

Improved Memory Functioning following Gamma Cognitive Exercises and Gamma Coherence Training in Patients at High Risk For Subjective Cognitive Decline

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ABSTRACT

In this case study we looked at 5 individuals between the ages of 48 and 59 years old, at moderate or high risk for Subjective Cognitive Decline. These individuals were identified as being either moderate or high risk for Subjective Cognitive Decline using the CerebroCore Quick Cog Assessment. Each individual was then given an interactive cognitive assessment that measured the nine components of memory and cognition. They received a baseline score for each of the 9 components as well as a baseline overall cognition score. Based on these scores, a customized brain exercise protocol was prescribed for each participant. For the next 30 days, each participant utilized the CerebroCore Gamma Brain Exercise tool for at least 15 minutes, three times per week. They also used the CerebroCore Gamma Coherence tool for at least 15 minutes, three times per week. At the end of thirty days, each participant was given the CerebroCore Quick Cog assessment, and the 9-part, interactive cognitive assessment and their scores were compared to their baseline scores. Based on this comparison, their scores demonstrated a 23.4% improvement on the Quick Cog Assessment and a 16.2% improvement on the 9-part, interactive cognitive assessment.

INTRODUCTION

Subjective Cognitive Decline (SUBJECTIVE COGNITIVE DECLINE) is the self-reported experience of worsening or more frequent confusion or memory loss.^{1,2} It is a form of cognitive impairment and one of the earliest noticeable symptoms of Alzheimer's disease and related dementias.^{2,3}

The term subjective cognitive decline (SUBJECTIVE COGNITIVE DECLINE) was conceived in 2014 to describe this condition. Epidemiological data provide evidence that the risk for mild cognitive impairment and dementia is increased in individuals with SUBJECTIVE COGNITIVE DECLINE⁴.

When cognition is impaired, it can have a profound impact on an individual's overall health and well-being.¹ Cognitive decline can range from mild cognitive impairment to dementia, a form of decline in abilities severe enough to interfere with daily life.¹ Alzheimer's disease is the most common form of dementia.¹⁻³

By educating people about modifiable risk factors, encouraging early assessment and intervention, the health and well-being of many adults may be improved.^{1,2}

PREVALENCE OF SUBJECTIVE COGNITIVE DECLINE

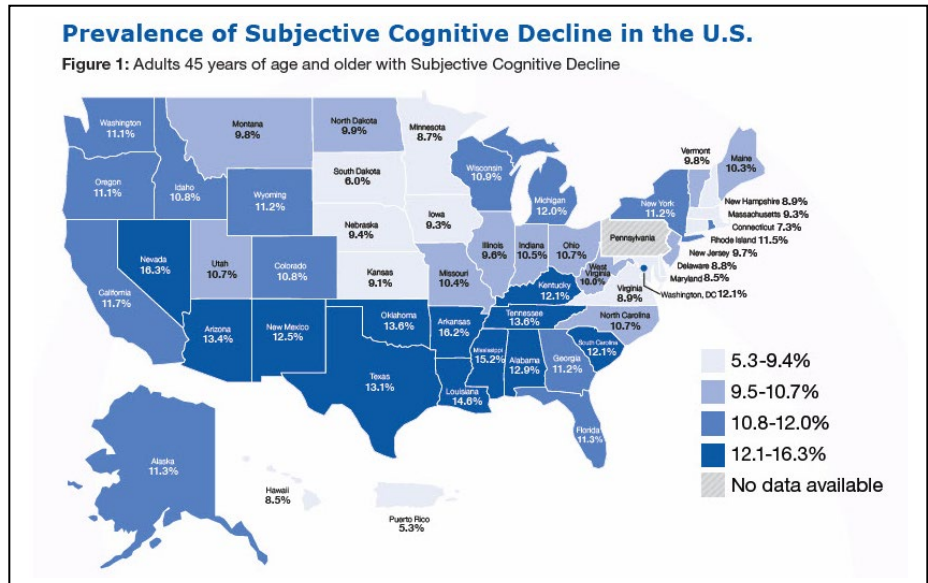
The prevalence of subjective cognitive decline (SCD) is 11.1%, or 1 in 9 adults.

