

# Why stressed, Mom?

## Exploring Family Reflection on Social and Emotional Sensor Data through Family Informatics



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\* Corresponding authors are Hyunsoo Lee, Jennifer G. Kim, and Uichin Lee. Jennifer G. Kim and Uichin Lee served as co-senior authors and jointly supervised the project.





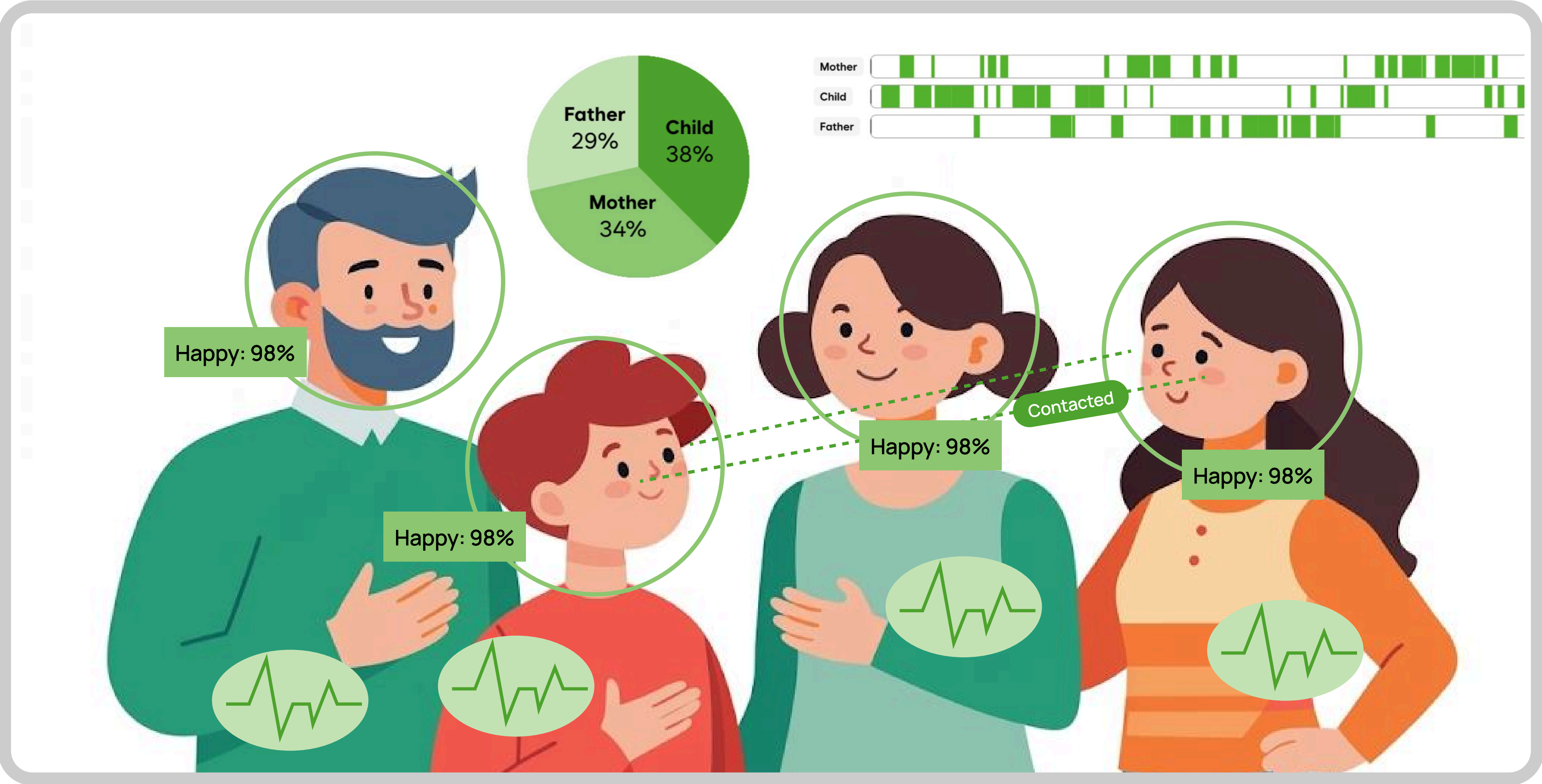


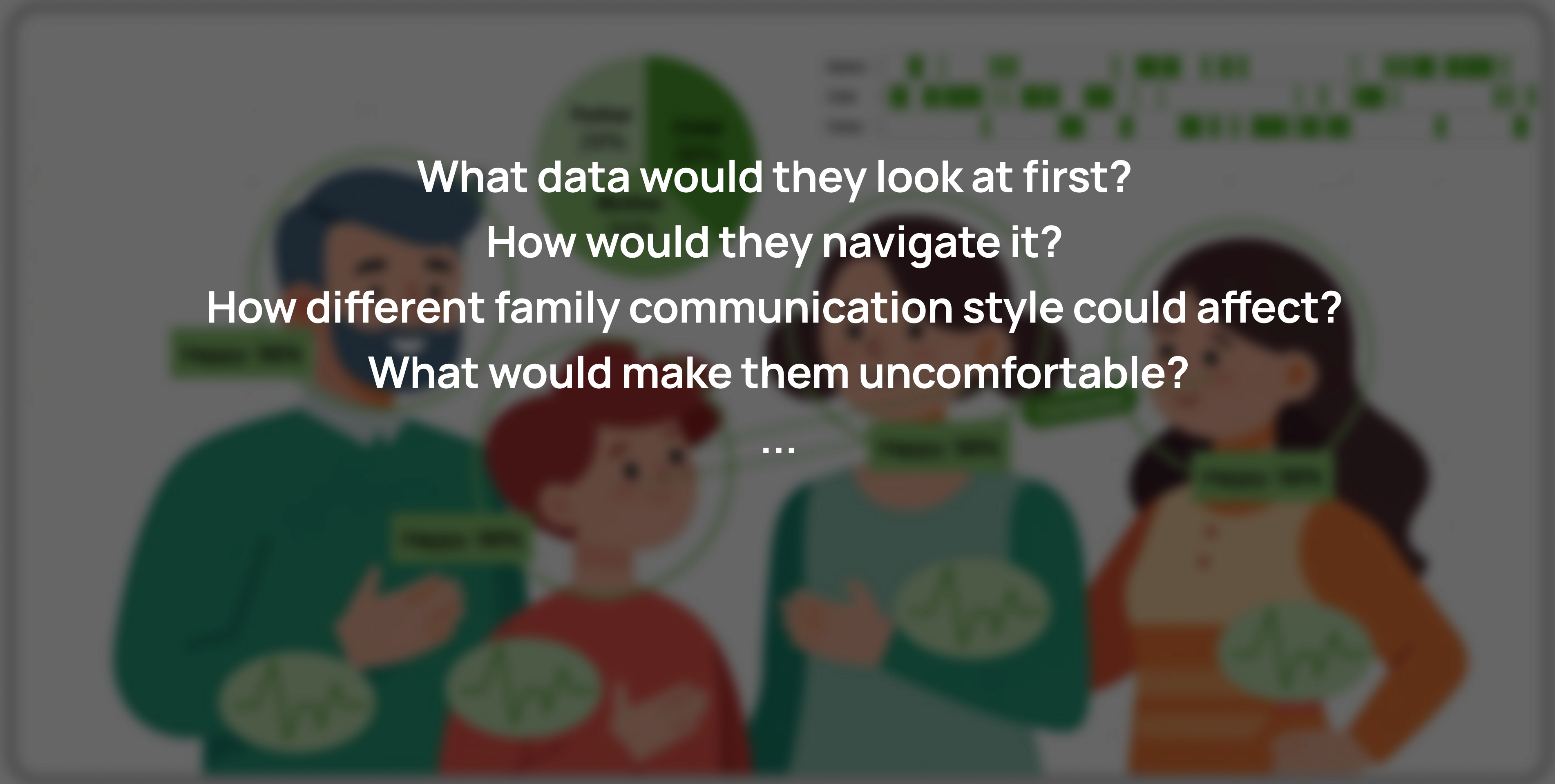
**Recognize my feeling?  
Understand others' feeling?**





# What if...





What data would they look at first?

How would they navigate it?

How different family communication style could affect?

What would make them uncomfortable?

...

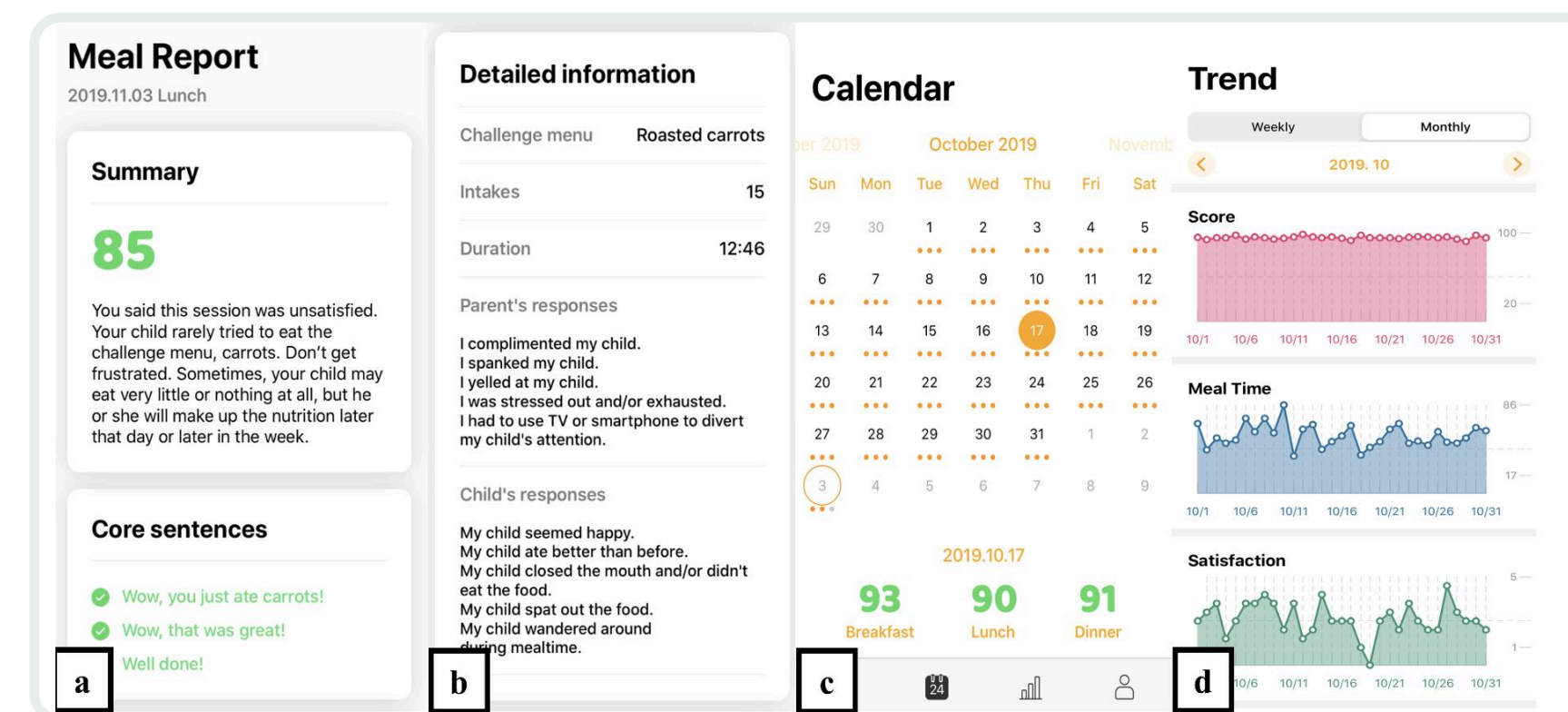
# Prior studies on Assessing Social-Emotional Behaviors in Family Conversations

## Professional Evaluation



[Rusconi-Serpa, 2009]

## Sensing Technology



[Jo, 2020]

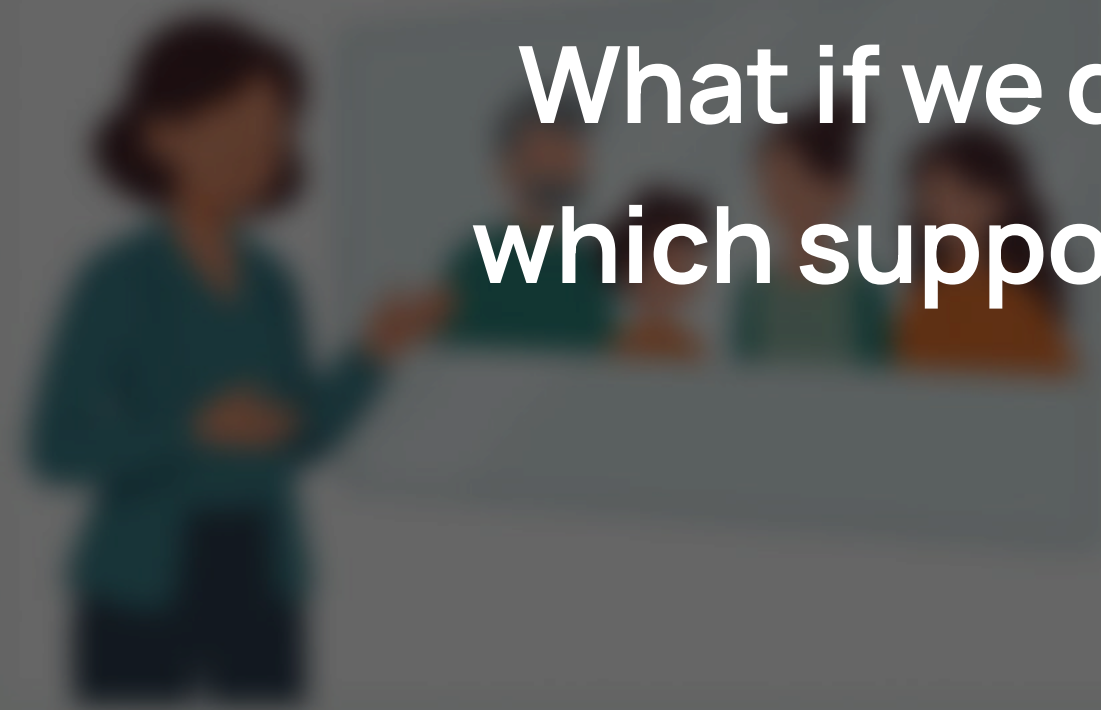
**one-directional, monitoring children under parental instruction.**

Sandra Rusconi-Serpa, Ana Sancho Rossignol, and Susan C McDonough. 2009. Video feedback in parent-infant treatments. *Child and Adolescent Psychiatric Clinics* 18, 3 (2009), 735–751

Eunkyung Jo, Hyeonseok Bang, Myeonghan Ryu, Eun Jee Sung, Sungmook Leem, and Hwajung Hong. 2020. MAMAS: supporting parent-child mealtime interactions using automated tracking and speech recognition. *Proceedings of the ACM on Human-Computer Interaction* 4, CSCW1 (2020), 1–32.

