

COMMUNICATIVE LISTENER FEEDBACK IN HUMAN-AGENT INTERACTION

ARTIFICIAL SPEAKERS NEED TO BE

ATTENTIVE AND ADAPTIVE

Hendrik Buschmeier & Stefan Kopp

Social Cognitive Systems Group · CITEC · Bielefeld University

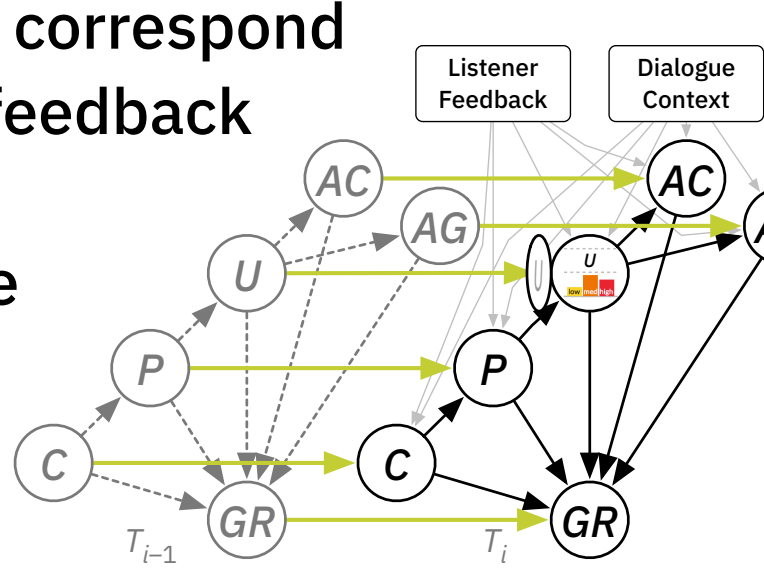
FEEDBACK & ATTENTIVE SPEAKING

Communicative listener feedback is an important coordination mechanisms for efficiently reaching understanding in dialogue. Based on feedback, speakers reason about listeners' mental state of listening and adapt ongoing utterances to their needs.

A computational model of attentive speaking:

Feedback interpretation as listener state attribution (Buschmeier & Kopp, SemDial 2012/2014)

- Listening-related mental states correspond to communicative functions of feedback (perception, understanding, ...)
- Tracking the user's mental state with a dynamic Bayesian network, which represents the *attributed listener state (ALS)*



Adaptive behaviour generation

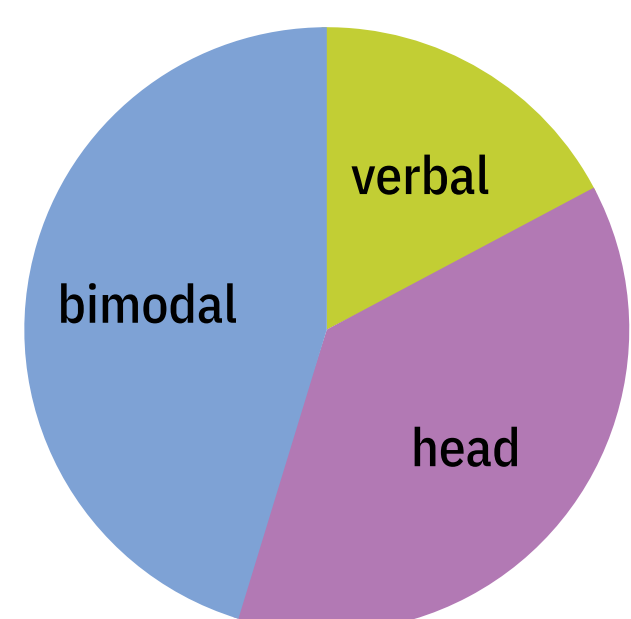
- Decisions in dialogue management can be based on ALS
- Incrementally adaptive natural language generation, using ALS (Buschmeier et al., SigDial 2012)

Feedback elicitation cue generation (Buschmeier & Kopp, IVA 2014)

