Data Analysis

CHISEL home trials data analysis

Database files

articaresLite_v2_CHISEL_HOME_P001.db

articaresLite_v2_CHISEL_HOME_P002.db

articaresLite_v2_CHISEL_HOME_P003.db

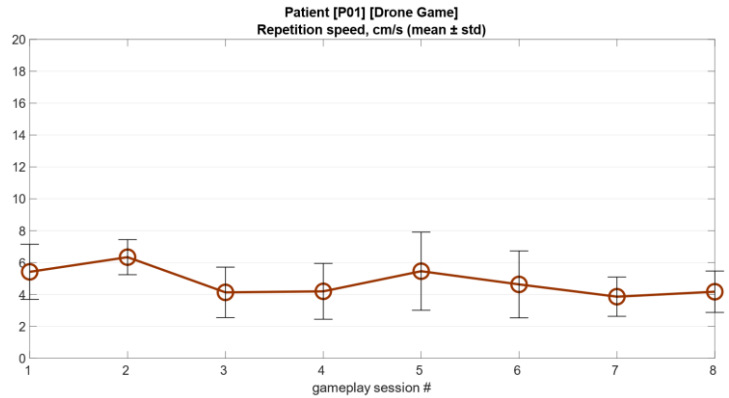
articaresLite_v2_CHISEL_HOME_P004.db

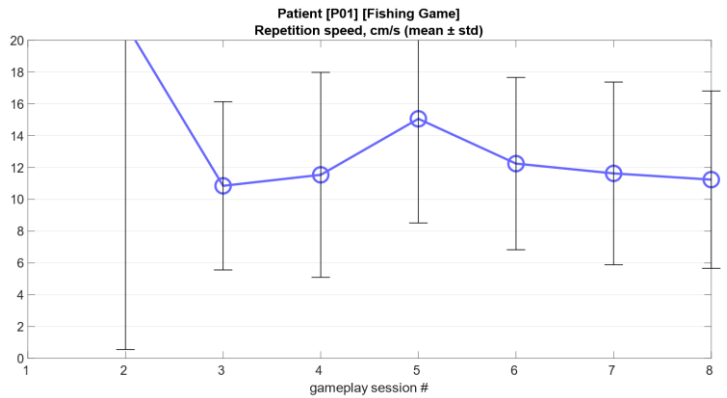
articaresLite_v2_CHISEL_HOME_P006.db

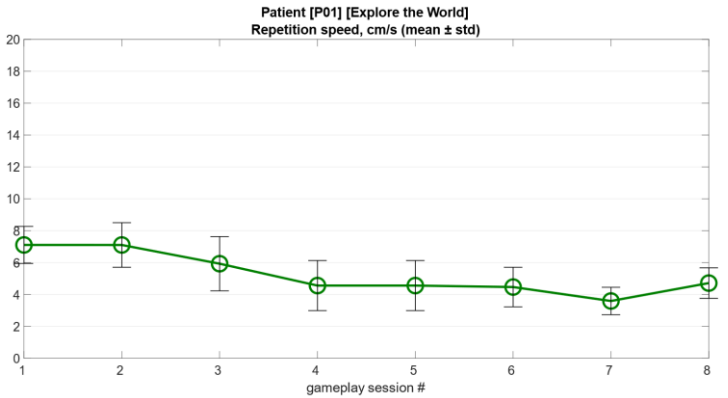
Analysis / Research Questions

Usage stats

- Usage stats for each game and total usage







Smoothness ('Coordination')

- Does SPARC tend to stabilize during gameplays?
- Does smoothness increase (SPARC less negative) as gameplays progress?

Velocity

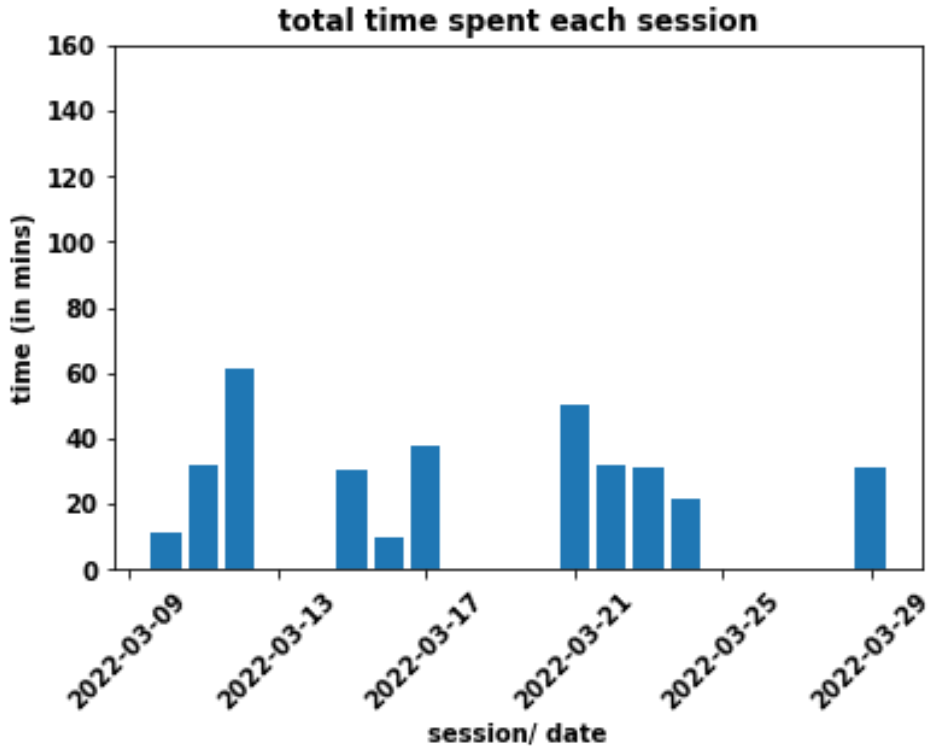
- Compare stats (TIME SERIES MEAN ± STD) for velocity for Explore the World, Fishing and Drone. In which game does the user move faster?

Metrics

- Usage
- Velocity
- Smoothness (‘Coordination’)

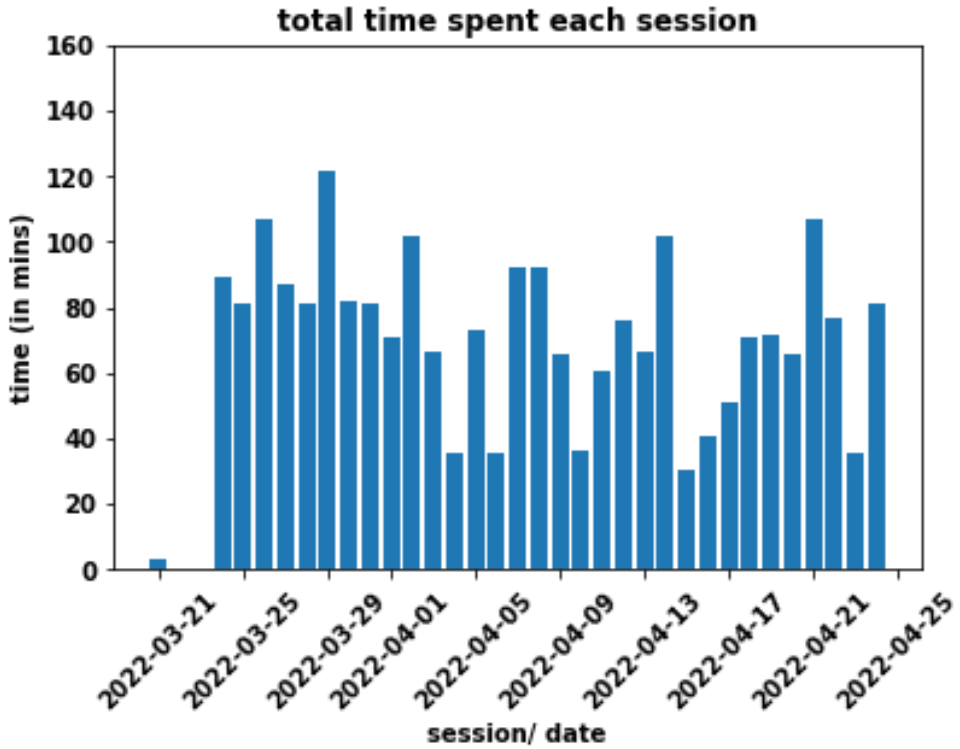
Usage (by day/date)

P001



total number of days played = 11 days
total time spent = 353.38 mins
(0 days, **5.00 hours**, 53.38 mins)

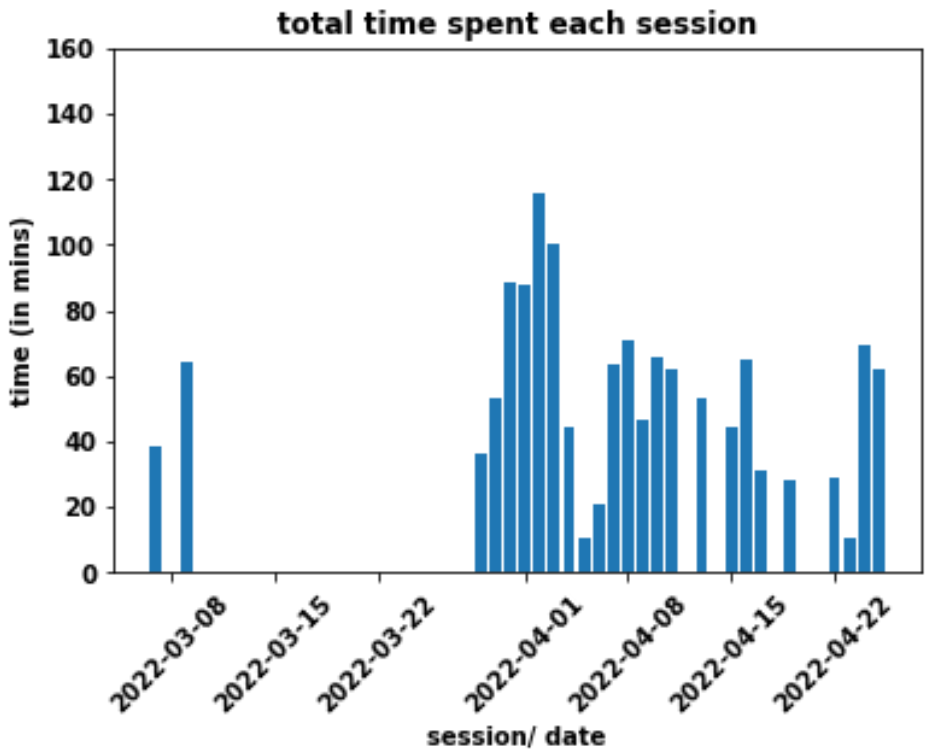
P002



total number of days played = 34 days
total time spent = 2355.78 mins
(**1 days, 15.00 hours**, 15.78 mins)

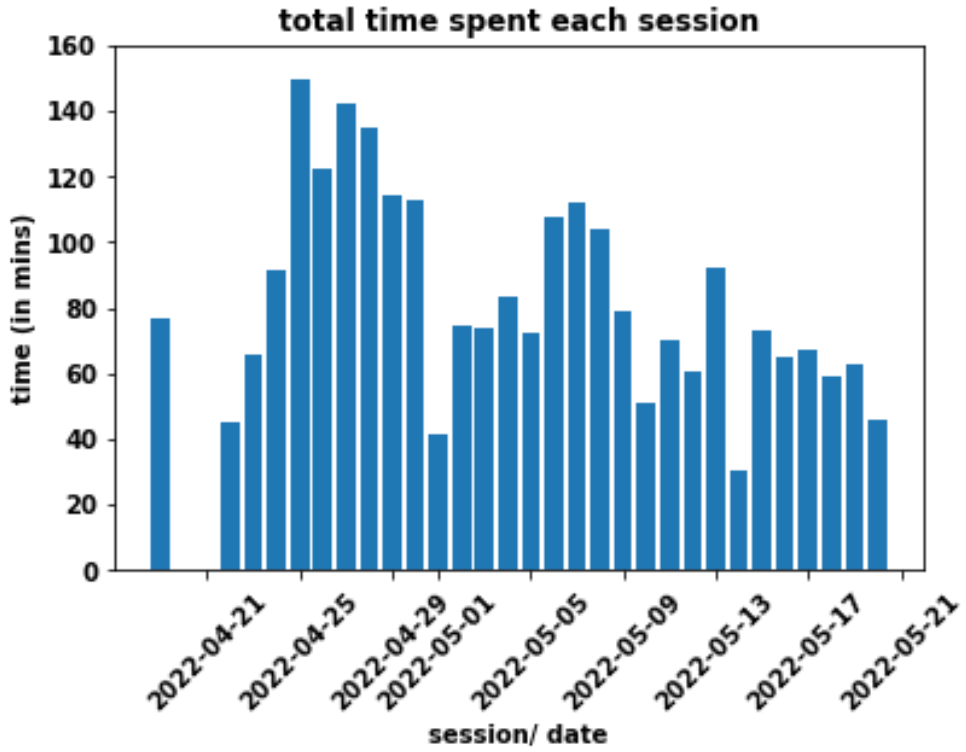
Usage (by day/date)

P003



total number of days played = 25 days
total time spent = 1361.68 mins
(0 days, **22.00 hours,** 41.68 mins)

