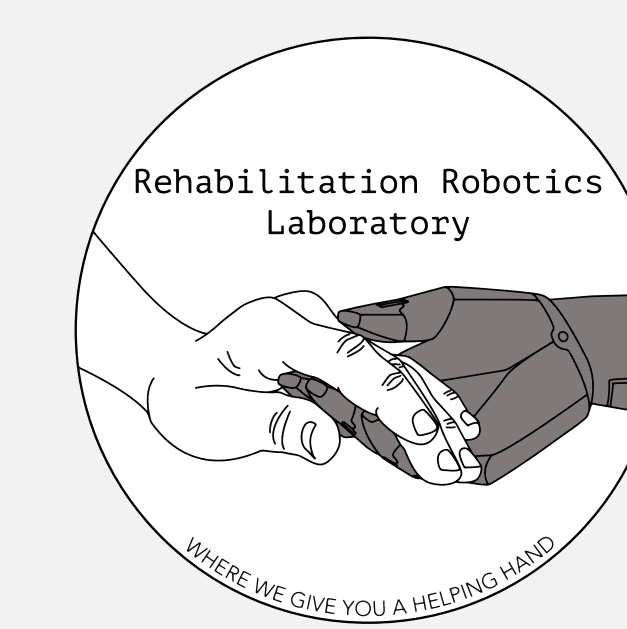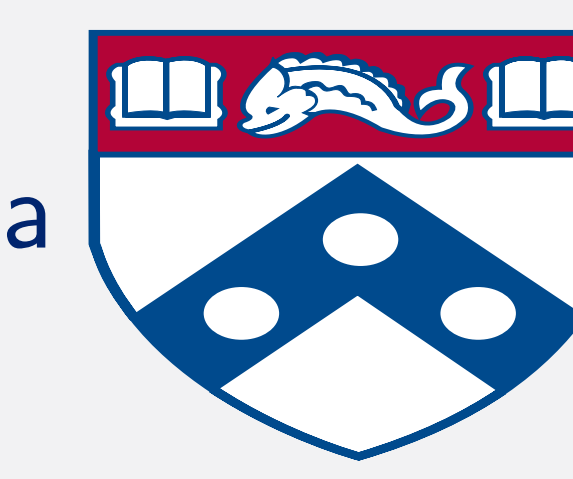# Can Ultra Low-Cost Social Robots Be Utilized as Assessment Tools of Upper Extremity Motor function?

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Social desktop robots could provide a low cost alternative of clinical assessments of upper extremity motion function.

Need for Low-Cost Alternate Systems of Motor Function Assessment

- Rural areas and third world countries are already facing a shortage of rehabilitation workers with developed countries soon to face a similar predicament due to a shift in demographics [1] [2].
- The utilization of robots as assessment and/or diagnostic tools has been employed to lessen the implications of this shortage, but the robots being used tend not to be low cost or easily commercial, and they also require immense rehabilitation knowledge[3].
- The goal of this project is to determine whether ultra low cost desktop social robots, like the Anki Cozmo, can ellicit valuable upper extremity movement that can be assessed for motor dysfunction.

