USC Viterbi School of Engineering

Ming Hsieh Department of Electrical Engineering

Computational Behavioral Analysis of Child-Psychologist Interactions

Daniel Bone, Chi-Chun Lee, Marian E. Williams, Sungbok Lee, Pat Levitt, Shrikanth Narayanan
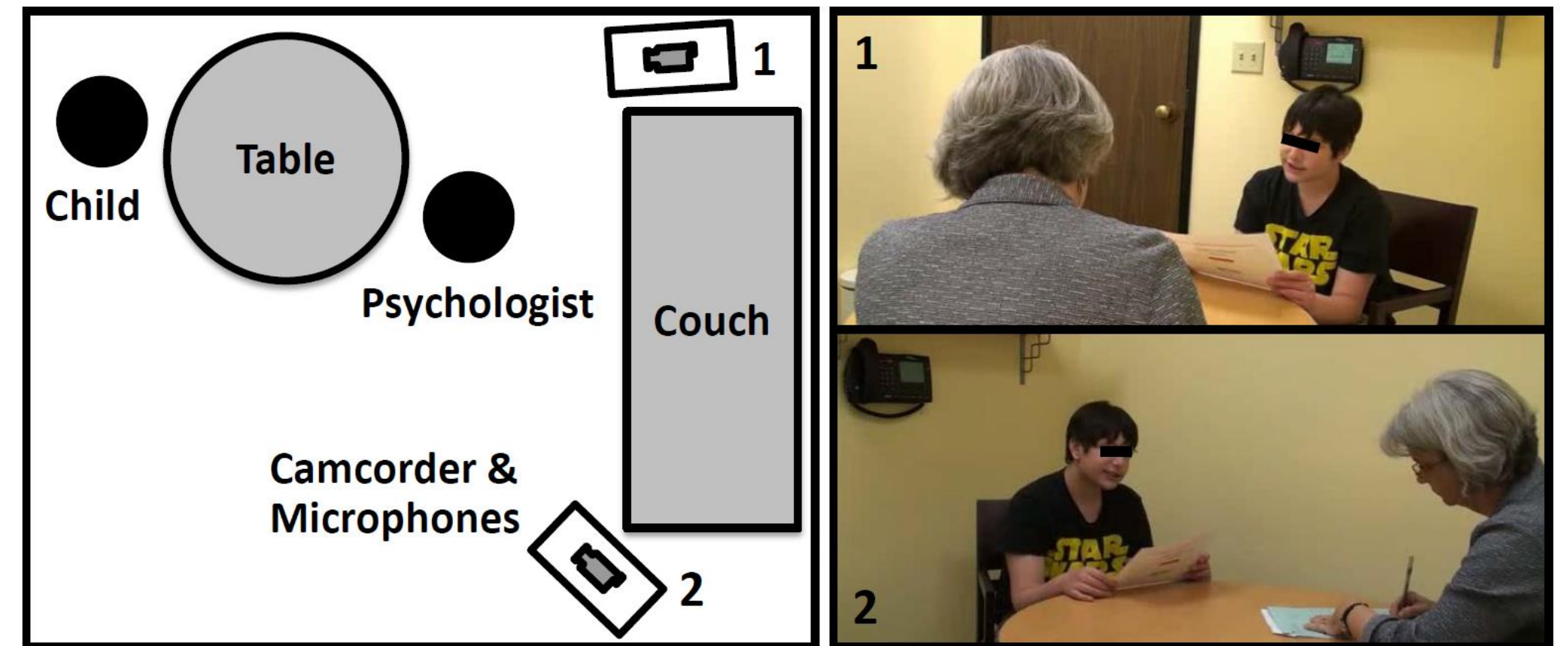**Signal Analysis and Interpretation Lab (SAIL), USC**

