Effect of heart rate variability coherence breathing and cognitive skills training on neuro-agility

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Abstract

Introduction: In today's society, it is important to continuously improve our adaptabilty, agility and flexibility. Neuro-agility is a way of measuring ones ability to think and draw conclusions quickly. It is the ease, speed and flexibility with which we learn and process information. The aim of the following study was to identify the effects of a 2 month heart rate variability coherence breathing and cognitive skills intervention on neuro-agility.

Methods: Pre and post intervention assessments were conducted in order to assess the visual skills and neuro-agility of each participant. The intervention phase consisted of a 2 month program of 1 hour sessions five times a week. Each session consisted of a heart rate variability coherence breathing intervention followed by a visual skills training and physical exercise intervention.

Results: The results showed some significant improvements in the variables for tracking and brain fitness in the visual skills assessments and neuro-agility profile assessments respectively. Slight improvements in the other variables were also noted.

Conclusion: Although the study is limited by the number of participants, it can be concluded from the results that cognitive skills, training and heart rate variability coherence breathing interventions could possibly help to improve the balance and simultaneous usage of both hemispheres of the brain.

Keywords: Neuro-agility, cognitive skills, visual skills, heart rate variability

1. Introduction

In today's ever-changing society, it is important to continuously attempt to improve our own adaptability, agility and flexibility. Agility refers to "the power of moving quickly and easily" and "the ability to think and draw conclusions quickly".[1] Our ability to adapt, adjust, learn new information and unlearn old behaviour quickly is important for our survival, progress and competitiveness.[1]

The Neuro-agility profile (NAP™) is a multi-dimensional, neuroscience based brain profile developed by Neurolink. It is used to assess 6 drivers which affect brain performance. These drivers include brain fitness, stress, sleep, movement, brain food and attitude.[1] The assessment also focuses on the neurophysiological components of learning, thinking and cognitive processes and differentiates each persons learning ability from the other. The assessment highlights issues such as learning problems, risk for human error and brain fitness.[1] This is referred to as the neurological design of each individual. The 6 drivers and our neurological design are said to affect the ease, speed and flexibility with which we learn and process information.[1]

1.1 HRV coherence breathing

When our heart beats, it does not beat at a constant rate. The amount of variation in the time between each R wave on an electrocardiograph (ECG) is known as heart rate variability (HRV).[2] Figure 1 shows an example of this variation. This variability in our heart rate (HR) is controlled by the balance between the sympathetic and parasympathetic nervous systems. These systems collectively form the autonomic nervous system (ANS).[3] When we are in a rested state, a parasympathetic response results in pacemaker cells in the sinoatrial node of the heart to decrease impulses. This leads to a decrease in HR.[3] The sympathetic nervous system contrasts this and functions to respond to stressors, resulting in increased HR.[3] When the body is under too much stress, the balance of the ANS can be disrupted. HRV has been shown to be a useful indicator of this balance and reflects the physiological factors that have an effect on the normal rhythm of the heart.[3-4]

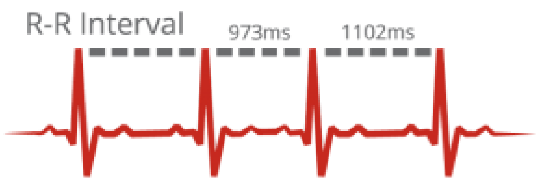


Figure 1: R-R interval variation[5]

Besides HR control, the ANS also controls other physiological functions such as breathing and digestion. HRV is an indicator of the body's ability to continuously and effectively adapt to changes in conditions during breathing.[3] The baroreflex is a negative feedback loop that is used to maintain the balance in blood pressure (BP) and HR.[6] When HRV is low, the negative feedback loop becomes desensitized, leading to continuous sympathetic stimulation. This contributes to anxiety, depression and chronic stress.[6-7]
Respiratory sinus arrhythmia (RSA) is the change in HR that occurs during breathing, and is regulated by the vagus nerve.[8] RSA can be observed by the increase in HR during inspiration and decrease in HR during expiration.[9] RSA is a measure of parasympathetic activity.[6]

Biofeedback is a technique used to teach an individual how to change their own physiological activity.[6] Physiological parameters such as HR, muscle tension, skin temperature or respiration are measured and presented in real time to allow the participant to gain control over these functions.[6,10] HRV biofeedback is a slow breathing technique. Studies have shown that conscious control over breathing can result in increased physiological coherence, specifically, cardiorespiratory synchronization.[11-12] Studies also suggest that this effect occurs most at a "resonance frequency" of about 6 breaths/minute.[6] This resonance frequency may differ from person to person, and can be determined by breathing at different frequencies during an ECG recording to identify the greatest change in HRV.[6] The HRV coherence breathing technique helps to balance the HR by regulating efferent vagal activity.[13] It has also been found to decrease physiological responses to stressful situations, as well as generate increased baroreflex sensitivity.[12,14]

