| Project Details | |
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| Project Code | MRC23NMHCa DaviesJ |
| Title | When we're too afraid to move: Using virtual reality and brain stimulation to understand excessively cautious walking in older adults |
| Research Theme | Neuroscience and Mental Health |
| Summary | Many older people become fearful of falling and develop excessive postural stiffening and cautious movement patterns. Paradoxically, this can serve to increase fall risk. This problem is thought to originate within the motor cortex through deficient intracortical inhibition. This studentship will explore this topic using state-of-the-art techniques including transcranial magnetic stimulation and virtual reality in older adults and people with Parkinson's disease |
| Description | The consequences of falls in older adults represent one of the most significant social and economic challenges in the developed world. There are many reasons why people fall. However, the majority of falls occur through unintentional slips and trips (Berg et al 1997; 10.1093/ageing/26.4.261); errors that might have been avoided through improved movement planning and/or execution. Fear of falling is as a major contributor to falls, partly because it often causes people to adopt excessively cautious movement patterns. These 'stiffening strategies' are both inefficient and lead to stepping errors. People even stop visually scanning their intended path, meaning that they are ill-equipped to deal with upcoming stepping hazards (Young & Williams 2015; 10.1016/j.gaitpost.2014.09.006). We (Young) have previously proposed that overly cautious gait emerges when an individual is not able to inhibit the conscious processing of stepping movements. This is supported by evidence that older adults with poor ability to inhibit a prepared movement were more likely to exhibit characteristics of cautious gait (Ellmers et al 2001; 10.1093/ageing/afaa230). Inhibitory networks within the motor cortex (M1) contribute to volitional inhibition of a prepared movement of the hand (Coxon et al 2006; 10.1152/jn.01334.2005). However, it is not known whether these networks contribute to volitional inhibition of movements such as walking or stepping, and whether they are involved in the expression of overly cautious walking behaviour. The impact of fear and anxiety is pervasive across patient groups. Fear is known to be a particular problem for people with Parkinson's disease, especially those with a specific pathology known as 'freezing of gait' (the feeling that one's feet are glued to the floor). In these patients, anxiety is known to exacerbate freezing symptoms, often culminating in observable 'knee trembling'; thought to represent defective and uninhibited attempts to produce anticipatory postural adjustments required to initiate walking. As such, the inhibitory networks in M1 may also play a key role in specific neurodegenerative pathologies. The key research question of this studentship is therefore "Is anxiety-related overly cautious walking behaviour in older adults associated with the responsiveness of inhibitory networks within M1?" This will be evaluated through four specific objectives: (1) Develop an ecologically valid task to evaluate the inhibition of prepared movements relevant to walking (akin to aborting a pre-planned step); (2) Evaluate whether inhibitory networks within M1 contribute to volitional inhibition of the prepared step in no-go trials; (3) |

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| | Evaluate whether impaired inhibition within M1 is associated with gait characteristics indicative of cautious walking behaviour in older adults under conditions of low and high anxiety; (4) replicate objective 2 in the specific cohort of people with Parkinson's disease and freezing of gait. Inhibition within M1 will be evaluated using transcranial magnetic stimulation (TMS), a type of non-invasive brain stimulation that can be used to probe cortical processes with high temporal resolution. We (Davies) have developed and validated a system that allows TMS during upright balance and walking. This is integrated within a gait real-time interactive laboratory that provides a unique and highly valuable system with which to experimentally manipulate postural threat and probe the effects of this on the control of movement. The system can deliver single- or paired-pulse TMS at a consistent location over M1 at defined points in a task, and the response to this stimulation can be measured using surface electromyography. The response to paired-pulse TMS indicates the responsiveness of inhibitory networks within M1. With guided support, the student will take ownership of the approaches used to evaluate inhibition of prepared movements and experimentally manipulate anxiety. |
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