Original Research Article

Clinical Study Report

Study Title

THE EFFECTIVENESS OF PROPRIOCEPTIVE FINE MUSIC MOTOR SKILL TRAINERS IN THE ACQUISITION OF FINE MUSIC MOTOR SKILLS

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Disclosure of Interests
Edwards and Denison are shareholders in Preceptive Neurosciences Pty Ltd, the company that developed the Proprioceptive Fine Music Motor Skills Trainers being evaluated in this study.

KEYWORDS: Motor Skills, Music Motor Skills, Proprioception, Proprioceptive Awareness, Proprioceptive Sensory Feedback, Fine Motor Skills

Details:

Protocol Number:	VP01062024.
Investigational product:	PROPRIOCEPTIVE FINE MUSIC MOTOR SKILL TRAINERS
Device classification:	IPC 61H, Low-Risk General Wellness Device, GMDN Code 6633
Manufacturer:	Perceptive Neurosciences Pty Ltd
Study dates:	30th April 2024 to 26th November 2024
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Result Summary

Students attended weekly Music lessons over the 12 week period. Lessons included Music Theory, Music Notation and Practice playing the Decant Recorder. Actual Recorder practise was for approximately 15 minutes per week.
The Active Group, (who used the enhanced Proprioceptive Fine Music Motor Skill Trainers), outperformed the Control Group (not using proprioceptive fine music motor skill trainers) on every Musical challenge.

The students in the Active Group scored an average of 16.35% higher scores across all challenges than the students in the Control Groups. Gains in Musical Skills by the Active Group over the Control Group in individual challengers, ranged from a minimum of 106.5% to a maximum of 146.4%.

As the difficulty and complexity of the music challenges increased in the second half of the study, compared to the first, Students for the Active Group accommodated the increasing musical difficulties and complexities, 56% better than those in the Control group.

Introduction

Learning to play a musical instrument without having to look at your fingers to know where they are on the instrument involves the creation of a Fine Music Motor Skill in the mind of the player. A Motor Skill is a skill or ability we acquire through practice, repetition and rehearsal.

Fine Motor Skills refer to skills involving the small muscle groups and joints of the fingers and hands, use in drawing, cutting out and manual manipulation of small objects, while Gross Motor Skill refer to skills involving the larger muscle groups and limbs used in running, jumping and in many sporting activities.

Motor Skills are memories of how we execute complex sequences of actions and activities and contain all the information that the body and mind need to execute the action with minimal conscious contribution or effort.

Such memories are referred to as Procedural memories, which are created, stored and recalled quite differently from memories of facts and knowledge we may learn. Factual memories are referred to as Declarative Memories.

The purpose of a Fine Music Motor skills is to be able to undertake the dexterous finger and hand movements necessary to create the chords and notes on stringed, wind and keyboard musical instruments, without having to look at your fingers to know where they are on the instrument.

Without this skill, a player will be limited in what they can achieve. They will be unable to read sheet music, limiting their repertoire to the few tunes they can remember. They will be unable to watch teachers, other musicians or their audience while playing, greatly limiting their scope for musical growth and success.

Objectives of the study

The primary objective of this study was to monitor and assess student's progress in the acquisition of Fine Music Motor Skills and to determine whether the use of Proprioceptive

Music Motor Skill Trainers provided measurable benefits in an Active Group when compared to the Control Group, who undertook the same program without the use of the Proprioceptive Fine Music Motor Skills Trainers.

None of the students had previous experience or tuition with the Recorder and were consider naïve to the music challenges presented.

About Music Motor Skill Trainers

Proprioceptive Fine Music Motor Skills Trainers are an innovation by Perceptive Neurosciences Pty Ltd, a small, privately owned, Australian Neuroscience company active in the development of low-cost, drug-free, easy-to-use, General Wellness devices, designed to enhance and strengthen Proprioception, Proprioceptive Sensory feedback and Motor Skills.

The Trainers are skin adhesive devices that are placed over the fingers and thumbs, with the circular sections aligned with the interphalangeal joints of the fingers and thumbs. As the fingers are moved during musical instrument practice, the Trainers stimulate special force sensing organs, known as Proprioceptors, located in and around the muscles, tendons and skin of the finger joints.

