Angular orientation during social contact: Relative orientation among developmental disorders and sexes in the classroom

Blake Williams[1], Jack Weissburg[2], Laura Vitale[3], Daniel Messinger[3]

[1]University of Vermont, [2]University of Wisconsin-Madison, [3]University of Miami

Introduction

- Social contact in children can be investigated using continuous measurement of location.
- Angular orientation within the radius of proximity-based social contact defined by a radial distribution function improves the definition of social contact.
- Common types of angular contact arise, including face-to-face and side-by-side contact.
- Child-child angular contact can be used to investigate differences in social contact in children with developmental disorders.
- Observing angular contact can also reveal contact preferences within and between the sexes.
- Spatial observations were collected from children in a developmental disorder inclusive preschool classroom.

Data Collection

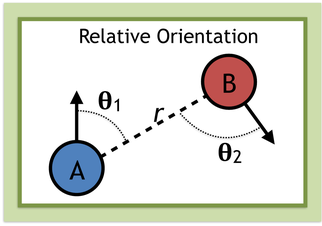
- Real-time tracking of child location was collected using the Ubisense Dimension 4 location system. Children wore vests with left and right tags recording location at 1-4Hz using radio frequency ID.
- Preschool children (average age: 2.4yrs) were given free play time each day in which they would interact with toys, games, and one another.
- An average of 29.5 min of free play time was recorded across 6 days (max: 47 min, min: 16 min).
- Analyses were restricted to free play time to reduce predetermined influences on interaction, such as seating arrangement.

Condition	Male	Female
Typical	3	2
Autism	2	1
Developmental Delay	2	0
Dev. Delay & Encephalopathy	1	0
Down Syndrome	1	0
Goldenhar Syndrome & Prematurity	1	0
Williams Biuren Syndrome	0	1

Vest (rear view) with RFID tags shown

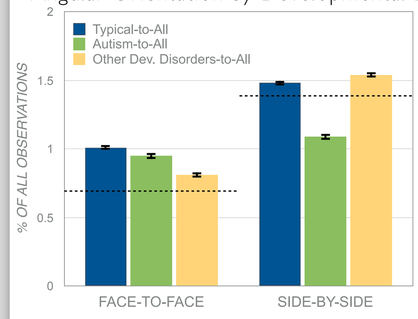
Measuring Orientation

- **Relative orientation:** angle between the heading of a child and another child within social contact (0.2m-2.0m).
- Utilizing two tags per child allowed heading to be determined. For each child, heading and location were found from the left and right tags.
- Ubisense tag data was extrapolated to every 0.1s time step *t*. Gaps in individual tag data longer than 60s were recorded as missing.
- At each time *t*, the relative orientations for each child-child pair are found.
- θ_1 is the angular position of child B relative to child A
- θ_2 is the angular position of child A relative to child B



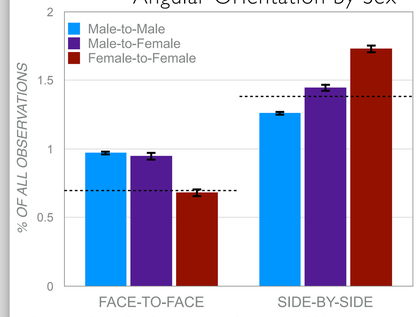
Results

Angular Orientation by Developmental Disorder



Expected value from a uniform angular distribution: 0.694% for face-to-face, 1.389% for side-by-side

Angular Orientation by Sex

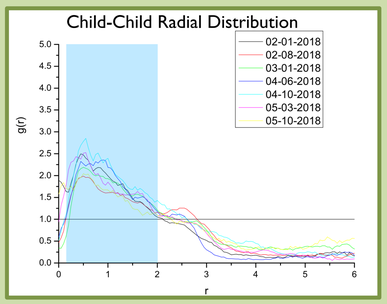


Expected value from a uniform angular distribution: 0.694% for face-to-face, 1.389% for side-by-side

- Face-to-face: both θ_1, θ_2 within 15° of 0°
- Side-by-side: both θ_1, θ_2 within 15° of |90|°

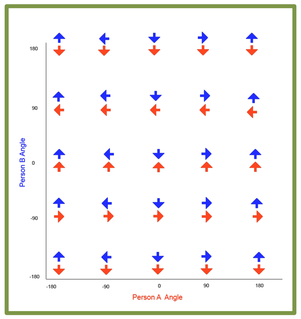
Determining Social Contact

- Observations were restricted to a radius of 0.2m-2.0m between children, the range of social contact as defined by a radial distribution function, *g(r)*.
- $g(r)=P_{AB}(r)/P_{AB,NULL}(r)$, where $P_{AB}(r)$ is the total time child A and B were separated by *r* and $P_{AB,NULL}(r)$ is the product of child A and B's location probabilities for radius *r*.
- Values of *g(r)* indicate the prevalence of contact at each distance normalized by the expected prevalence found using temporally randomized positions.
- Where *g(r)*>1, children are more likely to be found at *r* than expected.