The prevalence of SCD among adults aged 65 years and older is 11.7% compared to 10.8% among adults 45-64 years of age.

The prevalence of SCD is 11.3% among men compared to 10.6% among women.

The prevalence of SCD differs among racial/ethnic groups, 10.9% of Whites report SCD compared to 12.8% of Blacks/African Americans, 11.0% of Hispanics, and 6.7% of Asians and Pacific Islanders.

Lower prevalence of SCD is reported in adults with more years of formal education.



Centers for Disease Control. Subjective Cognitive Decline — A Public Health Issue

IDENTIFYING SUBJECTIVE COGNITIVE DECLINE

The proposed Subjective Cognitive Decline criteria were developed for Alzheimer's disease research. The Subjective Cognitive Decline criteria include two major features. First, a self-experienced persistent decline in cognitive capacity, compared with a previously normal cognitive status, which is unrelated to an acute event. This criterion infers that Subjective Cognitive Decline reflects a state of cognitive decline from the perspective of the individual; observation of such a decline by others is not required. The second criterion is normal performance on standardized cognitive tests used to classify Mild Cognitive Impairment. As such, the individual's cognition is unimpaired from an objective standpoint. The absence of objective cognitive impairment distinguishes Subjective Cognitive Decline from Mild Cognitive Impairment.

Since then, a more comprehensive questionnaire known as the Subjective Cognitive Decline Questionnaire (SCD-Q) has been identified and validated.⁵ The SCD-Q comprises 24 items administered to subjects with suspected SCD. The authors of this study concluded that the SCD-Q was a valuable tool in identifying Subjective Cognitive Decline.

The CerebroCore Quick Cog Assessment is a digital version of the SCD-Q and can be done online from a phone tablet or computer.



SUBJECTIVE COGNITIVE DECLINE QUESTIONNAIRE

In the last 5 years:

QUESTION	YES	NO
I find it harder to learn new telephone numbers.		
I find it harder to find personal possessions		
I find it harder to describe the plots of films.		
I find it harder to remember doctor's appointments.		
I find it harder to follow the plot of a book.		
I'm worse at recalling the details of a recent family event.		
I find it harder to remember the result of a recent sporting event.		
I find it harder to remember sums of money		
I find it harder to remember the details of a conversation.		
I find it harder to remember things without using strategies		
I find it harder to remember the details of recent news.		
I find it harder to remember famous people's names.		
I find it harder to remember the names of people I've met recently.		
I find it harder to remember street and city names.		
I'm worse at finding the word I want to use in a conversation.		
I find it harder to understand things the first time someone says them.		
I find it harder to remember the names of places I've visited recently.		
I find it harder to concentrate on what I am doing.		
I'm worse at planning things that aren't part of my daily routine		
I find it harder to use electronic devices.		
I find it harder to start new or different things		
I find it harder to start conversations.		
I find it harder to do mental arithmetic.		
I find it harder to do more than one thing at once without getting agitated		
Total Score		

The CerebroCore Quick Cog will provide a score. Based on that score, the individual is categorized into 3 probability categories. These include Low, Moderate and High.

METHODS

In this case study we looked at 5 individuals between the ages of 48 and 59 years old, at moderate or high risk for Subjective Cognitive Decline. These individuals were identified as being either moderate or high risk for Subjective Cognitive Decline using the CerebroCore Quick Cog Assessment. Each individual was then given an interactive cognitive assessment that measured the nine components of memory and cognition. They received a baseline score for each of the 9 components as well as a baseline overall cognition score.

Based on these scores, a customized brain exercise protocol was prescribed for each participant. For the next 30 days, each participant utilized the CerebroCore Gamma Brain Exercise tool for at least 15 minutes, three times per week. They also used the CerebroCore Gamma Coherence tool for at least 15 minutes, three times per week. At the end of thirty days, each participant was given the CerebroCore Quick Cog assessment, and the 9-part, interactive cognitive assessment and their scores were compared to their baseline scores.

Gamma Brain Exercises

The CerebroCore Gamma Brain Exercises couple Gamma Brainwave Entrainment with Cognitive Exercises. To our knowledge, CerebroCore is the only brain training system that uses these two modalities in conjunction with one another. The purpose of this is to enhance the efficacy of the exercises by creating a neural environment that is conducive to memory.