Conclusions and Implications
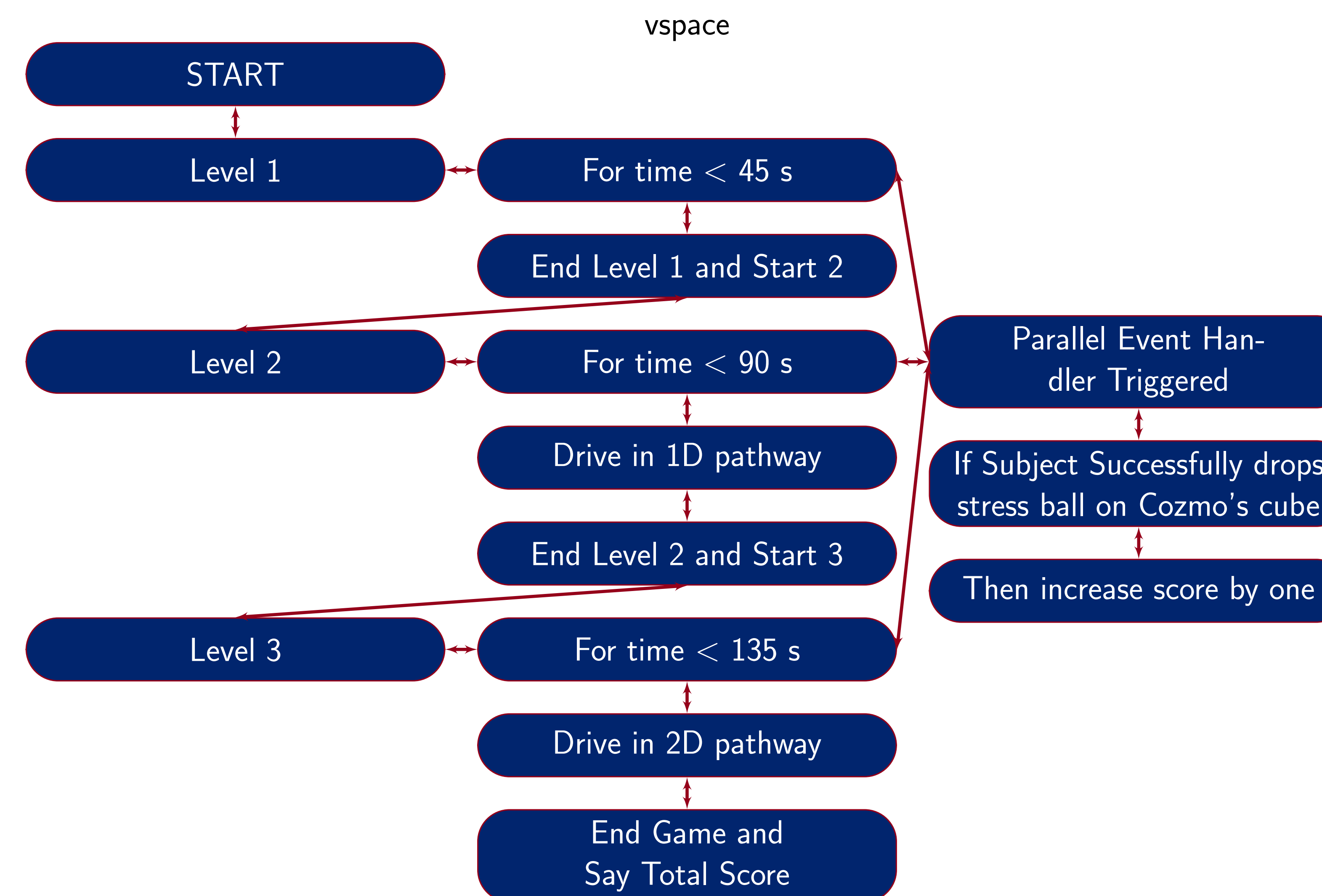
Looking at the data, we see that:

- The brace did succeed in impairing the arms as seen by the significant decrease in the range of scores from typical to impaired data in the box and block test.
- The game is successfully discriminatory within individuals as seen in the decrease of each subject's scores when braced. This implies that the interaction could be used to monitor progress during rehabilitation.
- There is significant correlation found between the box and block test score and the game score from the Spearman correlation test: .82.
- This result support the possibility of a predictive relationship between the two values. This predictive relationship would imply that interactions between subjects and social desktop robots could be developed further to become alternative UEx motor function assessment tools.

Directions for Future Research

- The interaction could further be developed to emphasize more reach and grasp motion. It can also include more social aspects of the desktop robots: the collaborative aspects of the robot-subject interaction could also be studied as whether it could provide valuable data that could be used as an assessment.
- This study can be further developed by testing the game on subjects with actual physical impairments. This could provide more information on how discriminatory the game is and how helpful the game scores would be to clinicians when performing diagnoses.
- There are other low-cost social desktop robots that could be studied, and we could also venture into trying to create games that could correlate with results from different clinical assessments other than the BBT.