1.2 Quantitative electroencephalography

Cortical activity is measured as brain waves. The cortex is connected to higher neurological functions such as thought, emotion and memory.[15] The cortex is divided into 4 lobes (Figure 2). The frontal lobe is used for reasoning and planning. The occipital lobe is important for visual processes. The parietal lobe is used for movement and perception of orientation, while the temporal lobe is used for auditory perception and speech.[15]

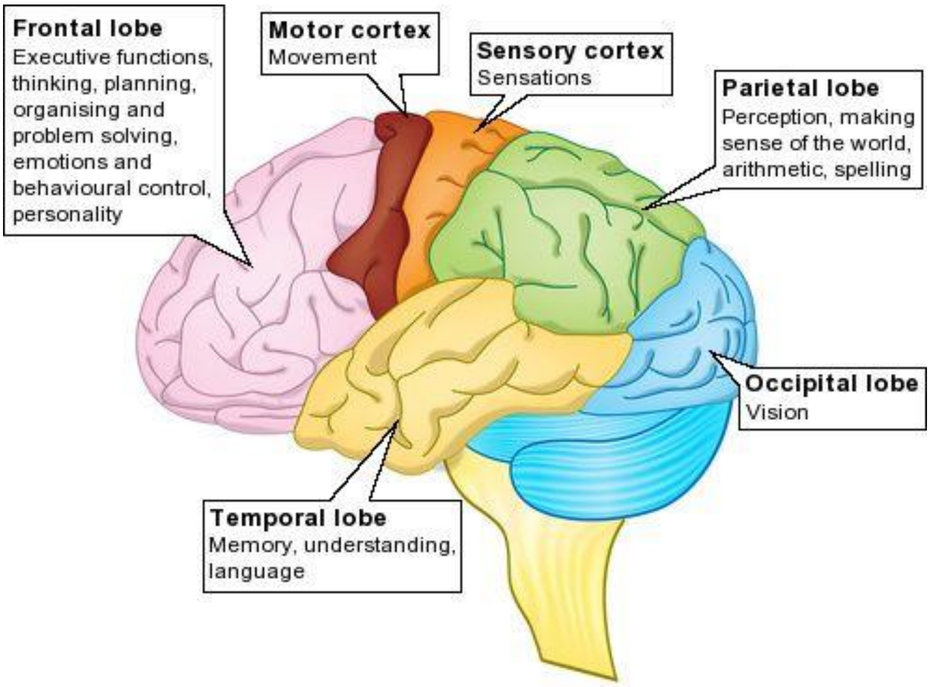


Figure 2: The four lobes of the brain[16]

Electroencephalography (EEG) is a method used to monitor and assess the electrical activity of the cortical lobes. Electrical activity is recorded by placing electrodes at specific sites on the scalp according to the international 10/20 system shown in figure 3.

Quantitative electroencephalography (QEEG) is a method used to analyze standard EEG readings to identify the changes in activation that occur during certain cognitive processes.[17] The data is processed and converted into brain maps that indicate which brain waves are active and to what extent.

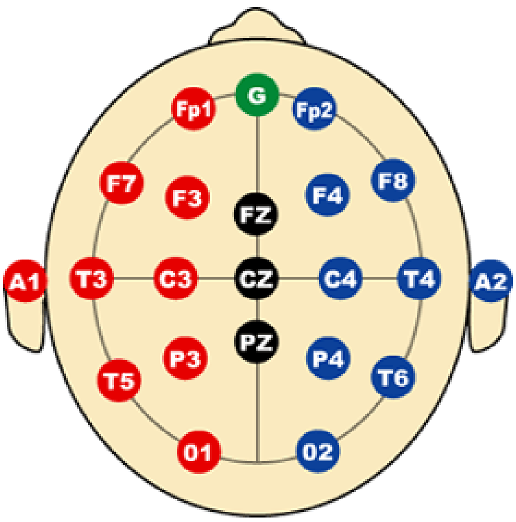


Figure 3: International 10/20 system for electrode placement.

1.3 Information gathering and processing skills

Vision is one of our most important senses and helps the body to identify and adapt to its environment. The human eye is made up of photoreceptors that convert light energy into electrical signals which are relayed to the visual cortex.[18-19] Visual skills training focuses on improving ones perception, decision making and response time.[20] By training the processing capabilities of the visual system, one can improve the speed at which this response pathway occurs.[19] The visual skills training helps to improve cognitive abilities by focusing on a number of tests. Focussing, tracking and vergence are aimed at improving ones ability to focus at varying distances and maintain binocular vision by keeping the image of moving objects on the retina as well as shifting focus between different images.[21] Sequencing and visualisation help to improve ones concentration and memory recall by memorising sequences and responding in the correct sequence.[22] Other assessment such as the ice-cube coin toss and hand-wall toss, aim at improving hand eye coordination by improving the fine motor skills and reaction time of participants. Hand-eye coordination refers to the ability of the hands, eyes and body to operate as a single constituent, ensuring an effective response to visual stimuli.[23]

The focus of the following study was to identify the effects of a HRV coherence breathing and cognitive skill intervention programme on brain activity, neuro-agility and visual skills.