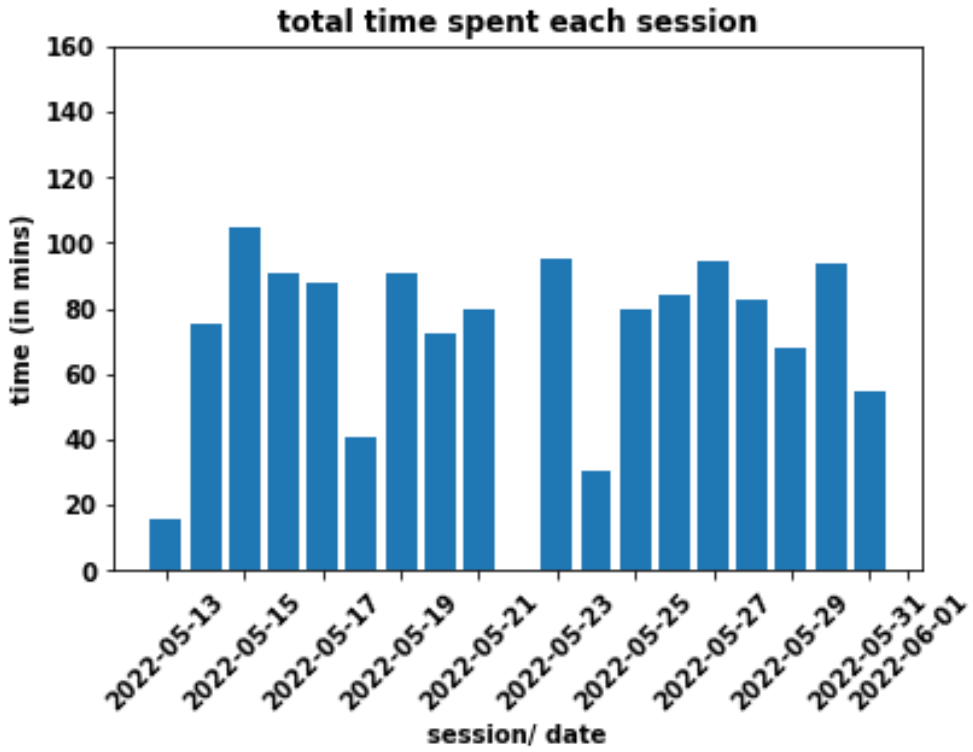
P004



total number of days played = 30 days
total time spent = 2478.12 mins
(**1 days, 17.00 hours,** 18.12 mins)

Usage (by day/date)

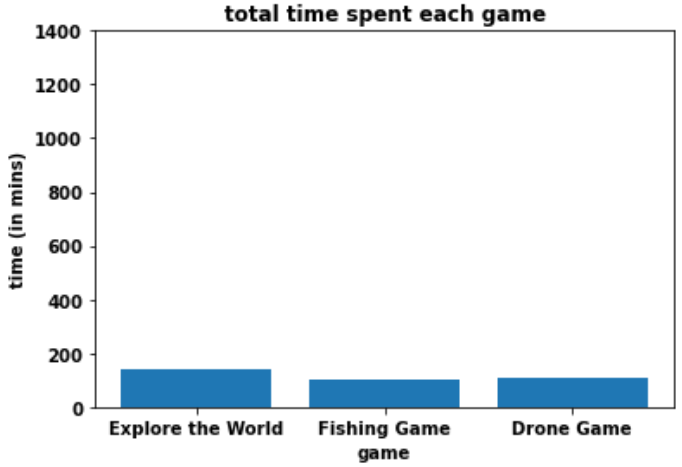
P006

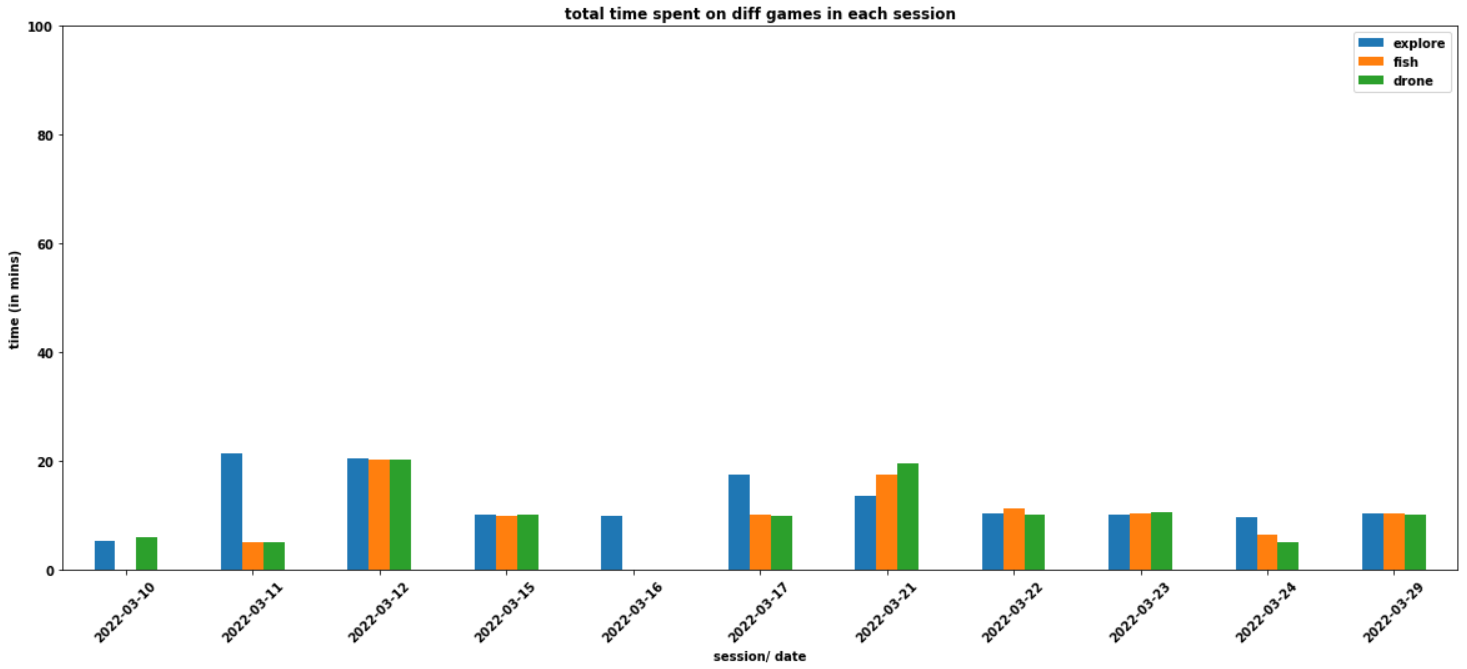


total number of days played = 18 days
total time spent = 1338.87 mins
(0 days, **22.00 hours**, 18.87 mins)

Usage (by game)

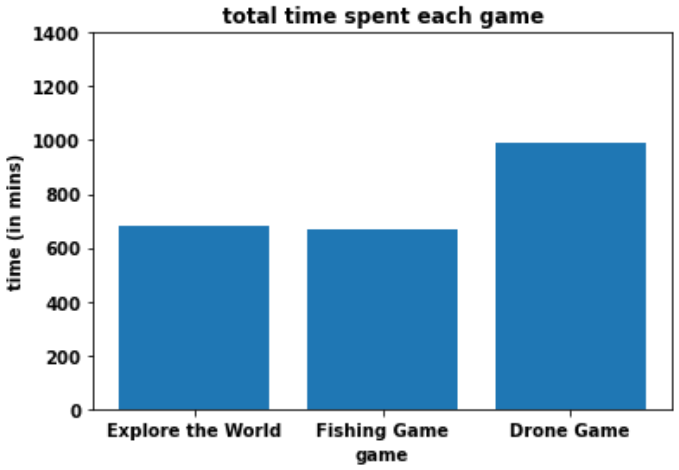
P001

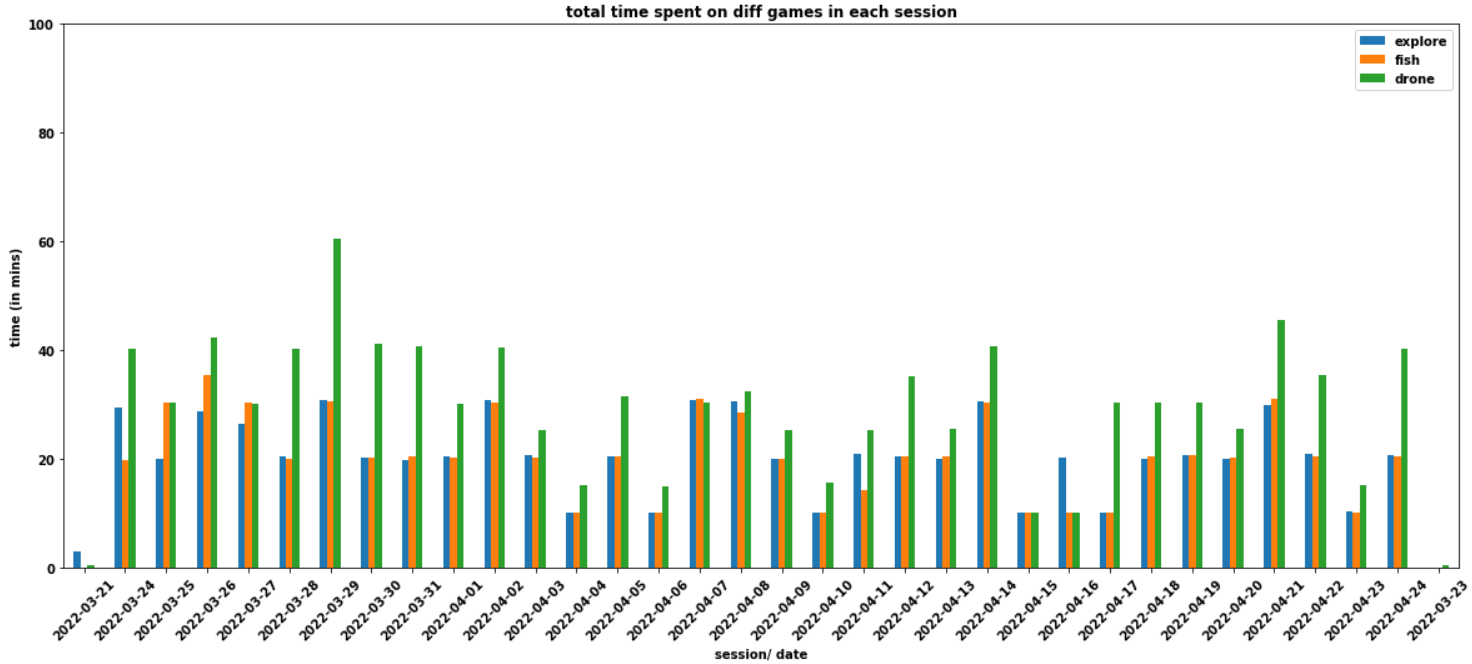




Usage (by game)

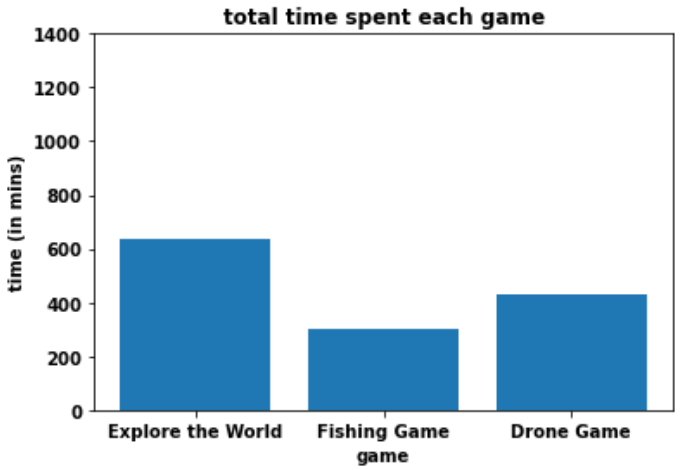
P002

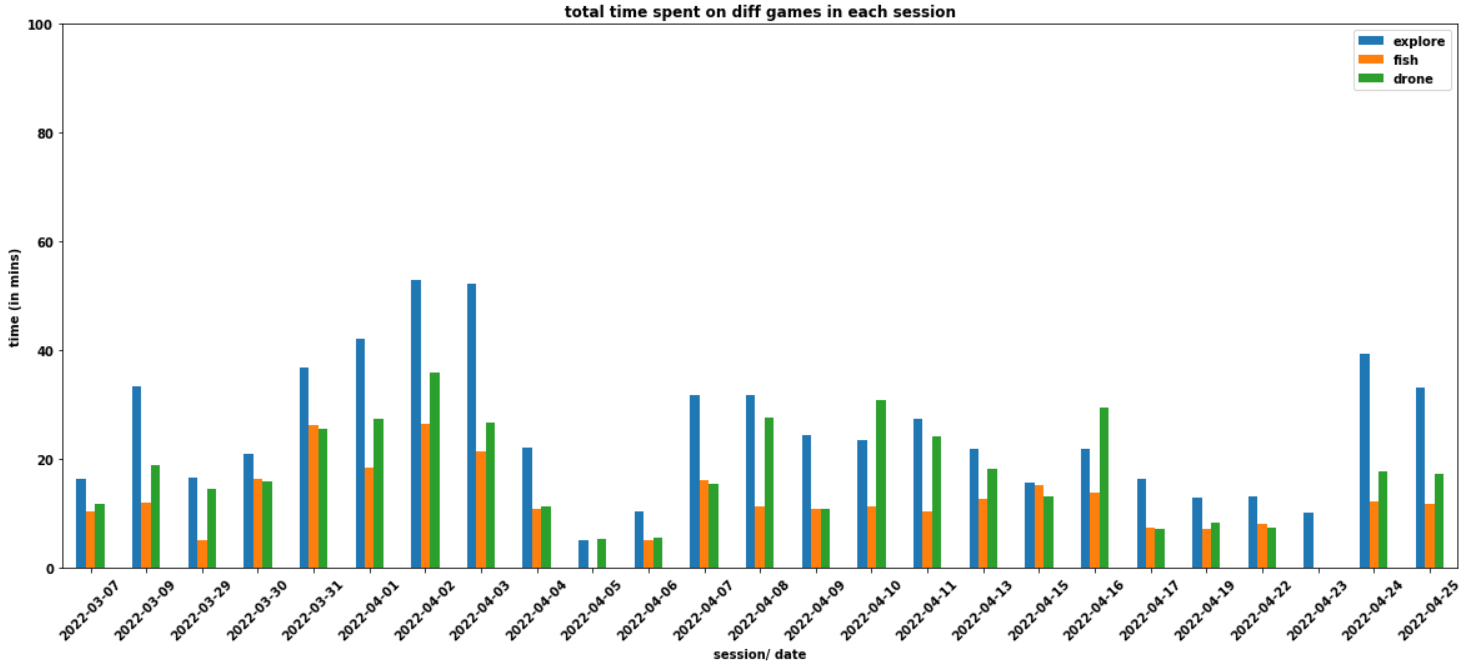




Usage (by game)

