Investigating the Effect of Shared Gaze on Multi-person Teams

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Introduction

In 2023, 13% of employees worked full time and 28% hybrid. Remote work introduces unique challenges among teams, such as feelings of isolation, lack of shared attention and awareness. Visualizing the gaze of collaboration is a new methodology that is known as *shared gaze*. Shared gaze has been shown to improve different aspects of remote collaboration in different contexts but almost all prior work has focused on teams of two, with the exception of two studies on teams of three. This summer, we have been working on the infrastructure of a user study that will examine the effect of shared gaze in larger groups. We have chosen a visual search task, a common task used in prior literature on shared gaze.

Related Work

The use of shared gaze has been shown to facilitate closer collaboration and improve performance on various tasks across several settings. We discuss relevant literature on shared gaze in relationship to theories surrounding communication and studies on how group size affects collaboration.

Shared Gaze

- Shared gaze benefits: spatial task division [Brennan et al., 2008; Niehorster et al., 2019],
- Grounding theory: shared gaze facilitates common ground in communication [Clark & Brennan, 1991; Olson & Olson, 2000]
- Social presence: shared gaze can create "virtual togetherness" [Biocca et al., 2003; Hacker et al., 2020]
- Common metrics: accuracy, search time, consensus time [Brennan et al., 2008; Siirtola et al., 2019; Yamani et al., 2017]

Group Size

- Computer-mediated communication mitigates some negative effects of larger groups [Gallupe & Dennis, 1992; Paulus & Brown, 2007]
- Groups of 3-6 members considered optimal for productivity [Wheelan, 2009]
- Visual cues important for maintaining attention in larger groups [Riopelle et al., 2003]
- Smaller groups (3) maintain higher-quality communication than larger groups (6) [Lowry et al., 2006]
- Social loafing: Individuals in teams exerted less effort compared to working alone on complex tasks, but larger teams still outperformed due to increased collaboration [Mao et al., 2016]

Methods / System

Primary Task: Visual Search Task: Identify a hidden letter "O among Qs" [Brennan et al., 2008], where the target 'O' may or may not be present.

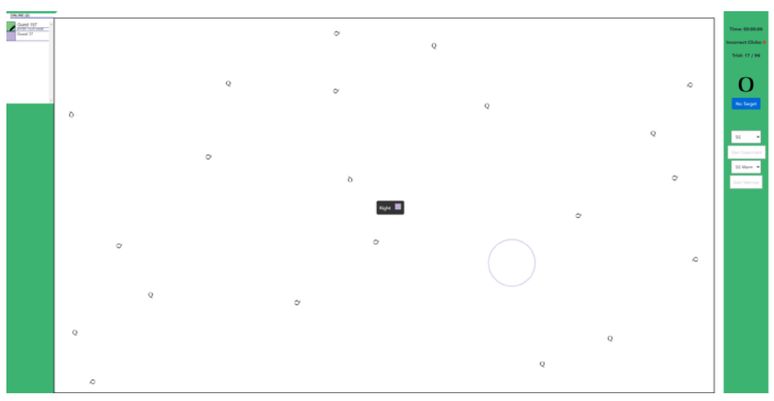
Equipment: Windows PCs with Tobii 4C eye trackers and custom software

Experiment Design:

- 4x3x2x2 mixed factorial design
- Group sizes: 1, 2, 4, and 6 participants
- Communication conditions: Shared Gaze (SG), Shared Voice (SV), and Shared Gaze and Shared Voice (SG+SV)
- Trials evenly divided for small (21) and large (35) set sizes and trials with and without target
- 96 trials per condition (288 total)
- Baseline condition with solo participants performing visual search task alone.

Process:

- 288 trials evenly pre-shuffled into 3 communication conditions
- Each condition, group gets 4 warmup trials, followed by 96 real trials
- Group has to collaborate to find target or decide 'O' isn't present in the trial
- Collective incorrect clicks displayed per trial
- After each trial, participants will know if who made the choice and if it was the correct choice
- After finishing 96 trials, participants complete survey



Questionnaires per each Condition:

- Social Loafing evaluating individual/group efficiency
- NASA-TLX measuring Cognitive Load
- Reviews on Gaze Tracking

Compensation:

- 1 (45 mins): 15$ base + extra
- 2, 4, 6 (90 mins): 25$ + extra

Technology

- Pre-generated all trials and trial data in a CSV using JavaScript Canvas
- **Backend**: Node.js with Express.js server
- **Frontend**: Basic HTML and JavaScript for interactive UI
- **Real-time communication**: Socket.IO for live connections
- **Eye tracking**: Tobii 4C eye trackers for gaze logging and shared gaze
- **Database**: Firebase Realtime DB
  - Synchronized experiment actions across users
  - Tracked new users, correct/ incorrect clicks, task completion
  - Managed experiment start/ end
- **Data collection**:
  - Quantitive gazes and gaze overlap data, server logs, mouse actions recorded onto CSVs throughout experiment
  - Qualitative survey data gathered through Qualtrics

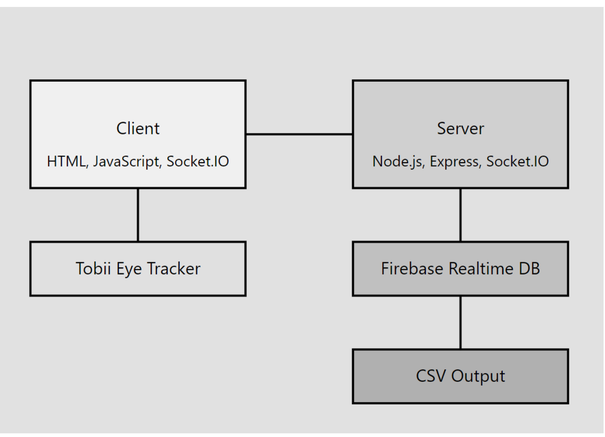


Figure 3. System architecture for necessary software to conduct experiments

Next Steps

- Design a flyer
- Recruit students/staff from the Claremont Colleges and conduct the experiments
- Analyze data, evaluate the effect of shared gaze and group size on accuracy and search time
- Compile findings into a research paper and submit it to peer review.
- Present the work to accepted conference

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