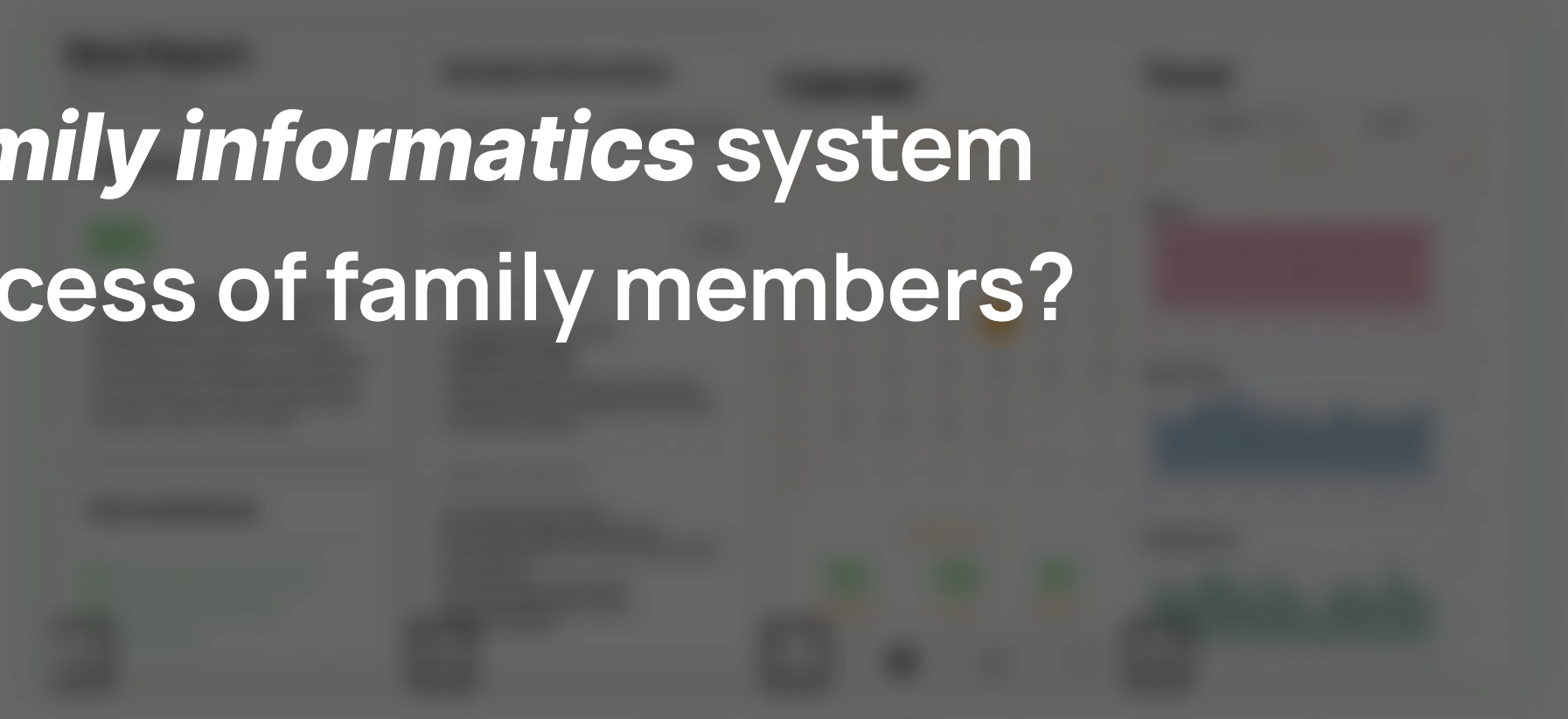
# Prior studies on Assessing Social-Emotional Behaviors in Family Conversations

Parental Monitoring



Shawhan et al., 2009

Family Informativity



Lee, 2009

What if we design a **family informatics** system which support equal access of family members?

one-directional, monitoring children under parental instruction.

## Research Questions

How do families reflect on the family conversation by interpreting **multimodal social and emotional data collaboratively?**

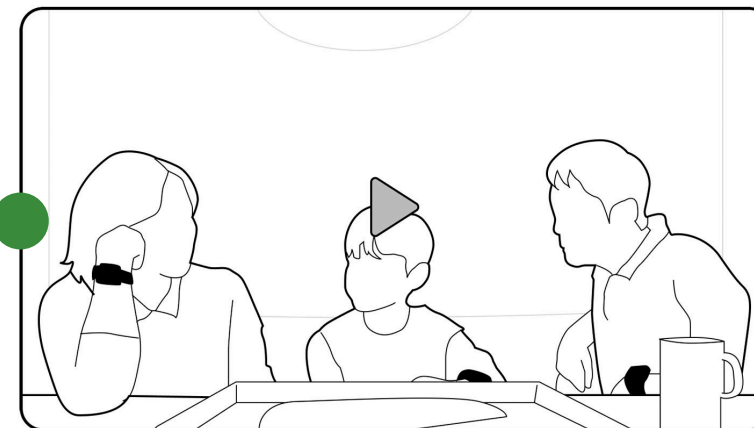
# Probe Design

# Overview



Conversation Video

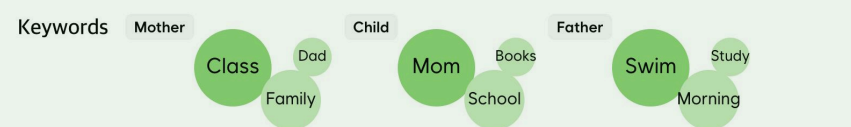
Reminiscing **Supporting** Planning



### Conversation Summary

Did the topics and keywords of the conversation match well? What was the proportion of positive words used by each member?  
Identify the strengths and weaknesses that appeared in the conversation.  
Did you communicate well to the other family members what you want and what you are pursuing?

Topic **Supporting**

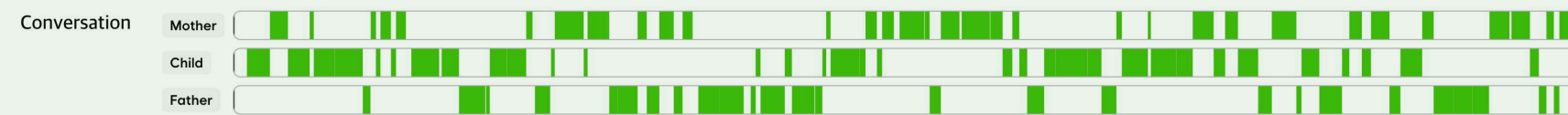


Positive Words Proportion	Mother	Child	Father
	26%	14%	4%

Extracted Data

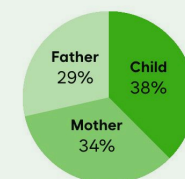
### Conversation Behaviors

When do you think was the time our family engaged in the most conversation? What do you think were the feelings of the other family members at that time?  
When do you think was the moment our family all found it most enjoyable and actively participated? Why do you think so?  
Do you think that everyone in our family equally participated in the conversation? Why do you think so?



Speaking speed >

### Conversation Proportion



Questions	Mother	Child	Father
	3 times	5 times	4 times

Speaking Initiation	Mother	Child	Father
	33 times	33 times	26 times

### Interaction Behavior

What emotions did you mostly feel during the conversation? Why did you feel those emotions?  
What emotions did the family members feel? What makes you think they felt those emotions?  
Do you think the family members generally felt synchronized emotions? How did their emotions change?

### Emotion Synchrony



Emotions of each member >

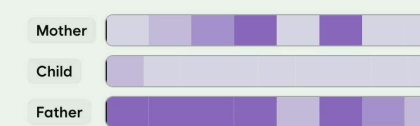
### Eye Contact



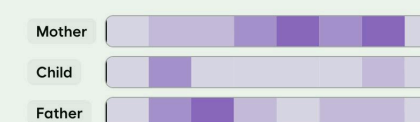
### Physiological Response

Who seemed to be the most excited? Why do you think so?  
Were the reactions of the family members similar to what you thought? Was there any family member who showed unexpected reactions?  
Were you able to manage and express our emotions when discussing different perspectives?  
Were you influenced by the emotions of other family members?

### Stress Level



### Emotional Arousal Level

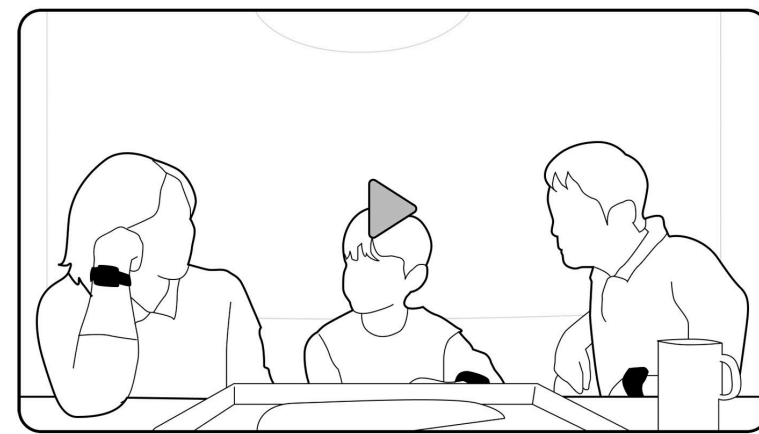


# Probe Design

# Conversation Summary

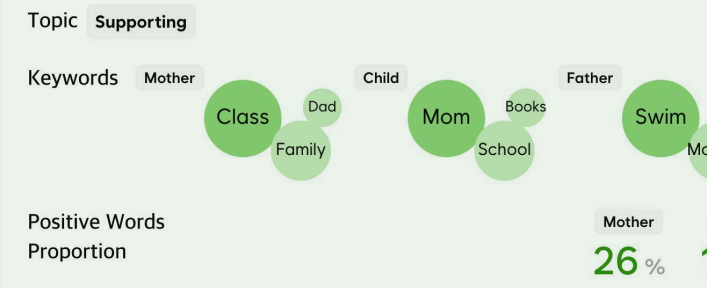


Reminiscing **Supporting** Planning



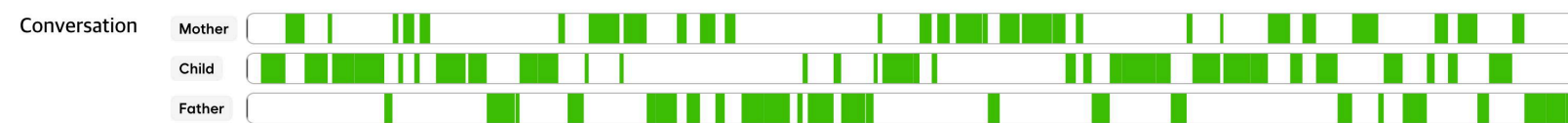
### Conversation Summary

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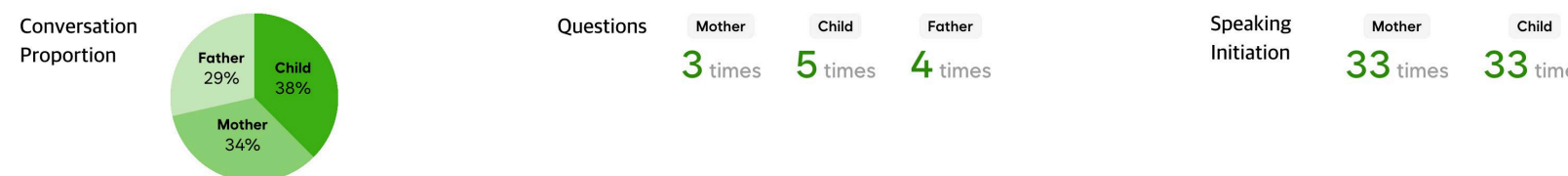


### Conversation Behaviors

When do you think was the time our family engaged in the most conversation? What do you think were the feelings of the other family members at that time?  
 When do you think was the moment our family all found it most enjoyable and actively participated? Why do you think so?  
 Do you think that everyone in our family equally participated in the conversation? Why do you think so?



Speaking speed >



### Interaction Behavior

What emotions did you mostly feel during the conversation? Why did you feel those emotions?  
 What emotions did the family members feel? What makes you think they felt those emotions?  
 Do you think the family members generally felt synchronized emotions? How did their emotions change?



Emotions of each member >



### Physiological Response

Who seemed to be the most excited? Why do you think so?  
 Were the reactions of the family members similar to what you thought? Was there anyone who showed unexpected reactions?  
 Were you able to manage and express our emotions when discussing different perspectives?  
 Were you influenced by the emotions of other family members?



### Conversation Summary

Did the topics and keywords of the conversation match well? What was the proportion of positive words used by each member?