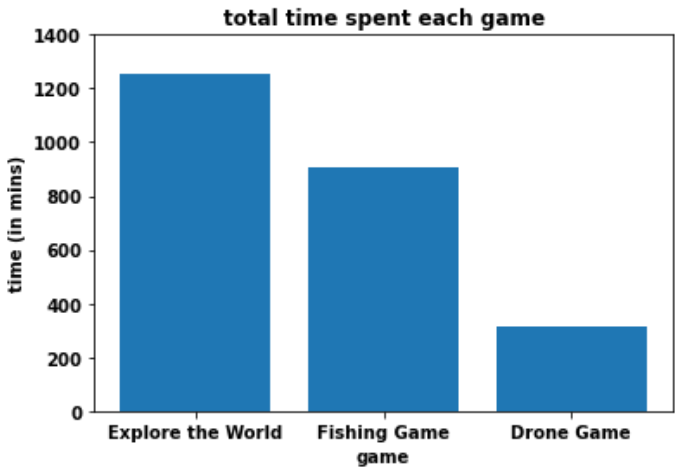
P003

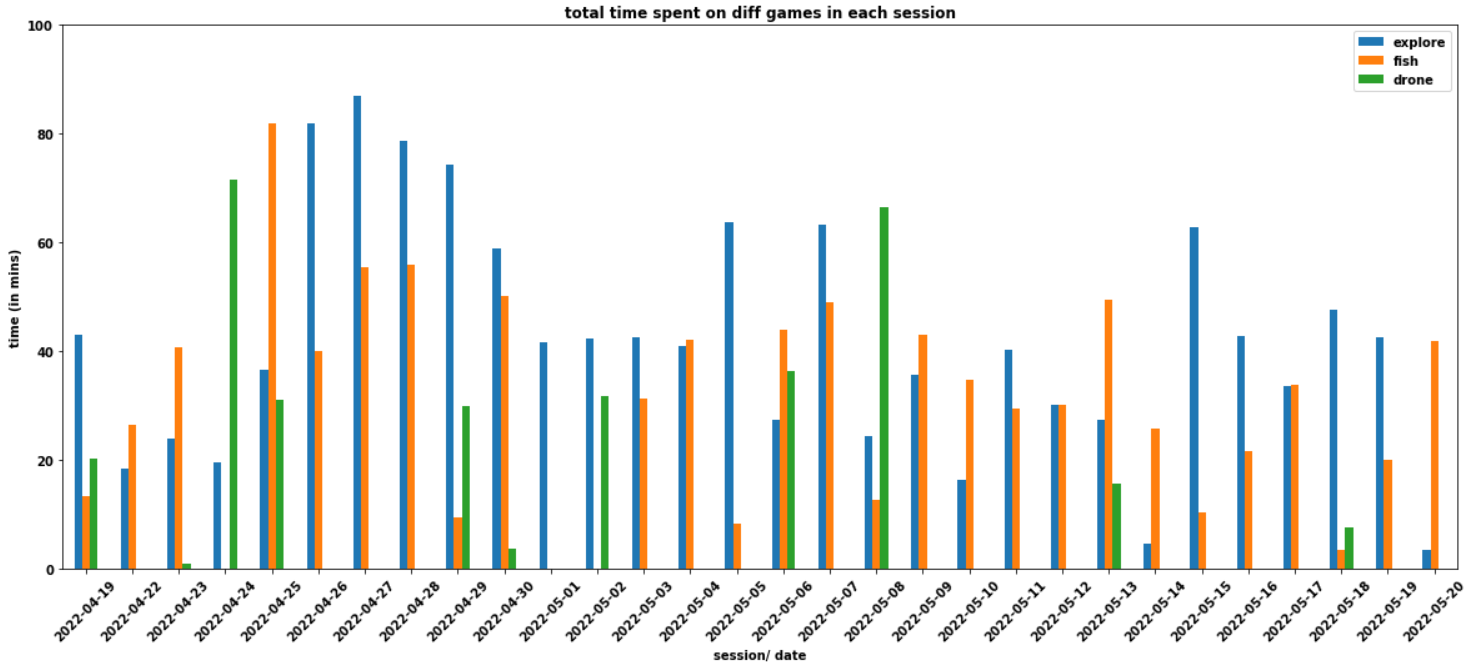




Usage (by game)

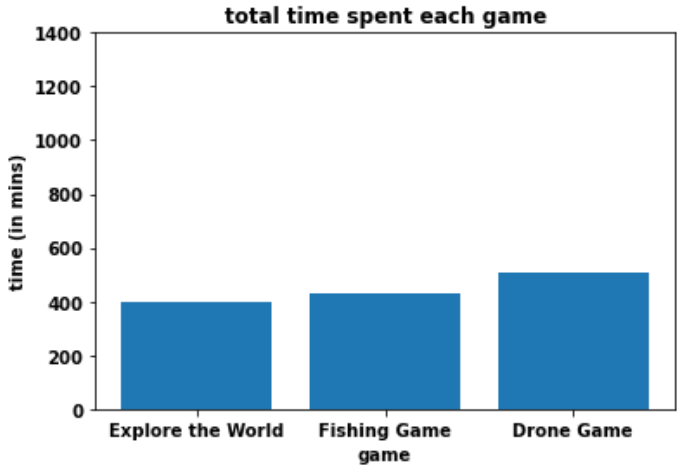
P004

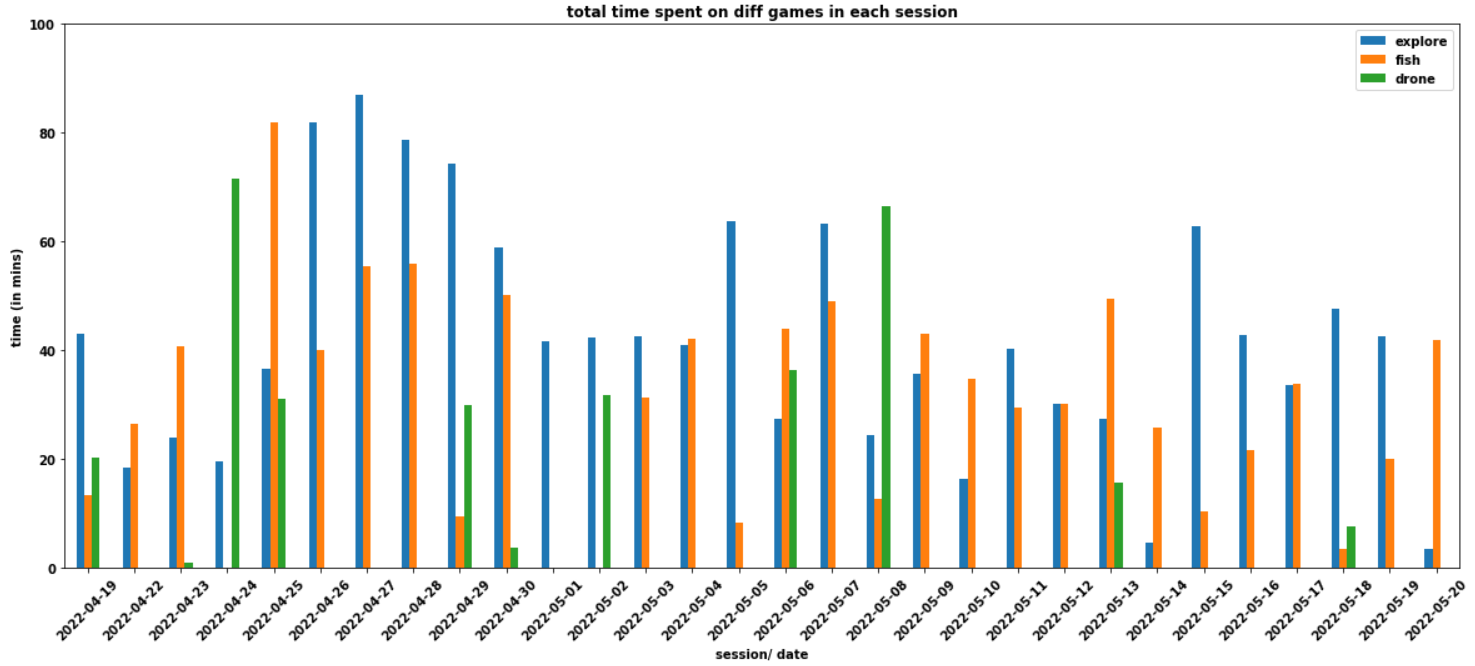




Usage (by game)

P006





Usage – patients' comparison

	Nr of days	Total time	Ave time spent on playing days	Favourite game	% time spent on favourite game
P001	11	0 day, 5 hrs	32 mins	Explore	40 %
P002	34	1 day, 15 hrs	69 mins	Drone	42 %
P003	25	0 day, 22 hrs	54 mins	Explore	47 %
P004	30	1 day, 17 hrs	82 mins	Explore	51 %
P006	18	0 day, 22 hrs	74 mins	Drone	38 %

With the exception of P001, other players spend approximately 54-82 mins on a playing day (if using the H-Man).
P003 and P006 might spend similar total time on the H-Man, but P006 spend 20mins more on a playing day.

Velocity

In which game do the players moves the fastest?

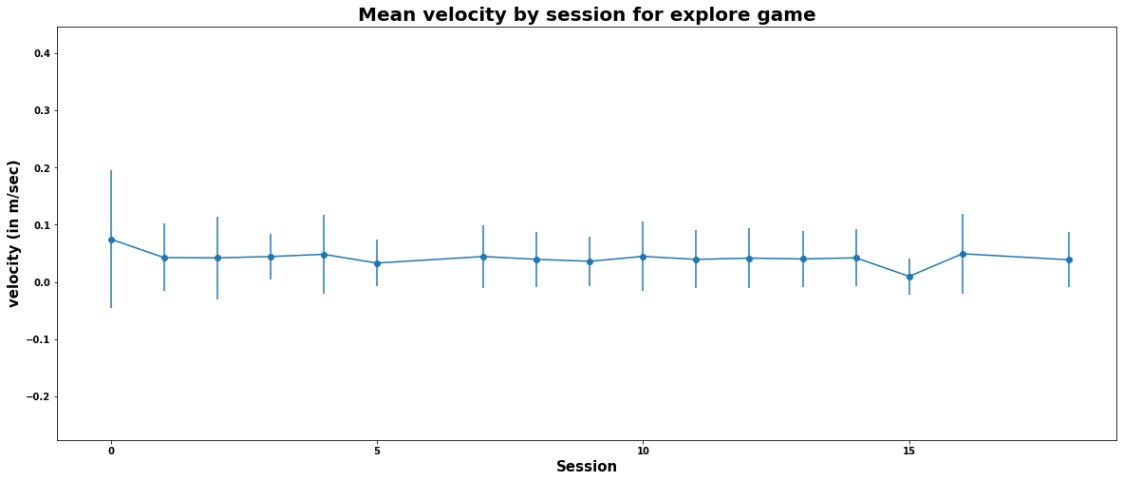
	speed	game
P001	0.134 m/s	Fish
P002	0.179 m/s	Fish
P003	0.081 m/s	Fish
P004	0.110 m/s	Fish
P006	0.239 m/s	Fish

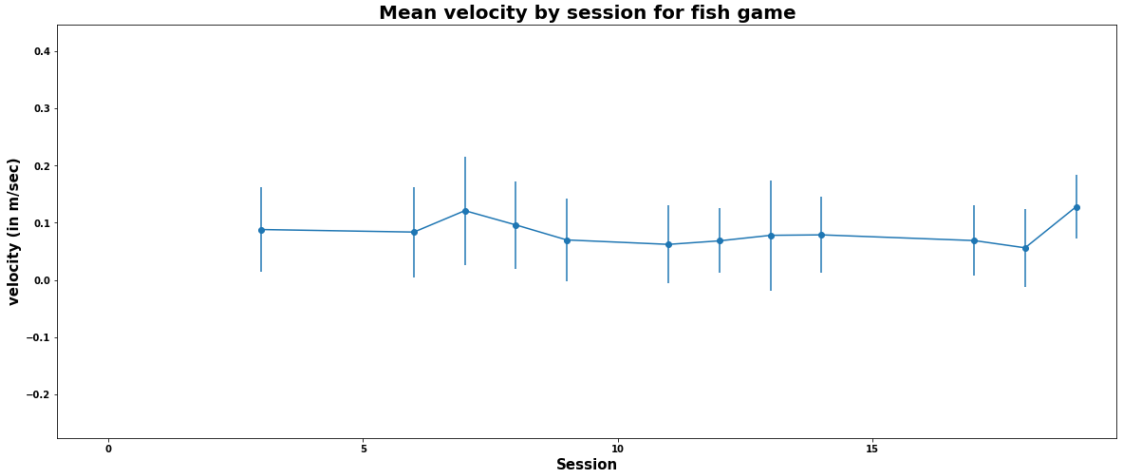
Velocity
P001

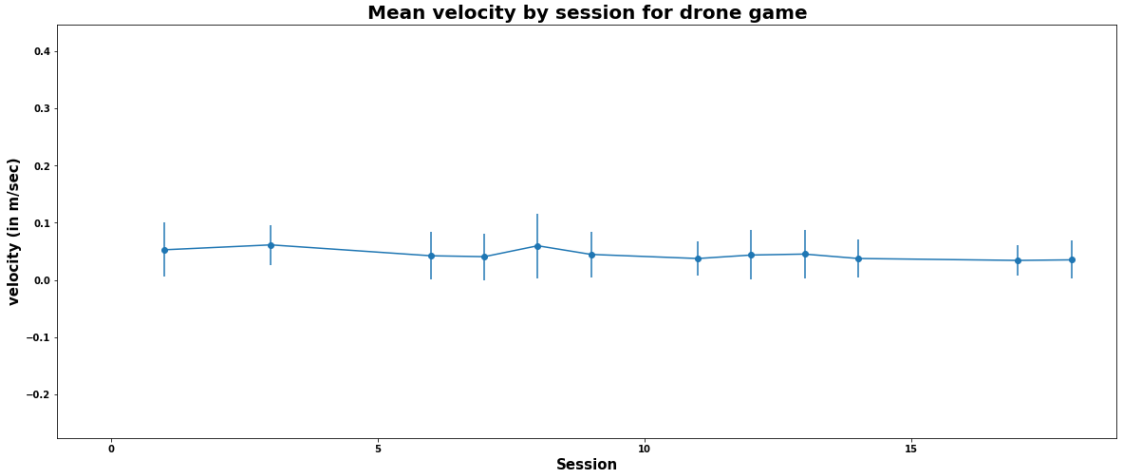
In which game does the player P001 moves the fastest?

Mean velocity in each session was determined.

