0.309	**<0.001**	0.734	**<0.001**
Valence	0.243	**0.001**	0.91	**0.035**

Table 3 One-tailed Wilcoxon signed-rank test results: z-score (test statistic), p-values, and effect size r. P-values less than 0.05 are in bold

	Test statistic	*P*	*r*
Physical	3.774	**<0.001**	0.545

Emotional	3.659	**<0.001**	0.528
Relationships	0.373	0.354	0.054
Sense of meaning	3.490	**<0.001**	0.504
Valence	2.721	**0.003**	0.393

Correlation between wellbeing variables:

Pearson correlation coefficients between different wellbeing dimensions and valence are shown in Table 4. Valence is highly correlated to all wellbeing dimensions, particularly physical wellbeing (ρ=0.809) and emotional wellbeing (ρ = 0.807). Inter-correlations among the four wellbeing variables are also high, the highest being between physical and emotional wellbeing (ρ = 0.899), and the lowest between relational wellbeing and sense of meaning (ρ = 0.568).

Table 4 Pearson correlation coefficients between valence and various wellbeing dimensions.

	Physical	**Emotional**	**Relationships**	**Meaning**	**Valence**
Physical	1.000	0.899	0.612	0.737	0.809
Emotional	0.899	1.000	0.620	0.802	0.807
Relationships	0.612	0.620	1.000	0.568	0.600
Meaning	0.737	0.802	0.568	1.000	0.715
Valence	0.809	0.807	0.600	0.715	1.000

Negative emotions – including sadness, guilt, apathy, anger, fear and anxiety – and positive emotions – including peace, love, safety, joy, motivation, and enthusiasm – were rated by users on a scale from 0 (low) to 10 (high). We compute the correlations between the six negative emotions and the six positive emotions separately using Pearson correlation coefficients. The results are shown in Tables 5 and 6, respectively.

There were only 3 entries with a negative valence rating, i.e. negative emotions. Therefore, correlation coefficients shown in Table 5 are not reliable. It was also not possible to compute correlations with 'anger' as it has a variance of 0. For the positive emotions, the highest correlations are found between joy and love (ρ = 0.892), and motivation and enthusiasm (ρ = 0.827); and the lowest correlations are between safety and motivation (ρ = 0.293), and safety and enthusiasm (ρ = 0.329).

Table 5 Pearson correlation coefficients for negative emotions.

	Sadness	**Guilt**	**Apathy**	**Anger**	**Fear**	**Anxiety**
Sadness	1.000	-0.189	-0.500	-	1.000	0.803
Guilt	-0.189	1.000	0.945	-	-0.189	-0.737
Apathy	-0.500	0.945	1.000	-	-0.500	-0.918
Anger	1.000	-0.189	-0.500	-	1.000	0.803
Fear	0.803	-0.737	-0.918	-	0.803	1.000
Anxiety	1.000	-0.189	-0.500	-	1.000	0.803

Table 6 Pearson correlation coefficients for positive emotions.

	Peace	**Love**	**Safety**	**Joy**	**Motivation**	**Enthusiasm**
Peace	1.000	0.725	0.593	0.690	0.607	0.705
Love	0.725	1.000	0.700	0.892	0.662	0.657
Safety	0.593	0.700	1.000	0.626	0.293	0.329
Joy	0.690	0.892	0.626	1.000	0.681	0.607
Motivation	0.607	0.662	0.293	0.681	1.000	0.827
Enthusiasm	0.705	0.657	0.329	0.607	0.827	1.000

The arousal/quietness level is also computed on a scale from −5 (quiet) to 5 (aroused) based on the most prevalent emotions for each user as follows.

1. Sadness, apathy, guilt, peace, love, and safety ratings are changed to negative values by taking their opposites. These emotions are associated with a quiet/calm state.
2. The scores for the displayed emotions for each person are then added. Each person rates 6 emotions (either positive or negative) on a scale from 0 to 10, out of which 3 are now on a scale from −10 to 0. Adding these will result in a range of values between −30 and 30.
3. These values are then re-coded between -5 and 5 indicating different levels of arousal as follows: [−30, −23] => −5; [−22, −18] => −4; [−17, −13] => −3; [−12, −8] => −2; [−7, −3] => −1; [−2, 2] => 0; [3, 7] => 1; [8, 12] => 2; [13, 17] => 3; [18, 22] => 4; [23, 30] => 5.