Identify the strengths and weaknesses that appeared in the conversation.

Did you communicate well to the other family members what you want and what you are pursuing?

Topic **Supporting**

Keywords



Positive Words Proportion



## Conversation Behaviors



Reminiscing **Supporting** Planning

Conversation Summary

Did the topics and keywords of the conversation match well? What was the proportion of positive words



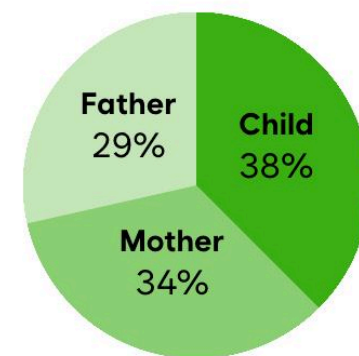
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### Speaking speed >

### Conversation Proportion



### Questions



### Speaking Initiation

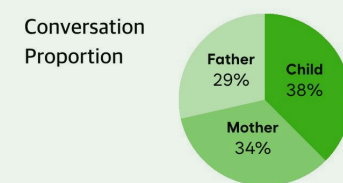


### Conversation Behaviors

When do you think was the time our family engaged in the most conversation?  
 When do you think was the moment our family all found it most enjoyable and actively participated?  
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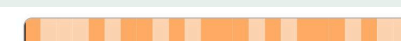
Speaking speed >



### Interaction Behavior

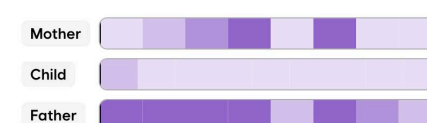
What emotions did you mostly feel during the conversation?  
 What emotions did the family members mostly feel?  
 Do you think the family members generally had similar emotions?

### Emotion Synchrony



Emotions of each member >

### Stress Level



### Eye Contact

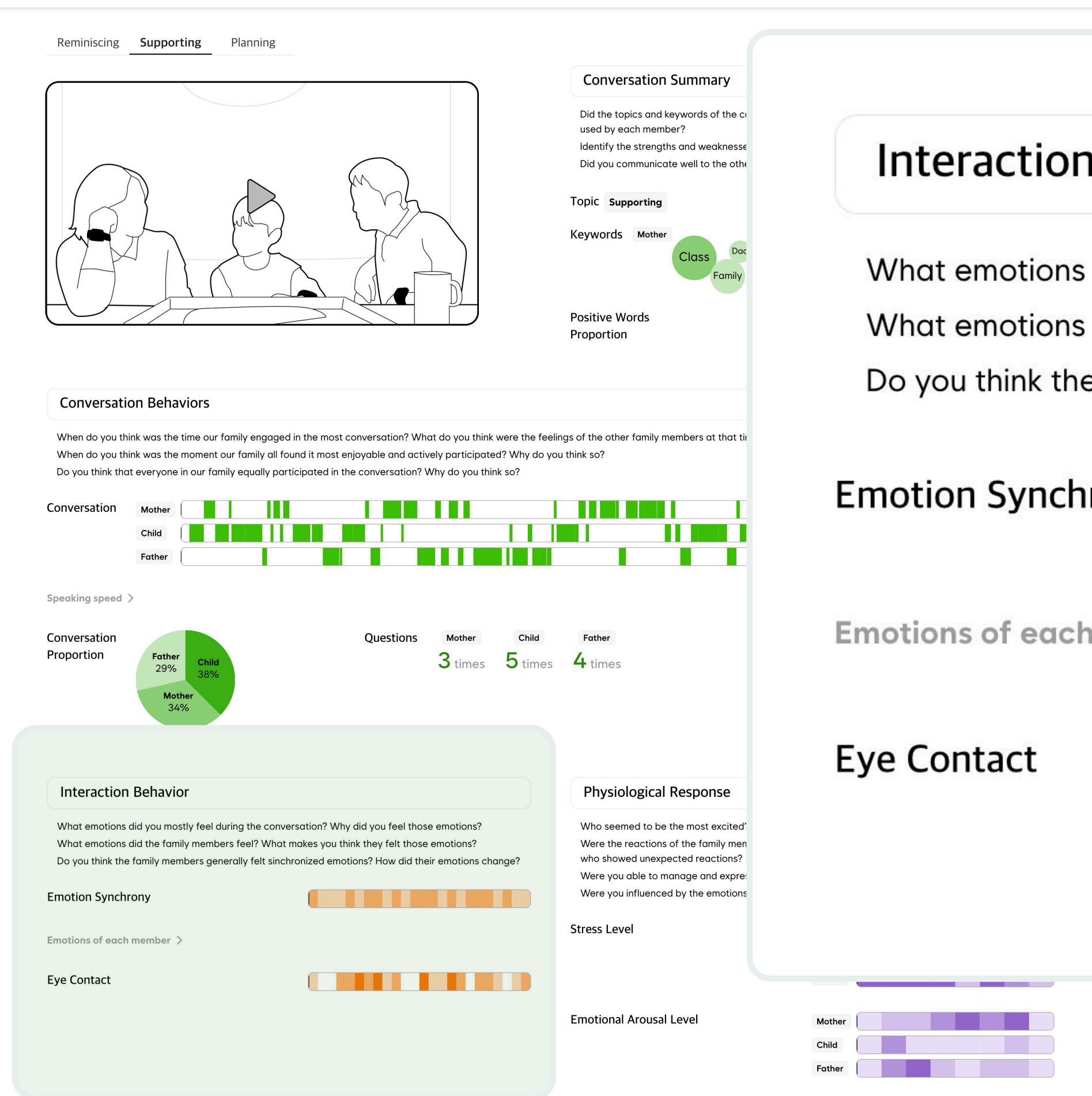


### Emotional Arousal Level



# Probe Design

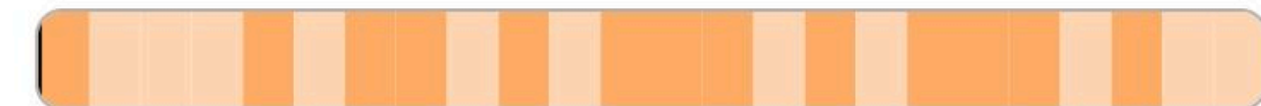
# Interaction Behaviors



## Interaction Behavior

What emotions did you mostly feel during the conversation? Why did you feel those emotions?  
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## Emotion Synchrony



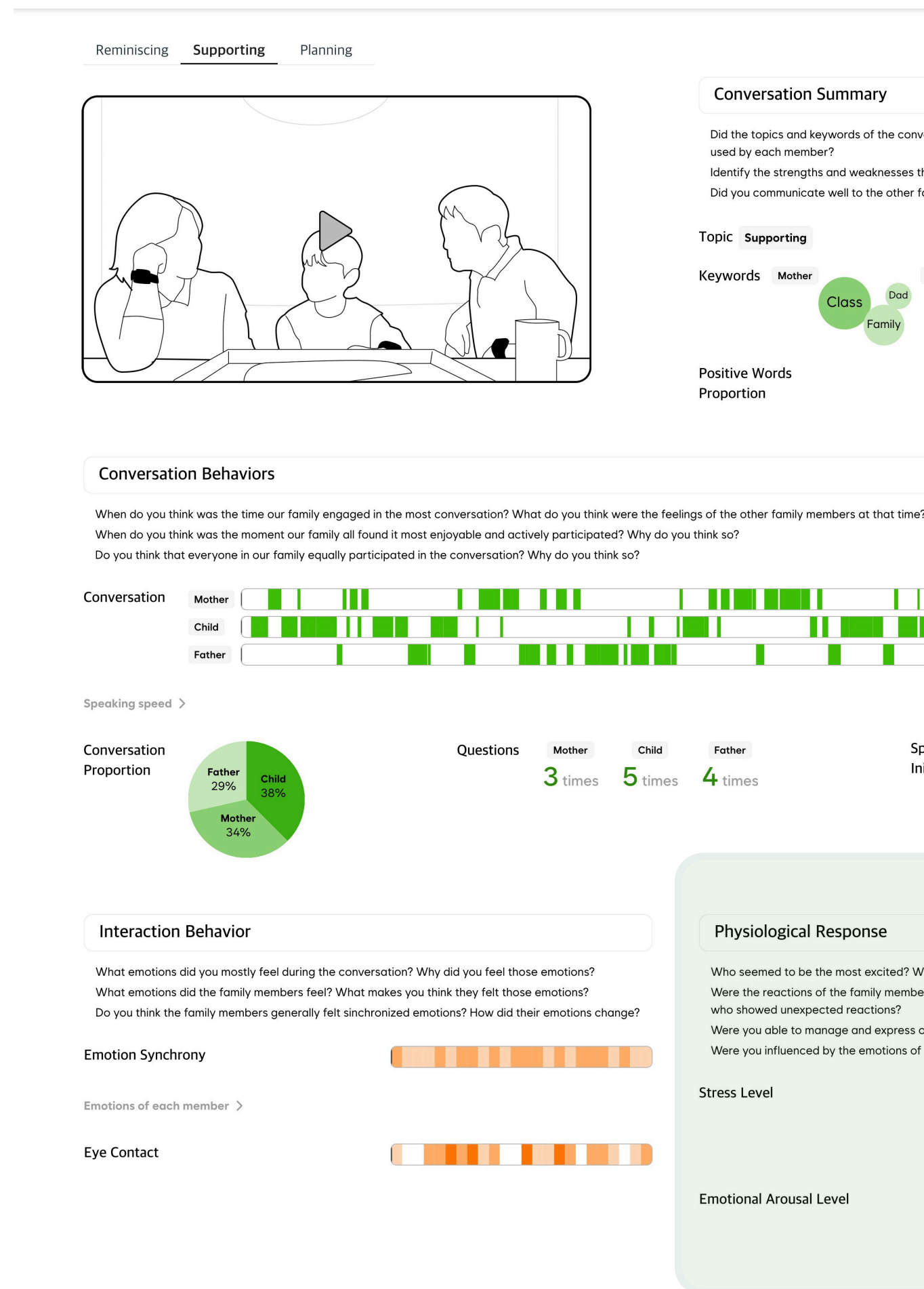
## Emotions of each member >

## Eye Contact



# Probe Design

# Physiological Responses



## Physiological Response

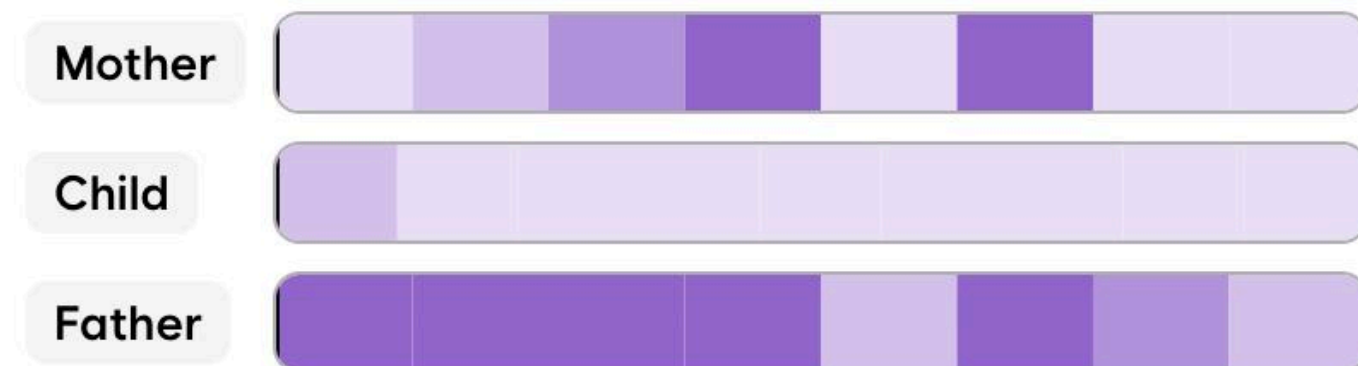
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Were the reactions of the family members similar to what you thought? Was there any family member who showed unexpected reactions?

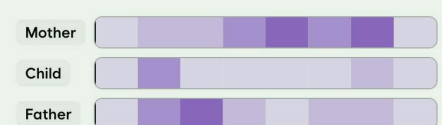
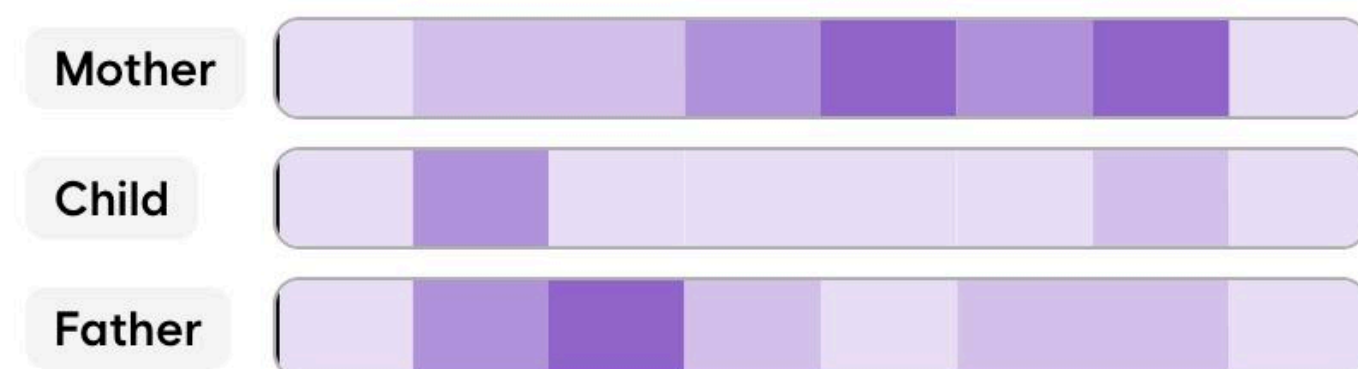
Were you able to manage and express our emotions when discussing different perspectives?