Max mean velocity of 0.134 m/s occurred during Fishing game





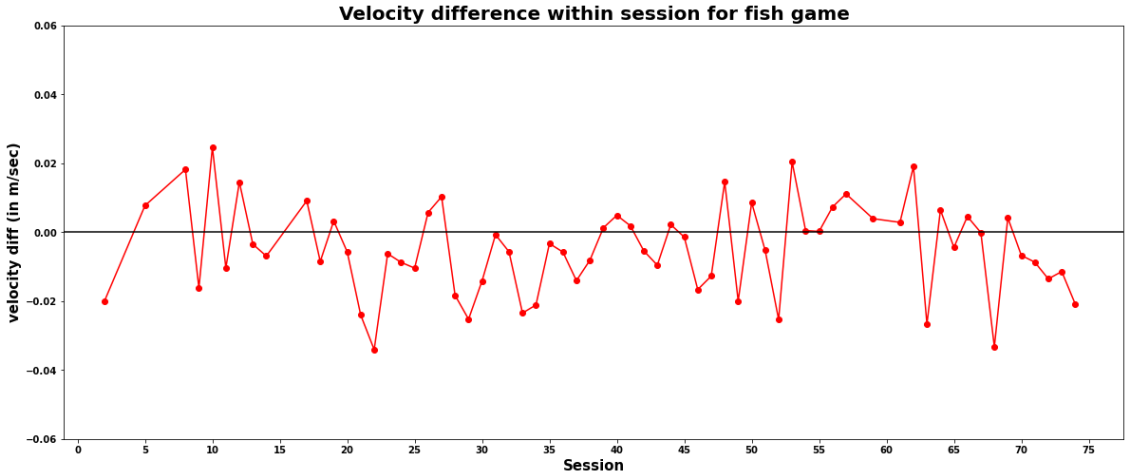


Velocity P002

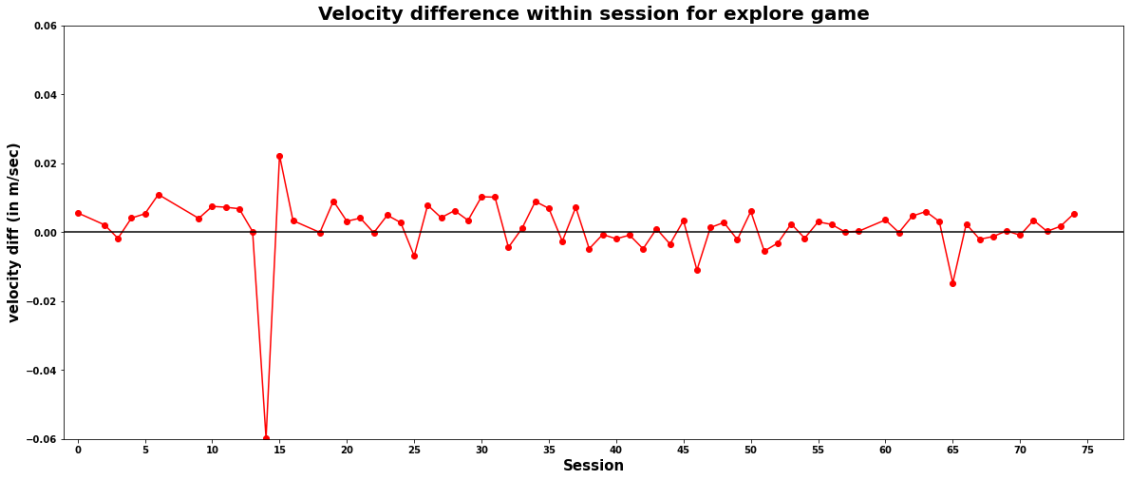
In which game does the player P002 moves the fastest?

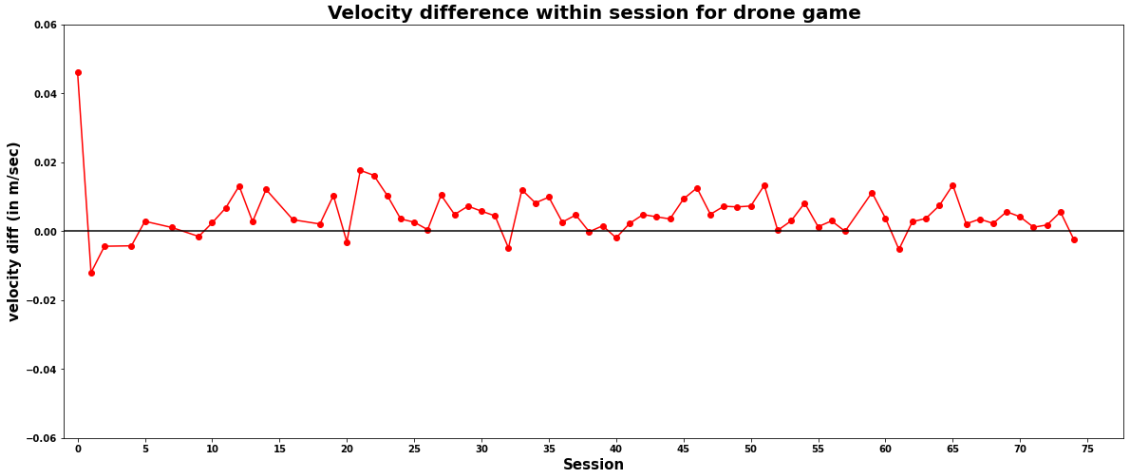
Max mean velocity of 0.179 m/s occurred during Fishing game.

Difference in velocity between first and last quadrant *within* the same session, showed velocity increase during explore/drone games as playing progresses.



Positive values (last quadrant minus first quadrant) signify increase in velocity as game play progresses *within* a session.





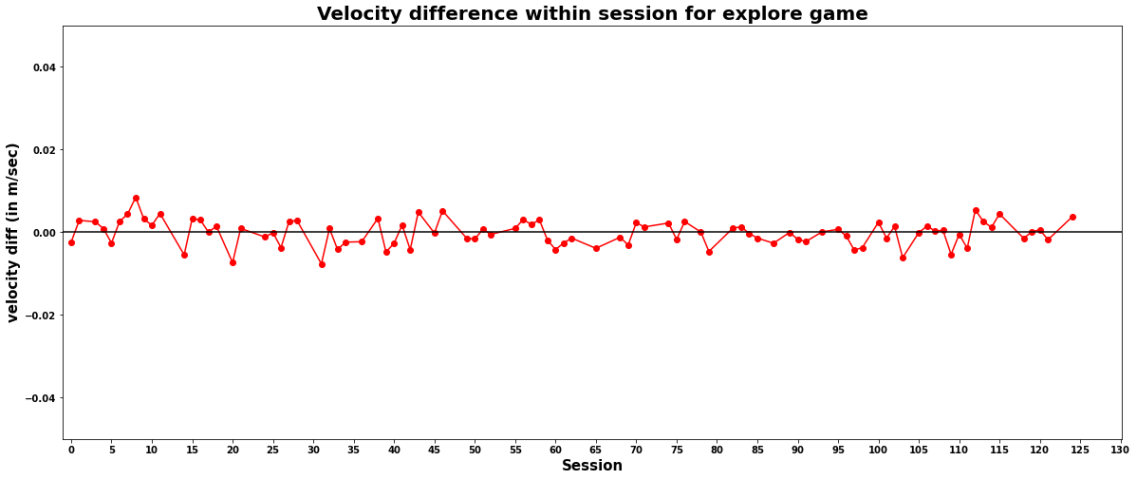
Velocity
P003

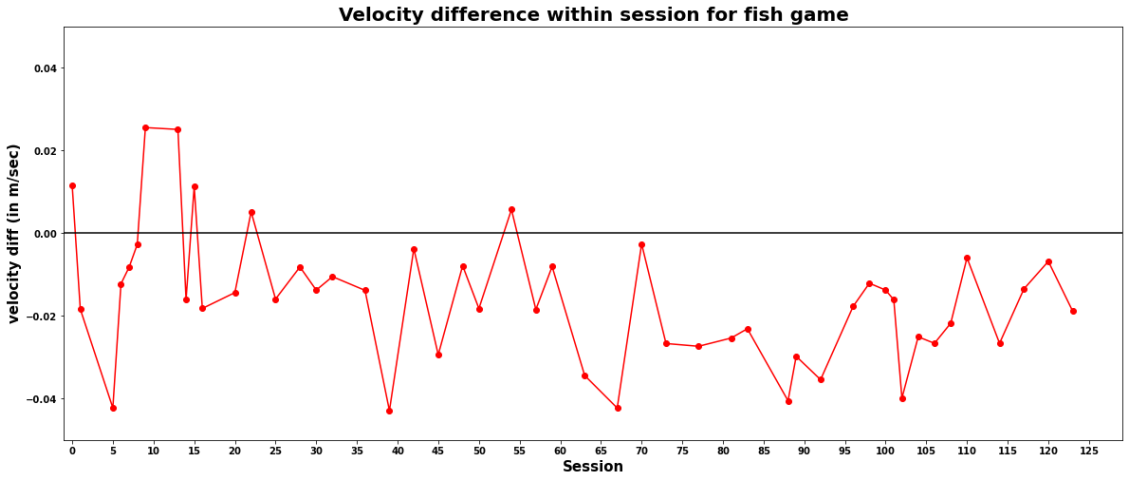
Positive values (last quadrant minus first quadrant) signify increase in velocity as game play progresses *within* a session.

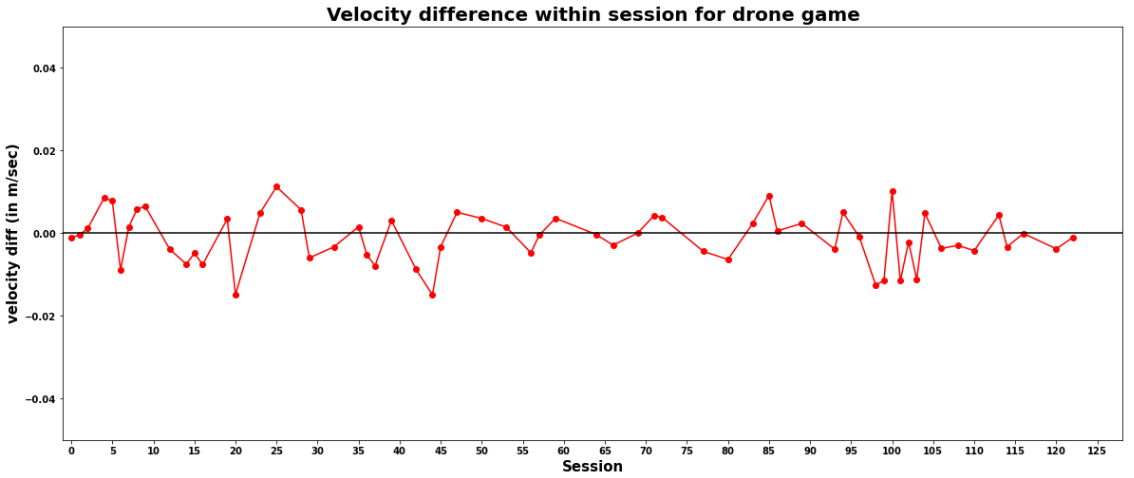
In which game does the player moves the fastest?

Max mean velocity of 0.081 m/s occurred during fish game.

Difference in velocity between first and last quadrant *within* the same session, showed that the highest variation in velocity within session also occurred during fish game.







Velocity
P004

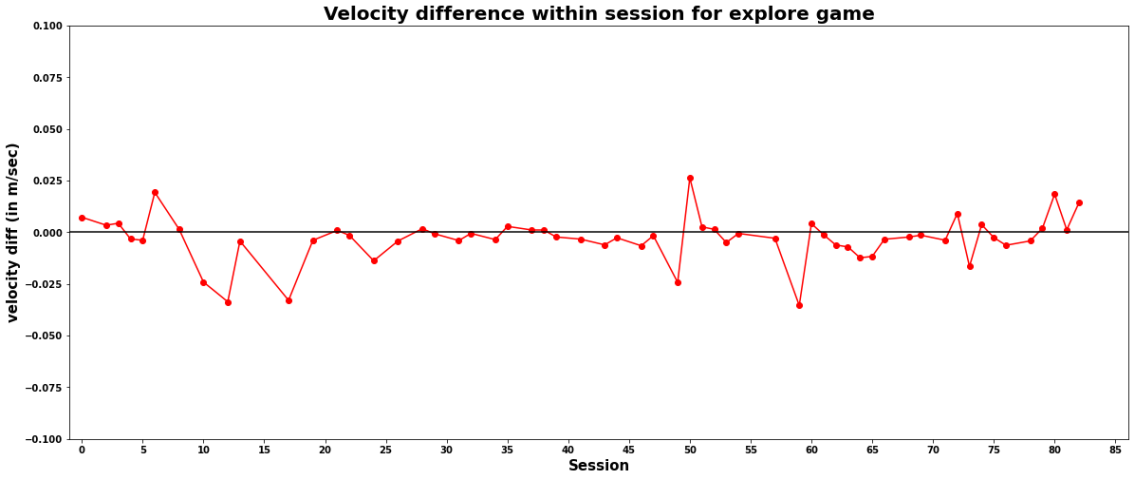
Positive values (last quadrant minus first quadrant) signify increase in velocity as game play progresses *within* the session.

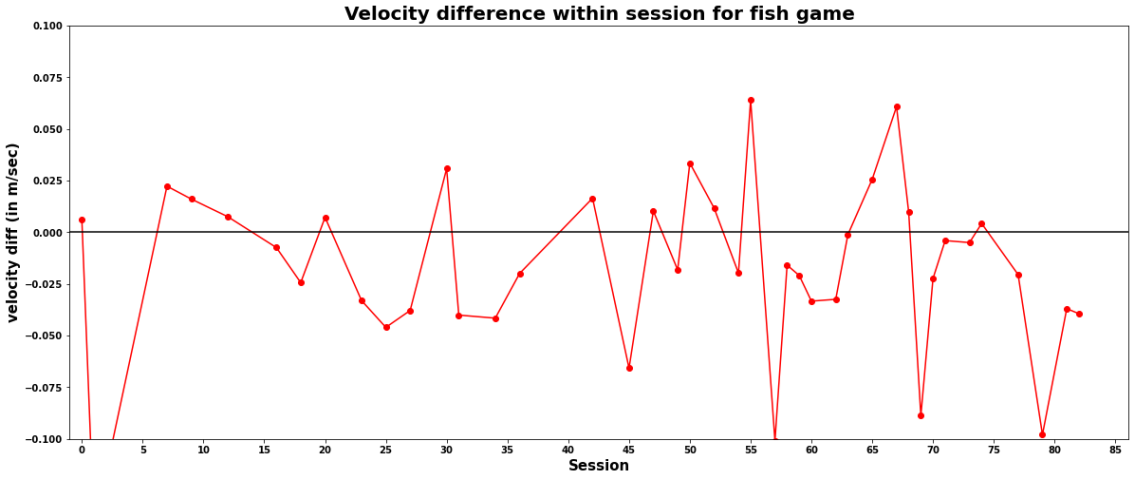
In which game does the player moves the fastest?