Relative Orientation During Free Play

Figure Interpretation

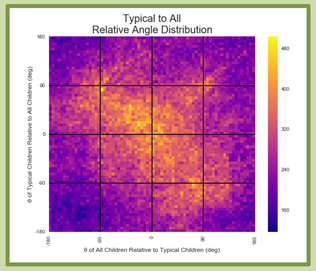


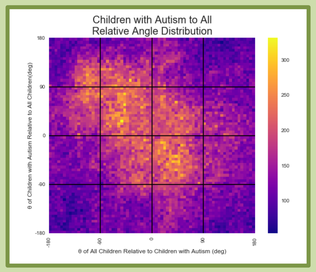
Each point represents the number of timesteps a pair was observed in a given 5x5 degree bin.

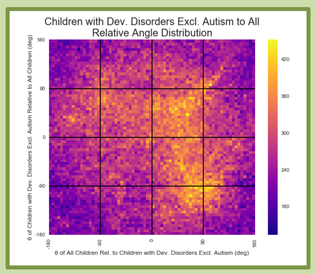
Orientations of interest:

- (0°, 0°): face-to-face
- (±90°, ∓90°): side-by-side

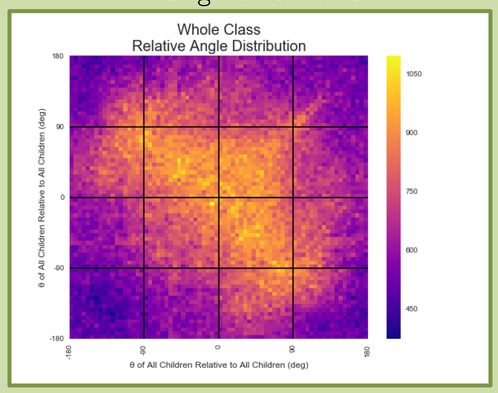
Developmental Disorders: Subgroup with All



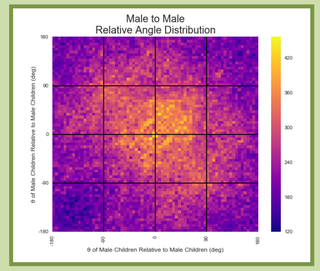


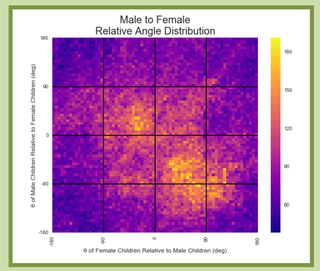


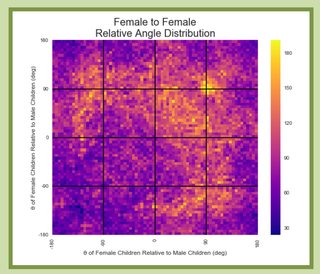
Among All Children



Sexes: Within and Between







Conclusions

- Female-to-female pairs is the only subgroup without greater than expected face-to-face orientation.
- Female-to-female pairs show more side-by-side orientation than male-to-female pairs, which show more side-by-side orientation than male-to-male pairs.
- Male-to-male pairs and autism-to-all show less than expected side-by-side orientation while all other groups show more than expected.
- Common features in relative orientation suggest including orientation in the definition of social contact, with an application to social network creation.

Acknowledgements

- This material is based upon work supported by the National Science Foundation under Grant No. CNS-1659144.
- We thank Burt Rosenberg, principal investigator to the REU site: *Scientific Computing for Structure in Big or Complex Datasets.*
- We would like to thank Chaoming Song, PhD, and all others involved in the *IBSS-L: Continuous Measurement of Children's Behavior and the Development of Social Dynamics* (1620294) project.

bwilli16@uvm.edu