Using the participant's own valence rating with their computed arousal level, the scatter plot in Figure 4 is obtained. Apart from all valence ratings becoming positive after the intervention, no special pattern is observed for the arousal level.

We also apply the two-tailed Wilcoxon signed rank to the arousal variable to detect any differences before and after the exercise. The results are shown in Table 7. The mean arousal level has stayed the same post-intervention (-0.208), and no statistical significance in the differences is observed (P=0.942, r=-0.011).

Table 7 Mean values and two-tailed Wilcoxon signed rank test results to compare the arousal level before and after the intervention.

Mean before	Mean after	*p*	*r*
-0.208	-0.208	0.942	-0.011

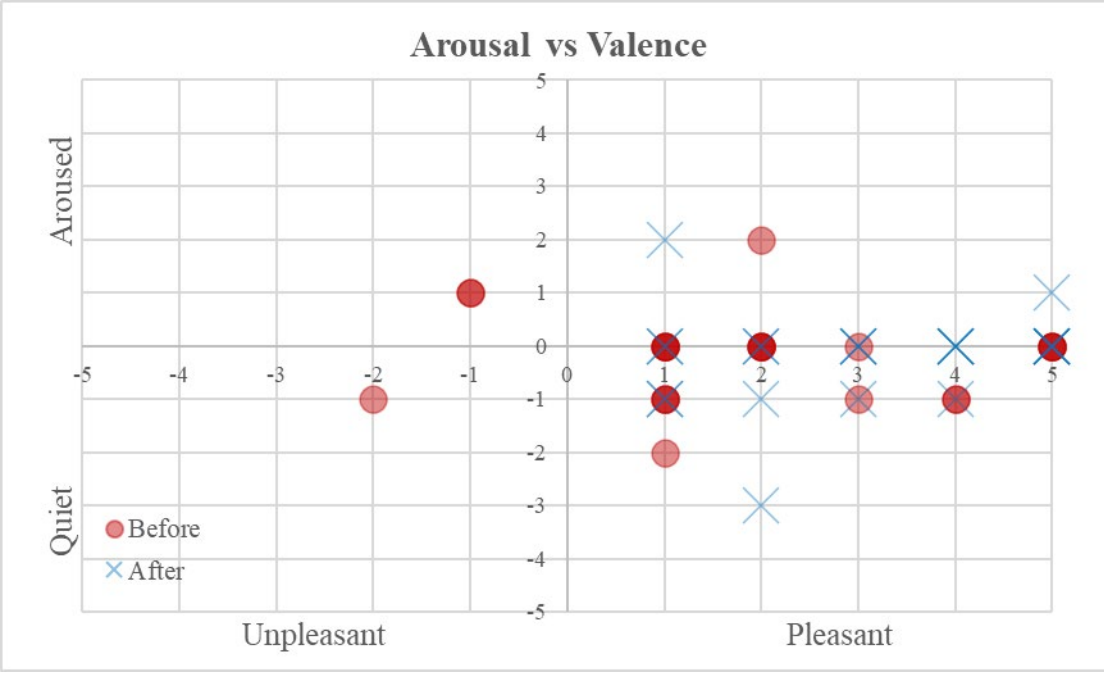

Figure 4. Activation level vs valence before and after the intervention.

Conclusion

The slow movement exercise was found to have a positive impact on physical and emotional wellbeing, valence and sense of meaning. The changes that these entrainments produced were measurable and significant with a large size for physical and emotional wellbeing, sense of meaning, and a medium effect size for valence. This suggests there are potential health benefits to slow movement

interventions and there is a need for further research into the impact of slow movement on health.

Research is in progress in integrating perceptual correlates of wellbeing with biomarkers (such as blood pressure, heart rate variability, brain activity, etc., and creating music and art spaces for exploring biofeedback (Figure 5, Calming movement videos with Dr Laurie Rauch - Recovery College Online).