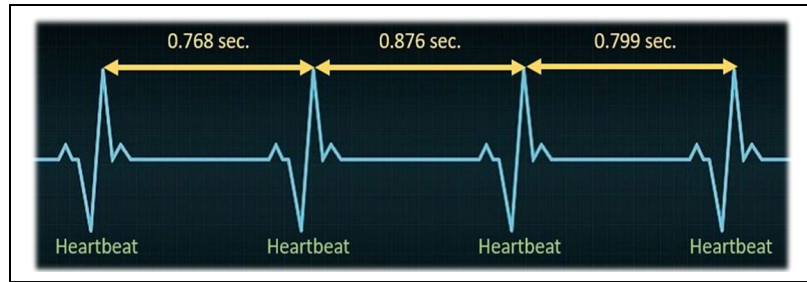
Gamma Brainwave Entrainment is the process by which brainwave frequencies are modified to resonate at a designated frequency. It has long been known that when you provide visual and/or auditory stimulus at a certain frequency, the brain will begin to resonate at that frequency. Different brainwave frequencies produce specific “states of mind”. For example, when the brain resonates at the theta frequency of 4 to 7 Hz, the person will feel tired and sleepy. Gamma Audio Entrainment uses Gamma Infused Music that creates a 40Hz frequency. When the patient listens to this music, their brain begins to resonate at the Gamma frequency. The Gamma brainwave frequency creates a state of mind that is associated with improved mental performance, improved memory, and improved attention. Recent studies have shown that when mice are exposed to this Gamma frequency, the microglial cells in the brain are stimulated resulting in a decrease in amyloid plaque formation¹⁰ Neural oscillations in the gamma band (30–80 Hz) are thought to play a crucial role for information processing in cortical networks¹¹

It has been shown that there is extensive evidence that brain-training interventions improve performance on the trained tasks¹². This is why we chose to custom prescribe the exercise routines based on the Cognitive Assessment results of each individual participant. The specific brain exercises that each participant did were dictated by their scores on each of the individual 9 assessments. For example, individuals that scored lowest on the short-term memory assessment, received exercises designed to specifically improve their short-term memory.

Gamma Coherence Training

Gamma Coherence Training combines the incredible benefits of Gamma Brainwave Guidance technology with the scientifically proven effectiveness of Heart rate Variability Training to optimize memory function and improve cognitive health.

Scientists and physicians once believed that heart operated much like a metronome, dutifully beating at a regular steady rhythm. They assumed that each beat occurred at a specific interval – like the second hand on a clock. However, this is far from the case! In fact, the rhythm of a healthy heart is remarkably irregular with the time period between each heartbeat always changing.



This naturally occurring variation between each heartbeat is referred to as Heart Rate Variability (HRV). This diagram shows four heartbeats recorded on an electrocardiogram (ECG). Note the variation in the time interval between consecutive heartbeats.

The variation in time between each heartbeat is controlled by Autonomic Nervous System. Signals coming from the sympathetic nerves accelerate the heart, while signals coming from the parasympathetic nerves slow the heart down. In a balanced nervous system, our hearts are constantly getting mixed messages commands to increase heart rate from the sympathetic nervous system and commands to decreases heart rate from the parasympathetic nervous system.

