Visualizing Alignment in Joint Attention

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Introduction

Research Question

How do task partners coordinate their behavior, including their language use and shared attention?

Background

- Alignment in language use supports success in joint tasks (Pickering & Garrod, 2004)
- In motor tasks, various coordination patterns (including alignment and complementary) can support achieving shared goals (Wallot et al., 2016; Gorman et al., 2017; M. J. Richardson et al., 2015)

Hypothesis

Pairs of participants' eye fixations will align more closely during a route planning than a landmark counting task.

Objectives

1. Explore the relationships between patterns in eye fixations and emergent strategies by dividing each session into four quarters across time and coding for patterns
2. Generate a coding system that can describe patterns of joint attention in these visualizations
3. Evaluate differences in coordination strategies based on consistent patterns of coordination in the two tasks (route planning vs. counting)

Method

- Pairs of participants completed two tasks
  - Count Landmarks (Counting)
  - Plan a Route (Planning)
- Eye movements and conversations were recorded with EyeLink® 1000 Plus & SR Research Experiment Builder.

Approach

- Snapshots were generated through EyeLink® Data Viewer.
- Using each pair's eye tracking data, visual representations were created for each quarter of time passed during each task (see Fig 1).
  This was done for 2 trials per pair: one for the planning, one for the counting task. Maps were controlled for difficulty.
- The four snapshots were entered into coding sheets to code for **patterns over time** and **between tasks**.

Coding Guidelines

Coding for each pair:

1. **Within a timeframe:** Patterns in each snapshot were described
2. **Across the trial**: Patterns across the four snapshots of a trial were described
3. **Across tasks**: Patterns across the two tasks were described as similar or dissimilar

Codes for Patterns of Coordination:

- Alignment – Overlapping Fixations
- Complementarity – Separated Fixations

Codes qualifying each pattern:

No/None, Nearly No/None, Very Little/Low, Little/Low/Less, Some/Moderate, Mostly/High/More, Very High, Nearly Complete, Complete
(e.g., "High Alignment")

Results

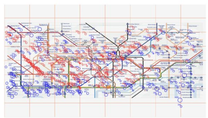
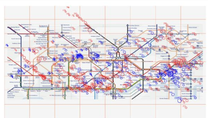
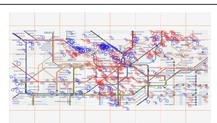
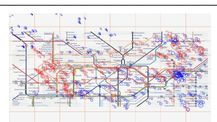
Descriptive Statistics

- 62 participants in 31 pairs
  6 Male-Male, 13 Female-Female, 12 Mixed
  1 Non-Binary, 38 Female, 23 Male participants
- 23 average years of age (mean)
- 6.3 deviation of years (SD)
- 34 distance of years (range)

Observed Strategies

1. Boundaries/Dividing the Map
   conventional sides (Left vs. Right)
   unconventional divisions (Interior/Center vs. Exterior/Periphery)
2. Temporal Lag/Time Lag [~0.5-6 seconds]
   A participant fixated on similar positions of the other participant after a delay
3. Side-Switching
   A pair will exchange regions to observe during a task (usually a 1-1 switch)

Figure 1: Chart of Pair 6

Time	Counting in London	Planning through Barcelona
Q1		
Q2		
Q3		
Q4		
Patterns in each image	1. Mostly Complementary, Less Alignment 2. Mostly Complementarity, Little Alignment; Time Lag of ~5 seconds 3. Mostly Complementary, Less Alignment 4. Mostly Complementary, Little Alignment	1. Mostly Aligned, Very Little Complementarity 2. Nearly Complete Complementarity, Nearly No Alignment Time Lag of ~5 seconds 3. Mostly Complementary, Less Alignment 4. Mostly Complementary, Little Alignment
Patterns across 4 images	Maintains a high level of Complementarity while decreasing in Alignment over time. Notable Time Lag during Q2.	Sharply decreases in Alignment after Q1 while increasing in Complementarity over time. Notable Time Lag during Q2.
Patterns across two tasks	Overall strategy was similar in origin; Complementarity rises as Alignment falls during both tasks. Time Lag was consistent across tasks and appears in the same time frame (Q2).	

Participant A is Red; Participant B is Blue

Frequencies

	Counting Task	Planning Task
Boundaries	13	11
Time Lag	11	11
Side-Switching	5	1
None	12	12
Total strategies	**29**	**23**

Conclusions

The hypothesis was consistent with the results as alignment was higher during route planning tasks than landmark counting.

- The majority of the pairs (n=18) used distinct strategies in the two tasks
- Pairs with high complementarity during a given task have shown the use of arbitrary boundaries or lines to divide the map
- Overall, pairs produced numerically more strategies for Counting (n=29) than for Planning (n=23)
- Pairs that aligned more strongly tended to temporally lag behind one another
- Pairs were more likely to switch their focus on map areas in Counting (n=5) than in Planning (n=1)
- Side-Switching was observed mostly when maps had salient boundaries (e.g., river, prominent subway lines)

These patterns are consistent with the idea that Counting (which relies on visual search) affords more flexible strategies for organizing the interaction.

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