

The movements of children with autism can be faster or slower than their typically developing counterparts, depending on the task

Szu-Ching Lu¹, Philip Rowe¹, Christos Tachtatzis¹, Ivan Andonovic¹, Anna Anzulewicz², Krzysiek Sobota², Jonathan Delafield-Butt¹

¹Laboratory for Innovation in Autism, University of Strathclyde, Glasgow, United Kingdom; ²Harimata Sp. z.o.o., Kraków, Poland



1. Introduction

- **Disruption to intentional movement** is evident in autism spectrum disorders (ASD) [1] with atypical movement kinematics during purposeful tasks, but velocity differences have been **inconsistent**
 - Compared with typical developing (TD) children, children with ASD were **slower** to complete a point-to-point movement [2]
 - Adults with ASD performed **faster** horizontal arm swings than their typical counterparts [3]
- Are the kinematic features in ASD **task-dependent**?
- Objectives of this study
 - To quantify the **swipe kinematics** during **smart tablet gameplay**
 - To compare the movements between ASD and TD children **within different gameplay contexts**

2. Methods

- 37 ASD children (mean age: 4.5 years) and 45 age-matched TD children played two games on an iPad, and their **touch trajectories** were recorded [4]
 1. Sharing: the children were tasked to share the food pieces to four characters
 2. Drawing: the children were tasked to select an object, trace the lines, and colour the object
- Movement characteristics
 - For both games, **travelled distance**, **duration**, and **speed** of each swipe were computed
 - For the sharing game, the difference between the travelled distance and the **optimal distance** (i.e. the straight line) was also calculated
- **Mann-Whitney U tests** were used to determine kinematic differences between ASD and TD groups