2. Materials and Methods

2.1 Study design

This study was an experimental design. At the beginning of the study, participants conducted pre assessment tests, which included a neuro-agility profile, which determines the ease, speed and flexibility with which they think, learn and process information. QEEG assessments determine their brain waves and visual skills assessments. The participants then performed 2 months of HRV coherence breathing, physical exercises and visual skills training. The study determined if there were any significant differences between the pre- and post- assessment tests. All subjects attended an information session, and signed an informed consent form. The exclusion criteria included: medical illness, injury, cardiovascular disease, Parkinson’s disease, untreated hyper/hypotension, visual deficiencies (e.g. colour deficiency), the use of medication that could affect the central nervous system, and those diagnosed with a learning disability or mental illness.

The study was approved by the research ethics committees of the Faculties of Health Sciences and Humanities (Protocol no: 383/2019).

2.2 Setting

Unmatched Potential

2.3 Study population

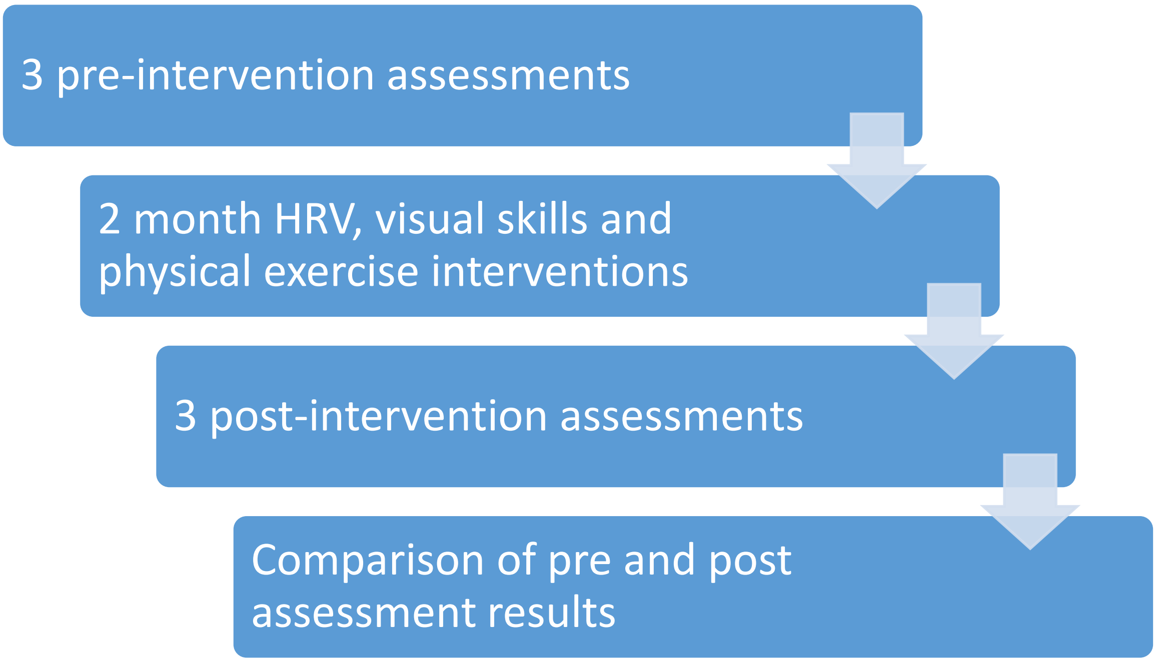
Twelve participants from Entrepreneurial Development Program volunteered to participate.

2.4 Materials and Methods

Pre and post intervention assessments were conducted to assess the QEEG's, visual skills and neuro-agility of each participant. The NAP^{TM} is an online questionnaire developed by Neurolink. The visual skills test consisted of assessments for focussing, tracking, visualisation, hand-eye coordination, vergence and sequencing.

The intervention phase consisted of a 2 month program of 1 hour sessions, five days a week. Each 1 hour session consisted of a HRV coherence breathing intervention for 20 minutes, visual skills training for 20 minutes and physical exercises for 30 minutes.

Figure 4. Flow diagram of the methods that were followed



2.4.1 NAP^{TM} assessment

In order to determine the effects of the intervention on the neuro-agility of the participants, each participant was required to complete the Neuro-Agility Profile™(NAP™) assessment created by Neurolink. The assessment is an accredited online questionnaire consisting of about 170 questions. Each participant received a unique link with a personal username and password to log onto the website to complete their assessment. The questions aim to identify 6 factors which are thought to optimize brain performance. The system then gave each participant an overall brain performance score based on the results. The questions also identify factors that are used to determine each individual's neurological design.[1] From all the results, each participant was also given an overall neuro-agility score. The participants were required to complete the NAP^{TM} assessment before and after the intervention phase.