Were you influenced by the emotions of other family members?

## Stress Level



## Emotional Arousal Level



## Tools for reflection

### Physiological Response

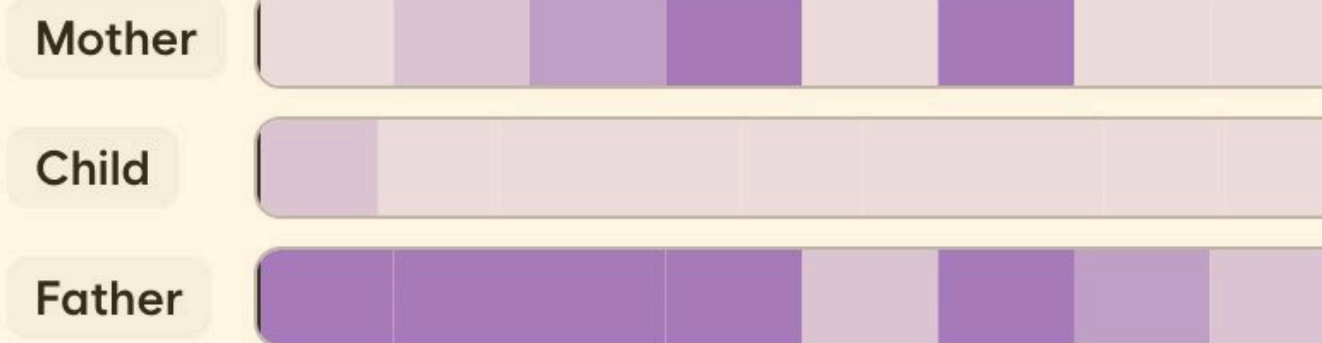
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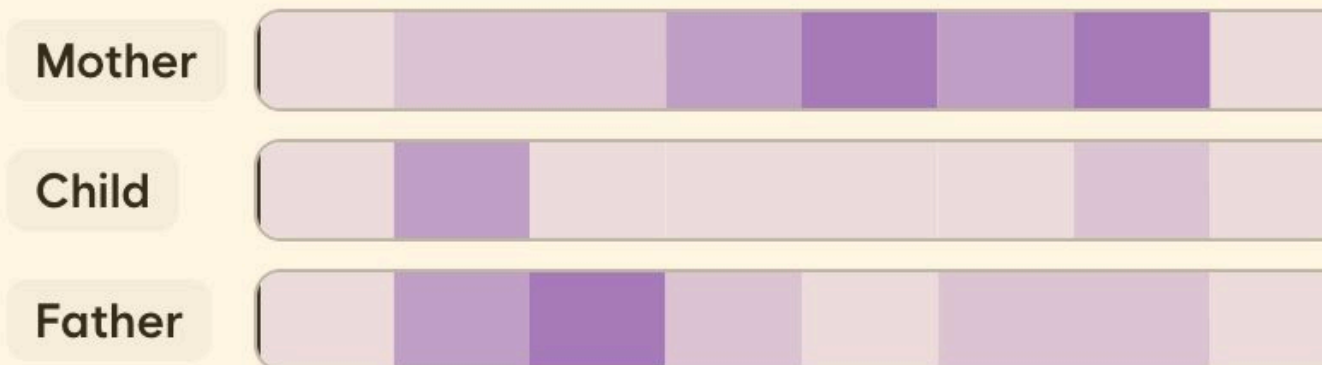
Were you able to manage and express our emotions when discussing different perspectives?

Were you influenced by the emotions of other family members?

### Stress Level



### Emotional Arousal Level



### Question-type prompts

Related to family member's social and emotional reflection

### Data Chart

Level-based chart adopting color saturation mapping

## Tools for reflection

### Physiological Response

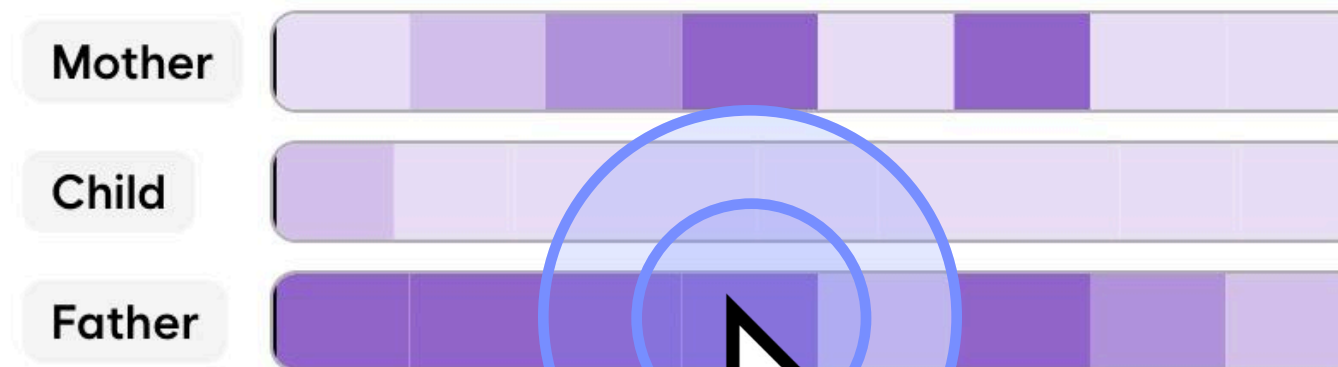
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### Stress Level



### Emotional Arousal Level



### Aligned Timeline

Video was synchronized with other data chart

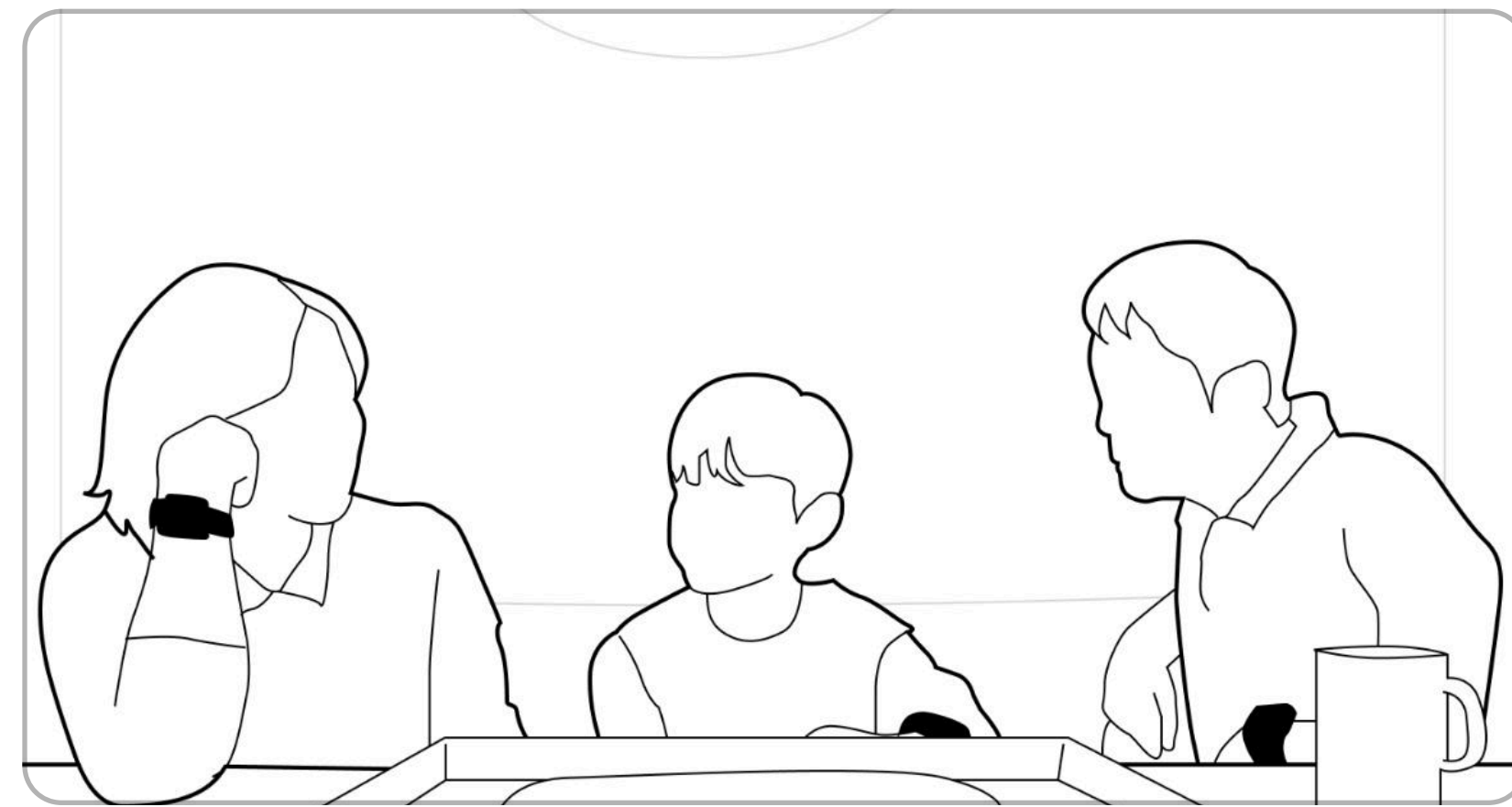
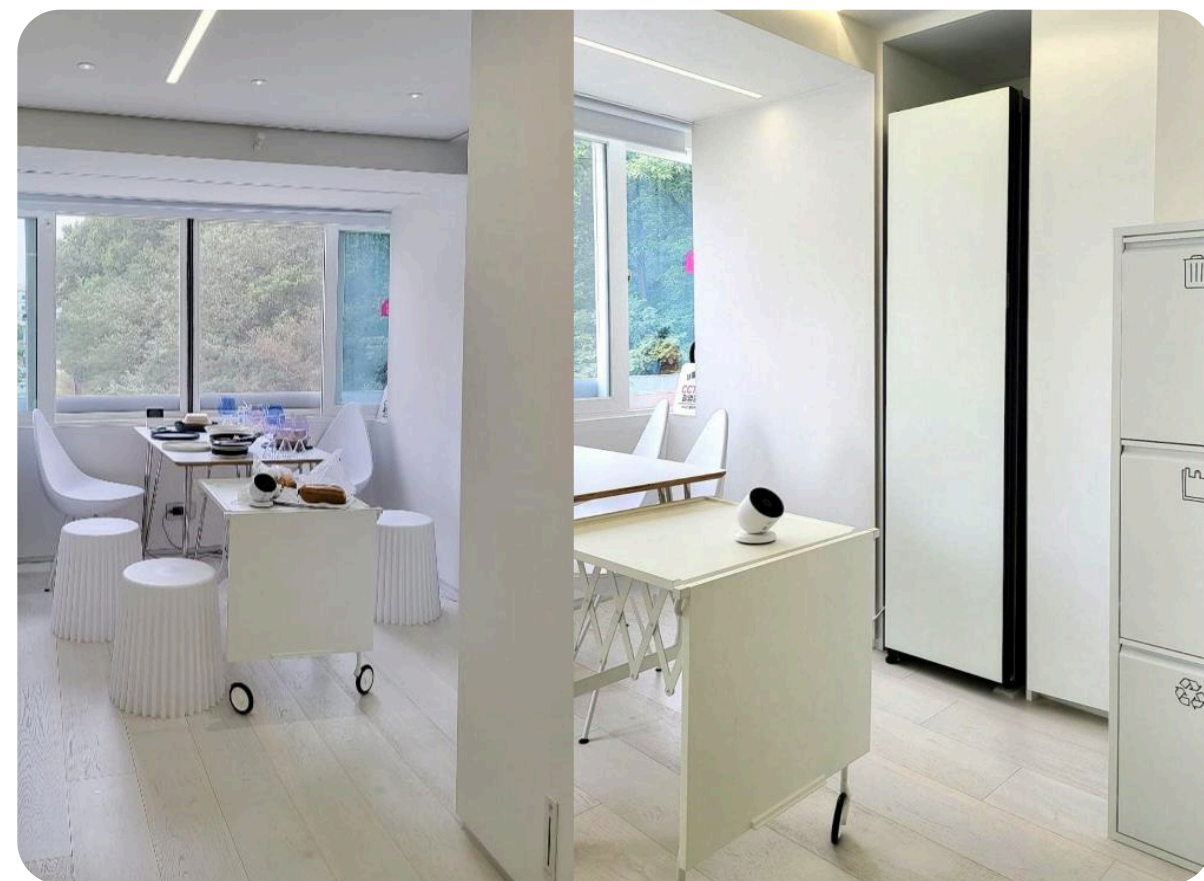
## User Study

# User study in the semi-naturalistic setting

17 families 51 participants

### Participants

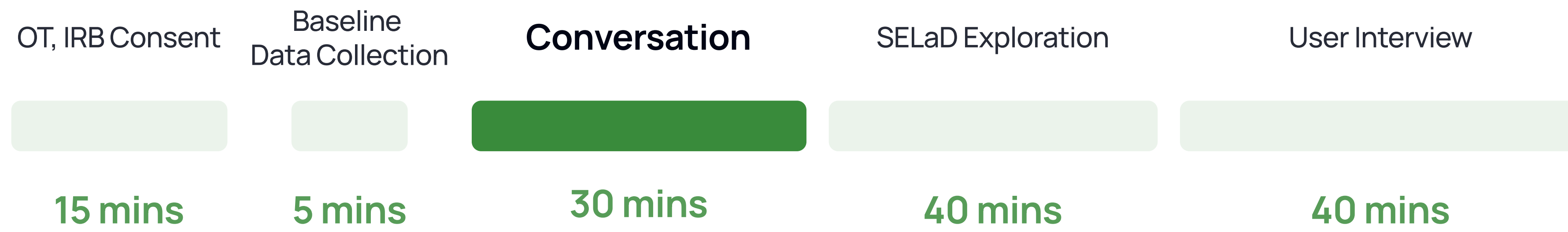
Recruit a 3-member South Korean family with an elementary school child