Game 1: Sharing

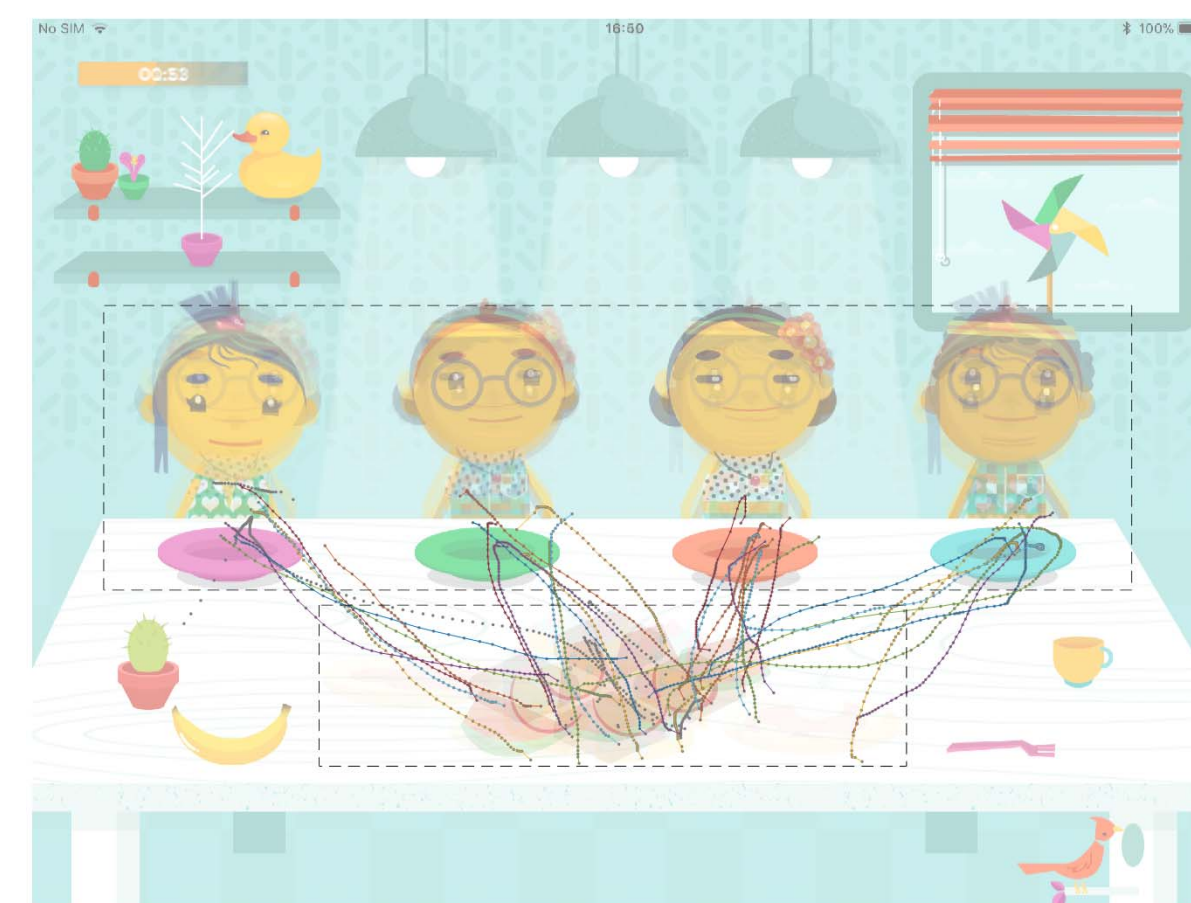


Figure 1. An example of food-to-target swipes from one ASD child (33 identified swipes)

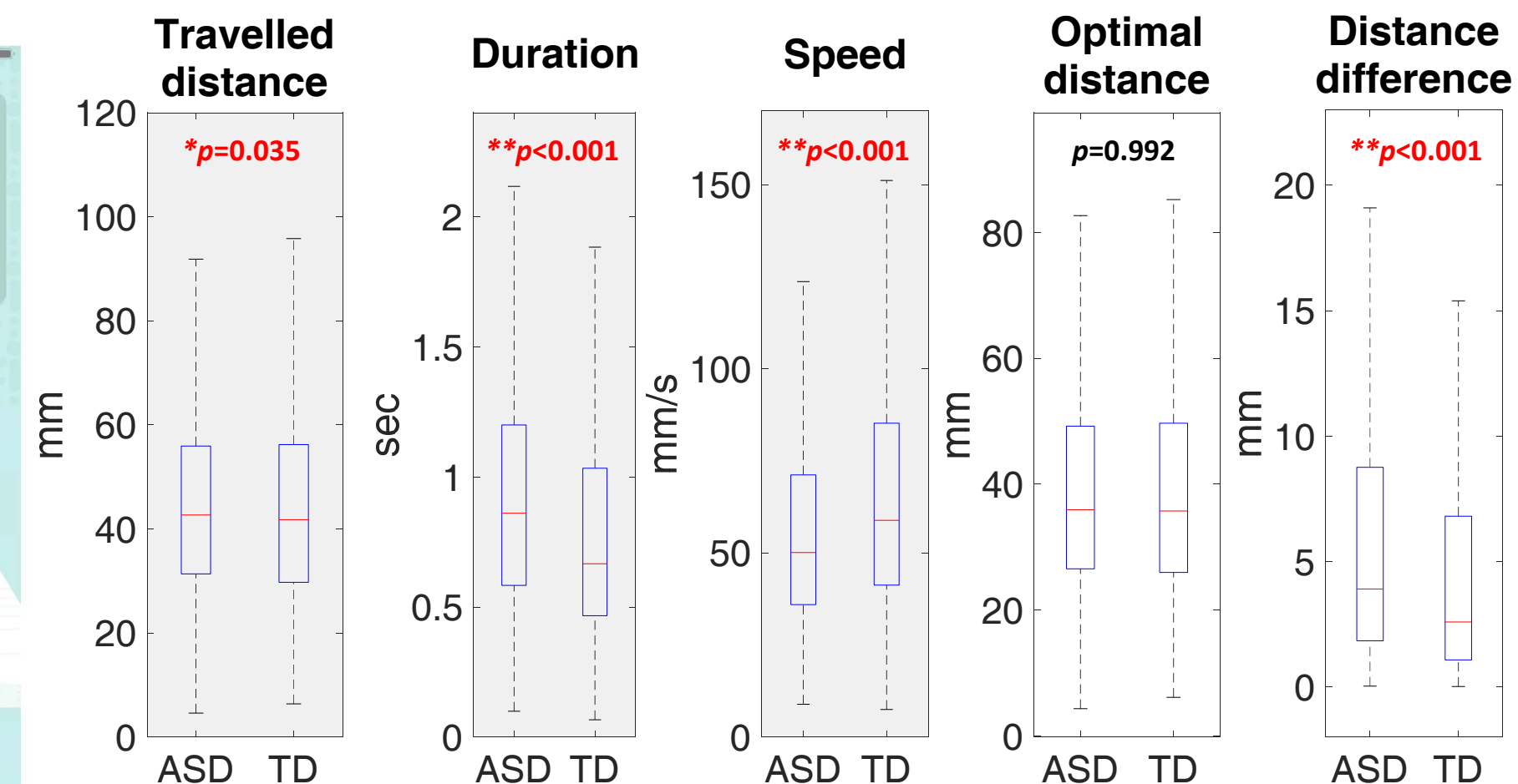


Figure 2. Boxplots and the comparison between the 1585 food-to-target swipes from the ASD group and the 3200 swipes from the TD group

