Title: Rhythm & Able

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Background

The Ronnie Gardiner rhythm and music (RGRM) method is a music-based movement therapy incorporating aspects of gross bilateral movement, rhythm, colours (visuals) and sound (www.ronniegardinermethod.com). It has been applied in a wide range of movement disorders (e.g. stroke, PD etc.) due to being an engaging and customisable treatment. Through gradual learning of a simple musical scoring system, individuals are expected to link tailored movements to rhythm, colours indicating laterality (i.e. red for left, blue for right) and symbols thus providing a complete brain 'workout'. This coordinated effort is expected to improve functional re-connectivity by enhancing cross-cortical pathways between disparate brain areas e.g. Occipital, M1, Parietal. However, RGRM is, as yet, not widely adopted due to requiring specialist training, with currently no real clinical evidence regarding its efficacy.

Aim

The aim of this study is to develop a virtual version of RGRM therapy specifically targeting recovery of grip function (in terms of control and strength). This will leverage a novel digital handgrip, GripAble, connected to mobile technology. Current virtual therapy involving GripAble involve modulation of attentional control to maximise motor recovery and retention. It is expected that Virtual RGRM therapy involving either one GripAble (or two handgrips for bilateral training) should have additional benefits in terms of increased neural coordination, engagement and intensity. Currently, RGRM is inaccessible to the most severely movement impaired patients, such as those bed bound or with extreme upper limb weakness due to stroke. It is expected that utilising GripAble in this context will enable more patients to interact with this type of therapy. In addition, a number of studies suggest that music can enhance a variety of cognitive functions, such as attention, learning, communication and memory, both in healthy subjects and in various patient groups.

Technology

GripAble is a hyper low-cost flexible handgrip for rehabilitation of grasp flexion and extension. It is a passive sensor-based technology promoting a) affordability thus targeting home based care and b) simplicity with the ability to be used independently by the patient. The core of the handgrip utilises a novel mechanism (patented) which enables flexible (iso-kinetic type) interaction, important for functional recovery of grip aperture control, prehension and extension. Despite there being a (flexible) transmission between hand and the force transducer, the handgrip is free from backlash and friction. This implies it is highly sensitive and therefore accessible across a wide variety of patients including the most severely affected patients (Rinne et. al 2015). To accommodate a wide spectrum of patients, both the compliance and size of the handgrip are adjustable. The 1D data related to grip force is wirelessly transmitted to a tablet PC whereby feedback is given through stimulating virtual therapy games (visuals, sound, reward etc.) alongside vibrotactile feedback from the handgrip itself.

The current version of the GripAble has been tested with over 100 acute stroke patients and over 100 healthy participants in various usability and feasibility studies. From this data we have found that the device enables access to mobile technology for even the most severely affected stroke patients (i.e. 89%

of patients with FM-short score of 0-4 could use 'GripAble+table' compared to 0% for tablet alone using finger swipe interaction) and there is significant user preference for flexible (compliant) interaction as opposed to using a completely rigid version of the device in an age-matched healthy cohort. Furthermore, we have so far developed five therapeutic tablet-based games that modulate motor function, attentional and cognitive load, and social interaction. We have funding to start (October) a 9 month project where a second prototype will be developed taking into consideration manufacturability and user experience. An inertial measure unit (IMU) will also be added at this stage so that more proximal arm movements can also be tracked.

Project scope

This will be a software development project with the student expected to design a full virtual RGRM-based therapy involving (two) GripAble(s) and a tablet-PC. The game will be run within our GameAble framework, written in C# and running on the Unity framework. The game should have multiple levels of difficulty/complexity (including training levels) as this will increase accessibility and engagement. There is also scope to include additional sensors for full upper arm tracking if the student wants to develop hardware but game development will be the primary focus of this project. The student will be expected to develop the game in a patient-centric and iterative manner based on close collaboration with the clinical stroke research team at Charing Cross hospital. If possible a research passport will be obtained for the student so that they will be able to test their game (at various stages of development) within an acute stroke setting. If this is not possible, we have a clinical neuroscientist who will be able to perform most of the clinical testing.

Contact

If you are interested in doing a 6-12 month Masters level project in the above topic please email:

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