

CO-DESIGNING A NOVEL AND PERSONALISED SMARTPHONE APP TO REDUCE FALLS IN PARKINSON’S DISEASE

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BACKGROUND

- Parkinson’s Disease (PD) causes gait abnormalities such as slow speed and stride shuffling, which increases fall risk and lowers quality of life [1-2].
- Auditory cueing, such as metronome cueing has shown effectiveness in reducing gait abnormalities [3-4].
- Personalised methods are underexplored and current one-size-fits-all approaches fail to help roughly 50% of patients [5].

OBJECTIVES

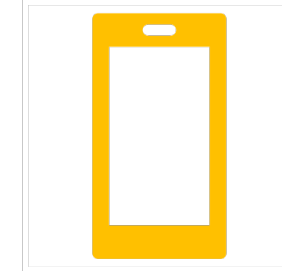
- Stage 1:**
- Develop an app within a proposed mobile smartphone-based system to retrain gait.
 - I. The app must provide real-time gait analysis and personalized auditory cues for a tailored intervention.
 - II. Validate the 1st version of the app in a group of younger adults
- Stage 2:**
- Conduct a focus group to:
 - I. Involve PwPD directly in the design process, ensuring the system meets their needs.
 - II. Assess the acceptance of tempo-altered music (without pitch distortion) and metronome cues.
 - III. To understand how well the system could fit in the daily lives and therapy routines of PwPD.

METHODOLOGY




Using

Using embedded sensors effectively as an Inertial Measurement Unit (IMU), to gather triaxial sensor data.



Developed

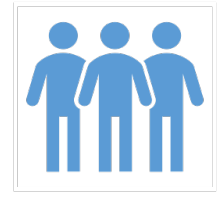
Developed a smartphone application that near real-time tracks gait characteristics using triaxial sensors.



Produces


Produces metronome that matches gait characteristics to deliver a more personalized approach to auditory cueing.

VALIDATION STUDY PROTOCOL




Participant Info

10 adults recruited (6F:4M, 27.4 ± 6.2 years, 79.6 ± 12.7kg, 174.7 ± 7.9cm)



Validation

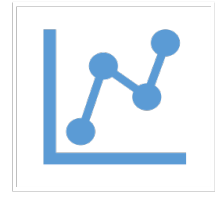
Gait characteristics from the smartphone compared to a reference standard IMU system (Opal, MobilityLab, APDM, sampling rate: 128Hz) attached to the talus joint of each foot.



Data Collection

Participants wore smartphones on lower back during two walking tasks:


1. At a self-selected pace
2. With a personalised metronome cue set at 10% faster than the first walk



Data Analysis


1. Clinically relevant gait characteristics measured via the smartphone app.
2. Data processed on a Python-based cloud server.
3. Gait metrics compared from smartphone and reference.

FOCUS GROUP PROTOCOL




Participant Info

8 older adults (7 with PD and 1 PD caregiver).