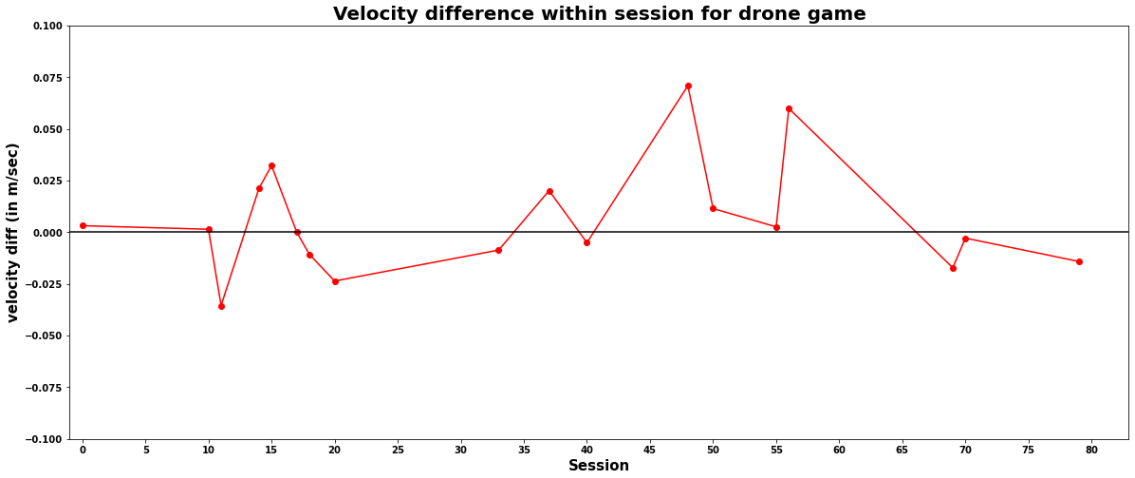
Max mean velocity of 0.110 m/s occurred during fish game.

Highest variation in velocity within session also occurred during fish game.

Again, velocity increase during in explore game as playing progresses.





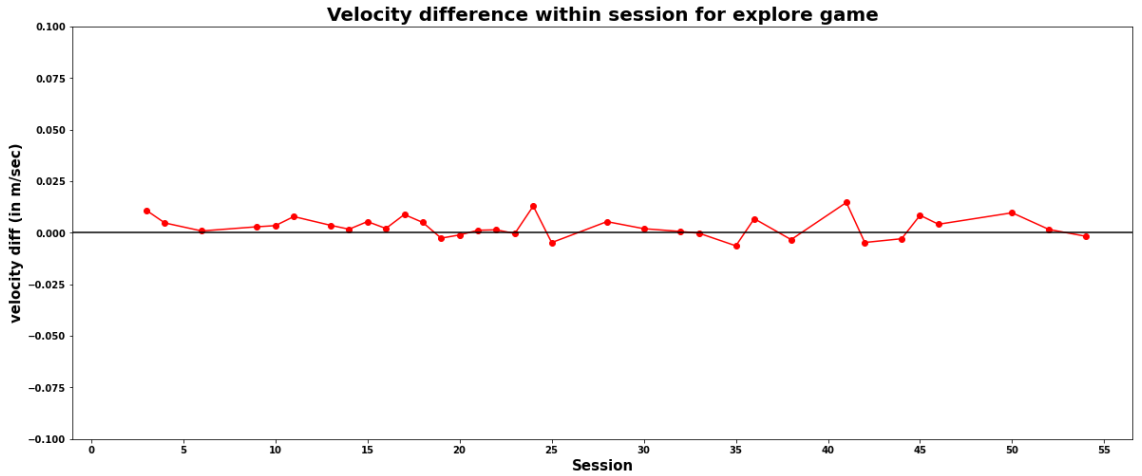


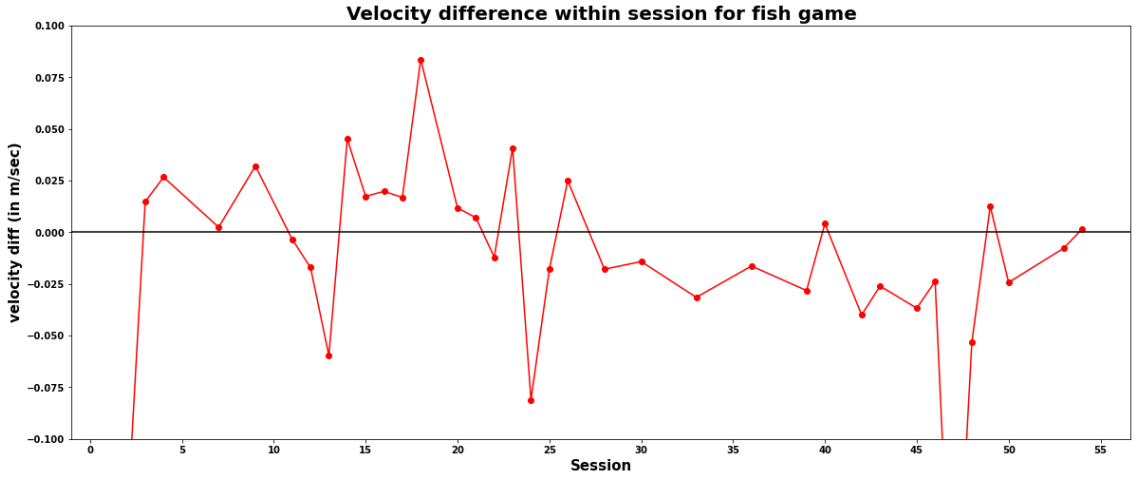
Velocity
P006

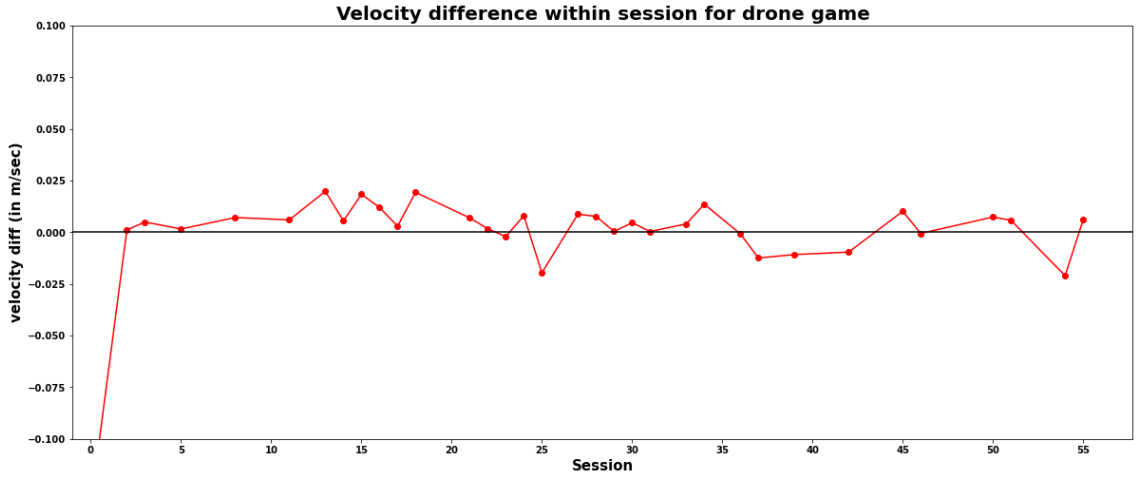
In which game does the player moves the fastest?

Max mean velocity of 0.239 m/s occurred during fish game

Positive values (last quadrant minus first quadrant) signify increase in velocity as game play progresses *within* the session.







Velocity - Summary

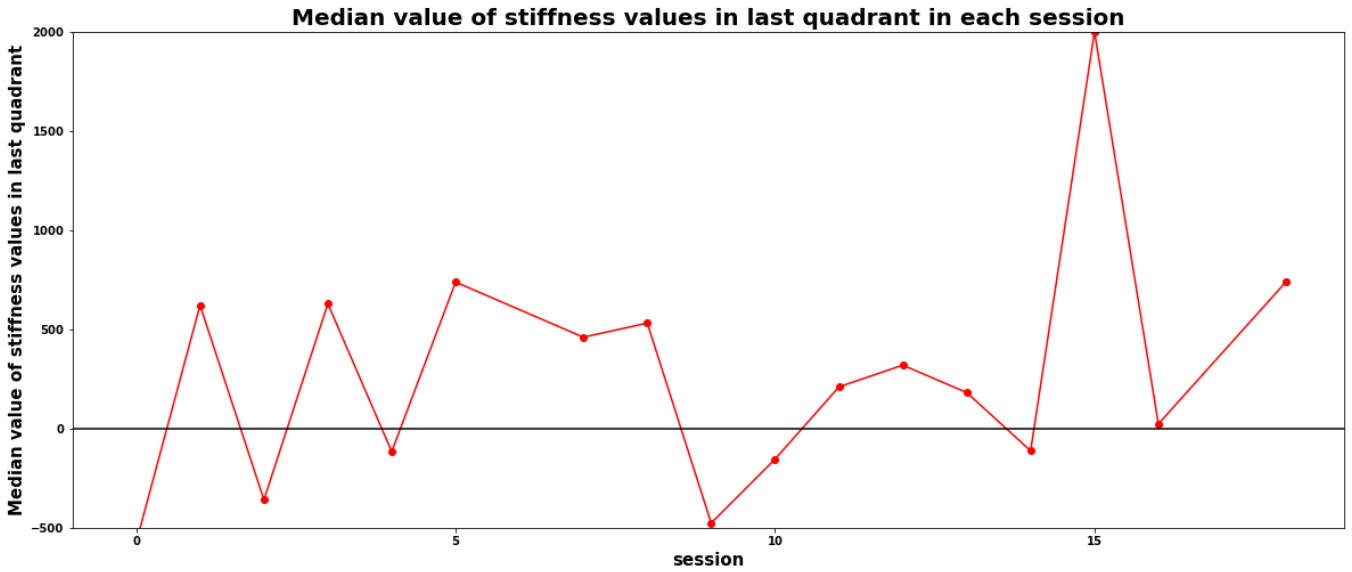
In which game do the players moves the fastest?

- On average, highest velocity was found in fish game for all players. So the fastest movement was performed during the fish game. Since there are many targets (ie. fish) with no obstacles to navigate, this is not surprising. On the other hand, due to the number of options/pathways to get to multiple targets, variation in velocity was also highest in fish game.
- General increase in velocity *within* session was found in explore or drone games. Explore and drone games have only one given target at any given time. Precision control would require the handle to move one optimal pathway to reach the target. So there is less variation in velocity for these games.
- As playing progresses, players should learn to navigate the one direct pathway and move at a higher velocity.

Smoothness
P001

Does smoothness (SPARC) stabilizes as gameplay progresses?

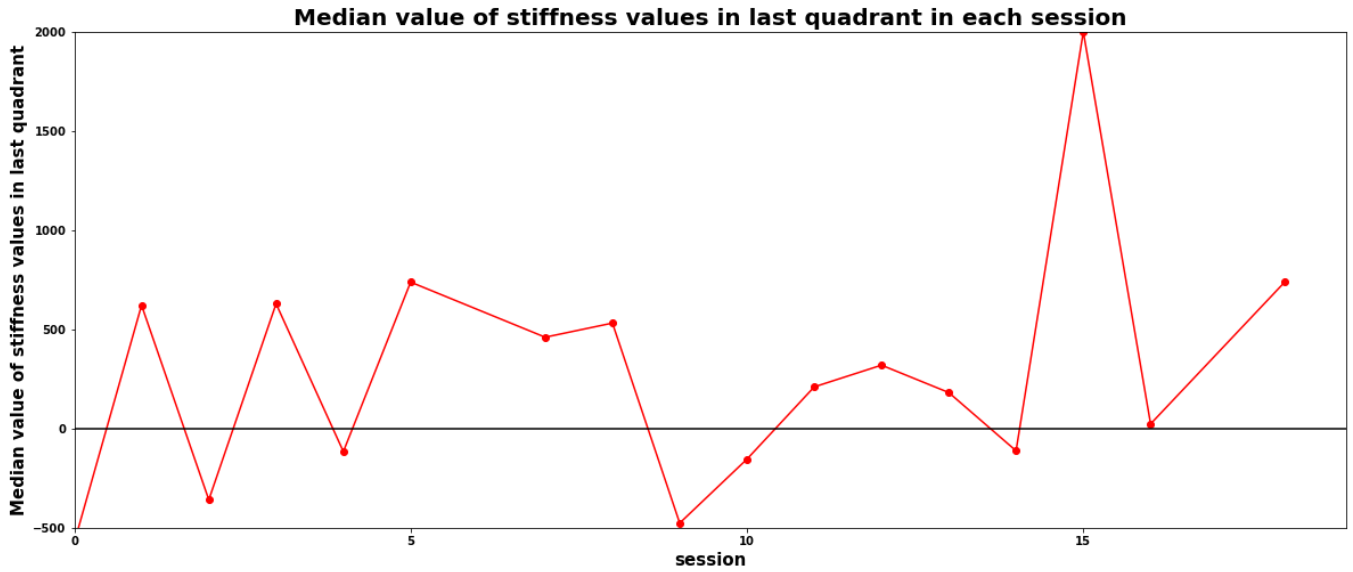
- Analyses was performed only on explore game.
- Since stiffness requires filtering several steps of SPARC, and is a function of SPARC, median stiffness values in the last quadrant of each session is used as proxy to determine how each player moves and adapts as gameplay progresses across sessions.

