CAPTURING "HONEST SIGNALS" OF COMMUNICATION BETWEEN INFANTS AND PARENTS

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ABSTRACT

We describe a preliminary project studying interaction patterns between parents and infants age 0 to 3, using sociometric badges worn by the children and parents.

INTRODUCTION

In seminal research Hart and Risley (1992) identified the "30 million word gap" between children on welfare, and children from professional parents. They found that professional family children hear 48 million words with six positive encouragements for every negative prohibition until age three, while welfare family infants hear 13 million words with two prohibitions for every positive encouragement.

Motivated by these results, and by the work of Dr Edward Tronick at Harvard[1] observing the mirroring between mother and child we are trying to extend this research using sociometric badges worn by infants and parents, trying to discover honest (hidden) interaction patterns between infants and parents.

Our goal is to identify what interaction patterns of parents will be most supportive of future development of child. This will allow us to develop recommendations for interventions for disadvantaged parents to nurture their child's development.

EXPERIMENT OVERVIEW

This paper describes highly preliminary results of a first feasibility study. We equipped one parent and two infants with sociometric badges for one afternoon. Child 1 is a 33 months old girl; child 2 is a 17-month-old girl. The badges were placed inside the girls' shirt. We broke the afternoon into three sessions:

- Session 1 (with mother), drive to park, play, 53 minutes.
- Session 2 (with mother), play at home, 14 minutes.
- Session 3 (with father), eating, watching TV, playing, bathing, 1 hour 10 minutes.

We are now describing the different honest signals we have been able to capture with the sociometric badges.

ACTIVITY

Activity has been measured using the accelerometer (figure 1). Notice that the average activity of the girls is clearly higher during Session 1 at the park. There is a reduction in the activity at home during sessions 2 and 3 (more so when the father takes over and the activities are watching TV, playing with dolls and eating).

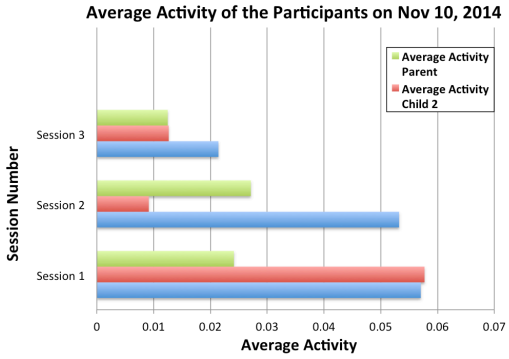

Figure 1: Activity on November 10 2014, for the participants during the three sessions.

MIRRORING

Mirroring compares two badges' activity. Mirroring values indicate how similar one badge's activity time series is to another badge's. The values range from 0 to 1, where 0 indicates no similarity and 1 indicates the two time series are the same.

Figure 1 shows the amount of mirroring and the time lag in session 1. The mother is mirroring child1 more, however with a higher lag than child2. Child1 is mirroring the mother more than child2, however with a higher lag than child2

[1] https://www.youtube.com/watch?v=apzXGEbZht0

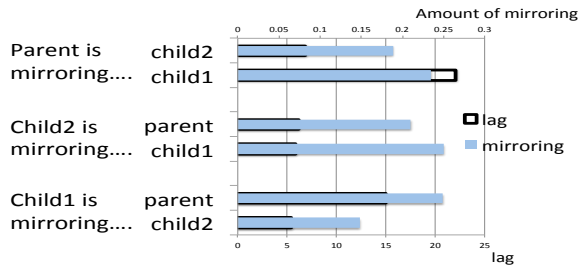

Figure 2: Mirroring in session 1

SPEECH PROFILE

The speech profile (figure 3) obtained from sociometric badge data includes the percentage of time spent by the badge wearers in speaking/listening/silence per time frame (frame duration is 1 minute for our data).

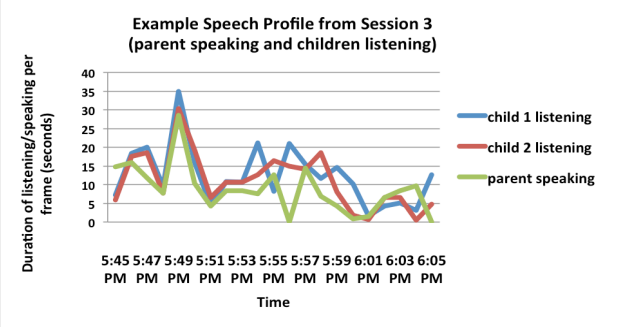

Figure 3: Example Speech profile from session 3

Session 1: At the Park with Mom		
Speaker	Listener	Correlation *r*
Parent (P)	Child 1 (C1)	0.306
Parent (P)	Child 2 (C2)	0.551
Child 1 (C1)	Parent (P)	0.450
Child 2 (C2)	Parent (P)	-0.053

Session 2: At Home with mother		
Speaker	Listener	*r*
P	C1	0.122
P	C2	0.749
C1	P	-0.059
C2	P	0.601

Session 3: At Home with father		
Speaker	Listener	*r*
P	C1	0.496
P	C2	0.487
C1	P	0.113
C2	P	0.556

(Anticlockwise from top) Table 1,2, and 3: Correlation in speaking/listening activity considering the parent, child 1 and child 2 as speakers/listeners alternately (r is the Pearson correlation coefficient).

There is a higher positive correlation between when

- Either parent speaks and child 2 is listening
- Child 1 and child 2 are both listening in the presence of the father
- Child 2 speaks at home and a parent is listening.

TURN TAKING

Turns are speaking segments that occur after and within 10 seconds of another speaking segment. A person can pause and then start speaking again. This would count as two speech segments, and one "self turn". The Turn taking matrix *n_tt* for a session indicate how many turns a badge-wearer took after each other badge-wearer. For example, in session 1 the parent takes 239 turns after child 1. So the parent speaks more often after child 1 who has taken 186 turns after the parent.

Session 1	Child 1 (C2)	Child 2 (C1)	Parent (P)
C1	413	62	186
C2	56	147	70
P	239	95	270

Session 2	C1	C2	P
C1	224	59	157
C2	66	54	36
P	183	33	209

Session 3	C1	C2	P
P	460	281	152
C1	246	387	159
C2	216	192	272

(Anticlockwise from top) Table 4,5, and 6: Turn taking matrices n_tt for sessions 1,2, and 3

Overall, the trends observed in sessions 1 to 3 are

- Children speak more often before the parent
- Child 2 speaks more often before child 1

CONCLUSIONS

With income inequality in the US economy stubbornly high, and unemployment among parents with little kids growing, it becomes increasingly important to identify key interventions that parents can take to stimulate a healthy growth not just for the body, but also for the mind. We hope to identify so far hidden communication patterns between parent and infant that will help nurture the developing intelligence of the child.

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