This stimulation enhances the flow of sensory information from the Peripheral Nervous System to the Motor Learning centres (Motor Cortex) of the Central Nervous System to enhance the fidelity and quantity of proprioceptive sensory feedback, leading to stronger motor memories that require less practice and effort to develop strong, life-long Fine Music Motor Skills.

The present study set out to clinically evaluate the level of functional benefit provided by the use of Proprioceptive Enhanced Music Motor Skill Trainers, in an Active versus Control study into the Acquisition of Music Motor Skills while learning to play the descant Recorders by naïve Year 3 Music students at a local, public primary school in Perth, Western Australia.

Investigational plan

The plan was to seek collaboration with a typical Australian primary school and a highly experienced and well qualified music teachers to assist in the design and execution of the Study Methodology.

One of our team, Mr G Denison, was well acquainted with Mrs J Ewers, a professional music teacher with over 30 years of teaching experience in primary schools and private teaching environments. Mrs Ewers recommended that we approach a school where she would be teaching Year 3 Primary School students the decant Recorder, in the following school term. The school's Principal kindly agreed to support the study.

Student groupings

The study commenced with the Year 3 class of 21 students. All students were provided with a Parent Informed Consent Form containing full disclosure of the proposed study and details of the Music Motor Skill Trainers that would be used by students assigned to the Active Cohort.

13 of the 21 students provided a signed Parent Informed Consent Forms. Those 13 students were assigned to the Active Groups, who would undertake the program using the Proprioceptive Music Motor Skill Trainers during each music lesson over a 12 week period..

The remaining 8 students, who were not able to provide a signed Parent Informed Consent Form, were assigned to the Control Group, who would attend the same music lessons, without the use of the Proprioceptive Fine Music Motor Skills Trainers.

During the course of the study, 5 students were unable to complete the full set of challenges, due to absenteeism, family relocation and illness typical in such school groups, and were eliminated from the final analysis. As a result, the final student participation numbers were 10 students in the Active Group, and 6 students in the Control Group.

Participant disposition:

All students were from the Year 3 co-educational, Primary School class at a working-class suburban, public Primary School, in Perth, Western Australia.
The school's catchment area was 5 kilometres from the Perth CBD and has a median age of 36 years.

21% of households have at least one primary-school-aged child.
The average weekly income is AU$ 1,866 (US$1,179 per week).
38% of households had at least one parent born overseas.
24% of households speak another language other than English at home.
33% of the students were fluent in at least two languages, several fluent in three languages.

Study methodology

The methodology used to determine the students' progress in Fine Music Motor Skills Acquisition, involved the evaluation of each student's ability to:

Accurately place their fingers over the Tone holes of the descant Recorder, without looking at their fingers and while playing a sequence of notes to create a tune.

The Purity/ Quality of sound produced was a key performance indicator, as even the smallest of positional errors in sealing of the tone holes with their fingers produced a distinctive and discordant sound.

Their ability to remember the precise sequence of finger locations to play tunes of increasing complexity , difficulty and to varying beats without looking at their fingers.

These Music challenges draw heavily on the student's intrinsic proprioceptive and tactile senses to detect if any tone hole is not perfected covered, and their proprioceptive awareness that informed them of the location of their fingers on the instrument at all times, without looking.

Safety evaluation:

There were no adverse safety events or outcomes during the study. There were no other health issues reported.

Participation:

All 5 students who were excluded from the final analysis were eliminated simply by being unable to complete all the challenges in the study,. No students withdrew from the study due to any dislike of the study or the use of the Proprioceptive Music Motor Skills Trainers.

A survey of all students from the Active Group reported that using the Trainers was a fun, interesting and pleasant experience.

Performance evaluation

Performance Evaluation was undertaken by Mrs Ewers by careful evaluation of video evidence taken by her during each music class and each music challenge.

Challenges commenced at an early basic level and increased in complexity and difficulty thought-out the 12 week program.

students in the Active Group (With Trainer Group) scored an average of 16.35% higher scores across all challenges than the students in the Control Groups who undertook the Study without Trainers.

Interpretation of results

The raw data was evaluated by mean scores and the comparison of the Active versus Control groups

Of the 12 separate Musical Challenges, undertaken over the 12 week program, the Active Group scored greater mean scores than the Control Group in every challenge and at every evaluation event. The Gains by the Active Group over the Control Group ranged from a minimum of 106.5% to a maximum of 146.4%.