### Testbed Setting

resembling actual home

## Procedure of user study



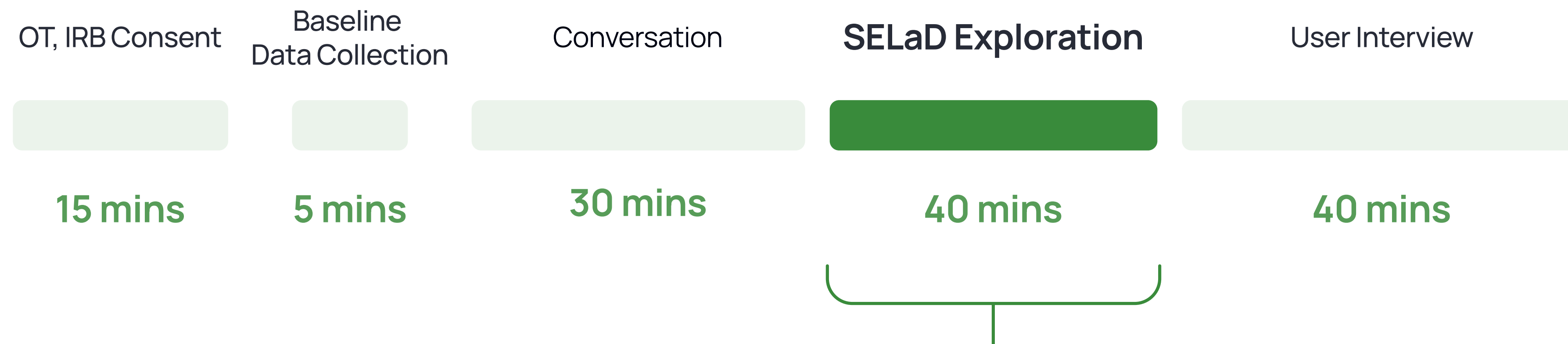
Conversation on the topics:

- Reminiscing
- Supporting
- Planning

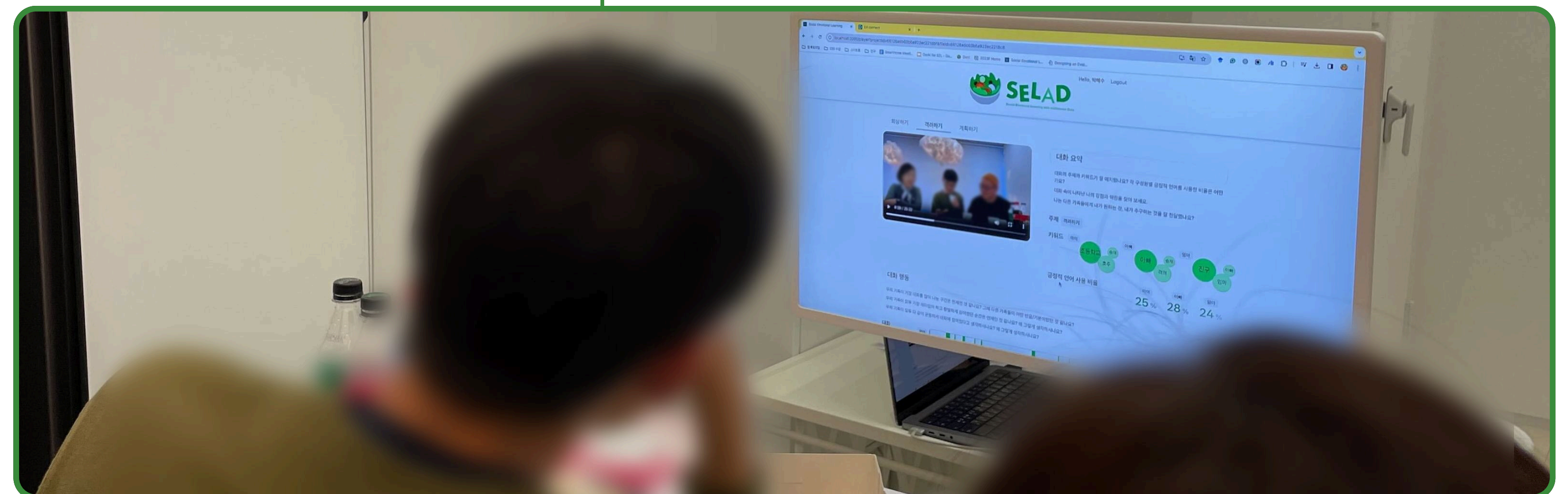


# User Study

## Procedure of user study



**Participants collaborately reflect**  
on their data collected in the  
conversation using SELaD



# Findings



[1] Gabriela Marcu, Anind K Dey, and Sara Kiesler. 2014. Designing for collaborative reflection. In Proceedings of the 8th International Conference on Pervasive Computing Technologies for Healthcare. 9-16.

[2] Lisa Graham, Anthony Tang, and Carman Neustaedter. 2016. Help me help you: Shared reflection for personal data. In Proceedings of the 2016 ACM International Conference on Supporting Group Work. 99-109.

### Relational Reflection

Families collaboratively interpret multimodal social-emotional data by drawing on **shared histories** and **shared expectations** of family interaction

## Findings

### Relational Reflection

Families collaboratively interpret multimodal social-emotional data by drawing on **shared histories** and **shared expectations** of family interaction

habits, preferences, memories

balance, positive influence



Recognizing Conversational Patterns

Discovering Emotional Influence

## Findings

Recognizing Conversational Patterns

Discovering Emotional Influence

### Recognizing Conversational Patterns

“

*I thought this was hilarious. He says the word **'anyway'** so often.*

[pointing to the keyword **'anyway'** in Conversation Summary]

M12

Recalled **habits, preferences, memories** to interpret keywords and speech patterns

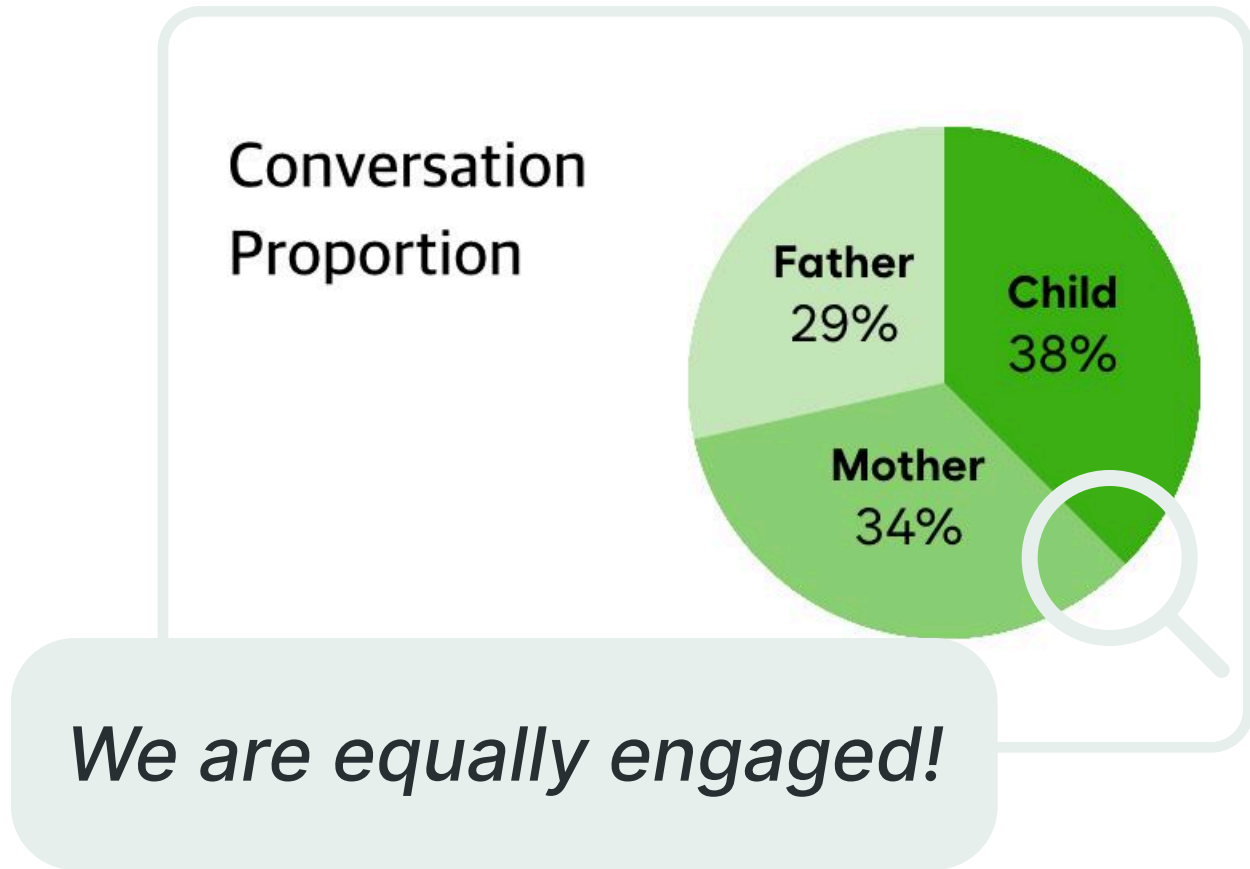
# Findings

Recognizing Conversational Patterns

Discovering Emotional Influence

## Recognizing Conversational Patterns

Shared Expectation of Balance



OR

“

*I need to talk less. I already knew I talked too much. However, looking at the conversation proportion, I realized I really need to look back on myself. **I think I need to practice listening more.***

M09 (Dominant speaker)

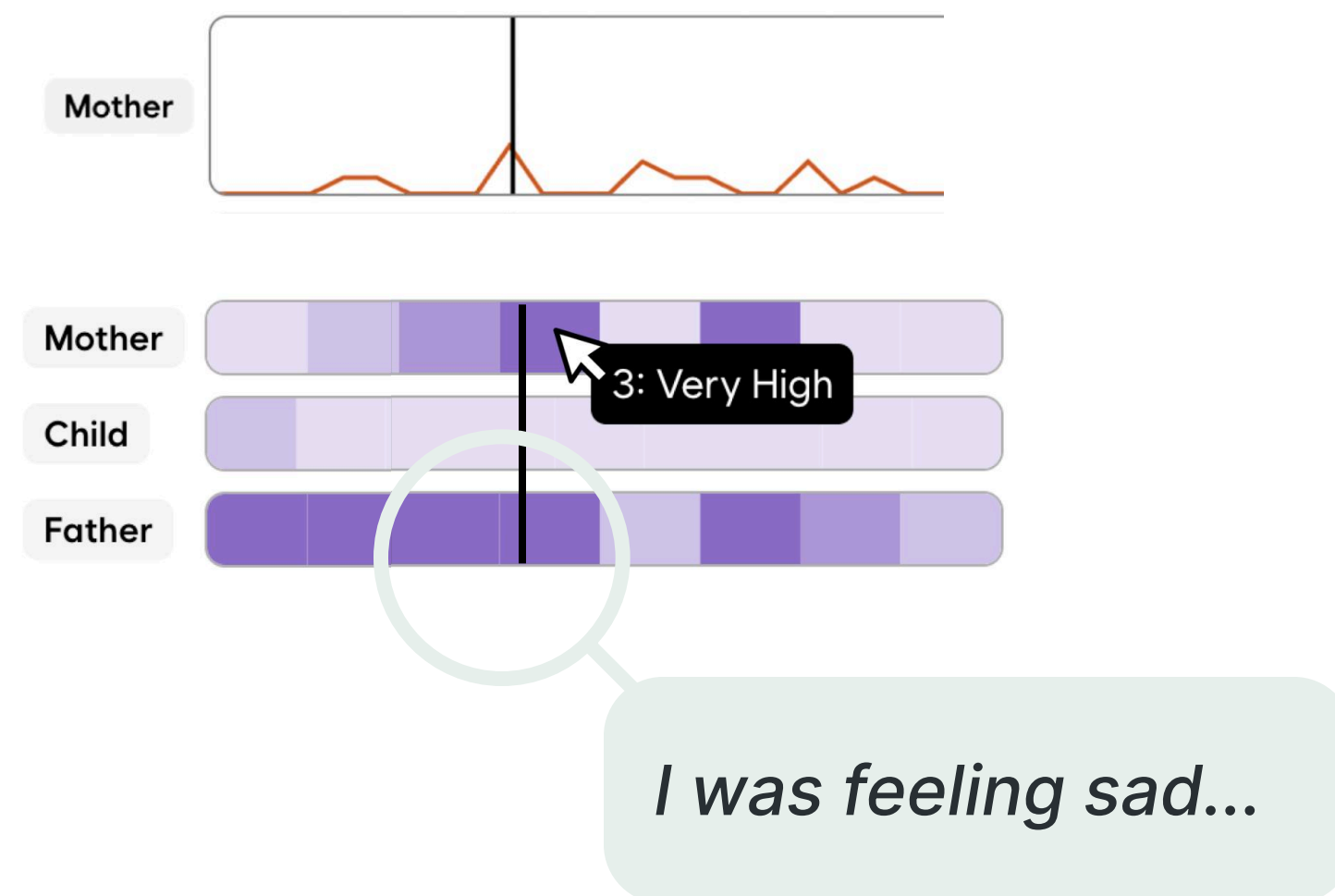
# Findings

Recognizing Conversational Patterns

Discovering Emotional Influence

## Discovering Emotional Influence

Shared Knowledge about Emotional Tendency



“

*It's still hard to understand their feelings if they don't talk much. But seeing SELaD, I can see that [F04] is also experiencing emotional fluctuations when I'm feeling sad. It makes me realize that **this person is not a robot**, and it can actually be comforting.*

