

# Gaze Complements Control Input for Goal Prediction During Assisted Teleoperation: Supplementary Material

Reuben M. Aronson  
Robotics Institute  
Carnegie Mellon University  
Pittsburgh, PA, USA  
rmaronson@cmu.edu

Henny Admoni  
Robotics Institute  
Carnegie Mellon University  
Pittsburgh, PA, USA  
henny@cmu.edu

## I. SUBJECTIVE RESULTS

After completing trials for each condition, participants ( $N = 12$ ) answered questions on a seven-point Likert scale, following Javdani et al. [1] (emphasis added; emphasized words act as references for reporting results):

- I felt in **control** while using this system.
- I was able to accomplish the tasks **quickly** while using this system.
- The robot did what I **wanted** while using this system.
- My goals were perceived **accurately** by this system.
- If I were going to teleoperate a robotic arm, I would **like** to use this system.

Participants also answered two open-response questions:

- Did you use any particular strategies while operating the robot?

- What are your comments about this system?

Participant responses are given in Fig. 1 and the statistical analysis is summarized in Tab. I. Overall, participants disliked the gaze-only condition and showed no preference between the merged and joystick conditions.

## REFERENCES

- [1] Shervin Javdani, Henny Admoni, Stefania Pellegrinelli, Siddhartha S. Srinivasa, and J. Andrew Bagnell. Shared autonomy via hindsight optimization for teleoperation and teaming. *The International Journal of Robotics Research*, 37(7):717–742, 6 2018. ISSN 0278-3649. doi: 10.1177/0278364918776060. URL <http://journals.sagepub.com/doi/10.1177/0278364918776060>.

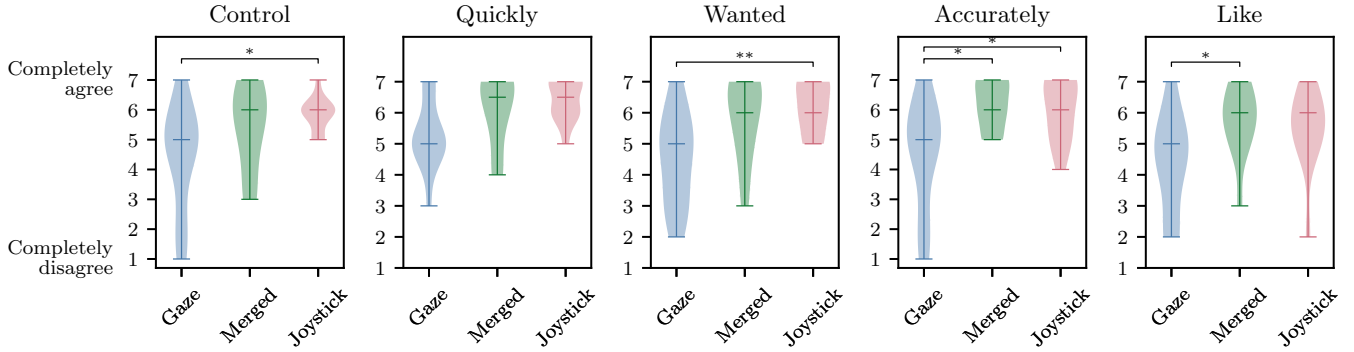


Fig. 1: Participant answers to the post-condition Likert questions. Significance testing per question was performed with a Kruskal-Wallis test with  $\alpha = 0.05$ , and when significance was achieved, a Mann-Whitney U test was used for post-hoc evaluation. Conditions annotated with \* indicate significance at  $p < 0.05$ , and \*\* at  $p < 0.01$ . Overall, participants disliked the gaze condition, while showing no clear preference between the other two.

Question	$\chi^2(2)$	$p$	Conditions	$U$	Corrected $p$
Control	6.3	0.042*	gaze-merged	45.5	n.s.
			gaze-joystick	29	0.013*
			merged-joystick	65.5	n.s.
Quickly	5.9	n.s. (0.054)			
Wanted	8.5	0.014*	gaze-merged	35.5	n.s. (0.050)
			gaze-joystick	25.5	0.0094**
			merged-joystick	65.5	n.s.
Accurately	8.0	0.019*	gaze-merged	28.5	0.014*
			gaze-joystick	35.5	0.046*
			merged-joystick	67.0	n.s.
Like	7.1	0.029*	gaze-merged	31.5	0.026*
			gaze-joystick	37	n.s. (0.058)
			merged-joystick	63.5	n.s.

TABLE I: Statistical analysis of participant answers to questions. Significance testing was performed first with a Kruskal-Wallis test for overall significance, and post-hoc analysis was done using the Mann-Whitney U test ( $n_1 = n_2 = 12$ ) with Bonferroni correction for multiple comparisons. \* indicates significance at  $p < 0.05$ , \*\* at  $p < 0.01$ . Marginally significant values ( $p < 0.1$ ) are shown in parentheses. n.s. means “not significant” at  $\alpha = 0.05$ .