



Figure 1: Key frame examples of EmoReact [1] (a newly collected dataset of children’s emotional responses) where children are labeled as curious. As it can be seen, depending on the context under which curiosity has been elicited and the individual, curiosity can be expressed in various ways. Hands over face gestures and other hand gestures such as pointing and manipulating an object are among the indicator behaviors for automatic recognition of curiosity.

Hands-on: Context-driven Hand Gesture Recognition for Automatic Recognition of Curiosity

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Abstract

Curiosity has been identified as one of the key factors in learning and education of people. In this paper, we share some of our findings on automatic understanding and recognition of curiosity and discuss the role of hand gestures and behaviors under a variety of contexts in understanding and recognition of curiosity.

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Introduction

Curiosity is the desire to know more about someone or something and plays a key role in one’s learning and education. Automatic understanding and recognition of curiosity is important to the design of optimal learning environments in today’s digital world. In spite of extensive studies on this topic, there has been very little research on automatic understanding and recognition of curiosity. In this paper we first go over our previous findings on this topic, then we discuss the importance of hand gestures under a variety of contexts in automatic recognition of curiosity. Finally, we provide some insights on how one might leverage these important additional cues to achieve more accurate models with better generalizability.

Previous Findings

In our earlier work on recognition of curiosity [1], we have used multimodal behavioral cues such as facial expressions, eye gaze behavior, head orientation, prosody and speech quality features to build initial

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References

1. Behnaz Nojavanasghari, Tadas Baltrušaitis, Charles E Hughes, and Louis-Philippe Morency. 2016. EmoReact: a multimodal approach and dataset for recognizing emotional responses in children. In Proceedings of the 18th ACM International Conference on Multimodal Interaction.
2. Behnaz Nojavanasghari, Tadas Baltrušaitis, Charles E Hughes, and Louis-Philippe Morency. The Future Belongs to the Curious: Towards Automatic Understanding and Recognition of Curiosity in Children. In Workshop on Child Computer Interaction

computational models. Our findings suggested that gaze shifting, tilted head and breathy voice are among the most indicative cues for recognizing curiosity. These findings were confirmed by our later work [2] where we studied the co-occurrence of curiosity with different affective states. We found that exploration and uncertainty are among the top co-occurring states with curiosity.

What Is Missing?

Curiosity can be expressed differently under various contexts. We use the term "context"¹ to refer to the followings:

- **Who?** Previous research has shown that individuals express curiosity in different ways. Personality (i.e. introvert vs extravert), gender, age, culture, social class and previous knowledge of the person about the subject are some of the impacting factors.
- **What?** Depending on how curiosity is being elicited, its expression might differ [2]. For example, in a problem solving task it can be expressed by asking questions whereas when introduced to a new object it can be shown by manipulating or inspecting the object.
- **When?** Intensity of expression of curiosity decreases over time as a person gets familiar with subject.
- **Where?** The environment can have an impact on the authenticity and expression of emotional responses and the expression of curiosity can vary depending on where the person is.
- **Why?** Curiosity can be elicited because of various reasons such as novelty, partial exposure, complexity or conflict. The reason that is making the person curious has an impact on their expression of it.

¹ This model is known as w5+ context model. "Maja Pantic et al, Human computing and machine understanding of human behavior: A survey". In Artificial Intelligence for Human Computing.

- **How?** Considering the mentioned factors, one can express curiosity by showing different behaviors (i.e. eye gaze, inspection or manipulating an object, etc. Figure 1 shows examples key frames of EmoReact [1] where children have been labeled as curious. Next, we will introduce two sets of hand gestures and behaviors that play an important role in recognizing the expression of curiosity.

Role of Hand Gestures and Behaviors

In this section we will discuss the importance of different hand gestures in recognizing the curiosity.

- Hand over face gestures

Recognizing hand and over face gestures are among the most challenging problems in computer vision. These gestures can be informative for some of the affective states, such as hand over chin for thinking and leaning over hand for boredom. These gestures not only carry information about affective states, but they can also occlude the face, negatively impacting the facial expression analysis, which could result in inaccurate estimations which would impact conclusions and inferences about curiosity.

- Hand Gestures and Behaviors

Hands gesture recognition is a challenging problem, partially because of the many degrees of freedom of hands. There are certain types of expression of curiosity that can only be captured by taking into account the hand gestures. For example, people can show their curiosity about an object by inspecting, rotating or manipulating it. Automatically capturing these behaviors is not possible unless, hand gestures and behaviors are considered as inputs to the models.