Motor abilities in individuals with ADHD

Thank you to everybody who took part. In this study, we investigated motor ability in ADHD. The literature states that approximately 50% of children with ADHD present a severe motor impairment. We were interested in whether this is part of ADHD or whether it reflects a co-occurring motor deficit in some children with ADHD (which is not specifically part of ADHD). In doing so, we have also been able to outline the strengths and weaknesses within the motor domain, for children with ADHD.

Study 1: Motor measures, including the Bruininks-Oseretsky Test of Motor Proficiency (BOT2: SF) and Motor Milestone Measures.

The BOT2-SF was used to determine the fine and gross motor skills of children with ADHD. The test battery includes three fine motor and five gross motor subtests. With reference to the three-fine motor sub domains, Fine Motor Precision comprises of two tasks. These are: the Crooked Line Task in which participants are asked to draw a line through a path from a picture of a car to a picture of a house; and the Folding Task where a piece of paper has to be folded on the designated lines. The Fine Motor Integration task includes the Star and Square task. Here participants are asked to copy a picture of a star or square on paper with a red pencil. Manual Dexterity comprised of the Transferring Pennies Task. In this task participants must pick up plastic pennies and move them from one hand to the other, to be dropped into a pot (*Figure 1a*).

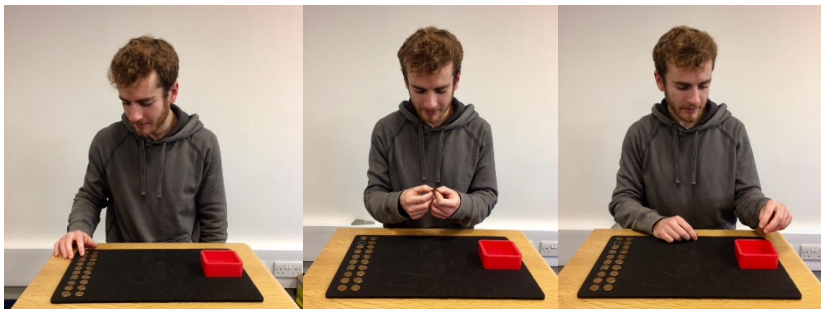

Figure 1: **a) The Transferring Pennies Task**

There were five gross motor subtests. To measure Bilateral Co-ordination, first participants tap their fingers and feet on the same side of the body at the same time to a rhythm. Second, in the Jumping Task, they are required to put the same arm and leg in front/behind them and jump, switching the arms and legs around so the other arm and leg are in front. Upper Limb Control involves the dropping and catching of a tennis ball five times. In the Dribbling Task a ball is dropped with one hand, and then dribbled with alternate hands ten times (*Figure 1b*). Balance was another subtest; participants balance on a beam on one leg for 10s while looking at a red target at eye level ten feet in front of them. Running Speed and Agility includes the Hopping Task and a Walking on Line Task. Finally, Strength consists of the Sit-Ups Task for 30 seconds and the Knee Push-Up Task, for 30 seconds.

The second motor measure was the motor milestone achievement questionnaire. Research with atypical populations has highlighted that early motor impairments can result in downstream impairments in the motor domain, but also in other cognitive domains. We were interested in whether children with ADHD who have a motor impairment, displayed motor difficulties in infancy. We measured this by asking parents when their child achieved specific motor milestones, like learning to walk. Parents were given a list of motor milestones and were asked what age their child was in months when these milestones were reached.

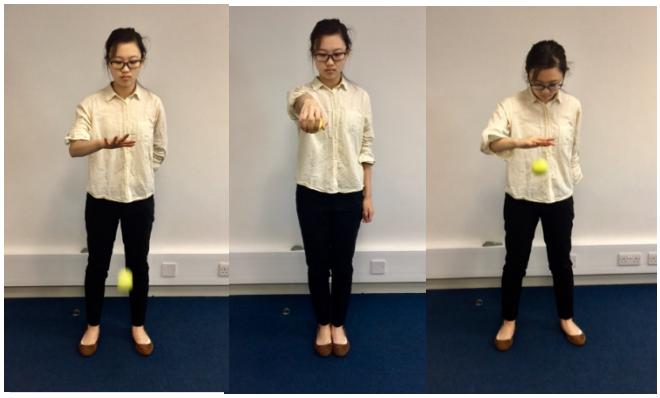

Figure 1**: b) The Dribbling Task**

Results.