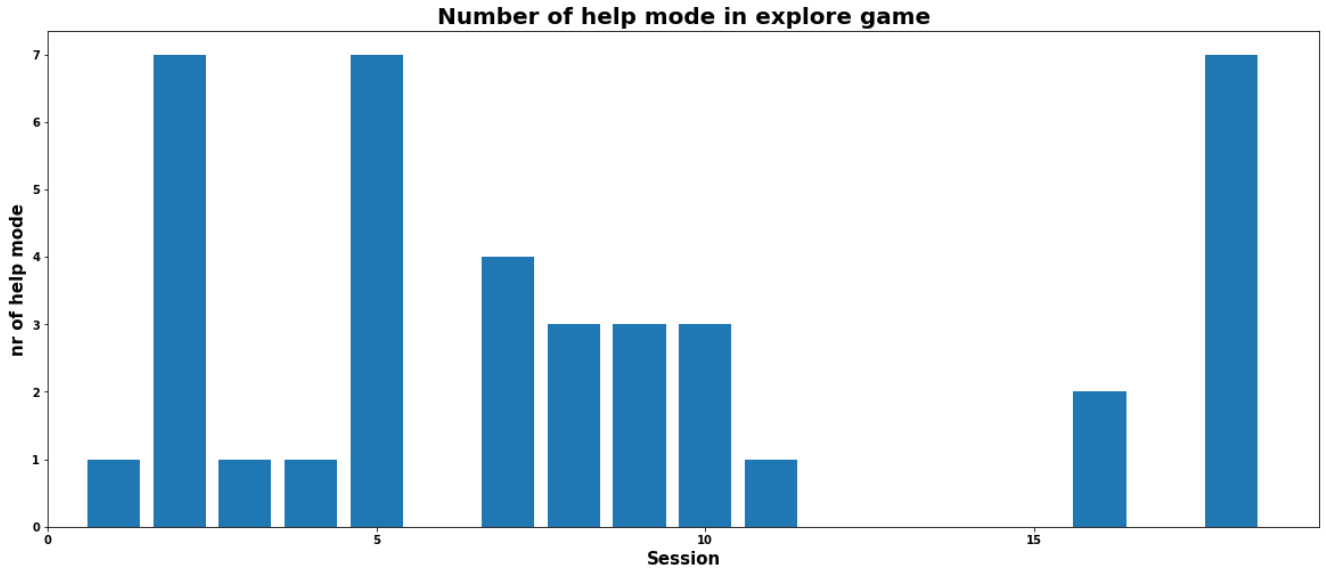


Smoothness P001

Does smoothness (SPARC) stabilizes as gameplay progresses?

- Analyses was performed only on explore game.
- Reason could be there is a correlation between SPARC and number of help modes (SPARC = -8)
- So large stiffness values are due, in part, to the number of help modes (SPARC = -8) in the explore game.

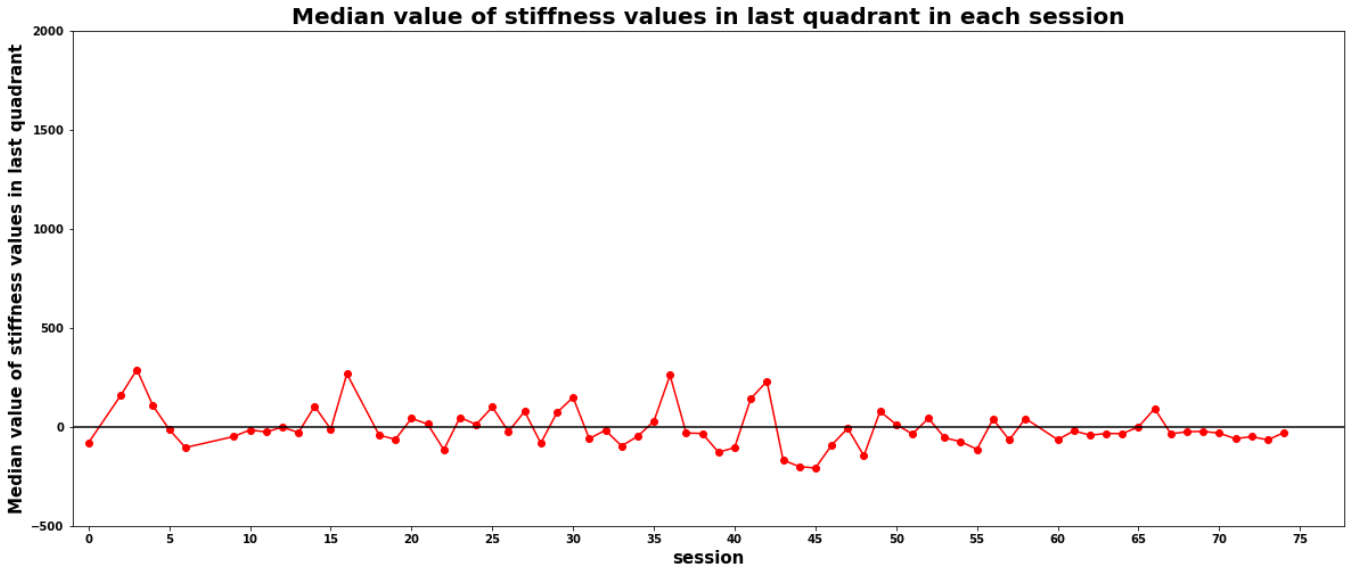


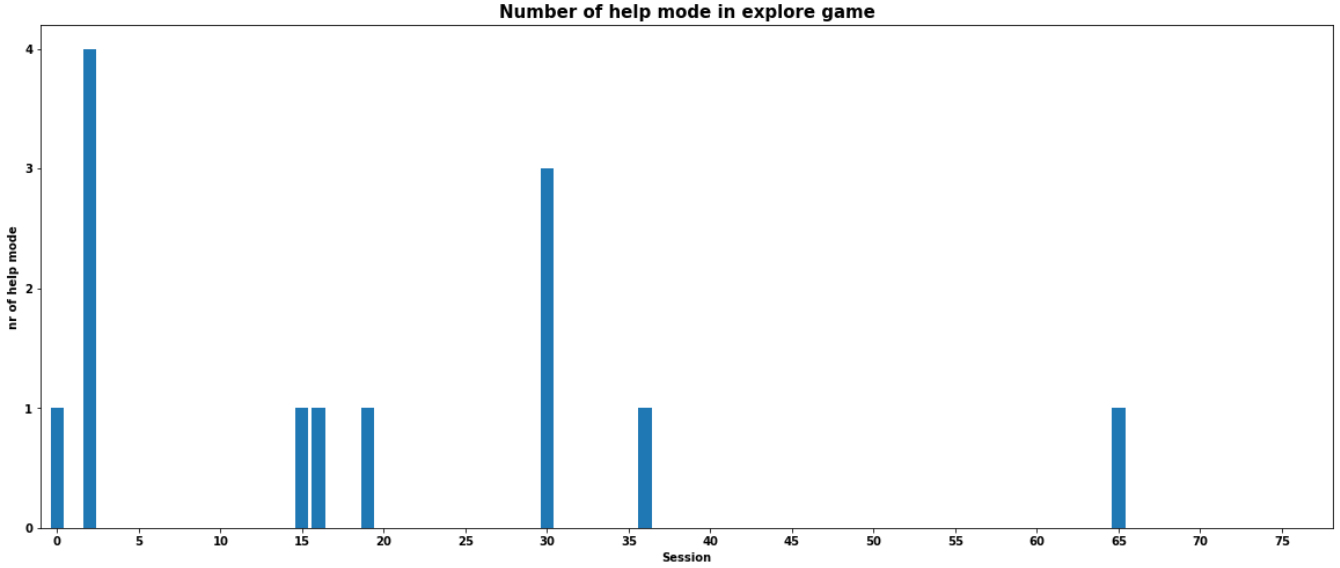


Smoothness P002

Does smoothness (SPARC) stabilizes as gameplay progresses?

- Analyses was performed only on explore game.
- There is little/no observable improvement in the earlier sessions, but there is a shift towards perturbed mode (negative stiffness values) in the later sessions.
- Large variances are due to the number of help modes (SPARC = -8) in the explore game.
- However, P002 requires less help mode as play progresses.

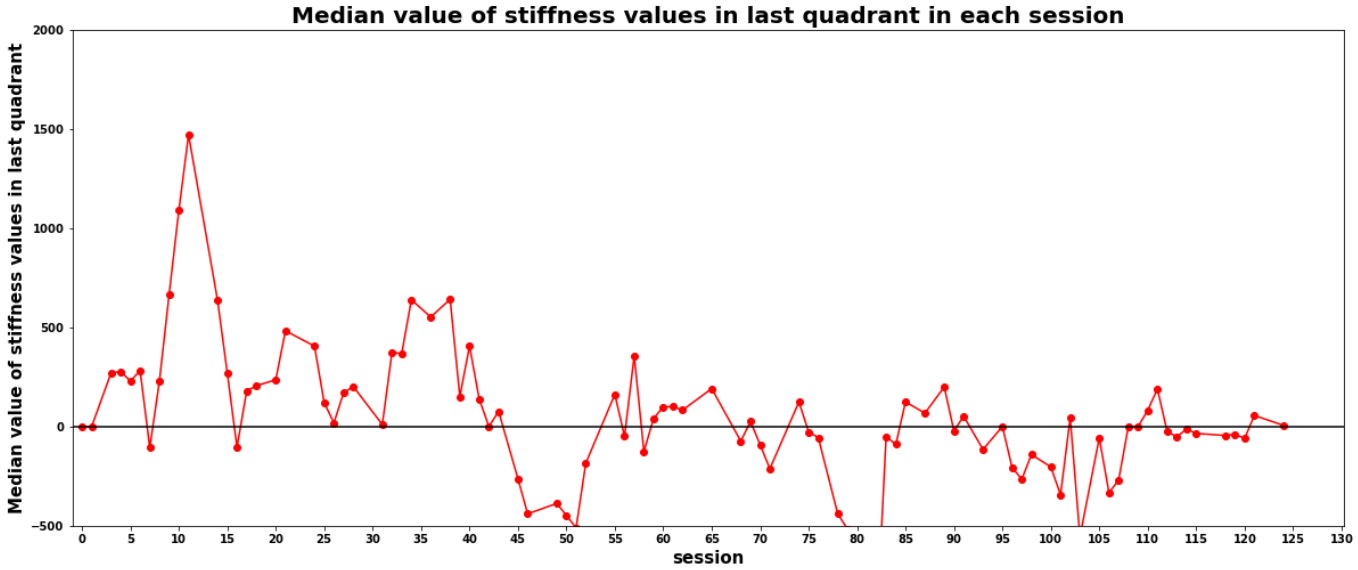


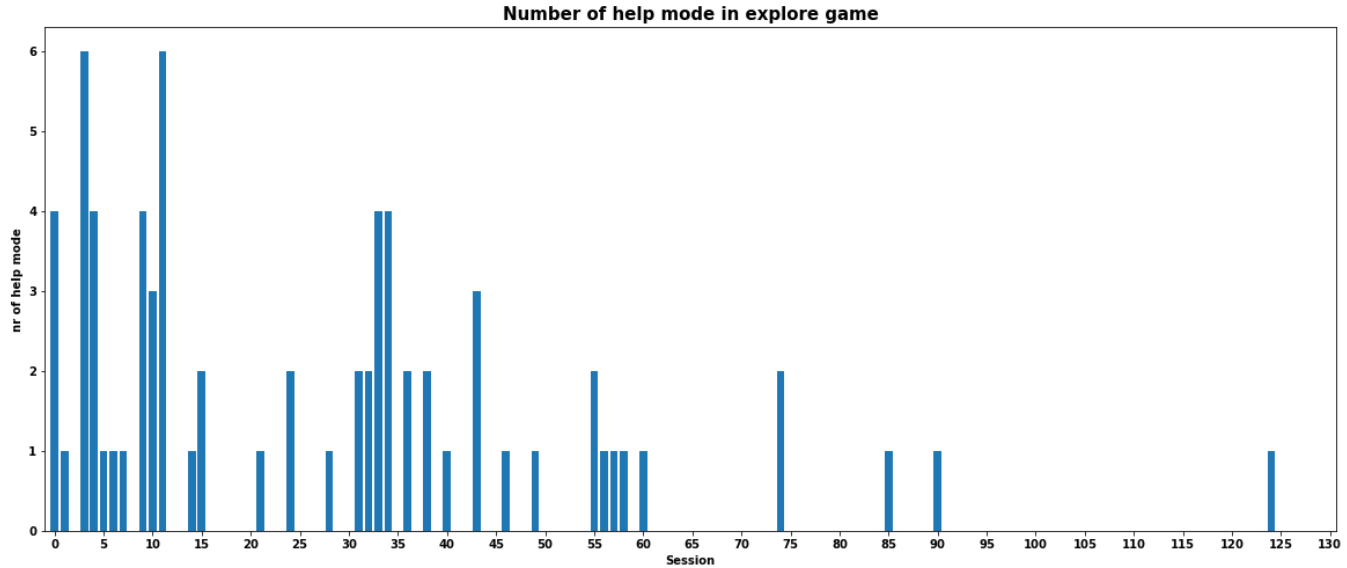


Smoothness P003

Does smoothness (SPARC) stabilize as gameplay progresses?

- Analyses was performed only on explore game.
- Similarly, while there were large stiffness values in the earlier trials, partly due to number of help modes, there were improvements in the later sessions (less number of help modes, stiffness in perturbed mode, smaller stiffness values).