2.4.2 QEEG assessment

To obtain a QEEG, a standard EEG was first conducted using the international 10/20 system shown in Figure 3. The placement sites on the scalp for each electrode were first prepared using ear buds coated with a specific perparation gell called Nuprep, to clean the sites of any dead skin cells to help improve the signals. 22 Sintered silver/silver chloride electrodes were then coated with Ten 20 conductive paste and placed on the 22 placement sites. There were 19 active sites which were used to measure electrical activity, while the remaining were used as reference sites, 2 of which were placed on the bone behind the ears where there is no electrical activity. The 19 channel resting state EEG recording was recorded using the Brainmaster Discovery amplifier. The data was then transferred to QEEG Pro, which analyzed and compared the data to an existing database.

2.4.3 Visual skills assessment

The visual skills assessment included a number of tests:[24]

<u>Focussing:</u> The participants were required to read a sequence of letters by shifting focus back and forth between a small chart held in their hands and a larger chart 1 metre away. The number of letters read in 1 minute was recorded.

<u>Tracking:</u> For this test, two strips of letters were placed on a wall approximately 1 meter apart. The participants were then required to stand approximately 1 meter from the wall and read

the sequence of letters on the charts by alternating from left to right without moving their heads.

Visualisation: This test focuses on the memory of the participant. A set of cards from 1-7 were placed on the table in front of the participant in a random order. The participant was then given time to memorise the order of the cards. The instructor then turned the cards over face down and the participant was then required to flip the cards back over in the correct order from 1 to 7. If the incorrect card was selected, the participant needed to turn it back over and select the correct card. The time it took for the participant to correctly turn over all the cards was recorded.

Ice-cube test: The ice-cube test is used to assess the participant's hand-eye coordination. The participants held an ice-cube tray numbered across from 1-12. They were then asked to flip the coin into each compartment starting at 1 and ending at 12. The time it took for them to get the coin to 12 was recorded.

Hand-wall toss: For this test the participants were required to stand approximately 1.5 meters from a wall and throw a tennis ball under-arm against the wall with their right hand and catch the ball in their left, and then continue alternating between left and right. The number of successful catches was recorded in one minute.

Vergence: The participants were required to hold a pen with a straight arm out infront of them. They then needed to slowly move the pen closer to their nose by focusing on the tip of the pen. The participants were instructed to stop when the pen started to appear blurry. The distance from the tip of their nose to the pen was then measured.

Sequencing: This test was used to assess the participants ability to respond to visual information. First the instructor showed the participant a sequence of hand signs which included "palm", "side" and "fist". The participants were then required to repeat the sequence after the demonstration. When the correct sequence was repeated, the participant would continue to the next level of sequences. The number of hand signs increased with each level. The last level that the participant could repeat successfully was recorded.

2.5 Interventions

2.5.1 HRV coherence breathing intervention

The Heart rate variability coherence breathing intervention (Appendix A) was done for 2 months, 5 days a week for 20 minutes/day.

2.5.2 Visual skills training

During each training session, participants repeated all the visual skills tests as listed in 2.4.3
Training sessions: 5 days a week, 20 minutes/day for 2 months

2.5.3 Physical exercise intervention

Each physical exercise intervention session was 30 minutes, 5 days a week for 2 months and a balance between health and skill related fitness exercises (Appendix B).

3. Results

3.1 QEEG Results

In all participants a global increase was seen in deviant activity where excesses occurred. This can be seen as a negative result as it can have a negative impact on regulation. Where there were deficits in Power it also increased which can be seen as a positive change.

When looking at coherences, the result was more positive. 50% of the participants had a positive effect on both hypercoherences decreasing and hypocoherences decreasing. In the other 50% however there was an increase in the hypercoherences percentage and a decrease in hypocoherences which is positive.

When looking at the sLoreta source amplitude, the same trend is seen with an increase in excessive deviances and a positive decrease in the standard deviation of decreased powers. 2 of the participants also had a positive change in excessive amplitudes where it showed a decrease in the standard deviation. In the source hypocoherences positive changes are noted in all participants with a decrease in the standard deviations for both hyper- and hypo-coherences.

3.2 Visual skills results

Statistical analysis for the NAP^{TM} and visual skills assessments were performed using IBM SPSS Statistics (2017) statistical data software. The data was analysed to determine the mean and standard deviation for each variable. The Wilcoxon Signed Rank Test was used to analyse the differences in pre and post intervention results. The Wilcoxon Signed Rank Test was used because it is specifically intended for studies with repeated measurements on a single sample. The test is a non-parametric substitute recurrent measured t-test.[25] Since the sample size was less than 30, a normality test was not required.