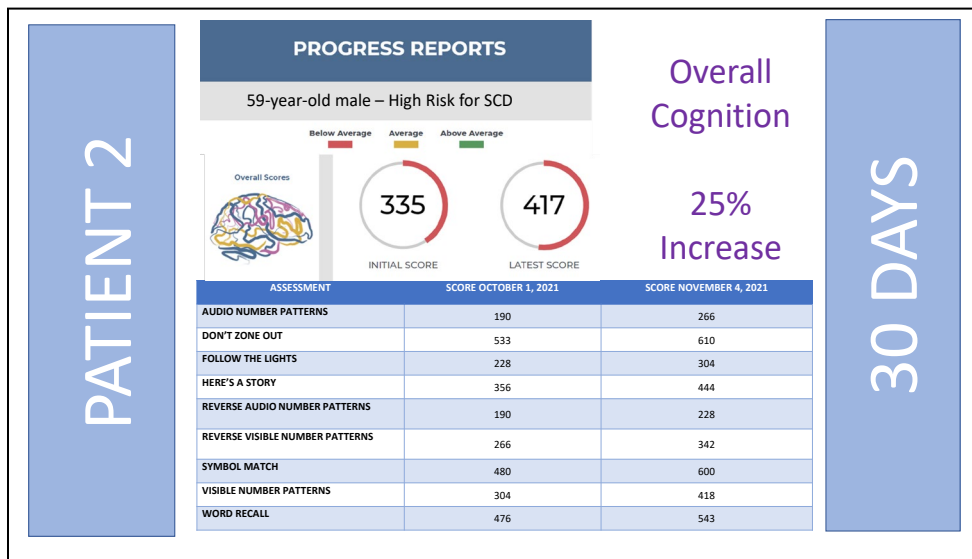
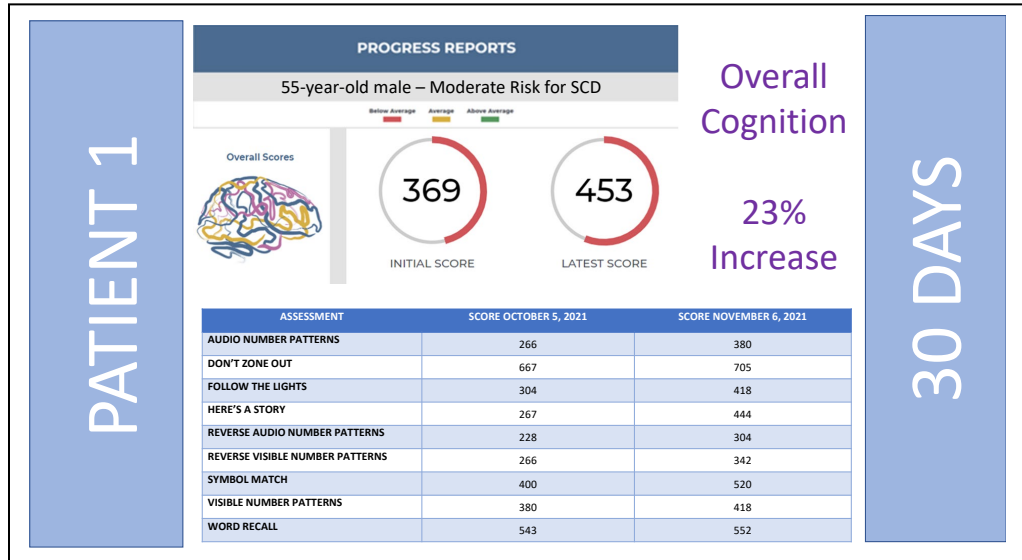
These mixed messages cause the resulting heart rate to be in a constant state of fluctuation. When you have high heart rate variability (high coherence), it means that your body is responsive to both sets of inputs (parasympathetic and sympathetic). This is a sign that your nervous system is balanced, and that your body is very capable of adapting to its environment and performing at its best.

Several studies have demonstrated that low heart rate variability, or low coherence, is associated with cognitive impairment, increased risk of Alzheimer's disease and dementia. Whereas high coherence was associated with higher performance on memory assessments and greater academic performance^{13,14,15}.

In this study, each individual utilized the CerebroCore Breathing pacer to learn how to increase their heart rate variability to achieve high coherence. The participants used the pacer at least 3 times per week for 15 minutes each time during the course of the 30 days.