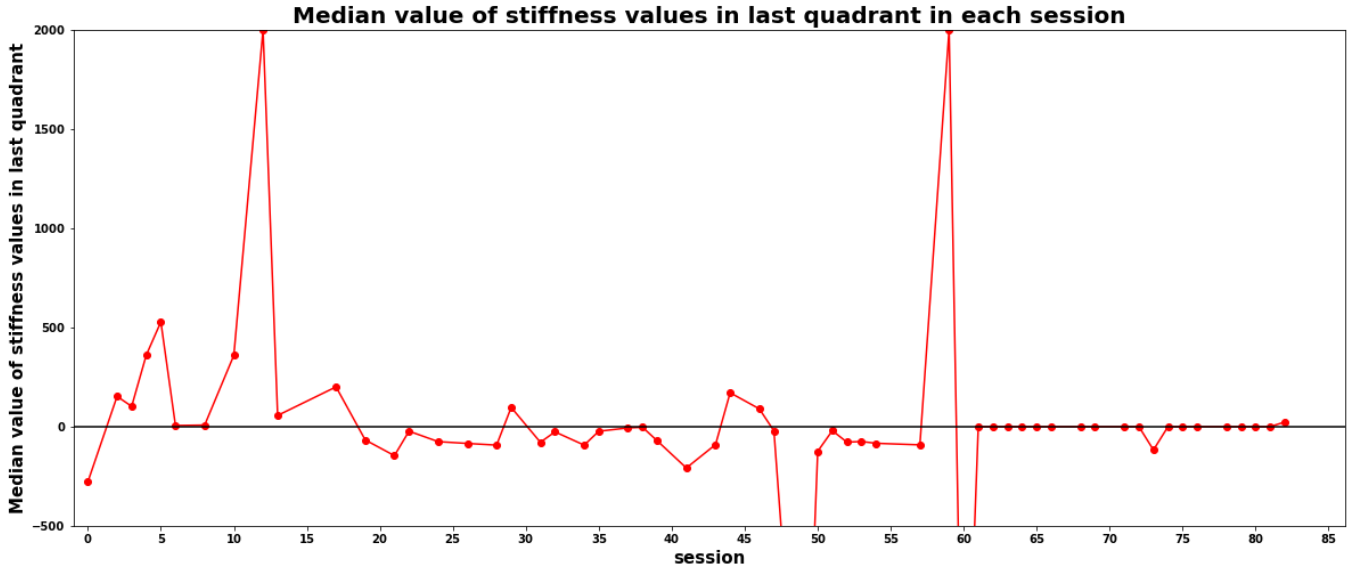


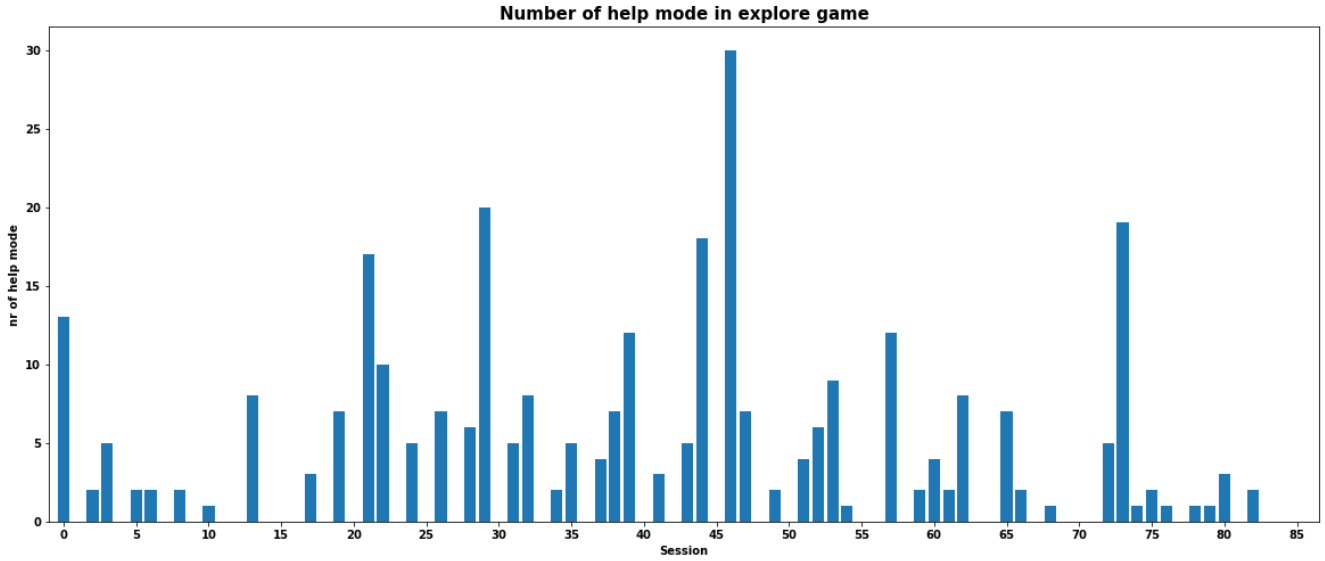


Smoothness P004

Does smoothness (SPARC) stabilize as gameplay progresses?

- Analyses was performed only on explore game.
- P004 did require a large number of help modes.

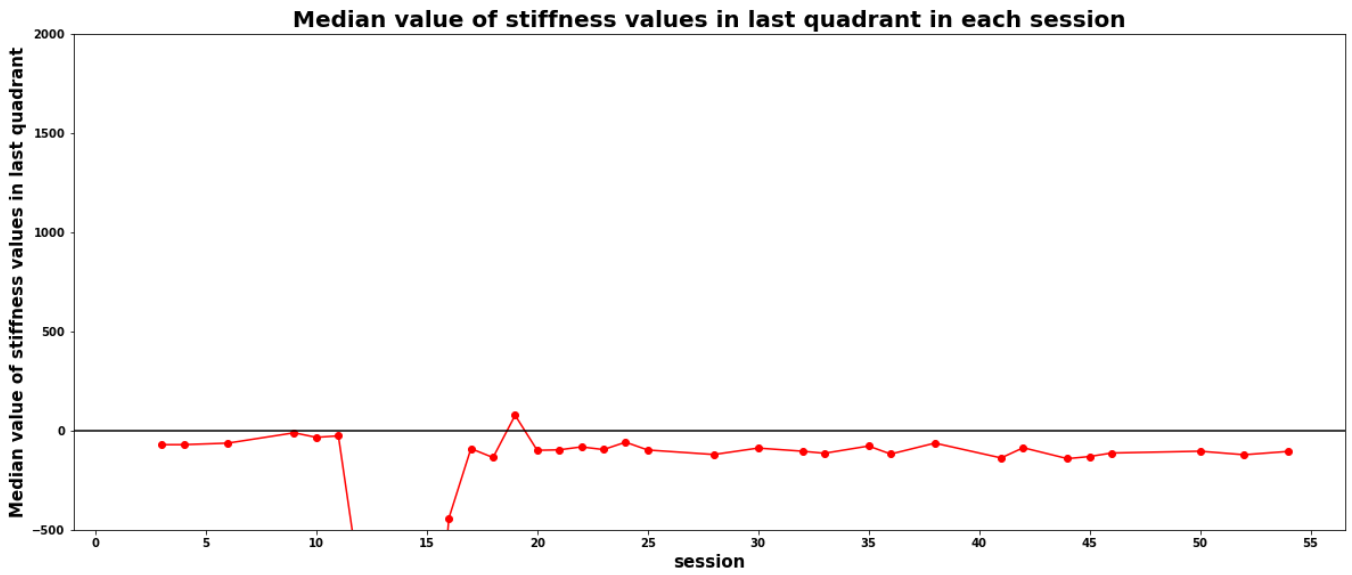


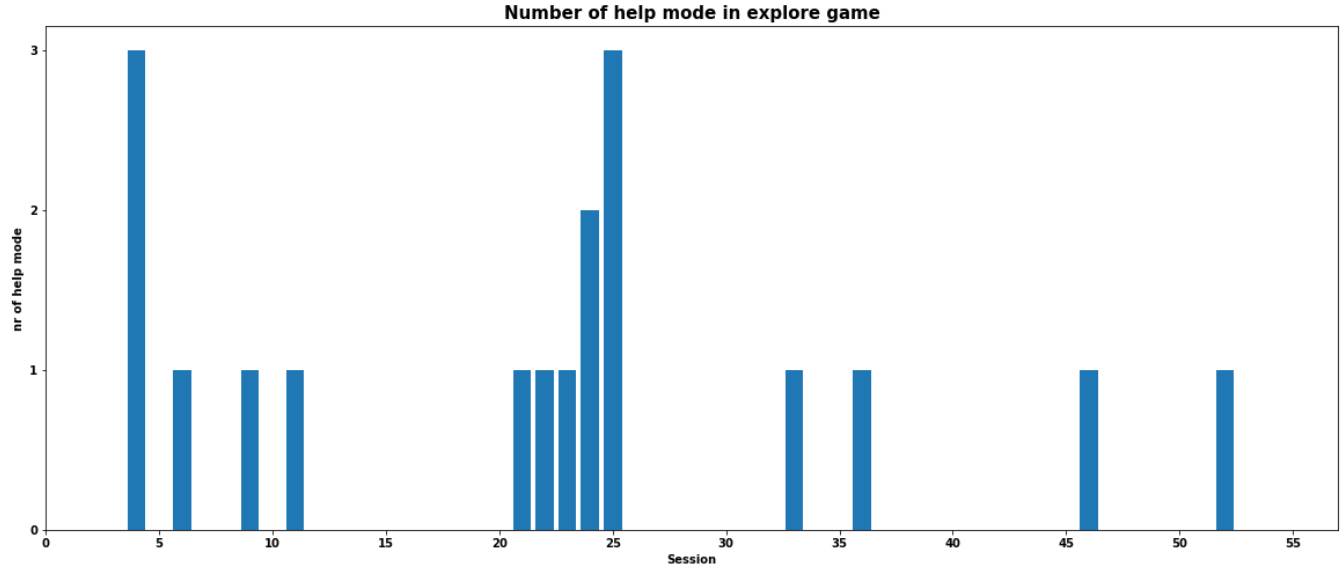


Smoothness P006

Does smoothness (SPARC) stabilize as gameplay progresses?

- Analyses was performed only on explore game.
- P006 was in perturbed mode in most of his sessions.





Smoothness

Does smoothness (SPARC) stabilize as gameplay progresses?

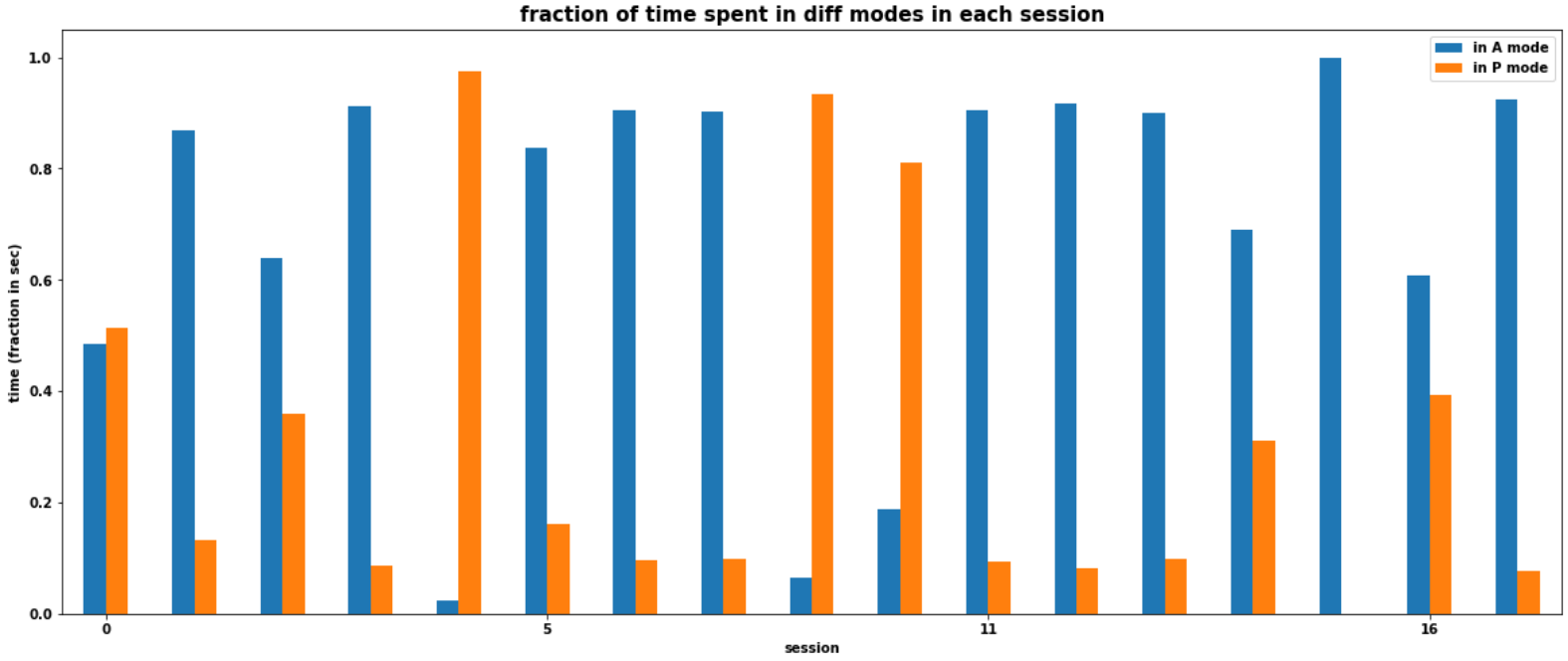
- A higher number of help modes will also result in higher range of stiffness (max-min) experienced by the player.
- In general, there were improvements in the last quadrant in each session, demonstrated by either less number of help modes, being in perturbed mode, smaller stiffness values.
- As mentioned, more time spent in perturbed mode (rather than assistive mode) also demonstrate that the player is navigating a more challenging movement while reaching target. And thus, is improving.

Stiffness (KxGain) behaviour P001

What is the fraction of time spent in Assistive or Perturbed mode in Explore game?

Determine if the players spend more time in perturbed mode as play progresses.

P001 spend 0.22 less time in perturbed mode in the last quadrant compared to the earlier sessions.