Table 1 shows the descriptive statistics for the variables of the visual skills assessments to ensure the minimum and maximum ranges correspond to the mean value for each variables, as well as to identify the standard deviation for each variable. Table 2 shows the Wilcoxon Signed Rank Test for the visual skills assessments.

Table 1. Descriptive statistics for the pre and post variables of the Visual skills assessment

	N	Minimum	Maximum	Mean	Std. Deviation
Focussing Pre	5	22	58	41	16.882
Focussing Post	5	34	68	51.4	14.893
Tracking Pre	5	38	72	52.8	16.3
Tracking Post	5	44	75	56.6	15.947
Visualisation Pre	5	20	164	76.26	59.6
Visualisation Post	5	20	119	70.48	44.595
Ice-cube Pre	5	26	138	81.84	51.176
Ice-cube Post	5	29	67	51.57	15.273
Hand-ball Pre	5	2	22	14.6	8.414
Hand-ball Post	5	7	27	18	9.327
Vergence Pre	5	5	16	9.2	4.207
Vergence Post	5	7	17	10.4	3.912
Sequencing Pre	5	2	3	2.2	0.447
Sequencing Post	5	2	4	3.2	0.837

**N=5: only five delegates completed all the assessments*

Table 2. Wilcoxon Signed Rank Test for the Visual skills

Test Statistics[a]							
	Focussing Post – Focussing Pre	**Tracking Post – Tracking Pre**	**Visualisation Post – Visualisation Pre**	**Ice cube Post – Ice cube Pre**	**Hand ball Post – Hand ball Pre**	**Vergence Post – Vergence Pre**	**Sequencing Post – Sequencing Pre**
Z	-1.826[b]	-2.041[b]	-0.405[c]	-1.483[c]	-1.761[b]	-1.300[b]	-1.890[b]
Asymp. Sig. (2-tailed)	0.068	0.041	0.686	0.138	0.078	0.194	0.059
a. Wilcoxon Signed Ranks Test							
b. Based on negative ranks							
c. Based on positive ranks							

The significance level of the test statistic was set at ($p<0.05$). According to the results in Table 2, we can see that there was only a significant improvement in pre and post results for the tracking variable, while the other variables showed non-significant changes.

3.3 Neuro-agility results

Table 3 shows the descriptive statistics for the variables of the NAP^{TM} assessment to ensure the minimum and maximum ranges correspond to the mean value for each variables, as well as to identify the standard deviation for each variable. Table 4 shows the Wilcoxon Signed Rank Test for the NAP^{TM} assessment.

Table 3. Descriptive statistics for the pre and post variables of the NAP^{TM}

	N	Minimum	Maximum	Mean	Std. Deviation
Brain fitness Pre	5	20	70	36	19.494
Brain fitness Post	5	30	80	44	20.736
Stress Pre	5	50	70	58	8.367
Stress Post	5	70	90	74	8.944
Sleep Pre	5	40	60	50	7.071
Sleep Post	5	50	80	62	10.954
Movement Pre	5	20	70	40	20.000
Movement Post	5	10	70	40	21.213
Attitude Pre	5	50	100	72	25.884
Attitude Post	5	60	100	84	15.166
Food Pre	5	30	60	48	10.954
Food Post	5	40	70	50	14.142
Neuro-design flexibility (%) Pre	5	49	80	65.6	11.803
Neuro-design flexibility (%) Post	5	48	71	61.4	10.090
Overall brain fitness (%) Pre	5	41	61	50.2	7.530
Overall brain fitness (%) Post	5	51	66	58.6	5.771
Neuro-agility score (%) Pre	5	45	70	57.6	9.236
Neuro-agility score (%) Post	5	52	68	60	7.071

Table 4. Wilcoxon Signed Rank Test for the NAP^{TM}

Test Statistics[a]									
	Brain fitness Post- Brain fitness Pre	**Stress Post- Stress Pre**	**Sleep Post- Sleep Pre**	**Movement Post- Movement Pre**	**Attitude Post- Attitude Pre**	**Food Post- Food Pre**	**NDF (%) Post- NDF(%) Pre**	**OBF (%) Post – OBF (%) Pre**	**NAS (%) Post – NAS (%) Pre**
Z	-2.000[b]	-1.841[b]	-1.857[b]	0.000[c]	-1.300[b]	-0.276[b]	-1.214[d]	-1.841[b]	-1.084[b]
Asymp. Sig. (2-tailed)	0.046	0.066	0.063	1.000	0.194	0.783	0.225	0.066	0.279
a. Wilcoxon Signed Ranks Test									
b. Based on negative ranks									
c. The sum of negative ranks equals the sum of positive ranks									
d. Based on positive ranks									

NDF: Neuro-design flexibility
OBF: Overall brain fitness
NAS: Neuro-agility score

The significance level of the test statistic was set at ($p<0.05$). According to the results in Table 4, we can see that there was only a significant improvement in pre and post results for the brain fitness variable, while the improvement for the other NAP™ assessment variables were not significant.

