

# Explain *with*, rather than explain *to*: How explainees shape their learning

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## Introduction

Research about explanation processes is gaining relevance because of the increased popularity of artificial systems required to explain their function or outcome. To make technology accessible is the goal of Explainable Artificial Intelligence (XAI) that develops models capable of explaining their functions. Current approaches in XAI allow the user to steer an explanations by asking questions [1], thus, allowing to personalize the interaction. However, although they build on the **users' ability to ask questions**, they currently lack an empirical basis. Research from human–human interactions following an interactive approach, has emphasized that not only explainers but also explainees contribute to successful interactions [1]. However, little is known about how explainees actively guide explanation processes within the ongoing interaction and how their involvement relates to learning.

## Research Question

Little is known about how explainees in human–human interactions ask questions. Tutoring research found that explaining in form of long and monological statements only contribute little to learning [2]. Instead, requiring the active involvement of both participants contributed considerably to deep learning effects (see [3] for a summary). **Our question is therefore what type of questions can an explainee asks to steer their own knowledge gap and learning.**

## References

- [1] Sokol, K. & Flach, P. (2020). One explanation does not fit all. *KI-Künstliche Intelligenz*, 34(2), 235–250.  
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 [3] Chi et al. (2009). Active-Constructive-Interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science*, 1, 73–105.  
 [4] <http://www.language-cognition-lab.org/research/ecological-language/>  
 [5] ELAN (Version 6.2) [Computer software]. (2021). Nijmegen: Max Planck Institute for Psycholinguistics, The Language Archive. Retrieved from <https://archive.mpi.nl/la/elan>  
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## Method

**Participants** were 40 native English-speaking students (mean age of 25 years) observed in dyadic explanation dialogues, i.e. 20 dyads were considered (5 female-female, 4 male-male, 11 female-male). These dialogues are part of the ECOLANG Corpus [4].

### Stimuli

For each dyad, 24 stimuli objects (12 unknown, 12 known) out of a total of 36 objects were chosen. These objects belonged to four categories: tools, musical instruments, food, and animals (see Figure 1).

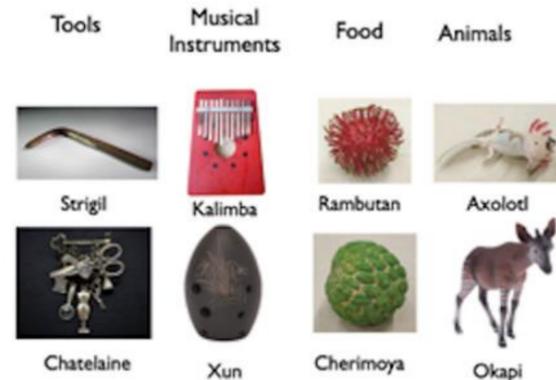


Figure 1. Examples of stimuli.

## Procedure

- 1. Training session:** The explainer (EX) learned about 12 unknown objects with video material prior to the dyadic interaction.
- 2. Explanation session:** EX provided a familiar partner (explainee (EE)) with information about the objects. The objects were presented in two conditions: present and absent. The order was randomized.
- 3. Recall task:** Test of EEs' labeling abilities of the unknown objects in a forced choice test, i.e. they had to decide whether a presented picture and label match. Each correct choice was coded as 1, each incorrect choice as 0.

The occurrence and type of EEs' questions in session 2 were explored (see “Coding Schema of Questions Types”) and related to EEs' subsequent recall score (session 3).

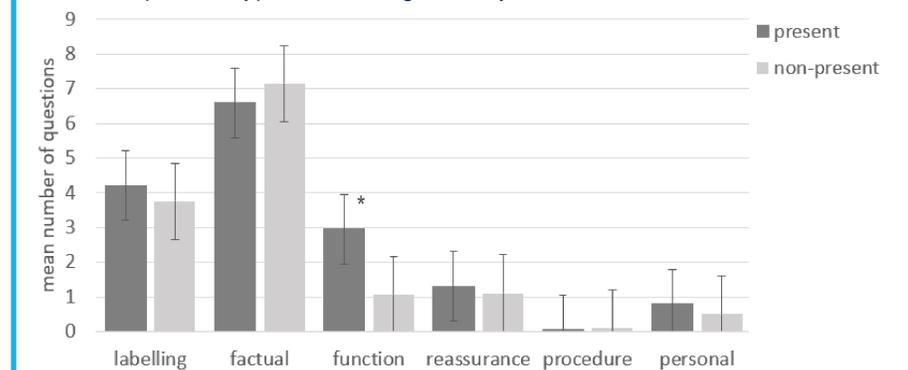
## Coding Schema of Question Types

The questions were coded into six categories and transcribed using ELAN (2021) [5]. The categories are mainly based on the ones presented in Tare and colleagues (2011) [6] with some adjustments of the labeling and procedure questions.

Question Type	Definition	Examples
<b>label</b>	Target the name of a stimuli in an oral or orthographic form.	<i>What is that?</i> <i>How do you spell that?</i> <i>What's it called okapi?</i>
<b>function</b>	Different functions of a music instrument, tool or body parts of an animal and what they do. How to eat a fruit.	<i>What does that do?</i> <i>And you eat it, like, with a spoon or something?</i>
<b>factual</b>	Seek information of a profile or product description. Include general demands for more information and examples.	<i>What's a gourd?</i> <i>Where do they live?</i> <i>When was it invented? And then?</i> <i>Like a necklace not a brooch?</i>
<b>reassurance</b>	Make sure the speaker is serious, a sign of disbelief or surprise or auditory difficulties.	<i>Really? Shells, right? Is it?</i>
<b>procedure</b>	Is an off-topic remark on how to continue with the discussion. Also includes information on the pre-session of the explainer.	<i>Can I try?</i> <i>Did you watch videos?</i> <i>Well, they not told you?</i>
<b>personal</b>	Includes individual preferences and experiences of the explainer and explainee.	<i>Have you played it before?</i> <i>Did you know that yourself?</i>

## Results

**Questions:** All EEs engaged in asking questions. On average, EEs asked 29 questions ( $SD = 15.9$ , range 9–73). Factual and labeling questions were the most frequent ones in both conditions (present/absent). The object-present condition ( $M = 2.95$ ,  $SD = 3.5$ ) elicited more function questions than the absent condition ( $M = 1.05$ ,  $SD = 1.2$ ),  $Z = -2.46$ ,  $p < .05$ . The other question types did not significantly differ between conditions.



**Recall task:** EEs' individual performance in this task was calculated as the mean of their correct choices. The average score obtained was .8 ( $SD = .14$ ). Only the question type of labeling in the present condition correlated positively with the recall score ( $r_s = .60$ ).

## Discussion

We found that EEs asked different types of questions, especially about the object's label and facts. The labeling questions were linked to better recall. In general, the presence of an object does not seem to trigger a better or different involvement of the EE, except for function questions, which were asked more when objects were present. This suggests that the physical presence of the objects rendered their function-affording properties more saliently. The results contribute to designing XAI: To provide relevant explanations it is crucial to involve the user/EE and to base the explanations on the users' questions.