Motivation & Introduction

Interactions with individuals with autism: **generally lower social rapport**
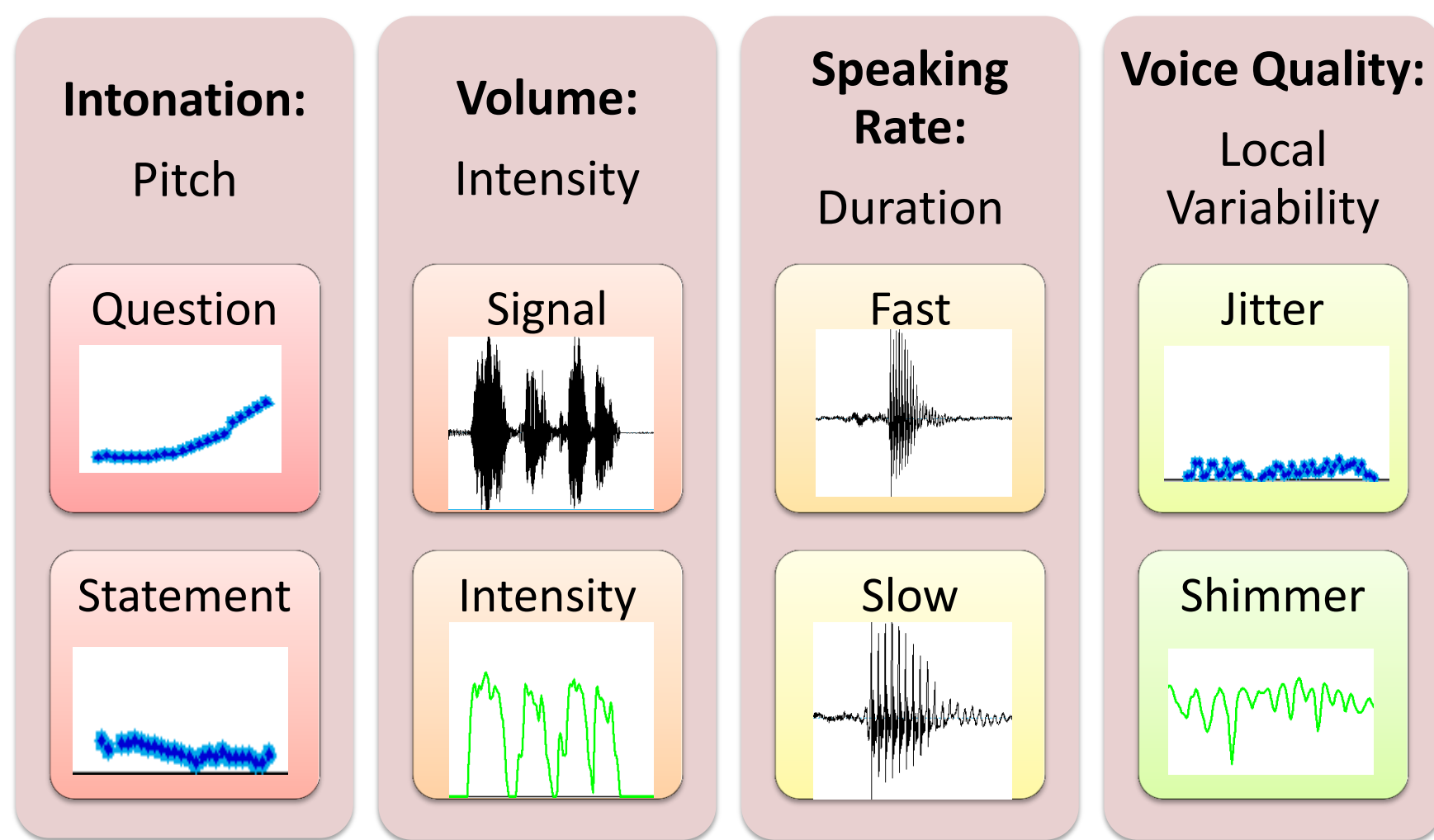**What** led to perceptions? Can we **objectively measure** this phenomena?

Goal: Create quantitative descriptors of interaction.
Purpose: Understand the underlying structure of interaction
For example, timing, phasing of salient events.
Application: Scale-up behavioral research, stratify spectrum, inform personalized intervention, long-term monitoring
We model the psychologist's behavior (an interlocutor) too!