4. Discussion

Adapting to our environment is an important part of life. According to previous studies, by simply participating in physical activity, we can naturally improve our visual processing skills and visual awareness.[26]

Stress is defined by Gabriel and Ainsworth as “a state of threatened homeostasis provoked by a psychological, environmental or physiological stressor”.[27] Studies have shown that conscious control of slow breathing can help to balance the autonomic nervous system and help to decrease physiological responses to stressful situations.[12-13] The NAP™ is used to assess drivers which are thought to affect brain performance including stress.[1] The profile assesses our Neuro-design flexibility. This identifies our preferences in terms of which brain areas we normally use to process information and then determines the extent of this preference and how easily and quickly we are able to switch between different areas and respond to stress in the real world.[1]

From statistical analysis of the data, we can see that the visual skills assessments only showed significant differences for the pre and post results of the tracking exercise, with a mean of 56.6 letters per minute (±15.947) for post intervention compared to 52.8 letters per minute (±16.3) for pre intervention. Tracking is a test used to determine the ability to continuously shift focus back and forth from left to right. Although this was the case, we can see that there were still slight improvements in all the variables post intervention. This suggests that the cognitive skills and HRV interventions, with a larger group or a longer time frame, could possibly show greater improvements.

Similar to the visual skills results, the NAP™ assessment also only showed significant results for the brain fitness variable, with a mean of 44% (±20.739) for post intervention and 36% (±19.494) for pre intervention. The other variables of the assessment were not significant, but also all showed slight improvements, apart from the neuro-design flexibility variable which did not improve. The neuro-design flexibility score is determined by the individuals own personal neurological preferences for information processing.[1] This includes hemispheric dominance, expressive/receptive preference and logical/emotional preference, therefore this variable would not necessarily be affected by the interventions. As discussed, the brain fitness variable did show significant improvements. Brain fitness is a measure of the ability to use both hemispheres simultaneously to process and integrate information. If someone has a higher brain fitness, it means that they are more bilateral.[1] This suggests that the cognitive skills and HRV coherence breathing interventions may have helped to improve simultaneous usage of both hemispheres and both sides of the body.

5. Conclusion

Although a large limitation of the study was the sample size (n=5), the slight improvements of the study suggest that cognitive skills training and HRV coherence breathing could possibly be used to improve neuro-agility and the brain drivers which affect brain performance by increasing the usage of different areas of the brain simultaneously.

Future studies would need to be done with a much larger sample, to include a control group, and possibly over a longer time period. This could help to improve the effectiveness of the interventions and the reliability of the resuls.

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Appendix A

KARLIEN BALT
NEUROFEEDBACK

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How to Perform Coherent Breathing

The key components of coherent breathing are to simultaneously:

- relax the mind and body a little and
- regulate one's breathing rate to about 5 breaths per minute, i.e. inhale for about 6 seconds then exhale for about 6 seconds so that a single breath takes about 12 seconds and you end up doing about 5 breaths per minute.

With coherent breathing induced relaxation, the priority is to create a relaxed feeling and as soon as we feel any strain at all, we do not push through it, we just let the breathing rhythm go. If at any point you find it demanding or a strain to maintain the breathing rhythm you give up controlling the breath let it do whatever it wants and concentrate on maintain the feeling of relaxation.

The Coherent Breathing Procedure

Step 1

Your body needs to be in an upright position not reclining more than 45°.
With practice you will be able to initiate the balance effect in your autonomic nervous system even when standing.
Your eyes can be open, you may want to fix your gaze in one direction.
Prepare your session by stretching out tension from your breathing muscles. Take three or four very deep breaths using your diaphragm and primarily breathing into your belly, inhale so deeply that you completely fill the belly and it starts to put up the rib cage, you should feel a stretching in the sides of your rib cage. The goal you're trying to achieve here is to stretch out tension that has built up in the diaphragm, it's just like stretching the muscles in your legs and back prior to going for a run. If you do the diaphragm stretch correctly you'll notice that your breathing naturally deepens straightaway afterwards.

Step 2

Choose to consciously relax all unnecessary tension in your muscles and adopt a relaxed mental state. Remembering the feeling you get when you practice the relaxation response can help.

