

Measuring individual differences in the understanding of gaze cues across the lifespan

Julia Prein<sup>1</sup>, Manuel Bohn<sup>1</sup>, Luke Maurits<sup>1</sup>, Steven Kalinke<sup>1</sup>, & Daniel M. Haun<sup>1</sup>

<sup>1</sup> Department of Comparative Cultural Psychology, Max Planck Institute for Evolutionary  
Anthropology

Author Note

Add complete departmental affiliations for each author here. Each new line herein  
must be indented, like this line.

Enter author note here.

Correspondence concerning this article should be addressed to Julia Prein, Max  
Planck Institute for Evolutionary Anthropology, Deutscher Platz 6, 04103 Leipzig,  
Germany. E-mail: julia\_prein@eva.mpg.de

## Abstract

There must be an abstract of no more than 250 words. One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.

Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines.

One sentence clearly stating the **general problem** being addressed by this particular study.

One sentence summarizing the main result (with the words “**here we show**” or their equivalent).

Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.

One or two sentences to put the results into a more **general context**.

Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline.

*Keywords:* social cognition, individual differences, gaze cues, psychometrics

Word count: X

Measuring individual differences in the understanding of gaze cues across the lifespan

Idea for an opener :)

Developmental psychology is facing a dilemma: many research questions are questions about individual differences, yet, there is a lack of tasks to reliably measure these individual differences. For example . . . .

## Methods

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study.

## Participants

## Material

Material is presented as an interactive web-app that is accessible for computers and tablets and runs on any web browser. The code is open-source (<https://github.com/ccp-eva/gafo-demo>) and a live demo version can be found under: <https://ccp-odc.eva.mpg.de/gafo-demo/>.

The web-app generates two files: (1) a text file (JSON) containing click responses, and (2) a video file (webm) of the participant's webcam recording. Data gets automatically collected and safely stored on local servers located in Leipzig, Germany.

The web-app was programmed in Vanilla JavaScript, HTML and CSS. For stimulus presentation, a scalable vector graphic (SVG) composition was parsed. This way, the composition scales according to the user's viewport without loss of quality, while keeping the aspect ratio and relative object positions. Furthermore, SVGs allow us to precisely control and calculate the size and position of all composite parts of the scene (e.g., pupil of the agent).

The GreenSock Animation Platform (GSAP; TODO insert citation) library was used to animate the movement of single SVG elements.

Study instructions were pre-recorded and, therefore, constant across participants. No interaction with the experimenter was necessary and children needed minimal assistance from their caregivers.

### **Procedure (from pre-reg)**

An animal character (i.e., agent; sheep, monkey, or pig) is placed centrally in a window. A balloon (i.e., target; blue, green, yellow, or red) is located in front of them. The target then falls to the ground. The agent’s gaze follows the movement of the target, that is, the pupils of the agent move in a way that their center aligns with the center of the target. Participants are then asked to locate the target’s position on the screen.

Visual access to the target’s true location is manipulated by a hedge. Participants either have full, partial, or no visual access to the true target location. When partial or no information about the target location is accessible, participants are expected to use the agent’s gaze as a cue.

There are two different versions of partial and no visual access trials. For families that use a tablet with touchscreen, the target lands behind a hedge (i.e., hedge version). Children are then asked to click directly on the hedge to indicate where the target is. For families that use a computer without touchscreen, the balloon falls into a box. Children are then asked to point to the box containing the target. Caregivers then act as the “digital finger” of their children and click on the indicated box.

The dependent variable depends on the study version: For the hedge version, our dependent variable is continuous. Here, the dependent variable is imprecision, which is defined as the absolute difference between the true x coordinate of the target and the x coordinate of the participant’s click on the screen. For the box version, we use our

categorical outcome (i.e., which box was clicked) to calculate the proportion of correct responses.

There are three different trial types, depending on the visual access to the target flight and end location. In touch training trials, participants have full visual access to the target flight and the target’s end location. In familiarization trials, participants have visual access to the target flight but not to the target’s end location. In the hedge version, the target’s end location is covered by a hedge. In the box version, the target flies into a box and is therefore not visible anymore. In test trials, participants have no visual access to the target flight nor the end location. In both versions, the target flight is covered by a hedge. In the hedge version, the hedge then shrinks to cover the target’s end location. In the box version, the hedge shrinks completely. The boxes then hide the target’s end location.

Depending on the participant’s device, participants have to indicate their estimated target location directly on the hedge (i.e., hedge version) or in one of five boxes (i.e., box version).