M04

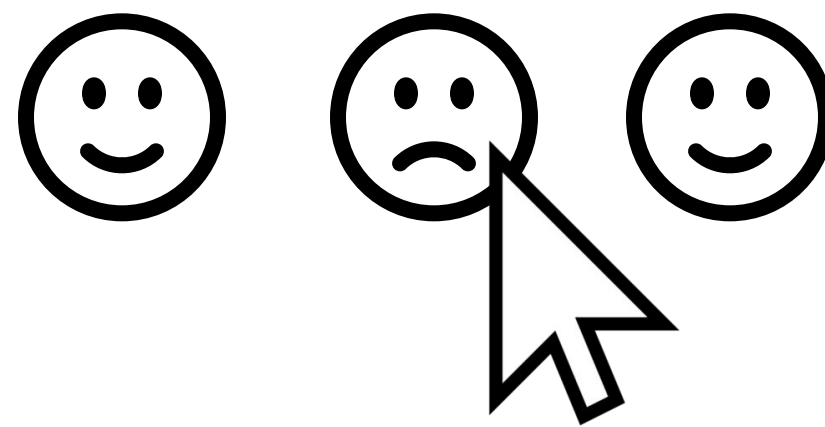
## Findings

Recognizing Conversational Patterns

Discovering Emotional Influence

### Discovering Emotional Influence

Expectations about a Positive Influence

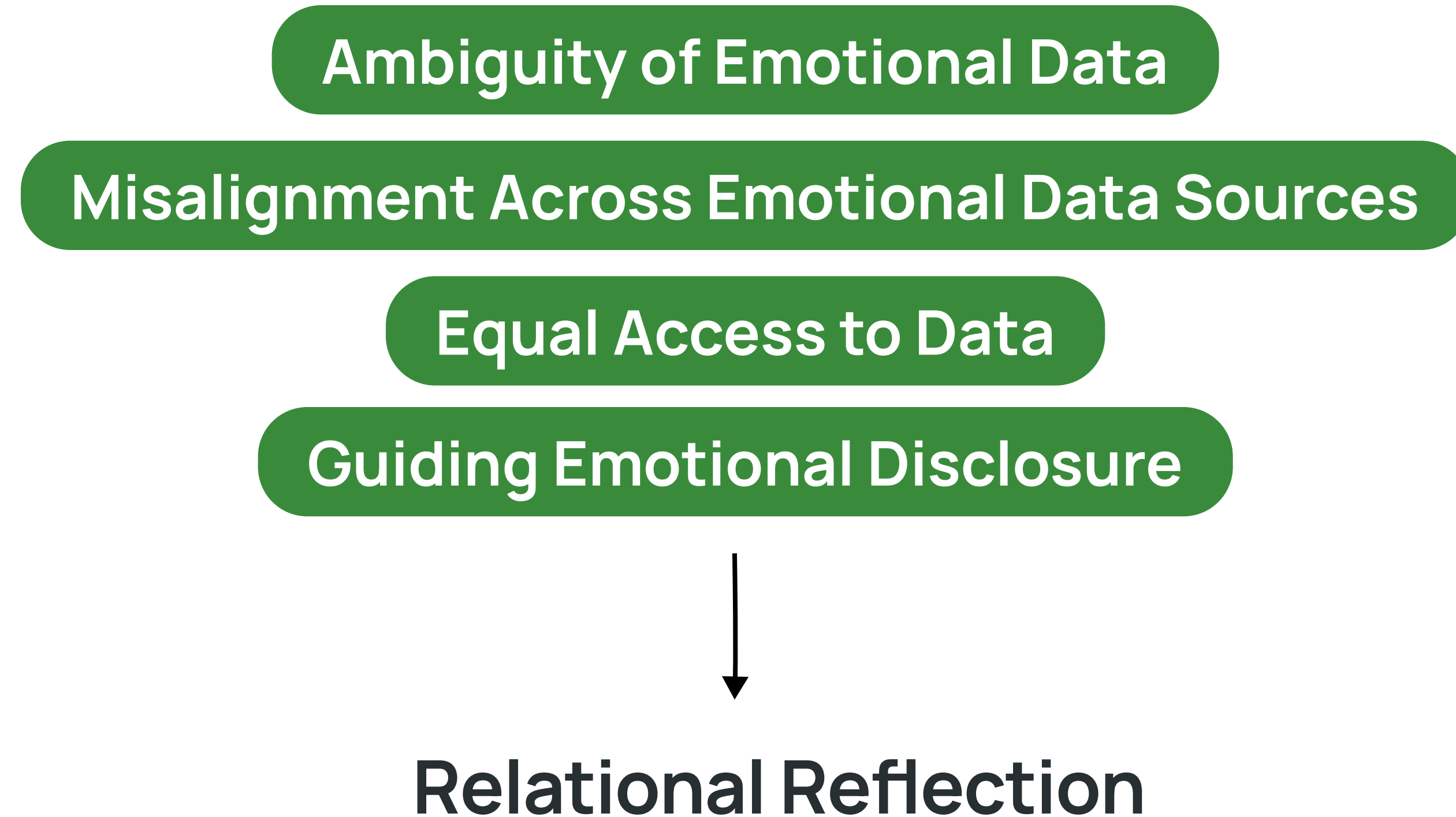


“

*When I reflected on the way I was talking, I realized I was trying to take control. I finally understand what my son meant when he said **I'm 'always angry' and 'like an angry bird,'** which I hadn't recognized the significance until now.*

M06, after seeing her facial expression data + child's reaction in video

## Findings



Families collaboratively interpret multimodal social-emotional data by drawing on **shared histories** and **shared expectations** of family interaction

# Findings

Ambiguity of Emotional Data

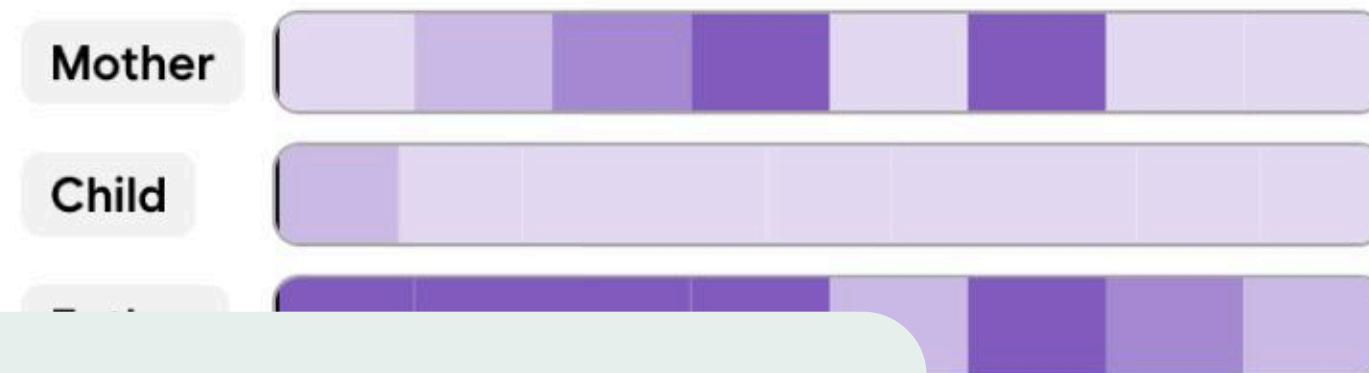
Misalignment Across Emotional Data Sources

Guiding Emotional Disclosure

Equal Access to Data

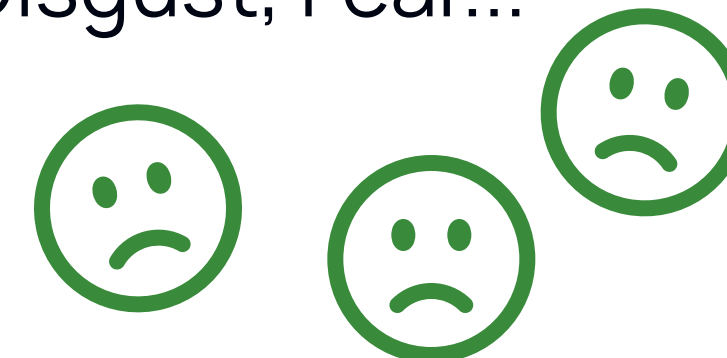
## Ambiguity of Emotional Data as Catalyst

Stress Level



*What is stress level exactly?*

Happy, Anger,  
Disgust, Fear...



*Is it just a facial expression, or my true emotion?*

## Findings

Ambiguity of Emotional Data

Misalignment Across Emotional Data Sources

Guiding Emotional Disclosure

Equal Access to Data

### Ambiguity of Emotional Data as Catalyst

Father

*[Child's] emotion data is too fluctuating.*

Child

*Did I feel "Disgusted"? "Scared"?*

Father

*I think it's because the emotion detection is only based on the look on the face, so it can be low accurate.*

This prompted the entire family to **critically question** whether the **emotion detection** is always accurate

# Findings

Ambiguity of Emotional Data

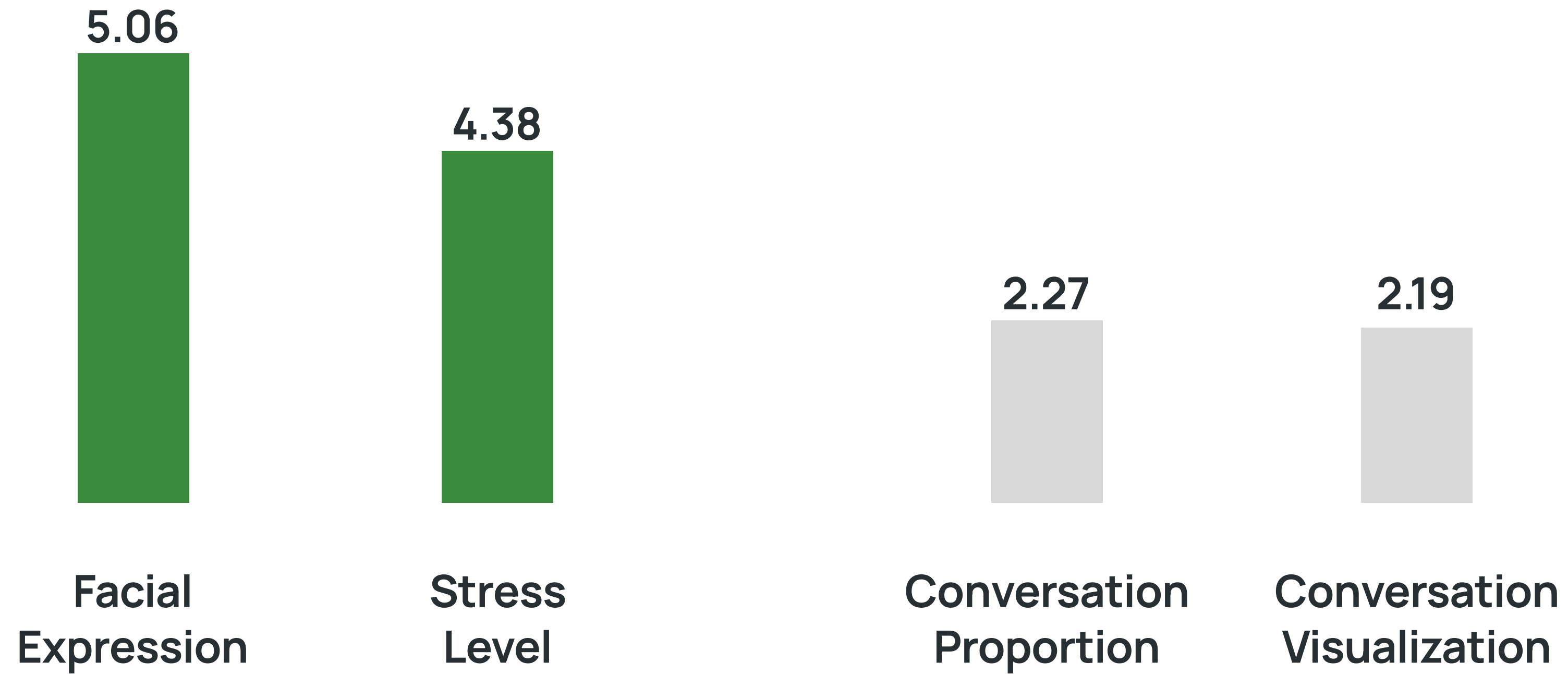
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Equal Access to Data