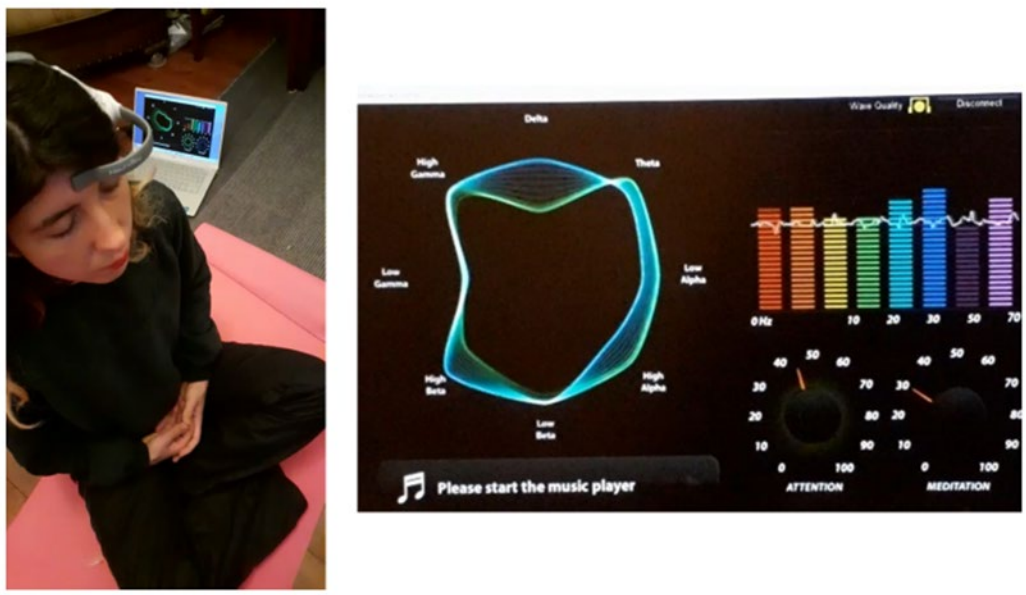

Figure 5. Spaces for Exploring Biofeedback

The wellbeing model and diary approach used in the evaluation allowed for monitoring change, i.e. before and after exercise. The quality of the data was enhanced by: focusing the participants awareness on their immediate embodied experience of physical, emotional and relational wellbeing and sense of pleasure/displeasure, while requesting that they rate and interpret the experience themselves.

Limitations

This was a study conducted during the time of the Covid-19 pandemic which presents several limitations that need to be addressed in future work. One limitation is the demographic information about the participants. Future investigation should include participants who are more thoroughly representative of different age groups

and other demographic factors. Another limitation is the limited qualitative data. Future research would benefit from encouraging participants to share their experience in free text, to allow for cross-reference between quantitative measures and individual perception of wellbeing and emotion.