- Feedback is elicited based on the agent's information needs

USERS' FEEDBACK BEHAVIOUR

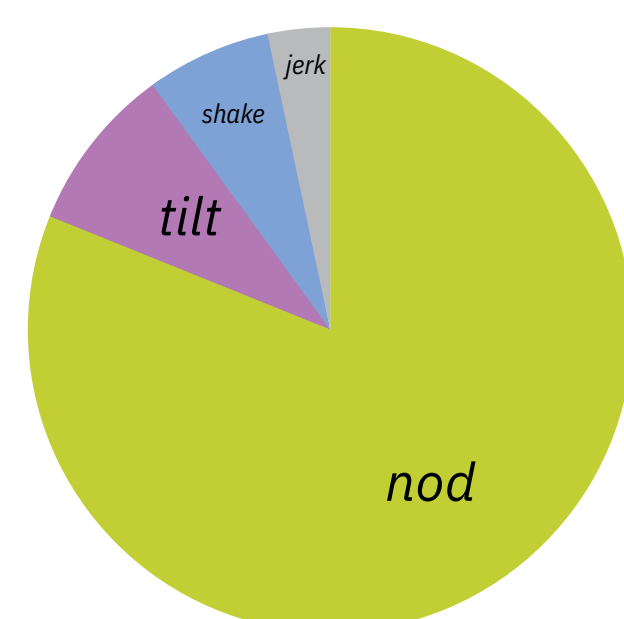
Users provided natural feedback to the agent they interacted with. Feedback distribution is similar as in human conversation.



Feedback modality

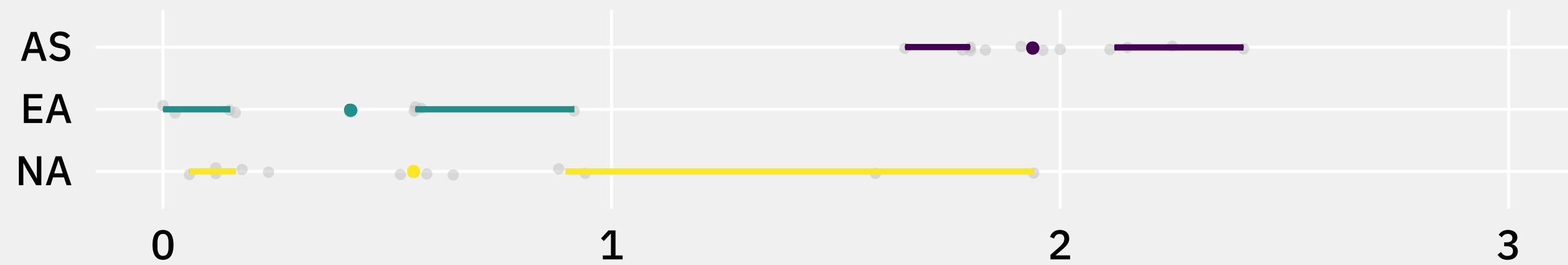


Feedback expression



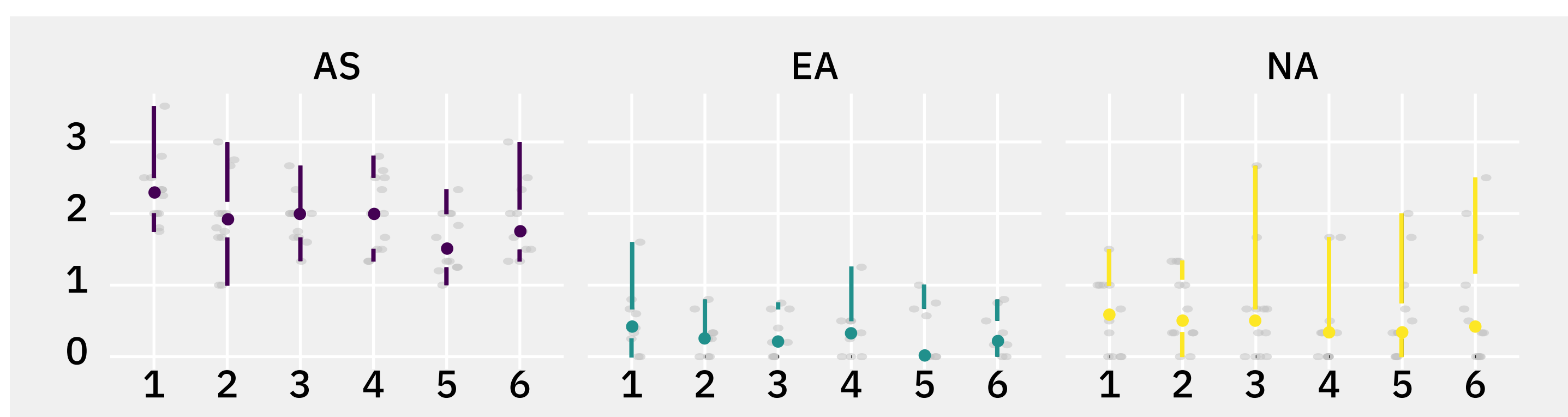
Head gesture types

Users' feedback rate differed by condition. They provided decisively more feedback to the attentive speaker agent.