## Ambiguity of Emotional Data as Catalyst

Average Usage of Data Type in Data Reflection



# Findings

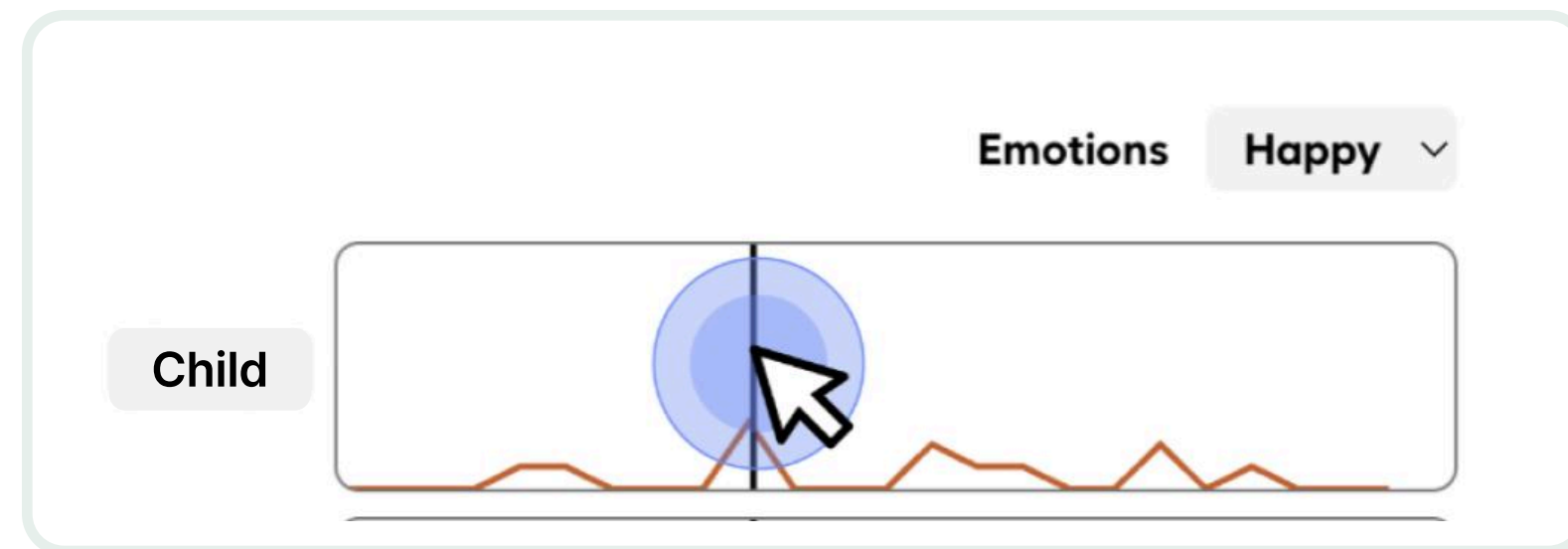
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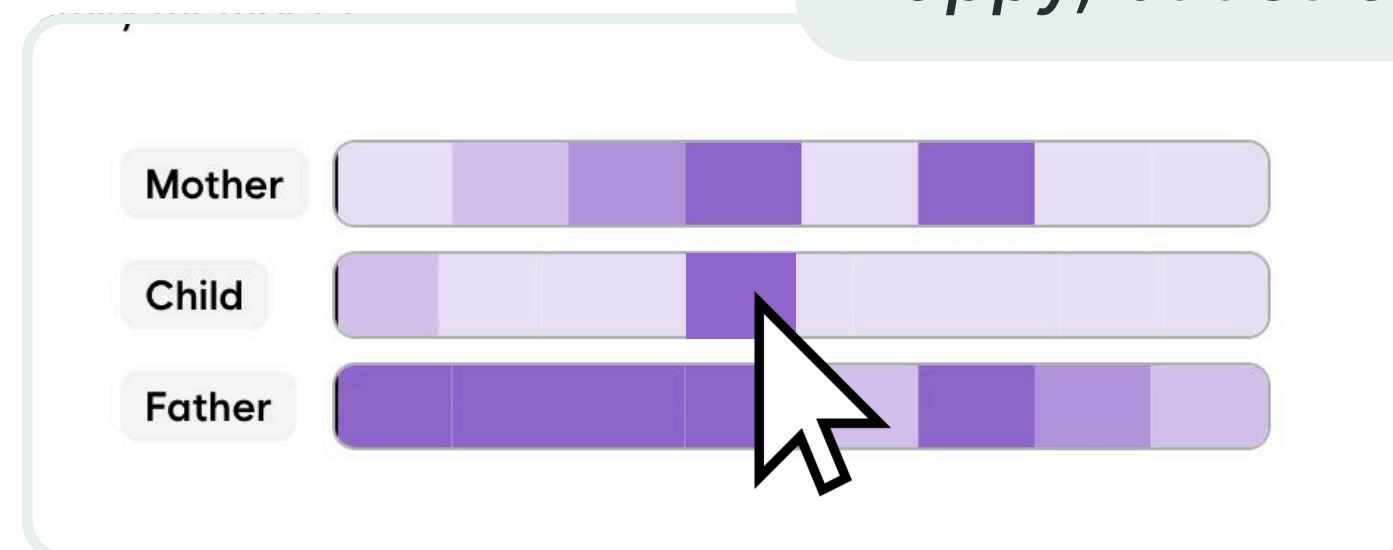
Guiding Emotional Disclosure

Equal Access to Data

## Misalignment Across Emotional Data Sources



*Happy, but stressed?*



C04

*Why was my stress level so high at that moment, different from the facial expression?*

M04

*Maybe you were pretending to be fine but actually weren't.*

## Findings

Ambiguity of Emotional Data

Misalignment Across Emotional Data Sources

Guiding Emotional Disclosure

Equal Access to Data

## Guiding Emotional Disclosure

Open Guidance - M12

*When do you think Dad was sad?*

*Why do you think this data appeared?*

*Aren't you curious about the stress peak?*

C12 began engaging & discovered unconscious stress of their experience

# Findings

Ambiguity of Emotional Data

Misalignment Across Emotional Data Sources

**Guiding Emotional Disclosure**

Equal Access to Data

## Guiding Emotional Disclosure

### Open Guidance - M12

*When do you think Dad was sad?*

*Why do you think this data appeared?*

*Aren't you curious about the stress peak?*

C12 began engaging & discovered unconscious stress of their experience

### Authoritarian Conversation

Questions	Mother	Child	Father
	9 times	1 times	4 times

*I asked so many questions. How can you have this low? You never engage in conversation — that's why I keep getting mad at you.*



# Findings

Ambiguity of Emotional Data

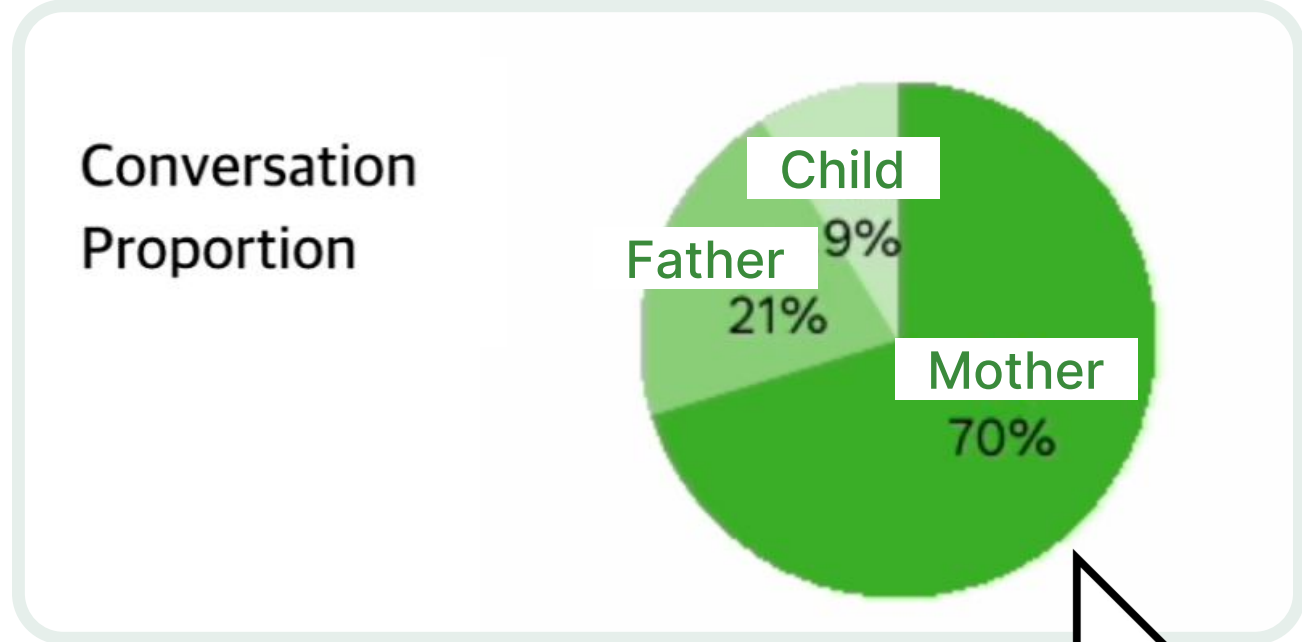
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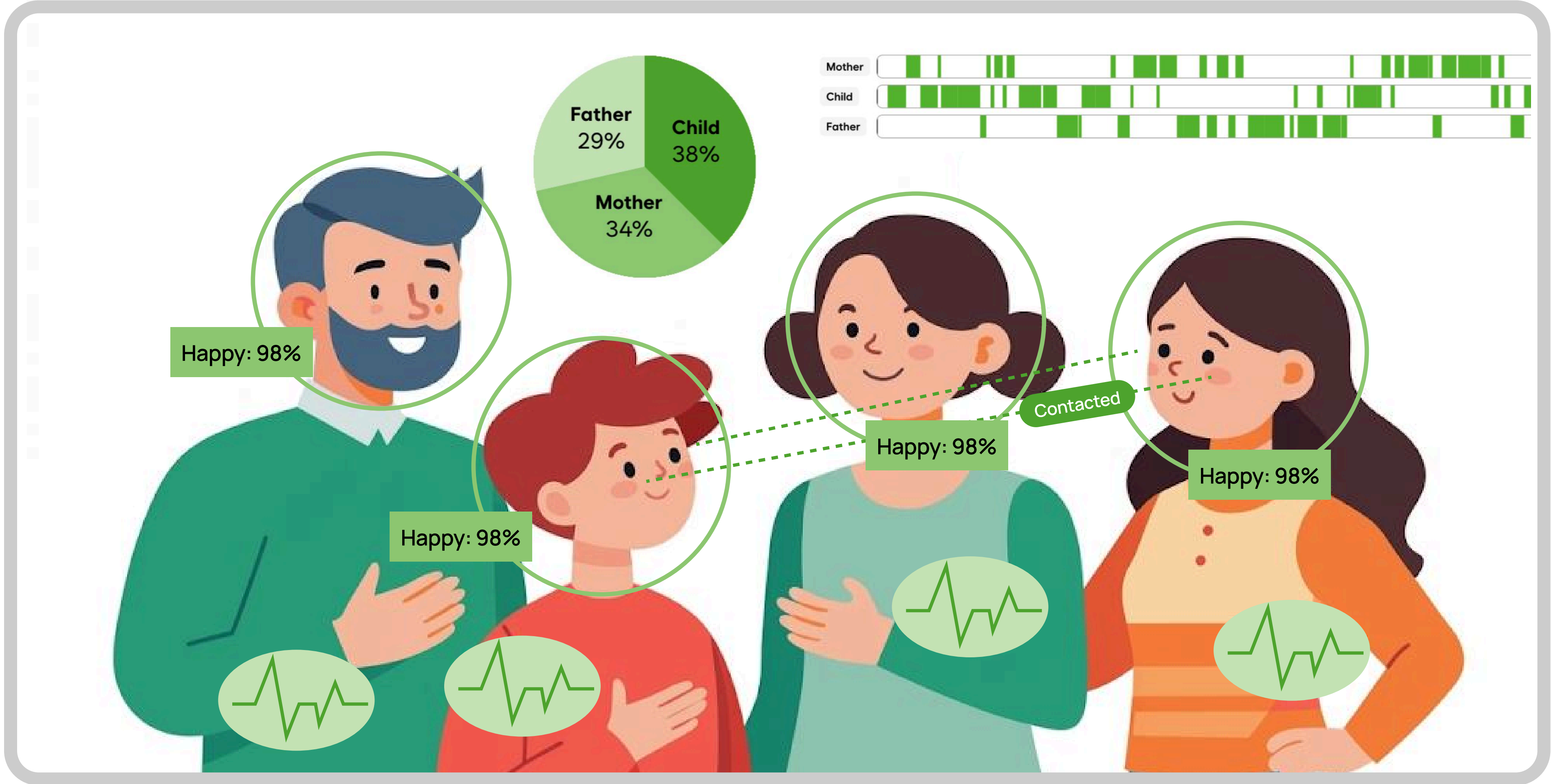
## Equal Access to Data Among Family Members

*I asked so many questions. How can you have this low? You never engage in conversation — that's why I keep getting mad at you.*



*Mom does most of the talking, which is mainly nagging, and I don't have a chance to chip in.*