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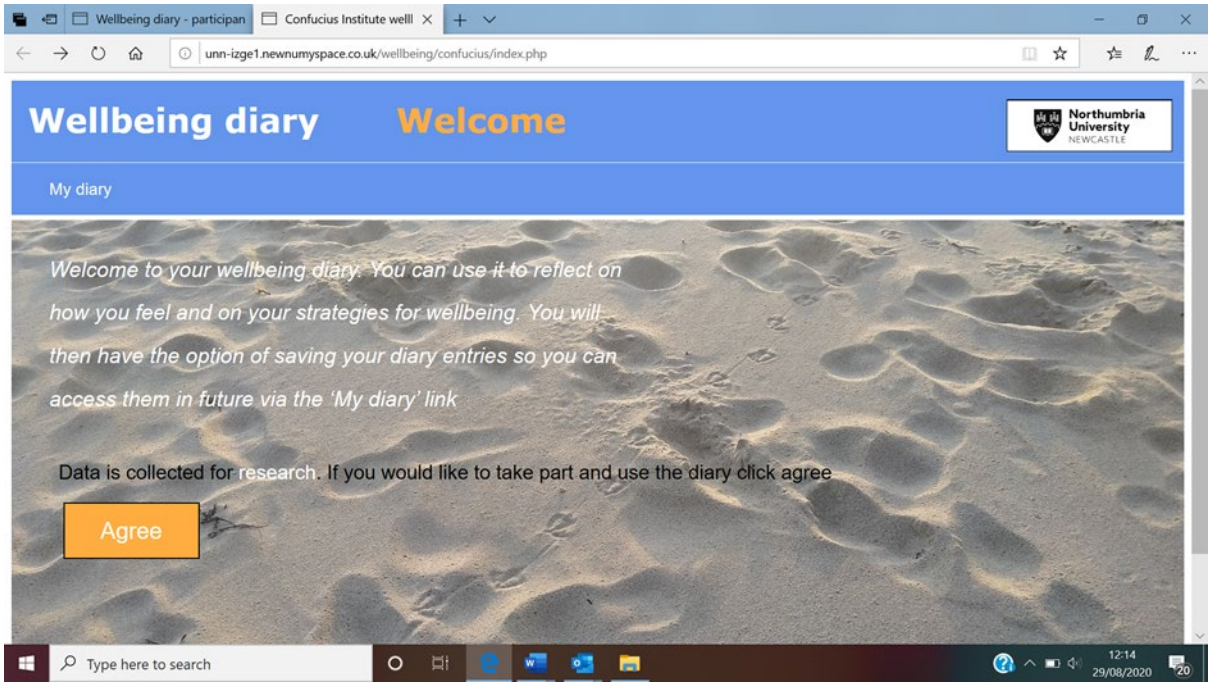
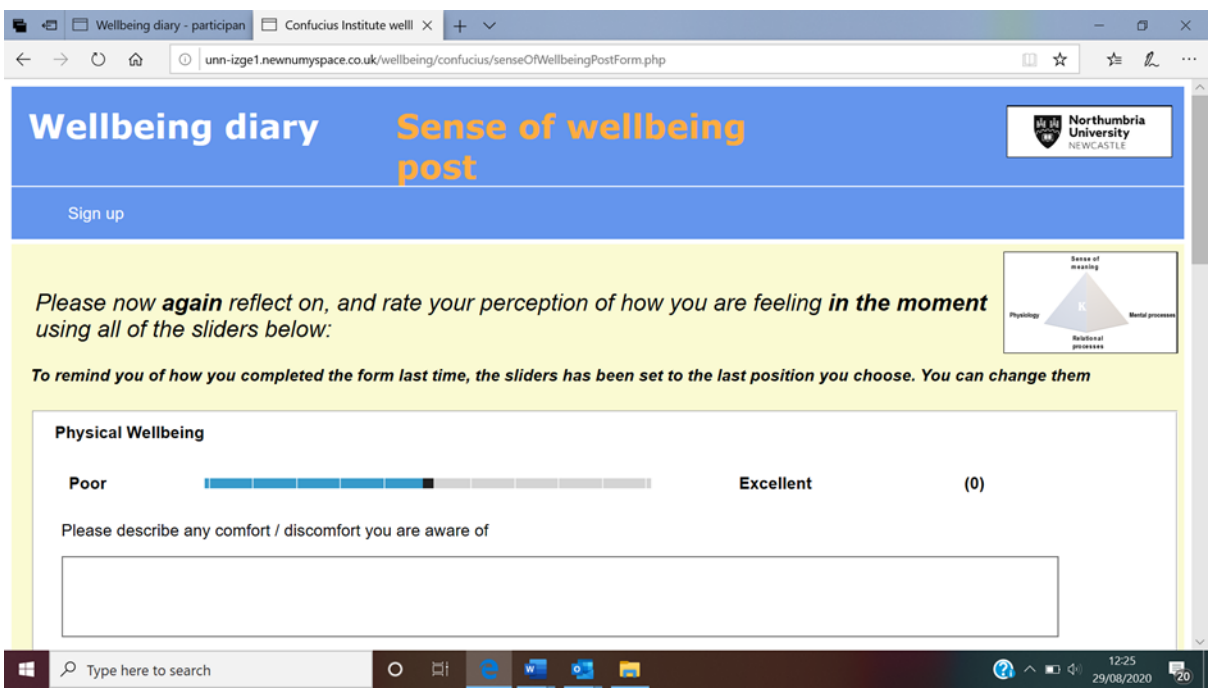
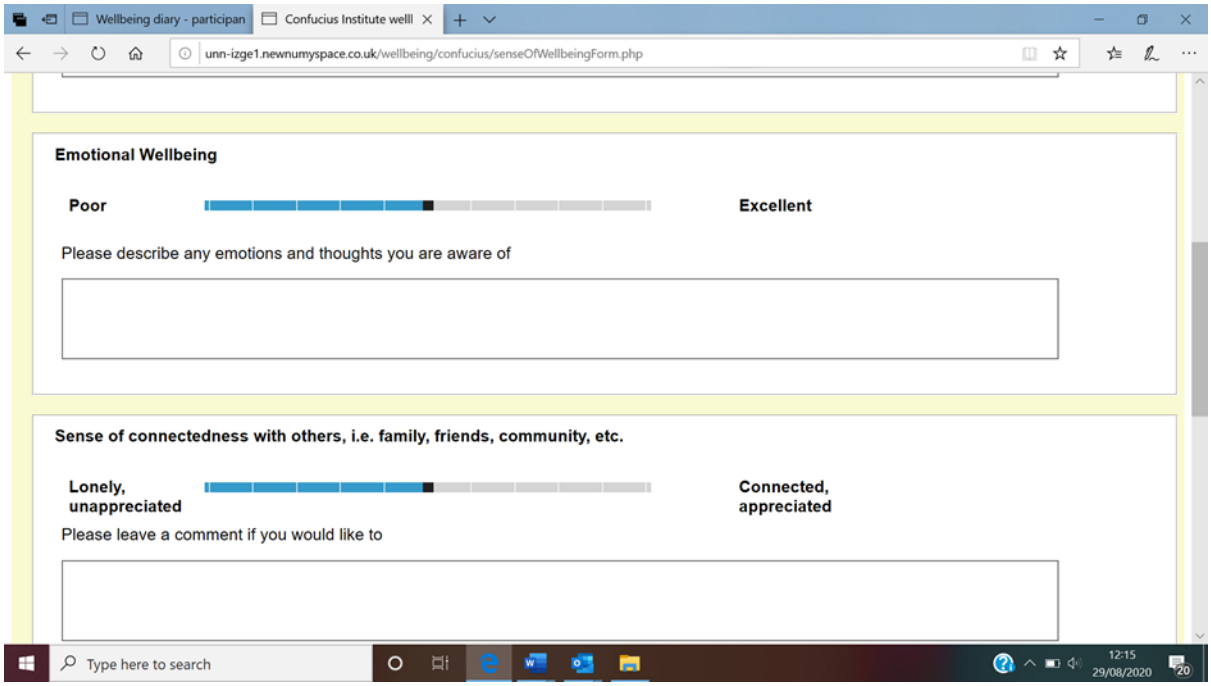
Appendix A