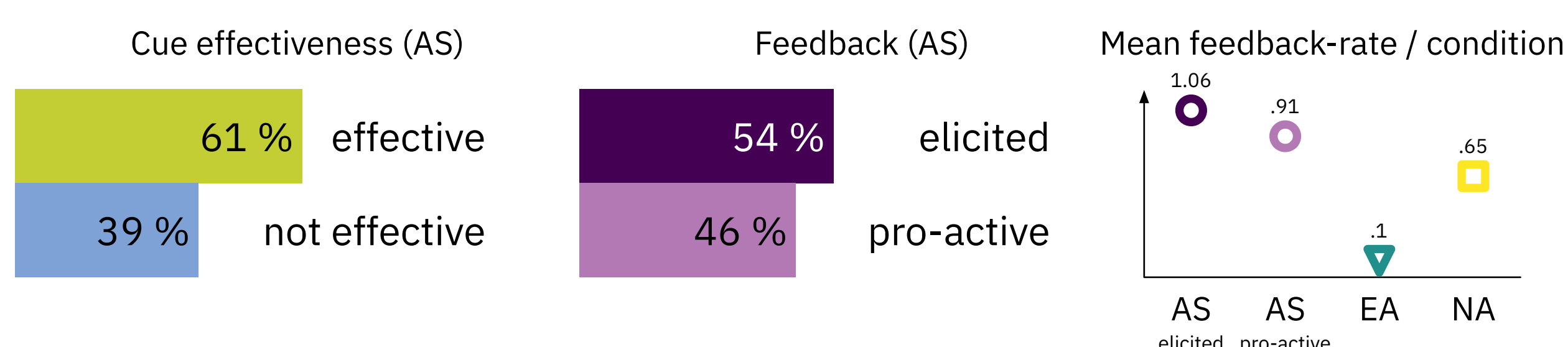
Distribution of users' feedback rate by experimental condition

Users' feedback rate did not vary much over time. They noticed early whether their feedback made a difference.



Development of users' feedback rate through the experiment by experimental condition

Differences in feedback rate cannot be reduced to the factor that the attentive speaker agent produced elicitation cues.

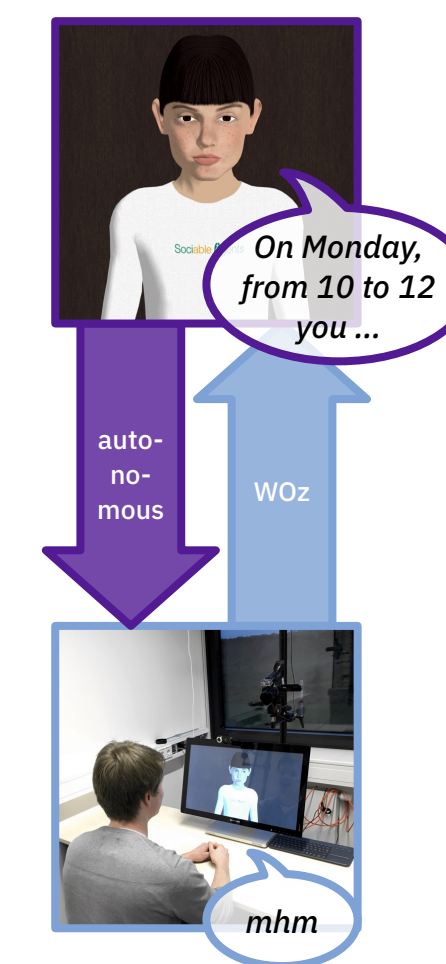


INTERACTION STUDY

¿Are users willing to provide natural communicative listener feedback to artificial conversational agents?
¿Do users notice that they are interacting with an attentive speaker agent that makes an effort towards being understood?

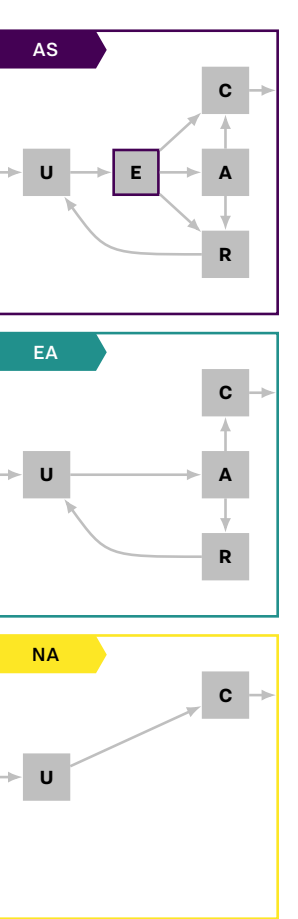
Information presentation task (calendar)
Semi-autonomous Wizard-of-Oz paradigm

- Wizard observes participants and 'annotates' feedback in real-time
 - Attentive speaker agent autonomously processes feedback, adapts its behaviour, and produces feedback elicitation cues
- Instruction: participants *can* only provide feedback, the agent *may* take this information into account in its own behaviour