Prosody is the *way in which something is said (intonation, volume, rate)*
Prosody indicates: syntax, semantics, pragmatics, and paralinguistics
Turn-taking and *language* cues can capture the *conversational style*.
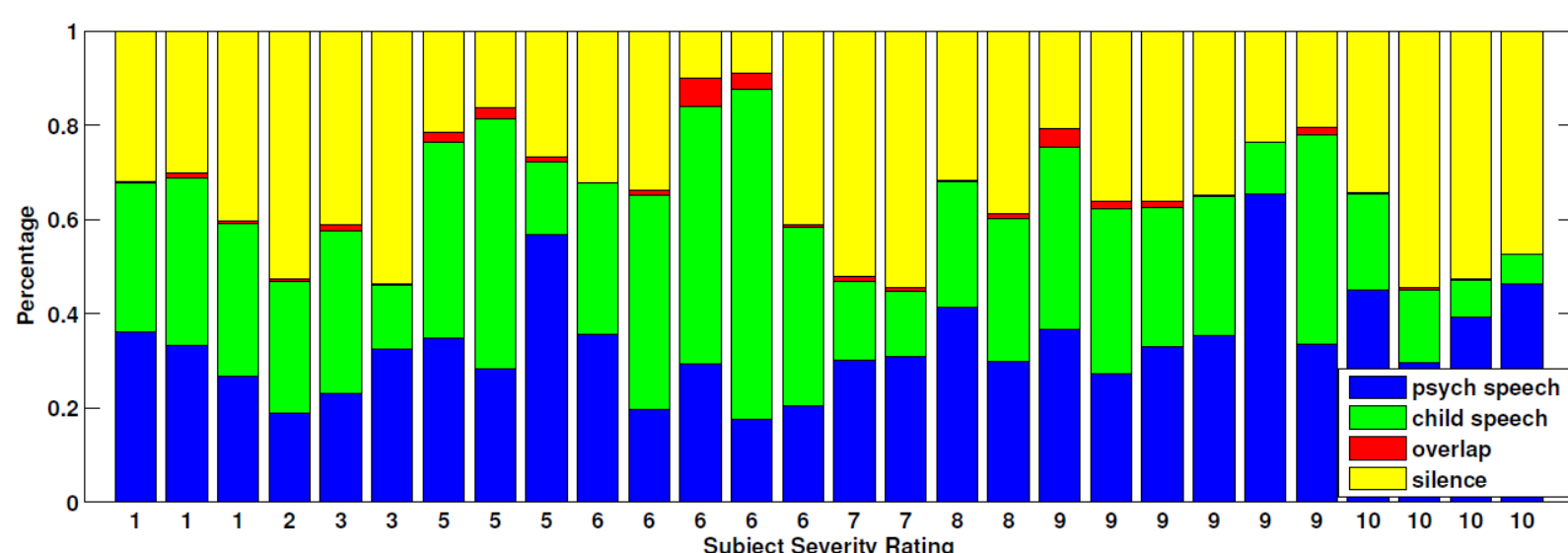
Data

Acoustic-Prosody

Intonation: Pitch — Question, Statement
Volume: Intensity — Signal, Intensity
Speaking Rate: Duration — Fast, Slow
Voice Quality: Local Variability — Jitter, Shimmer

Turn-taking and Language

Turn-taking:
- ☐ Speaking or silent?
- ☐ Interrupting?
- ☐ Latency?

Language:
- ☐ WPS (words per sentence) – similar to MLU
- ☐ First-person, singular pronouns
- ☐ Positive emotion, negative emotion, affect (+/-)
- ☐ Assents (okay)
- ☐ Non-fluencies (hmm, um)
- ☐ Fillers (I mean, you know)