Wellbeing diary - participan
Confucius Institute welll
unn-izge1.newnumyspace.co.uk/wellbeing/confucius/index.php
Wellbeing diary
Welcome
Northumbria University NEWCASTLE
My diary
Welcome to your wellbeing diary. You can use it to reflect on how you feel and on your strategies for wellbeing. You will then have the option of saving your diary entries so you can access them in future via the 'My diary' link
Data is collected for research. If you would like to take part and use the diary click agree
Agree
Type here to search
12:14
29/08/2020


Wellbeing diary - participan
Confucius Institute welll
unn-izge1.newnumyspace.co.uk/wellbeing/confucius/senseOfWellbeingPostForm.php
Wellbeing diary
Sense of wellbeing post
Northumbria University NEWCASTLE
Sign up
Please now again reflect on, and rate your perception of how you are feeling in the moment using all of the sliders below:
To remind you of how you completed the form last time, the sliders has been set to the last position you choose. You can change them
Physical Wellbeing
Poor
Excellent
(0)
Please describe any comfort / discomfort you are aware of
Type here to search
12:25
29/08/2020


Wellbeing diary - participan
Confucius Institute welll
unn-izge1.newnumyspace.co.uk/wellbeing/confucius/senseOfWellbeingForm.php
Emotional Wellbeing
Poor
Excellent
Please describe any emotions and thoughts you are aware of
Sense of connectedness with others, i.e. family, friends, community, etc.
Lonely, unappreciated
Connected, appreciated
Please leave a comment if you would like to
Type here to search
12:15
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