Three exp. conditions (between subject)

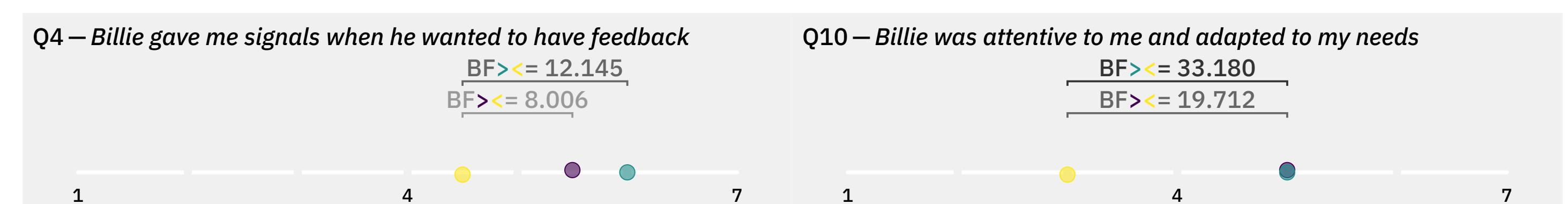
- AS:** attentive speaking
 - AS-models, ask if uncertain, target
- EA:** explicit asking
 - ignore feedback, always ask, control
- NA:** no adaptation
 - ignore user, control



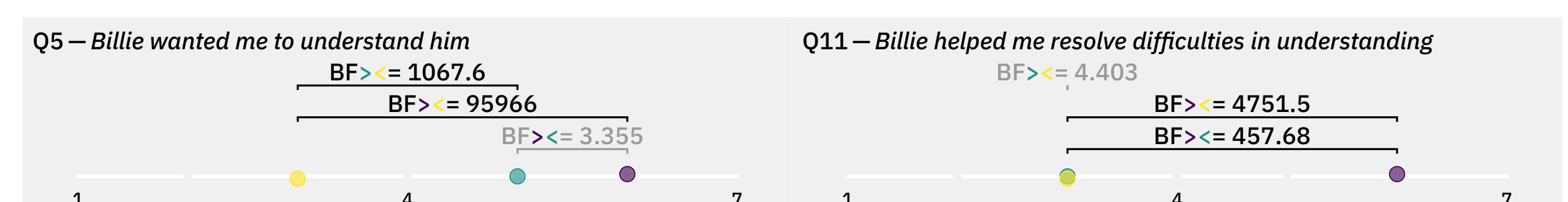
USERS' SUBJECTIVE PERCEPTION

The attentive speaker agent (AS) was consistently rated more favourably than the baseline agent that did not adapt (NA).

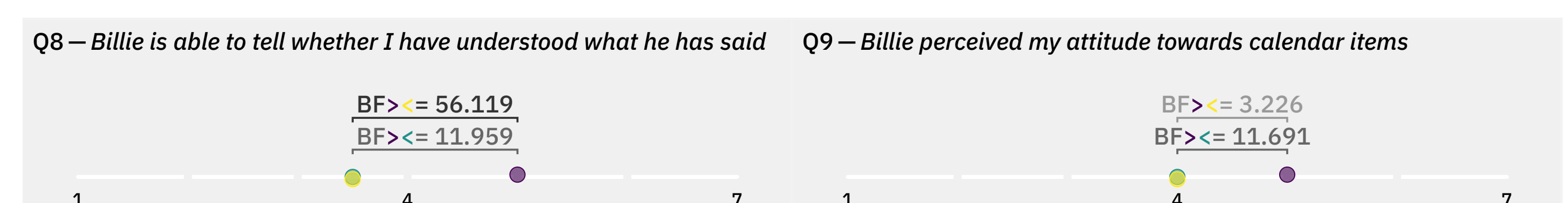
The comparison to the baseline agent that asked explicitly (EA) is complex: Users in conditions AS and EA noticed that their agent wanted to get 'feedback' and that it 'adapted' accordingly.



Yet, users more strongly attested the attentive speaker agent a desire to be understood and agreed more that it helped them in resolving difficulties in understanding.



Accordingly, users interacting with the attentive speaker agent clearly noticed that this agent had the ability to interpret their communicative feedback behaviour.



Median ratings and Bayes factor-based comparison of questionnaire items by experimental condition (●AS ●EA ●NA). Comparisons where evidence can only be considered *anecdotal* are not shown.

CONCLUSION

In order to receive communicative listener feedback from their users and to be perceived as an attentive speaker agent, artificial conversational agents need to actually be attentive and adaptive to their users' feedback and needs.