We worked with 52 children with ADHD, and for various reasons the data from some children was excluded. The data from 39 of the group are presented here. Of this group, 44% presented with a severe motor impairment as measured by the BOT2. The BOT2 provides zones of ability. These are labelled: well below average ($\leq 2^{nd}$ percentile); below average (3^{rd} to 16^{th} percentile); average (16^{th} to 83^{rd} percentile); above average (84^{th} to 97^{th} percentile); and well above average ($\geq 98^{th}$ percentile). *Figure 2* illustrates the BOT2 performance of the ADHD children that we worked with respect to the BOT2 zones. For subsequent analyses, we split the ADHD group into

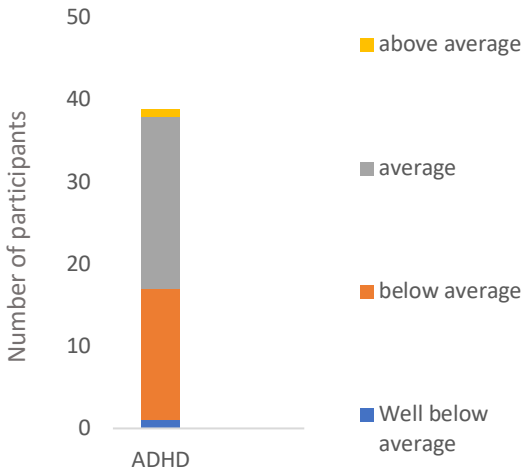

***Figure 2*: Distribution of BOT2-SF "zones" in the ADHD group as a whole.**

those with (ADHD-L) or without (ADHD-H) a severe motor impairment. The ADHD-L group were performing at the16th percentile or below on the BOT2-SF. The ADHD-H group scored above the 16th percentile.

Both groups differed in motor ability but displayed the same motor profile of relative strengths and weaknesses. That is both ADHD-L and ADHD-H groups had stronger performance for Upper Limb Coordination, Manual Dexterity and Fine Motor Precision, compared to relatively weaker ability in Bilateral Coordination and Running, Speed and Agility (*Figure 3).* The relative strength in Upper Limb Coordination and Manual Dexterity might relate to familiarity. For example, handwriting is something that becomes practised over time, resulting in a well-developed strategy. The practising of other motor skills can be more easily avoided, especially if children know they find certain actions hard. Individuals with ADHD achieved Motor Milestone within the same timeframe as children without ADHD. This was the case for both the ADHD-L and ADHD-H groups.

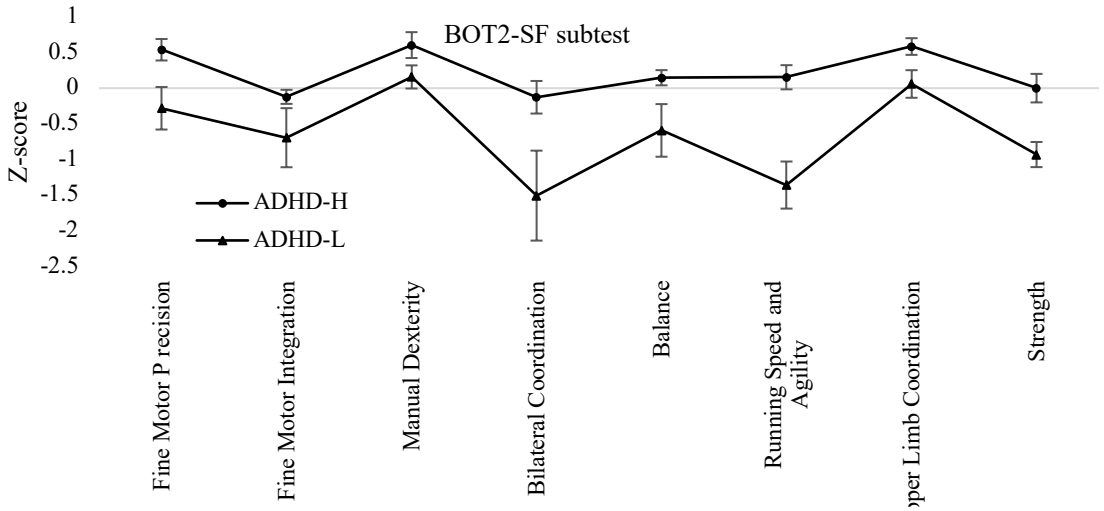

***Figure 4:* Profile of motor abilities in ADHD-L and ADHD-H groups: z scores based on the mean and standard error of TD children (matched for overall level of motor ability).**

To address whether motor impairments are part of ADHD symptomology, we first determined whether there were associations between motor performance and ADHD core characteristics. The majority of our measures of attention (this included the Conners 3 parent report) did not relate to motor ability in ADHD. That is, those with more severe motor impairments, did not have more severe attention and hyperactivity deficits suggesting that a motor impairment is not part of ADHD. However, we do not think that it is completely unrelated to ADHD. We hypothesise that the motor deficit present in a large sub group of those with ADHD is not the result of a primary motor deficit from infancy but is something that becomes apparent over time. That is, it is a cascading effect of initially more subtle impairments. Precisely what these impairments are, requires further research, but they might relate to attention in infancy or to very subtle aspects of the quality of motor movements.

Thanks again to everyone who was involved in the research!

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