On the examination of student performance over time, and in the face of increasingly more complex and difficult music challenges, we find that students from the Active group, who performed poorly (scored below average) in the first half of the program improved their means scores by 42% more that Control Group in the second half of the program.

Discussion

The consistent superior performance of the Active groups in comparison to the Control group supports the proposition that Proprioceptive Fine Music Motor Skill Trainers enhance both the acquisition of Fine Music Motor Skills but also further enhanced Music ability performance over time.

Results

The result of this study support the proposition that the use of Fine Music Motor Skills Trainers does impact positively on the acquisition of Fine Music Motors Skills by as much as 42% when compared to Control.

The results also suggest that the use of Enhanced Proprioceptive Fine Music Motor Skill Trainers can extend the period of neural growth into the 8th year of life, when past wisdom suggested that peak neural growth occurs in infancy (Birth to 1 year of age) and declines substantially as we age. The result also suggest that as the difficulty and complexity of the music challenges increased in the second half of the study, compared to the first, Students for the Active Group accommodated the increasing musical difficulties and complexities, 56% better than those in the Control group.

Appendix 1

A glossary of Neuroscience Terms

- **Synapse:**
  The junction between two neurons where information is transmitted via chemical or electrical signals

- **Neuron:**
  The fundamental nerve cell responsible for receiving, processing and transmitting information

- **Neural connection:**
  The linkage between neurons formed by synapses that enable communication within neural networks

- **Neuroplasticity:**
  The brain's ability to adapt and reorganize by forming new neural connections in response to learning, experience or injury

- **Proprioception:**
  The body's ability to sense the position and movement of its parts, crucial for coordinated movement

- **Procedural memory:**
  A type of long-term memory that enables us to perform tasks without conscious thought, such as riding a bike or writing

- **Cognitive processes:**
  Mental activities including thinking, learning, memory, attention, problem-solving and decision-making.

- **Neurorehabilitation:**
  Therapeutic interventions aimed at restoring neurological function through targeted exercises, practice or stimulation.

- **Motor skill:**
  An ability we learn through practice and repetition that can be executed with minimal conscious thought or effort

- **Fine motor skill:**
  A motor skill involving the smaller dexterous muscles of the fingers and hand

- **Gross motor skill:**
  A motor skill involving the larger and more powerful muscles and limbs of the body used in propulsion

Appendix 2

The Effectiveness of Proprioceptive Training on Improving Motor Function: A systematic review

http://www.frontiersin.org/journal/10.3389/fnhum.2014.01075/abstract

OBJECTIVE:
Numerous reports advocate that training the proprioceptive sense is a viable behavioural therapy for improving impaired motor function. However, there is little agreement on what constitutes proprioceptive training and how effective it is. We therefore conducted a comprehensive, systematic review of the available literature in order to provide clarity to the notion of training the proprioceptive system.

METHODS:
Four major scientific databases were searched. The following criteria were subsequently applied: (1) A quantified pre- and post-treatment measure of proprioceptive function. (2) An intervention or training program believed to influence or enhance proprioceptive function. (3) Contained at least one form of treatment or outcome measure that is indicative of somatosensory function. From a total of 1284 articles, 51 studies fulfilled all criteria and were selected for further review.

RESULTS:
Overall, proprioceptive training resulted in an average improvement of 52% across all outcome measures. Applying muscle vibration above 30Hz for longer durations (i.e., min vs. s) induced outcome improvements of up to 60%. Joint position and target reaching training consistently enhanced joint position sense (up to 109%) showing an average improvement of 48%. Cortical stroke was the most studied disease entity but no clear evidence indicated that proprioceptive training is differentially beneficial across the reported diseases.

CONCLUSIONS:
There is converging evidence that proprioceptive training can yield meaningful improvements in somatosensory and sensorimotor function. However, there is a clear need for further work. Those forms of training utilizing both passive and active movements with and without visual feedback tended to be most beneficial. There is also initial evidence suggesting that proprioceptive training induces cortical reorganization, reinforcing the notion that proprioceptive training is a viable method for improving sensorimotor function.