EVALUATION OF HAND FUNCTION TRANSPORTING FRAGILE OBJECTS: THE VIRTUAL EGGS TEST

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ABSTRACT

The evaluation of the hand function is of great importance in both clinical practice and research activities. Assessment tools are essential to provide the therapist or investigator with relevant and objective information concerning the patient status, the effectiveness of the treatment program and the assistive technology prescribed. This abstract presents the design and the administrative instructions of a new hand assessment test: the *Virtual Eggs Test* (VET), that resembles the task of transporting fragile objects. The test builds on investigations on pick and lift tasks, showing that humans exert on objects grip forces (GF) that are sufficient to prevent slips, and yet are not so excessive as to crush a fragile object. While grasping humans apply GF and load forces (LF) in coordination, which is disrupted when sensory information from the fingertips is lost. The VET replicates the box and blocks test except that breakable blocks are used instead of the standard wooden ones (Figure 1a). The performance is measured by the number of blocks transferred and percentage of blocks broken during 1 minute trials.

We designed two assessment instruments for this test that may be used depending on the performance that have to be recorded: the *magnetic Virtual Egg* (mVE), and the *instrumented Virtual Egg* (iVE). In the mVE (Figure 1b), empty blocks (40x40x40mm, ~80g) are equipped with a magnetic fuse which exploits the attraction force between two magnets to maintain a fixed distance between two opposite walls of the block. When a GF larger than the attraction force between the two magnets is exerted on the object, the walls collapse and the object "breaks". The iVE (Figure 1c) enriches the assessment power of the mVE by measuring the GF and LF. This allows to evaluate (i) the ability to modulate the GF and (ii) the rate of temporal GF-LF coordination. The iVE is a test-object (57×57×57mm; variable weight from ~180g up to 340g) equipped with two strain gauge-based force sensors, able to measure the GF. An additional sensor is placed on the base of the test object, acting as a stand able to measure the LF of the test-object when it is resting on it. If the subject generates a GF larger than the threshold, the instrumented object virtually breaks; this may be signalled to the subject through an acoustic signal, coloured light and/or short vibration. Data are recorded and transferred using a wireless protocol to the PC.

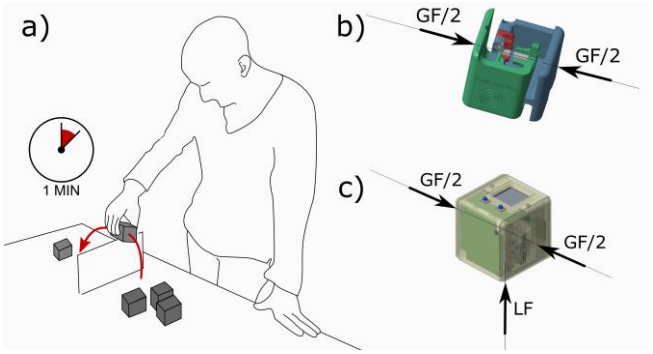

Figure 1- a) subject performing the VET, b) the *magnetic Virtual Egg* (mVE), c) the *instrumented Virtual Egg* (iVE).

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