Children could contest power imbalances using data as evidence



## Enhancing the Contestability of Emotion Sensing

Ambiguity of Emotional Data

Misalignment Across Emotional Data Sources

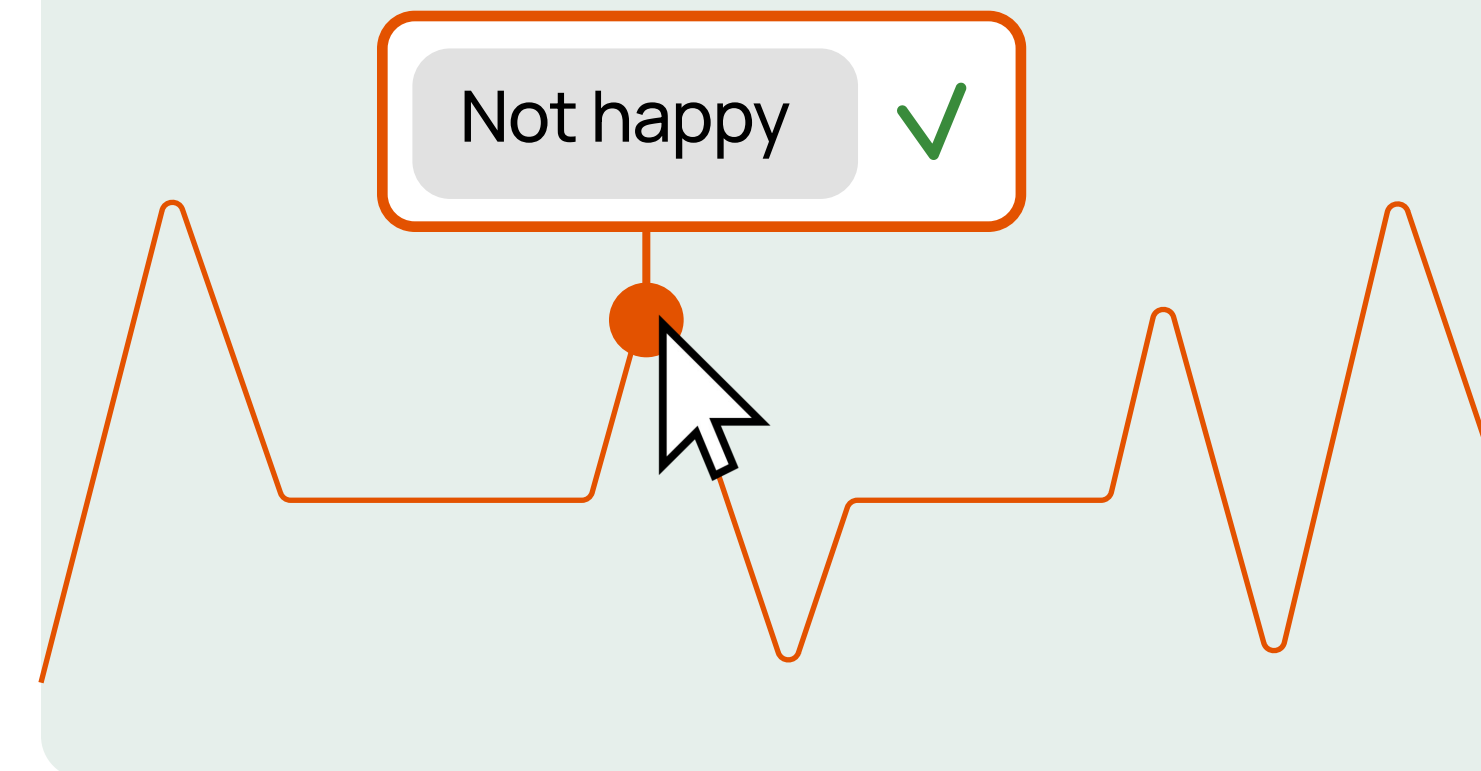
- Reduce risks of **blind trust on emotion sensing tech**
- Avoid **fully relying on a single source** of emotional data

## Enhancing the Contestability of Emotion Sensing

### Highlight Misalignments by Design



### Data as Hypotheses, Not Conclusions



# Privacy in Social-Emotional Data Sharing in Family

*“Privacy expectations are shaped by the specific context and norms surrounding the flow of information” [1]*

### Contexts:

Families with conflict

Sensitive topics

[1] Helen Nissenbaum. 2009. Privacy in context: Technology, policy, and the integrity of social life. In Privacy in context. Stanford University Press.

# Privacy in Social-Emotional Data Sharing in Family

*“Privacy expectations are shaped by the specific context and norms surrounding the flow of information” [1]*

### Contexts:

Families with conflict

Sensitive topics

## Design Implications

### Granular Privacy Control

Pause

Blur

Private Mode

### Contextual Consent

Stress peaks detected. Do you want to share?



[1] Helen Nissenbaum. 2009. Privacy in context: Technology, policy, and the integrity of social life. In Privacy in context. Stanford University Press.

Thank you! 

# Why stressed, Mom? Exploring Family Reflection on Social and Emotional Sensor Data through Family Informatics

## Research contribution

- **User study with 17 families (n=51)** – in-depth qualitative analysis of how families co-construct insights about family dynamics through **relational reflection**
- **Relational Reflection** – a new concept framing how families jointly interpret shared social-emotional data, with design implications for (i) multimodal data technologies, (ii) scaffolding prompts, and (iii) ethical safeguards



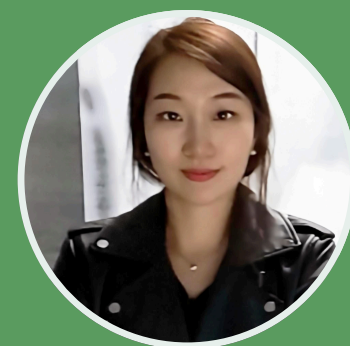
**Hyesoo Park**  
Georgia Institute of  
Technology



**Sueun Jang**  
KAIST



**Hyunsoo Lee\***  
KAIST



**Jennifer G. Kim\***  
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Full Paper

Table 3.2: Question type prompts in each section and related SEL Competencies

## Appendix

# Question type prompts in each section and related SEL Competencies

Sections	Question-type Prompts	Related Competencies
Conversation Summary	Did the topics and keywords of the conversation match well? What was the proportion of positive words used by each member?	Self-awareness
	Identify the strengths and weaknesses that appeared in the conversation.	Self-awareness
	Did you communicate well to the other family members what you want and what you are pursuing?	Self-management
Conversation Behavior	When do you think was the time your family engaged in the conversation most? What do you think were the feelings of the other family members at that time?	Relationship skills
	When do you think was the moment our family all found it most enjoyable and actively participated? Why do you think so?	Relationship skills
	Do you think that everyone in our family equally participated in the conversation? Why do you think so?	Social-awareness
Interaction Behaviors	What emotions did you mostly feel during the conversation? Why did you feel those emotions?	Self-awareness
	What emotions did the family members feel? What makes you think they felt those emotions?	Social-awareness
	Do you think the family members generally felt synchronized emotions? How did their emotions change?	Social-awareness
Physiological Response	Who seemed to be the most excited? Why do you think so?	Relationship skills
	Were you able to manage and express your emotions when discussing different perspectives?	Self-management
	Were the reactions of the family members similar to what you thought? Was there any family member who showed unexpected reactions?	Responsible decision-making
	Were you influenced by the emotions of other family members?	Responsible decision-making

## Appendix

# Implementation details used in the SELaD system

Feature	Tool
Emotion Recognition	A CNN based PyTorch implementation on facial expression recognition <a href="#">[72]</a>
Facial Landmarks	The FaceMesh model from Google's MediaPipe <a href="#">[73]</a>
Speech Transcription	Naver Clova Speech AI <a href="#">[74]</a>
Positive Words Proportion	Naver Clova Semantic Analysis AI
Transcript Tokenization	The Okt tokenizer from konlpy <a href="#">[75]</a>
Keywords Extraction	KRWordRank <a href="#">[76]</a>

## Appendix

### Demographic Table of Participant Ages (ID: Family Id, G: Girl, B: Boy)

ID	Father	Mother	Child	ID	Father	Mother	Child	ID	Father	Mother	Child
1	50	46	12 (G)	7	45	44	13 (B)	13	49	49	11 (G)
2	50	50	12 (G)	8	41	42	12 (B)	14	43	41	11 (B)
3	48	44	12 (B)	9	54	53	12 (B)	15	46	44	11 (B)
4	48	44	11 (G)	10	54	48	11 (G)	16	48	44	10 (G)
5	41	39	12 (B)	11	43	40	13 (B)	17	43	44	12 (B)
6	52	46	13 (B)	12	43	41	12 (B)				

# Appendix

Category	Coded Behaviors
Appropriate Content	Verbal content
Paralinguistic Behaviors	Clarity
	Fluency
	Meshing
Interactive Behaviors	Involvement
	Asks questions
Non-verbal Behaviors	Gaze
	Flat affect
	Appropriate affect



Features	Sections	Sensor
Keywords	Conversation Summary	Mic
Positive words proportion		
Speaking speed	Conversation Behaviors	Mic
Conversation visualization		
Speaking initiation		
Conversation proportion		
Number of questions	Interactions	Camera
Eye contact		
Emotional expression		
Emotion synchrony	Physiological Response	Wearable
Stress		
Emotional arousal		

## Conversation Probe (CP)

For interpersonal skill assessment [1]

[1] Pinkham, Amy E., and David L. Penn. "Neurocognitive and Social Cognitive Predictors of Interpersonal Skill in Schizophrenia." Psychiatry Research, vol. 143, no. 2-3, 2006, pp. 167-178.

# Appendix

## Emotional Expression Data Chart

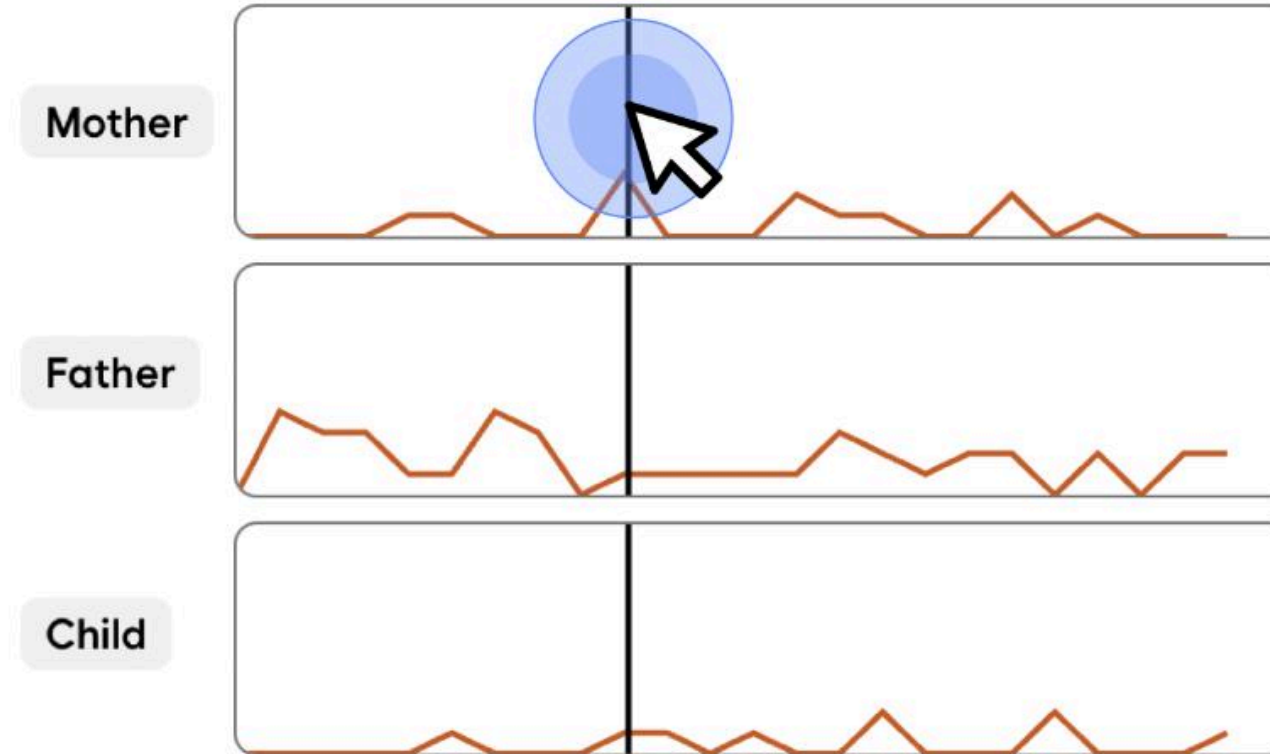
Emotion Synchrony



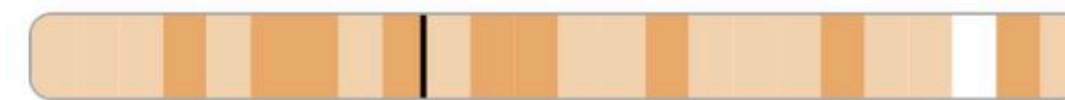
Emotions of each member ▼

Emotional Expression

Emotions **Happy** ▼



Eye Contact



## Appendix

# Interview Items (Data Exploration Using SELaD)

### **The usefulness of Data Types**

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(For each type of data) What do you think it represents?

Do you find each data helpful for understanding your family conversation better?

Which information was particularly useful, and which was difficult to understand?

If other types of information were needed, what kind of data do you think would be helpful?

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### **The usefulness of Data Visualization**

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Did you use the question-type prompts to interpret the visualizations often?

Was it easy to understand when data was displayed using different shades of color to represent intensity?

Do you think the data charts were useful in identifying and comparing the conversational styles of your family?

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### **The usefulness of the Connection Between Video and Data**

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Did you frequently use the feature of viewing video alongside the data, and if so, why and what were you looking for?

Did watching the video along with the data help you understand your family's emotions and interaction context? How did it help?

During your exploration of the system, when did you find this feature the most useful?

## Appendix

# Interview Items (Understanding Family Communication Using SELaD)

### **Family Communication Style**

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Was today's conversation different from your family's usual conversations? If it was different, why? What aspects were different?

How do you think your family normally communicates?

Have you ever thought about social-emotional learning before?

(For parents) How do you think you apply it?

(For children) How do you think you learn it?

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### **Insights About Families' Social-Emotional Behaviors**

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What do you consider a "good family conversation" or "good family communication"?

Do you think this tool helped you understand how good the conversation was and what areas needed improvement?

If not, what information do you think is missing, and if yes, what aspects were particularly helpful?

Did you gain any new insights about your or other family members' emotional states, conversational habits, or behaviors?

Do you think your family listened carefully to each other's stories? Do you think your family understood each other's stories accurately?

Do you think your family made good plans toward a common goal?

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### **Co-reflection Process**

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If there were discrepancies in data interpretation in co-reflection, what were they about, and how did each person interpret the situation?

When there were discrepancies in data interpretation, how did you resolve them?

As you reflect on the data together, did you discover any new information through others' opinions?

Who took the lead in presenting opinions and guiding the direction of reflection?

## Appendix

# Interview Items (Perception on Data Sharing, Overall Satisfaction)

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### **Families' Perception on Data Sharing**

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How do you feel about sharing physiological and behavioral data with your family members through the system?

(For children) Do you think it would be okay for your mother, father, or other family members to see your data? If not, in what situations do you think it would be inappropriate?

If this system were available for use at home, what concerns would you have?

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### **Overall Satisfaction of the System**

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If this type of system existed, do you think you would use it to understand your family's emotional states, communication styles, and others better?

If yes → Why do you think you would use it? What do you think would be the most helpful aspect?

If no → Why do you think you wouldn't use it? What aspects do you think would be uncomfortable or concerning?

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