Step 3

You can use a clock or just count seconds in your head, if you have a clock that ticks loudly at one second intervals or a metronome you can use the sound as a pacemaker.
Inhale deeply and then time your exhalation to be about 6 seconds long. Everyone's system is a little different and it's impossible to tell you exactly how deep your breathing should be, it should be a bit deeper than normal requiring a little gentle effort but still relaxed; this is not a very deep breathing pattern that requires any strain on the other hand you should have some sensation of breathing into

your belly and using your diaphragm so that you are not performing a shallow breathing. In the beginning when you're learning coherent breathing you only control the timing of your exhalation once in every few breaths, so you do a 6 second exhalation and then just completely relax and let your breathing carry on normally, uncontrolled in any way for a few breaths. Then do another 6 second exhalation, do not try and control every breath in the first few minutes. You may be impatient to do the whole thing from the beginning but take your time and ease yourself into it, the technique will get much easier and quicker with practice.

Step 4

The breathing must not be jerky or have any pauses between inhaling and exhaling, it must be smooth like a pendulum swinging back and forth or a sine wave going up and down.

Step 5

As you continue with the above breathing induces or just imagine physical relaxation spreading throughout your body every time you exhale. Some people imagine a wave of relaxation propagating throughout the body as they exhale, others imagine a sinking down heavy feeling, do use whatever method that feels the most natural for you. If you previously learnt how to switch on your relaxation parasympathetic response you may simply try to reproduce that feeling as you breathe.

Step 5

Continue doing what you're doing and pay attention to the sensations of breathing and your body relaxing. There can be a little variation in the exact length of time the breath should be from individual to individual but 6 seconds is a consistent average time that is correct for most people. If you come from a background of having done a lot of slow breathing meditations and pranayama you may find this step quite difficult, as you may keep spontaneously dropping into a slow breathing pattern that you have previously mastered, you must give this up for now.

When you are learning how to do coherent breathing use a 6 second breathing pattern. In the future once you have identified the sensations or felt sense of coherent breathing when you achieve a significant speeding up and slowing down of your heart rate (heart rate variation) and a balanced flow and ebb in your autonomic nervous system you can allow your breathing rate to adjust a little to exactly what's right for you. You do this simply by cultivating and deepening the feelings of balance and letting your breathing rate adjust slightly to cause this. Adjusting like this is quite advanced so stick to 6 seconds for at least a month and a half. What you're looking for is subtle, you're looking for a felt sense of what feels most relaxing. When you find the right rhythm, you feel your body settling into it, finding its rhythm.

Once mastered you will be a will to switch on this state in many everyday situations and significantly improve the way you manage unhealthy stress responses. You will be able to use it before a meeting or interview for example and be the calmest person in the room.

Step 6

Continue adding more 6 second exhalation s and relaxing until you can make every exclamation 6 seconds long and a distinct sensation of relaxation throughout your body each time you exhale. When this happens, you are successfully coordinating your exhalation with the parasympathetic phase of your heart rate variability cycle and inducing or coordinating an effective parasympathetic response. Congratulations you've already learned how to do something therapeutic to your stress responses.

Step 7

Now you repeat the same process with your inhalation i.e. make an inhalation 6 seconds long and then just relax your body and your breathing to do what it wants to do, and then do another 6 second inhalation, gradually doing more and more while maintaining a state of relaxation until you can continue doing each information and a 6 second place and staying relaxed at the same time. While you're focusing on your inhalation you can more less that the exhalation do what it wants for the time being.

Step 8

Start to combine 6 second inhalation with 6 second exhalations, a gain you don't try to make every inhalation/exhalation 6 seconds long, instead you do one or two and then take a break and letting your breathing do whatever it wants. Gradually do 2, then, 3 timed inhalations/exhalations, stringing more together without strain until you can maintain this pace of breathing continuously.

In the beginning of training to do coherent breathing it may take you 10 to 20 minutes before you can complete step 8. Spend about 20 minutes a day practising coherent breathing until you are able to get to step 8 within five minutes.

Do it at the least two or three times per day even while you're doing something else like working at the computer practice 5 to 8 minutes of coherent breathing and you should be able to prevent stress responses negatively impacting on your health.

During phases of heightened stress, or if you want to maximise your immunity, set aside 20 to 25 minutes and perform either a dedicated session of switching on your relaxation response or some form of control breathing meditation. For the breathing meditation, you could do coherent breathing, or a breathing meditation with a slower pace such as inhaling for 15 seconds then exhale in 15 seconds, which makes one breath cycle 30 seconds and therefore you take to breaths per minute; or do a combination of half the time slow breathing to induce a deep parasympathetic response and the other half of the time doing coherent breathing to induce a balanced condition in your autonomic nervous system.

