



Desirable Behaviors for Companion Bots in First-Person Shooters

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First-Person Shooter games are a popular genre that often includes a **team deathmatch mode of play**, in which teams of agents try to maximize score by killing members of the other team. When played without other humans, this mode features both opponent bots and companion bots. This paper uses a **human subject study with 30 participants to analyze player preference for cooperative teammates vs. skilled, but less cooperative, teammates in the game Unreal Tournament 2004**. Specifically, participants play games with both a **skilled bot based on neuroevolution** and a **less skilled bot hand-coded to be more cooperative**.



Unreal Tournament 2004

Unreal Tournament 2004 (UT2004) is a First-Person Shooter (FPS) video game known for its online multiplayer modes that still have active servers. One mode is **team deathmatch** in which players can repeatedly respawn after dying, and **points are earned by killing players on the opposing team**, and the collective team score determines victory.

Human Subject Study

The human subject study consisted of 30 participants, all of whom were students, faculty, or staff at Southwestern University. Participants first played a one-on-one tutorial match against a native bot with an investigator present to explain the game. The participant would then play two **10 minute rounds of team deathmatch** against two native bots with each experimental bot as a teammate.

After each round **players were asked to rate the bots on a scale from 1 to 5** on five different metrics, with a higher score meaning that they considered the bot to be better in that aspect. The bots were scored on **how well they followed the player, how helpful they were, how often the player saw them, their ability to score points, and their ability to avoid dying**. Participants also indicated **which bot they preferred playing with and the reasons for that preference**.

Results

Percentages(counts) for which bot users rated higher in each category, and the number of tied ratings. The *p*-values for the results of a Binomial Test are also shown (ties split between both bots), with significant differences in **bold**

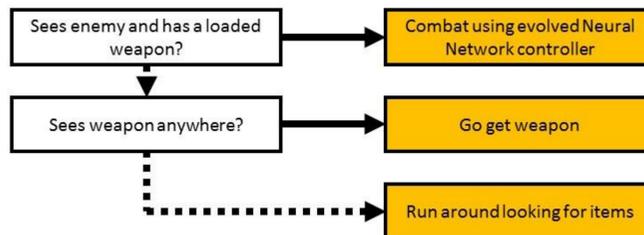
Better at...	Jude	Ethan	Tie	<i>p</i>
Following	53.33%(16)	30%(9)	16.67%(5)	0.3616
Helping	17.24%(5)	68.97%(20)	13.79%(4)	0.00813
Being Seen	43.33%(13)	6.67%(5)	40%(12)	0.2005
Scoring	6.67%(2)	60%(18)	33.33%(10)	0.005223
Avoiding Death	6.67%(2)	63.33%(19)	30%(9)	0.005223

Percentages(counts) for users who preferred the bot they rated better/worse in each category, with ties shown. Scores for the two bots in the same category were combined with each user's stated preference to determine if they prefer high or low scorer in the category. The *p*-values for the results of a Binomial Test are also shown (ties split between both bots), with significant differences in **bold**

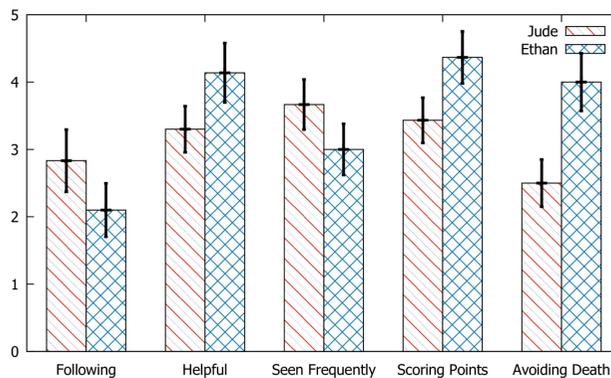
Category	Prefer Better	Prefer Worse	Tie	<i>p</i>
Follower	60%(18)	23.33%(7)	16.67%(5)	0.09874
Helper	65.52%(19)	20.69%(6)	13.79%(4)	0.02412
Seen More	50%(15)	10%(3)	40%(12)	0.04277
Scored	46.67%(14)	20%(6)	33.33%(10)	0.2005
Avoided Death	50%(15)	20%(6)	30%(9)	0.2005

Evolved Bot "Ethan"

Ethan's agent architecture is simpler, but has **more sophisticated combat behavior because its actions during combat are dictated by an evolved neural network**. Ethan is a streamlined version of UT2 [1] with tweaks for human-like play removed. However, Ethan was **evolved from scratch for this paper using a variant of NEAT [2] called MM-NEAT (Modular Multiobjective Neuroevolution of Augmenting Topologies [3])**.



Average User Assessments of Both Bots. Scores on a 1-5 scale are shown side-by-side for Jude and Ethan, with 95% confidence intervals.



Findings

- Players preferred Ethan (17) over Jude (13), but not significantly ($p \approx 0.5847$).
- Players preferred bots that were helpful, seen frequently, followed them, and scored well.
- Players who preferred Jude tended to emphasize its demeanor and the feeling of teamwork over the objective results.
- Players who preferred Ethan tended to emphasize its proficiency at scoring and avoiding death, both of which affected the final score.
- Able to employ more team based tactics with Jude, but Ethan made winning easier.
- Ethan made some players feel ignored and like their participation did not affect the game or that the game was too easy to win.
- Jude seen as overly aggressive as a result of its simplistic combat behavior which tells it to attack by rushing directly at opponents.
- Most players saw Jude's ability to follow as a positive trait, and commented that they wished Ethan would have done the same.
- The bots reportedly led players to enemies that they had not seen, but this is coincidental.
- The term "helpful" was found to be too ambiguous, and further clarification would have led to clearer results.

References

[1] J. Schrum, I. V. Karpov, and R. Miikkulainen, "Humanlike Combat Behavior via Multiobjective Neuroevolution," in *Believable Bots*. Springer, 2012, pp. 119-150.
 [2] K. O. Stanley and R. Miikkulainen, "Evolving Neural Networks Through Augmenting Topologies," *Evolutionary Computation*, vol. 10, pp. 99-127, 2002.
 [3] J. Schrum and R. Miikkulainen, "Discovering Multimodal Behavior in Ms. Pac-Man through Evolution of Modular Neural Networks," *IEEE Transactions on Computational Intelligence and AI in Games*, vol. 8, no. 1, pp. 67-81, 2016.