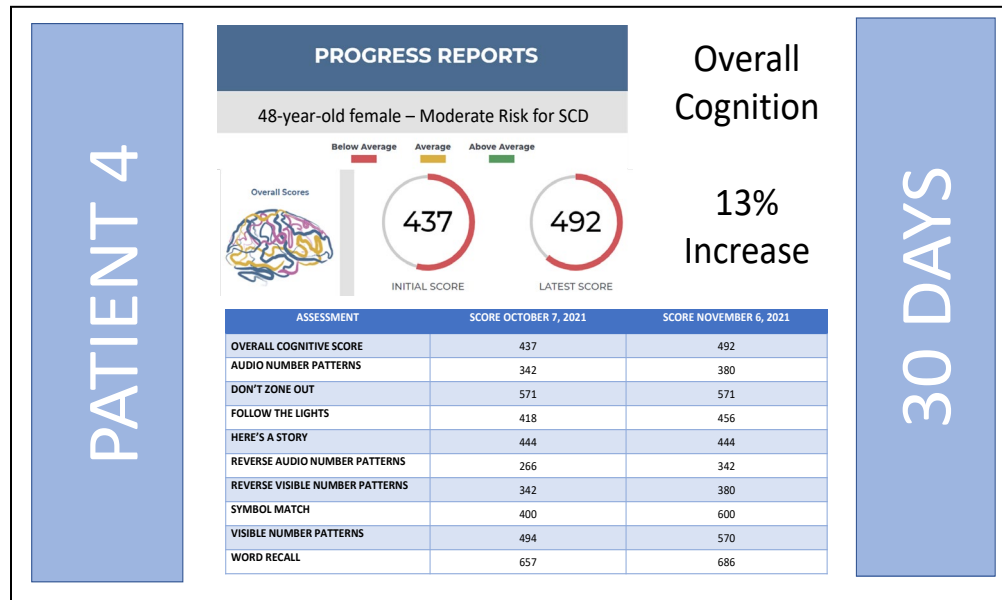
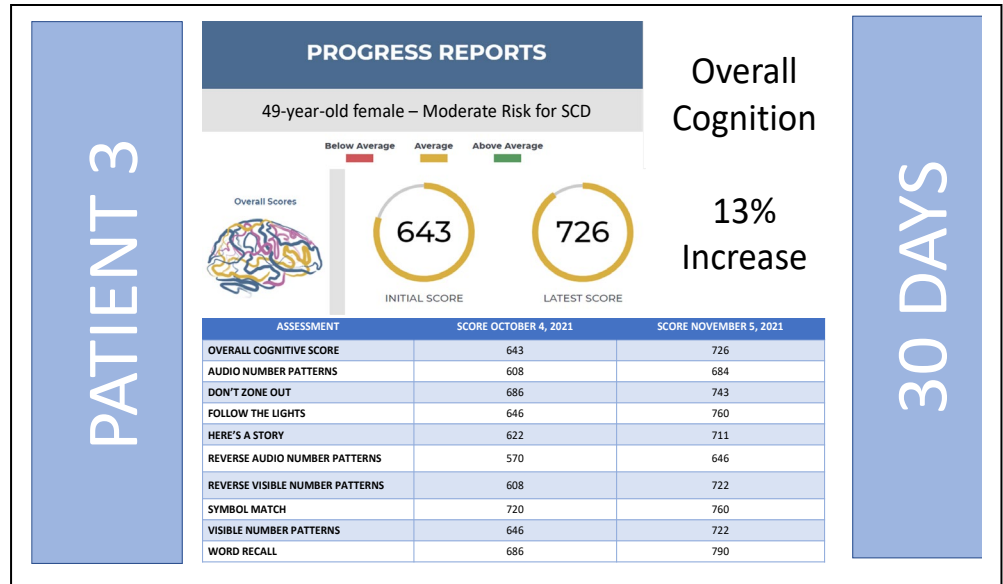
RESULTS

Patient 1 demonstrated a 23% increase in overall cognition and a 19% improvement on the Quick Cog