3. Results

- Sharing game
 - A total of 1585 food-to-target swipes were identified in the ASD group while 3200 swipes were identified in the TD group
 - ASD performed **slower food-to-target swipes** than TD (median of 50.12 mm/s vs. 58.84 mm/s)
 - ASD **deviated from the optimal distance more** than TD (median of 3.9 mm vs. 2.59 mm)
- Drawing game
 - A total of 2793 swipes were identified in the ASD group while 3385 swipes were identified in the TD group
 - ASD showed **faster gestures during drawing** than TD (median of 81.77 mm/s vs. 60 mm/s)

Game 2: Drawing

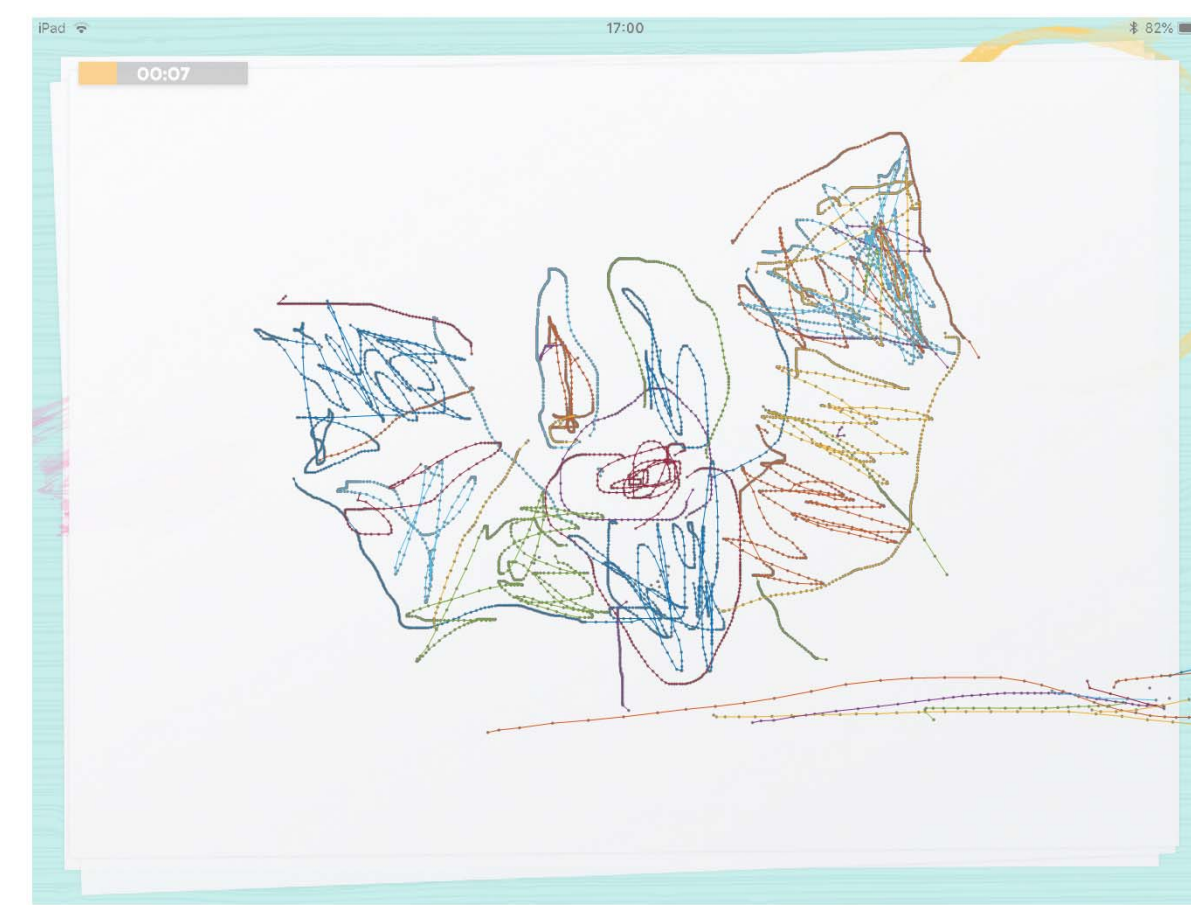


Figure 3. An example of swipe gestures from one TD child (45 identified swipes)