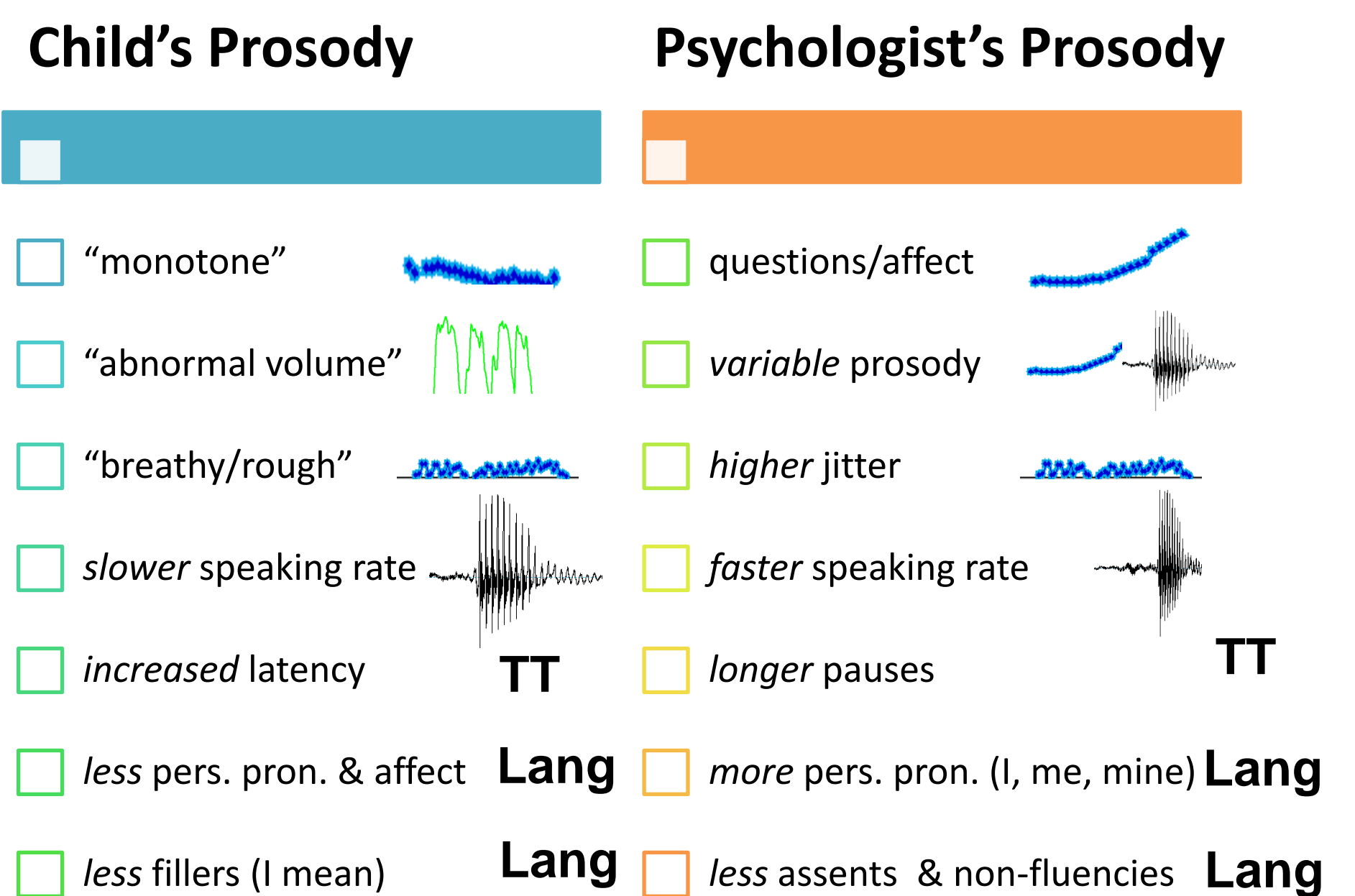Note: Feature extraction requires forced-alignment of speech to text

Simple Vocal Analysis

For **interactions** with **children with more severe autistic symptoms**
The *child* speaks *less*, while the *psychologist* speaks *more*.

Predictive Task

Acoustics&TT are most predictive in high Social Demand activities.
Psychologist's language is predictive even in low Social Demand.

*Spearman's ρ

	Psych Ac.	Child Ac.	P&C Ac.	Psych Lg.	Child Lg.	P&C Lg.
High SD	**+0.43**	**+0.76**	**+0.50**	**+0.49**	-0.01	+0.27
Med. SD	**+0.46**	+0.17	+0.29	0.10	+0.35	**+0.46**
Low SD	+0.20	+0.02	-0.11	**+0.39**	-0.97	+0.27

Conversational Analysis

For **interactions** with **children with more severe autistic symptoms**

Child's Prosody
- ☐ "monotone"
- ☐ "abnormal volume"
- ☐ "breathy/rough"
- ☐ *slower* speaking rate
- ☐ *increased* latency — **TT**
- ☐ *less* pers. pron. & affect — **Lang**
- ☐ *less* fillers (I mean) — **Lang**

Psychologist's Prosody
- ☐ questions/affect
- ☐ *variable* prosody
- ☐ *higher* jitter
- ☐ *faster* speaking rate
- ☐ *longer* pauses — **TT**
- ☐ *more* pers. pron. (I, me, mine) — **Lang**
- ☐ *less* assents & non-fluencies — **Lang**

Discussion / Future Work

➤ **The conversational quality degrades** for children with higher ASD severity.
➤ **Children** exhibit **difficulties conversing**, while the **psychologist varies** her speech and language **strategies to engage** the child.

➤ Model **temporal patterning** of interaction (e.g., vocal arousal)
➤ Model **strategies of the psychologist**

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