Appendix B

Lesson Layout

Warm-up (See warm-up sheet)

↓

Workout (See lessons sheets)

↓

Stretches (See stretches sheet)

↓

Cool-down – Jog on the spot for 60 seconds

	Monday	Tuesday	Wednesday	Tuesday	Friday
Week 1	Lesson 1 to 3				
Week 2	Lesson 4 to 6				
Week 3	Lesson 7 to 9				
Week 4	Lesson 10 to 12				

Warm-up Routine
(60 seconds for each activity)

Jog on the spot

Touching Toes

Squats

Plank

Stretches

(Hold each stretch for 20 seconds)

Triceps

Shoulders

Side Crunch

Back

Leg 1

Leg 2

Lesson 1

(30/60 second rest between each)

Warm-up

1.	Push-ups (half/full)	20 reps	Repeat sequence (1 to 3) 3 times
2.	Crunches	20 reps	
3.	Squats	20 reps	

Stretches

Cool-down

1. Push-ups

2. Crunches

3. Squats

Lesson 2
(30/60 second rest between each exercise)

Warm-up

1.	Jumping Jacks	20 reps	Repeat sequence (1 to 4) 3 times
2.	High Knees	40 reps	
3.	Plank	60 seconds	
4.	Wall Sit	60 seconds	

Stretches

Cool-down

1. Jumping Jacks

2. High Knees

3. Plank

4. Wall Sit

Lesson 3

(30/60 second rest between each exercise)

Warm-up

1.	Jumping Jacks	20 reps	Repeat sequence (1 to 3) 3 times
2.	Knee Pull-ins	20 reps	
3.	Push-ups (half or full)	20 reps	

Stretches

Cool-down

1. Jumping Jacks

2. Knee Pull-ins

3. Push-ups

Lesson 4

(30/60 second rest between each exercise)

Warm-up

1.	Jumping Jacks	20 reps	Repeat sequence (1 to 3) 3 times
2.	Cross-body Crunches	60 reps	
3.	Superman	20 reps	

Stretches

Cool-down

1. Jumping Jacks

2. Cross-body Crunches

3. Superman

Lesson 5
(10/15 second rest between each exercise)

Warm-up

1.	Jumping in One Place	60 seconds
2.	High Knees	60 seconds
3.	Step-ups	60 seconds

(Repeat sequence [1 to 3] for 10 to 20 minutes)

Stretches
Cool-down

1. Jumping

2. High Knees

3. Step-ups

Lesson 6
(30/60 second rest between each exercise)

Warm-up

1.	Mountain Climbers	20 reps	Repeat sequence (1 to 4) 3 times
2.	Cross-body Crunches	20 reps	
3.	Side-to-Side Lunges	20 reps	
4.	Straight Leg Raises	20 reps	

Stretches

Cool-down

1. Mountain Climbers

2. Cross-body Crunches

3. Side-to-Side Lunges

4. Straight Leg Raises

Lesson 7

(30/60 second rest between each exercise)

Warm-up

1.	High Knees	20 reps	Repeat sequence (1 to 6) 3 times
2.	Push-up (Half or Full)	20 reps	
3.	Lunges	20 reps	
4.	Crunches	20 reps	
5.	Squats	20 reps	
6.	Knee Pull-ins	20 reps	

Stretches

Cool-down

1. High Knees

2. Push-ups

3. Lunges

4. Crunches

5. Squats

6. Knee Pull-ins

Lesson 8

(30/60 second rest between each exercise)

Warm-up

1.	Squats	20 reps	Repeat sequence (1 to 3) 3 times
2.	Cross Body Crunches	20 reps	
3.	Push-ups (Half or Full)	20 reps	

Stretches

Cool-down

1. Squats

2. Cross Body Crunches

3. Push-ups

Lesson 9

(10/15 second rest between each exercise)

Warm-up

1.	Jumping in One Place	60 seconds
2.	High Knees	60 seconds
3.	Step-ups	60 seconds

(Repeat sequence [1 to 3] for 10 to 20 minutes)

Stretches
Cool-down

1. Jumping

2. High Knees

3. Step-ups

Lesson 10

(30/60 second rest between each exercise)

Warm-up

1. Jumping Jacks — 20 reps
2. Push-up (Half or Full) — 20 reps
3. Crunches — 20 reps
4. Squats — 20 reps
5. Mountain Climbers — 20 reps

Repeat sequence (1 to 5) 3 times

Stretches

Cool-down

1. Jumping Jacks

2. Push-ups

3. Crunches

4. Squats

5. Mountain Climbers

Lesson 11

(20 second jog on the sport counts as rest)

Warm-up

Sequence to repeat: Push-up → Crunches → Jog on the spot

x1→x2→x3→x4→5x→6x→7x→6x→5x→4x→3x→2x→1x

(Thus start with 1x push-up (half or full), followed by 1x sit-up and 20 seconds jog on the spot, work up to 7x and back down to 1x)

Stretches
Cool-down

1. Push-ups

2. Crunches

3. Jog on the spot

Lesson 12

(30/60 second rest between each exercise)

Warm-up

1. Mountain Climbers — 20 reps
2. Push-ups (Half or Full) — 20 reps

Repeat sequence (1 to 2) 5 times

Stretches

Cool-down

1. Mountain Climbers

2. Push-ups

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