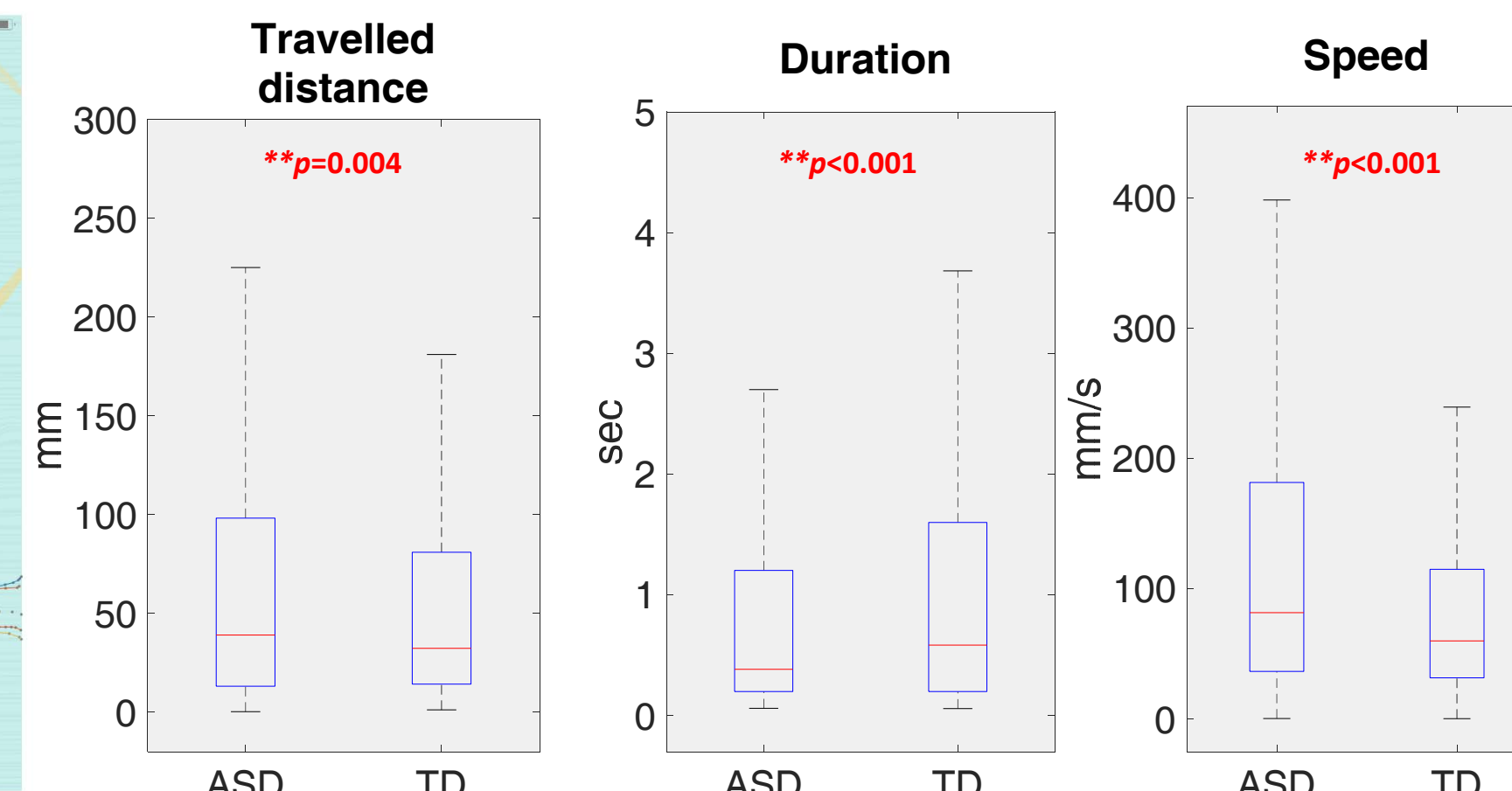


Figure 4. Boxplots and the comparison between the 2793 swipe gestures from the ASD group and the 3385 swipe gestures from the TD group

4. Conclusions

- This study compared the swipe kinematics between ASD and TD in two smart tablet gameplay contexts
 - ASD demonstrated **slower** movement than TD in a **goal-oriented** food-to-target task, deviating more from the optimal trajectory
 - ASD performed **faster** swipe gestures than TD in a **relatively unconstrained** drawing game
- The data of this study are the foundations to allow an understanding of **how movement is controlled in ASD within different contexts**
- The results of this study support the development of algorithms that enable the **early identification of ASD using smart sensors**

References

- [1] Trevarthen & Delafield-Butt (2013) *Frontiers in Integrative Neuroscience*
 [2] Dowd et al. (2012) *Journal of Autism and Developmental Disorders*

- [3] Cook et al. (2013) *Brain*
 [4] Anzulewicz et al. (2016) *Scientific Reports*