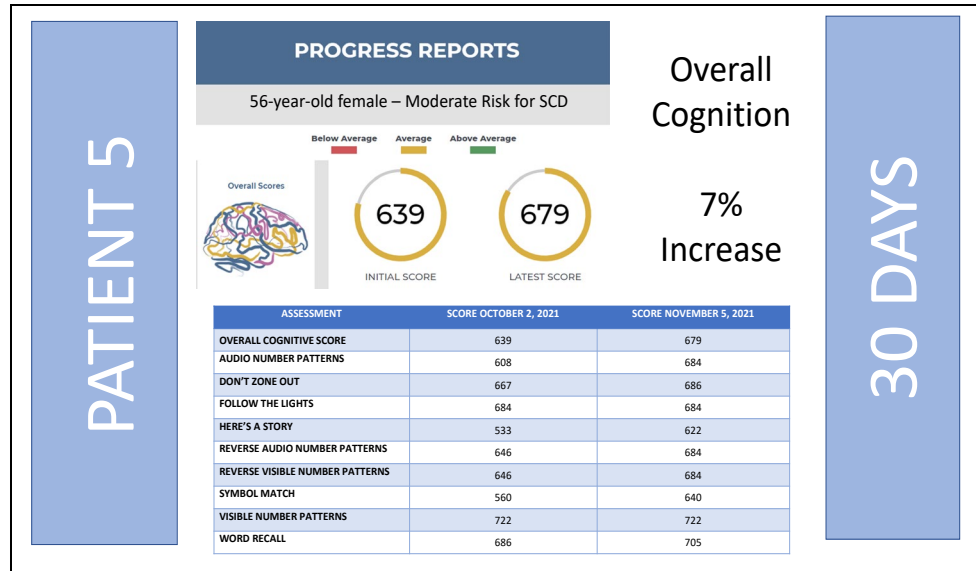
Patient 2 demonstrated a 25% increase in overall cognition and a 19% improvement on the Quick Cog

Patient 3 demonstrated a 13% improvement in overall cognition and a 25% improvement on the Quick Cog. This patient moved from a Moderate Probability for Subjective Cognitive Decline to a Low Probability.



Patient 4 demonstrated a 13% improvement in overall cognition and a 25% improvement on the Quick Cog.

Patient 5 demonstrated a 7% improvement in overall cognition and a 29% improvement on the Quick Cog. This patient moved from a Moderate Probability for Subjective Cognitive Decline to a Low Probability.



SUMMARY OF RESULTS

After 30 days of training with Gamma Brain Exercise and Coherence Training, their scores demonstrated a 23.4% improvement on the Quick Cog Assessment and a 16.2% improvement on the 9-part, interactive cognitive assessment. Two of the patients went from a moderate probability to a low probability.

DISCUSSION

A meta-analysis⁶ of longitudinal epidemiological studies of cognitively unimpaired individuals with SCD (with at least 4 years of follow-up data) found a future decline to dementia in 14% of individuals and a future decline to MCI in 27% of individuals. Based on this data, SCD could be an early indicator of future cognitive decline for some individuals.⁷ Long-term prospective studies^{8,9} in individuals who eventually went on to develop dementia, suggest that SCD occurs, on average, around 10 years before the dementia diagnosis.

Clinicians are faced with an increasing number of individuals who seek medical help because they experience a subjective decline in cognitive function. There is evidence that individuals with SCD are at a greater risk of future cognitive decline and dementia than individuals who are cognitively unimpaired and do not have subjective cognitive decline. SCD could also be the first symptom of incipient neurodegenerative disease.

The effect of subjective cognitive decline and brain training exercises on the gray matter of the brain

At present, a growing number of neuroimaging studies have suggested that patients with Subjective Cognitive Decline show atrophy of gray matter volume, degeneration of white matter fiber structure, in the frontal, lateral temporal, and parietal cortices¹⁶. In another study the authors examined 19 patients suffering with Subjective Cognitive Decline. They measured the volume of gray matter of different areas of the brain using MRI imaging. Then, those 19 patients did brain training exercises – specifically for episodic memory for 2 months. At the end of two months, they measured the gray matter again. They found significant increases of gray matter volume in the brain regions responsible for episodic memory (Hippocampus). Since the gray matter is composed of synaptic connections, This increase in gray matter volume represents neuroanatomical evidence that brain training exercises can result in neuroplastic changes in the brain¹⁷.

Combined, these studies demonstrate that individuals suffering with Subjective Cognitive Decline tend to have decreased volumes of gray matter in the brain, and that brain training exercises can increase gray matter volume in areas of the brain that are being trained.

CONCLUSION:

To our knowledge, this is the only study that examines the efficacy of Gamma Heart Rate Variability (Coherence) Training and Gamma Cognitive Exercises on cognitive improvement. Based on the results of this study, these training modalities may have a significant positive impact on improving memory, attention and cognition.

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