Methods/Game Logic

Voluntary subjects wore weighted braces on their non-dominant hand and took a modified Box and Block Test(BBT) to stimulate impairedness and then after an hour took the BBT without the brace on their more dominant hand. The subjects also played the game with the Cozmo with their dominant hand and then played again with the weighted brace on their non-dominant hand.

vspace

Results

- Spearman's rank correlation rho
- data: bbt scores vs game scores
- $S = 10$, p-value $= 0.03413$
- alternative hypothesis: true rho is not equal to 0
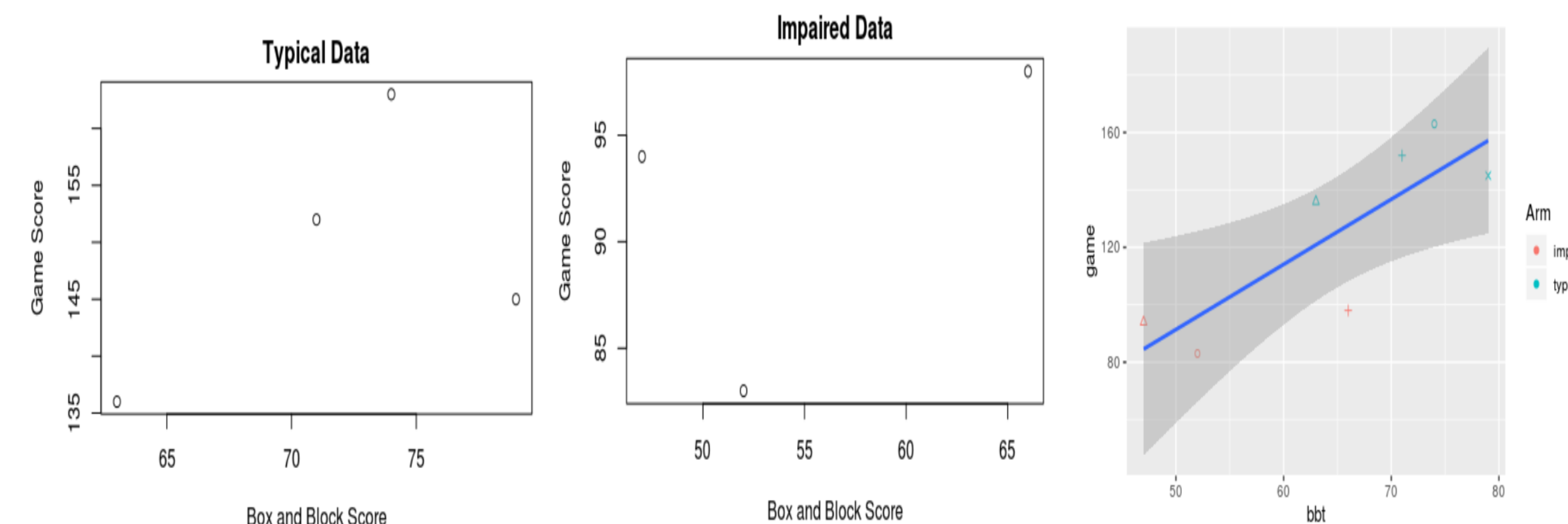- sample estimates: rho $= 0.8214286$

System

Attributes that make the Cozmo a good candidate as a rehab assessment tool are:

- The Cozmo is significantly low-cost compared to some clinical tests: average price of $139.99 to that of $200.00 for a Box and Block case.
- The Cozmo comes with sensorized cubes that can receive data that would be useful in rehabilitation assessment: motion parameters such as taps and shakes.
- The Cozmo has an in built camera that enables it to be aware of its surroundings. It also makes it incredibly social because of the facial recognition system that could be used to form relationships with users.
- It comes with in built activities that stress valuable upper extremity motion: reach and grasp motion.
- Comes with large API and public documentation making it comparatively easy to program.
- Long battery life.

References

References

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[3] S. Balasubramanian et al., "Robotic assessment of upper limb motor function after stroke," American Journal of Physical Medicine & Rehabilitation, 2012.

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