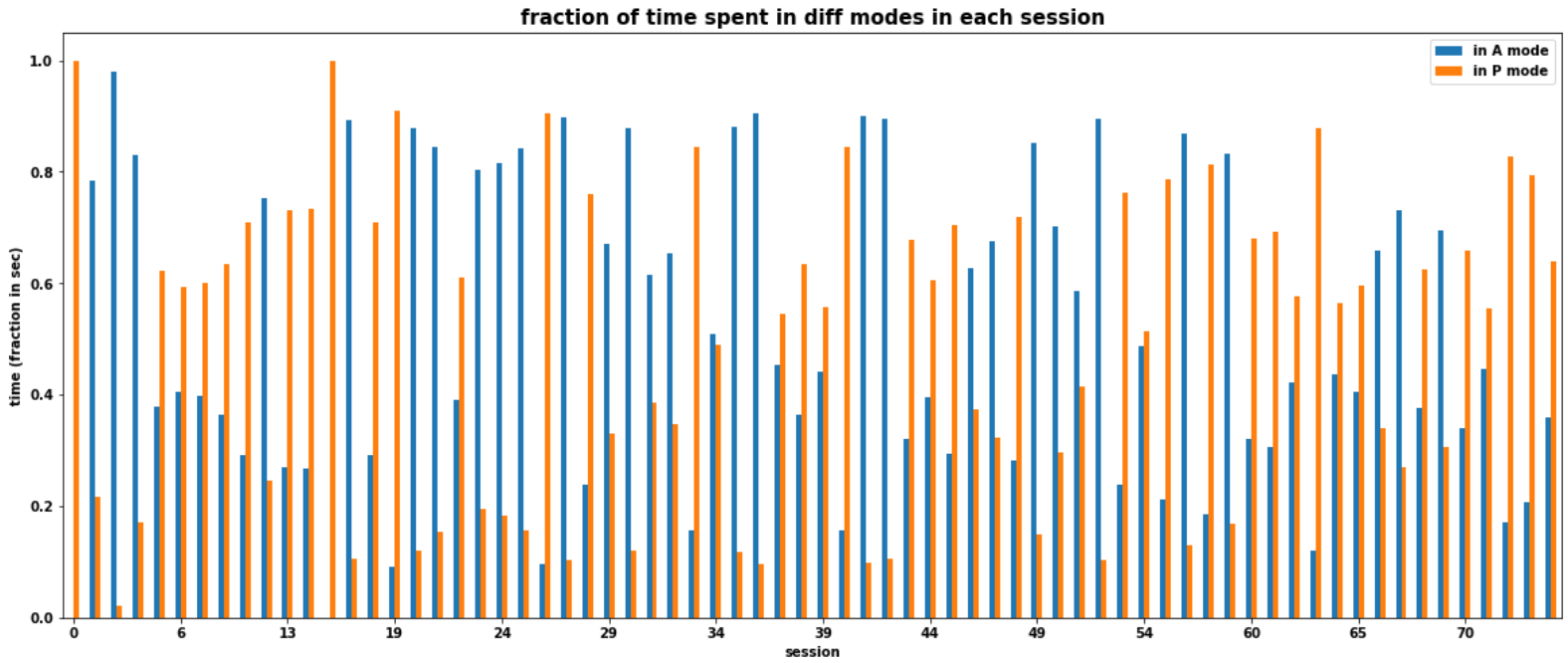


Stiffness (KxGain) behaviour P002

What is the fraction of time spent in Assistive or Perturbed mode in Explore game?

Determine if the players spend more time in perturbed mode as play progresses.

P002 spend 0.07 more time in perturbed mode as play progresses.

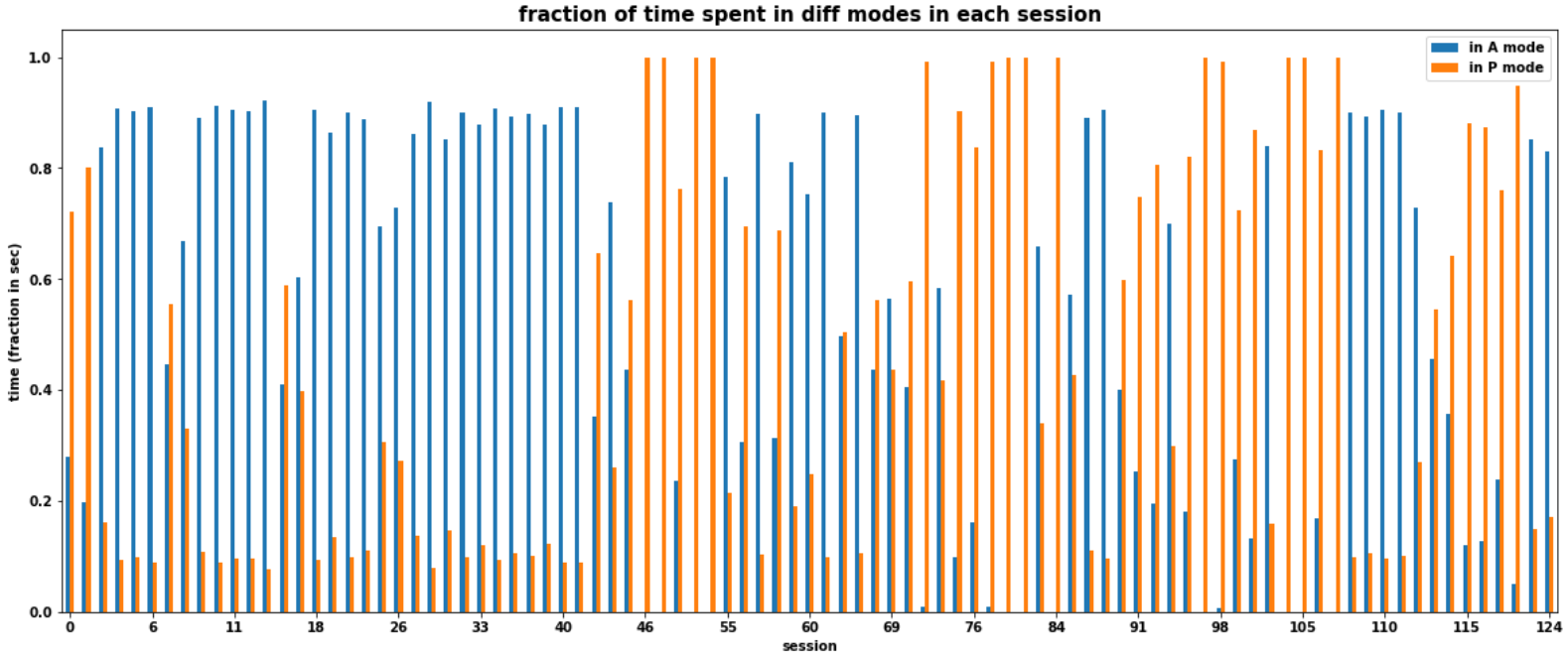


Stiffness (KxGain) behaviour P003

What is the fraction of time spent in Assistive or Perturbed mode in Explore game?

Determine if the players spend more time in perturbed mode as play progresses.

P003 spend 0.36 more time in perturbed mode as play progresses.



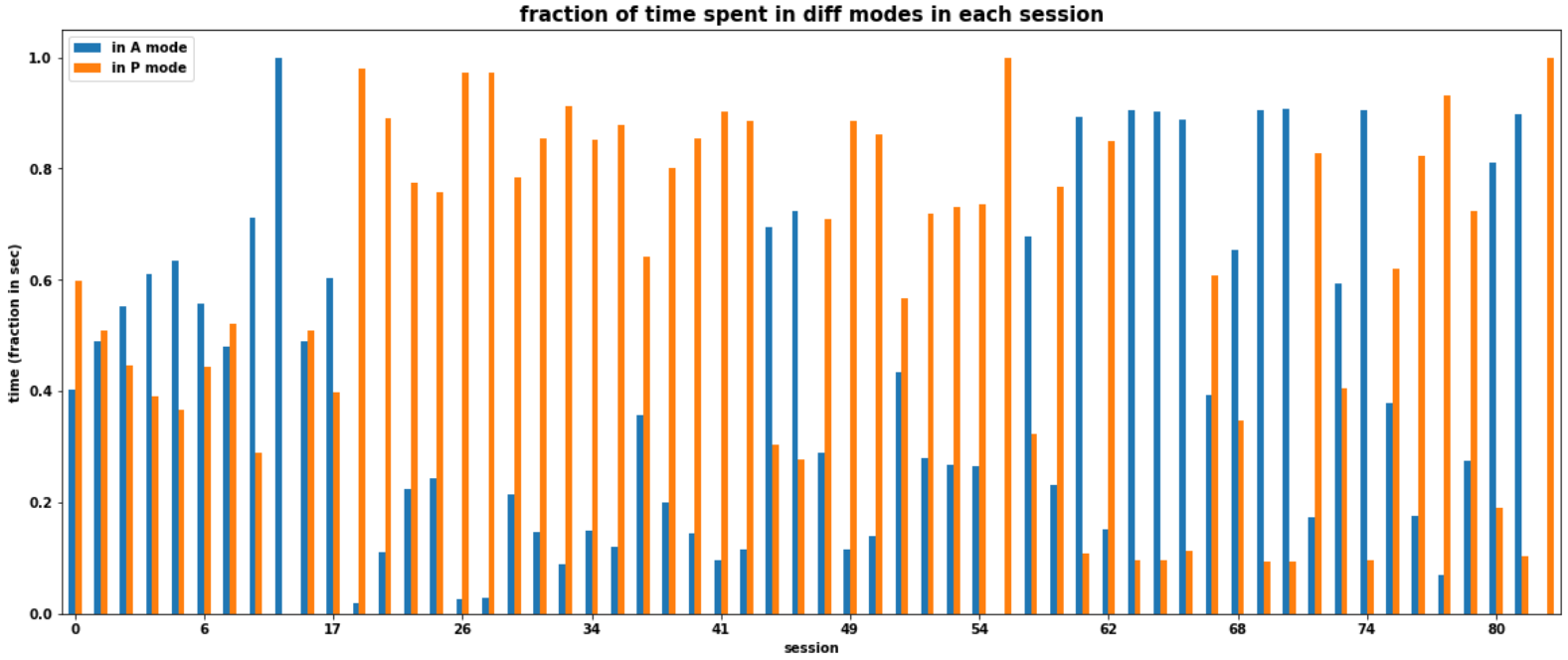
-0.035

Stiffness (KxGain) behaviour P004

What is the fraction of time spent in Assistive or Perturbed mode in Explore game?

Determine if the players spend more time in perturbed mode as play progresses.

P004 spend 0.04 less time in perturbed mode as play progresses.

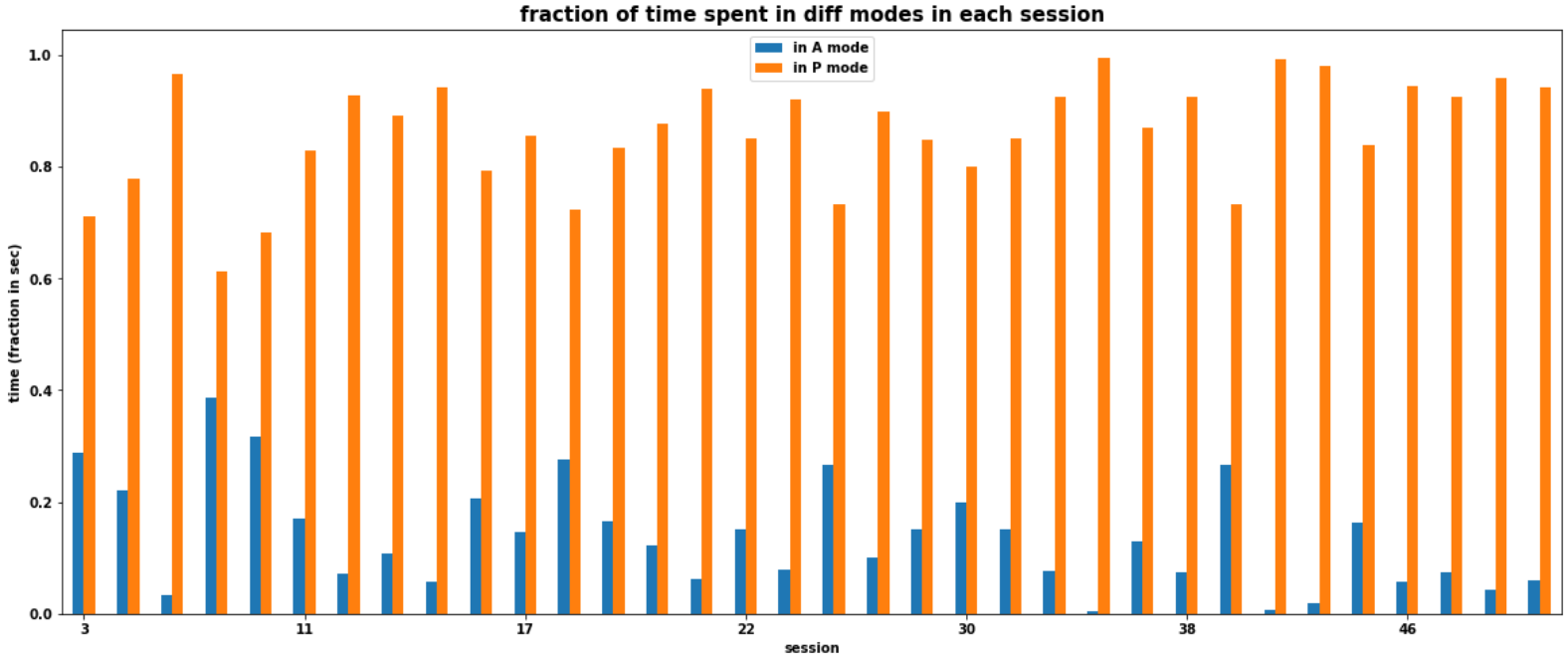


Stiffness (KxGain) behaviour P006

What is the fraction of time spent in Assistive or Perturbed mode in Explore game?

Determine if the players spend more time in perturbed mode as play progresses.

P006 spend 0.1 more time in perturbed mode as play progresses.



Stiffness (KxGain) behaviour

What is the fraction of time spent in Assistive or Perturbed mode in Explore game?

- P001 did not spend a lot of time playing the games, and spent most of the time in assistive mode. P003 showed an increase in time spend in perturbed mode. Other players showed little/no differences in time spend in perturbed mode, as game play progresses.
- Note that this is total time spend in the modes in each session. Since prolonged play in perturbed mode is more effective than intermittent play in perturbed mode, more analysis would be done on the longest/continuous time spend in perturbed mode.
- This would provide a better gauge if the players are navigating through a more challenging task in longer periods, rather than just intermittently.

Conclusions

Patients' performance

- Considerable differences in **usage** (net time and periodicity) from 5 hrs (P001) to 1 day, 17 hrs (P004)
- Players spend most time playing explore or drone games. P003 & P004 spend almost half of their playing time on the explore game. Otherwise, the other players spend about 38-42% on explore/drone, so there is no clear favourite.

Conclusions

Patients' performance

- Since stiffness requires filtering several steps of SPARC, and is a function of SPARC, median stiffness values in the last quadrant of each session is used as proxy to determine how each player moves and **adapts as gameplay progresses** across sessions.
- There is a correlation between SPARC and number of help modes (SPARC = -8), and large variances are due, in part, to the number of help modes (SPARC = -8) in the explore game.
- In general, there were improvements in the last quadrant in each session, demonstrated by either less number of help modes, being in perturbed mode, smaller stiffness values.
- Due to fluctuating stiffness values, this possibly suggests that 'assisting' players too often might not be a good thing.

Conclusions

Patients' performance

- On average, highest **velocity** was found in fish game for all players.
- Due to the nature of the fish game, highest variation in velocity *within* session was also found in fish game.
- General increase in velocity *within* session was found in explore or drone games.
- The ability to move quicker, or navigate the gaming environment better, may indicate an improvement in gross motor skills.