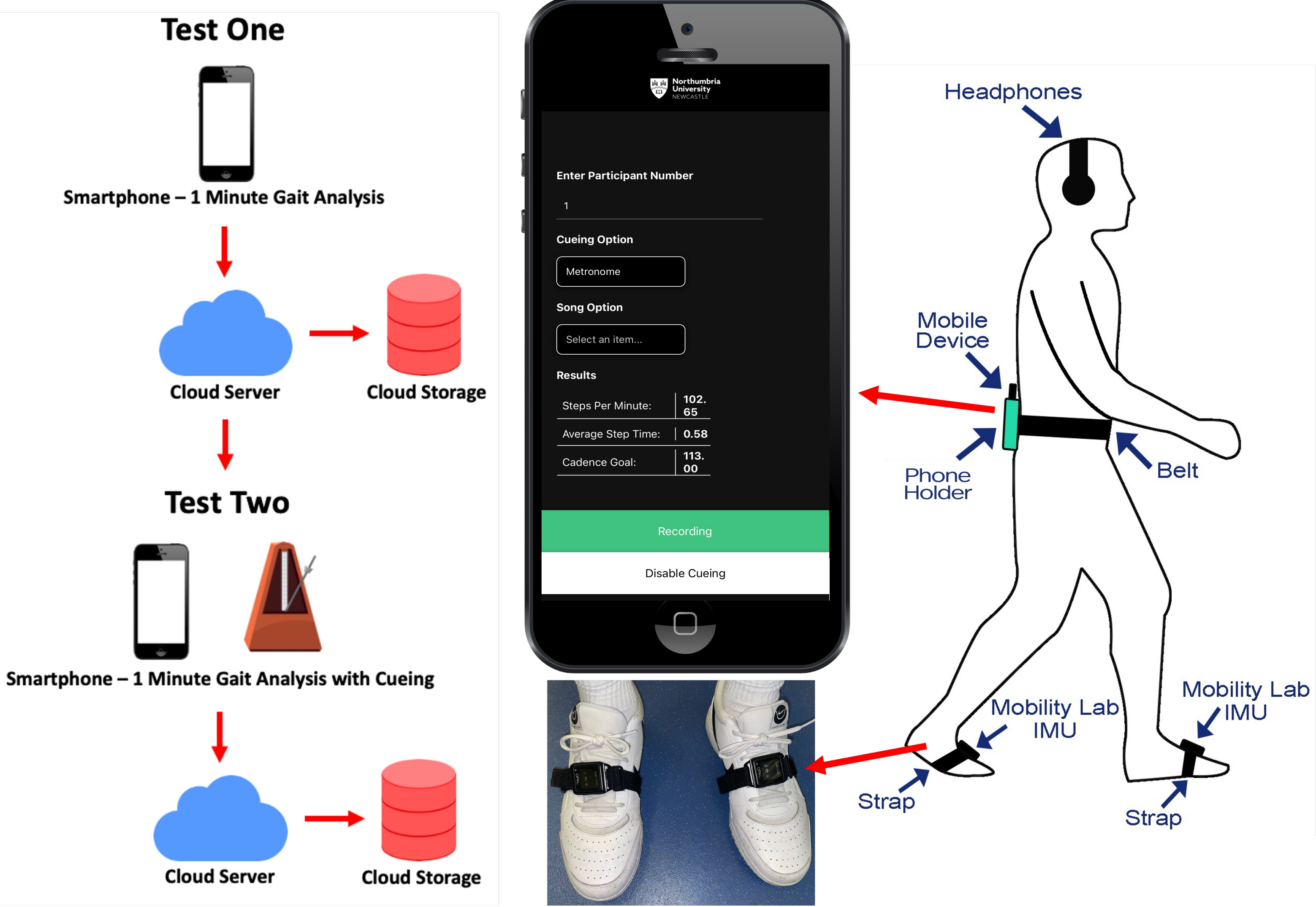
Structure

Semi-structured discussion for 1 hour 30 minutes.
Participants were shown several video demonstrations of the app and asked for their feedback.
Participants were also invited to discuss their daily lives and exercise habits.



Venue and Recording

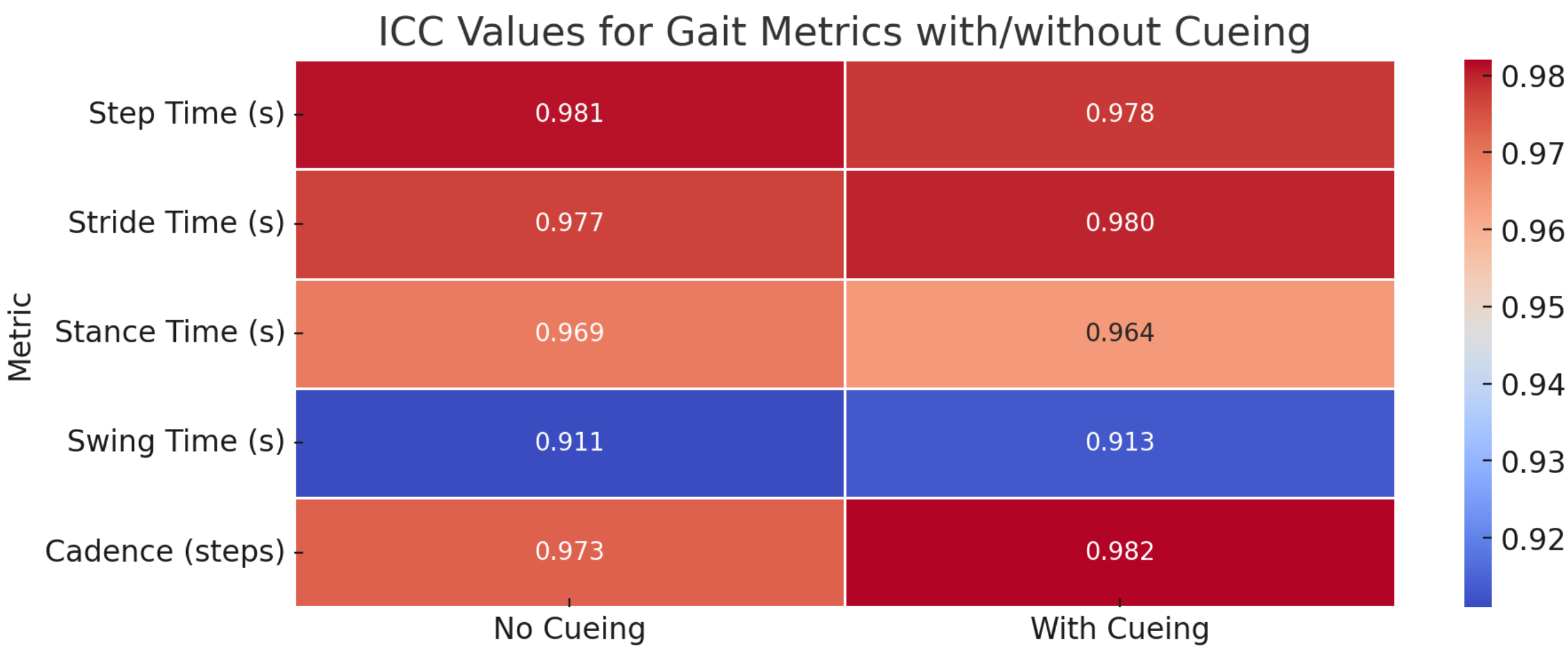
Focus group was held in room in Coach Lane Campus, Northumbria University, Newcastle Upon-Tyne and recorded using Dictaphone. Recording was subsequently transcribed verbatim.



RESULTS

VALIDATION STUDY

- Excellent agreement between the smartphone app and gold-standard reference (Intraclass Correlation ≥ 0.911 . Personalised cueing increased mean cadence by ~10%.



FOCUS GROUP

- Exercise in PD:
 - I. Walking is a key daily exercise for PwPD.
 - II. Music is integral to PD-specific exercises and rehabilitation.
- App Feedback:
 - I. Positive response to the app's potential to improve walking.
 - II. The +10% pace increase with enhanced music was favoured.
 - III. Smartphone placement on the lower back was not ideal.
 - IV. Pocket placement was favoured for accessibility.

DISCUSSION AND CONCLUSION

- Developed and validated a smartphone app for real-time gait assessment and personalised metronome cueing in young adults.
- PD-based focus group liked app and suggested demonstrated personalised cueing modalities (based on their own pace and mainstream music) is better than a traditional cue, but future work must reconsider wear location.

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