Participants receive 19 trials with one touch training, two familiarization trials, and 16 test trials. The first trial of each type comprises a voice-over description of the presented events. Touch and familiarization trials, as well as voice-over trials, will not be included in the analysis. Therefore, we will conduct our analysis with 15 test trials.

Target locations are generated as follows. For the hedge version, the full width of the screen is divided into ten bins. Exact coordinates within each bin are randomly generated. For the box version, the target randomly lands in one out of five boxes. Each bin/box occurs equally often. The same bin/box can occur only twice in a row.

## Data analysis

We used R [Version 4.1.2; R Core Team (2021)] and the R-package *papaja* [Version 0.1.0.9997; Aust and Barth (2020)] for all our analyses.

## Results

## Discussion

## Declarations

### Open practices statement

The web application (<https://ccp-odc.eva.mpg.de/gafo-demo/>) described here is open source (<https://github.com/ccp-eva/gafo-demo>). The datasets generated during and/or analysed during the current study are available in the [gazecues-methods] repository, (<https://github.com/jprein/gazecues-methods>). All experiments were preregistered (<https://osf.io/zjhsc/>).

### Funding

This study was funded by the Max Planck Society for the Advancement of Science, a noncommercial, publicly financed scientific organization (no grant number). We thank all the children and parents who participated in the study.

### Conflicts of interest

The authors declare that they have no conflict of interest.

### Ethics approval

### Consent to participate

Informed consent was obtained from all individual participants included in the study or their legal guardians.

121 **Consent for publication**

122 **Open access**

123 **Authors' contributions**

124 optional: please review the submission guidelines from the journal whether

125 statements are mandatory

## References

- Aust, F., & Barth, M. (2020). *papaja: Create APA manuscripts with R Markdown*. Retrieved from <https://github.com/crsh/papaja>
- R Core Team. (2021). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from <https://www.R-project.org/>



## Supplements

### Adult sample

**Recruitment.** We recruited participants using the online participant recruitment service *Prolific* from the University of Oxford. *Prolific*'s subject pool consists of a mostly European and US-american sample although subjects from all over the world are included.

The recruitment platform realises ethical payment of participants, which requires researchers to pay participants a fixed minimum wage

of £5.00 (around US\$6.50 or €6.00) per hour. We decided to pay all participants the same fixed fee which was in relation to the estimated average time taken to complete the task.

*Prolific* distributed our study link to potential participants, while the hosting of the online study was done by local servers in the Max Planck Institute for Evolutionary Anthropology, Leipzig. Therefore, study data was saved only on our internal servers, while *Prolific* provided demographic information of the participants.

Participants' *Prolific* ID was forwarded to our study website using URL parameters. This way, we could match participant demographic data to our study data. The same technique was used to confirm study completion: we redirected participants from our study website back to the *Prolific* website using URL parameters.

We used *Prolific*'s inbuilt prescreening filter to include only participants who were fluent in English and could therefore properly understand our written and oral study instructions.

**Study 1 - Validation hedge version.** We recruited participants online by advertising the study on *Prolific*.

50 adults participated in the study. One additional subject returned their submission, i.e., decided to leave the study early or withdrew their submission after study completion.

Data collection took place in May 2021.

Participants were compensated with £1.25 for completing the study. We estimated an average completion time of 6 minutes, resulting in an estimated hourly rate of £10.00. In average, participants took 05:56min to complete the study.

Participants were required to complete the study on a tablet or desktop. Participation on mobile devices was disabled since the display would be too small and would harm click precision. It was indicated that the study required audio sound.

We stored *Prolific*'s internal demographic information, while not asking for additional personal information.

After clicking the study title, participants were directed to our online study website.

...

**Study 2 - Validation box version.** As in study 1, we recruited participants on *Prolific*, and employed the same methodology. However, this time participants were presented with the box version of the task. We showed eight boxes in which the target could land.

50 adults participated in the study. One additional subject returned their submission, i.e., decided to leave the study early or withdrew their submission after study completion. Data collection took place in June 2021.

Participants were compensated with £1.00 for completing the study. We estimated an average completion time of 6 minutes, resulting in an estimated hourly rate of £10.00. In average, participants took 04:43min to complete the study.

**Study 3 - Reliability hedge version.** In addition to the beforementioned prescreening settings, we used a whitelist.

whitelist screener: "When the researcher uses a whitelist, only participants with IDs entered into the whitelist are invited to participate in a study. This allows gathering

182 information from the same subjects at different points in time.”

183       **Study 4 - Reliability box version.** As in study 3, we recruited participants on  
184 *Prolific*, and employed the same methodology. However, this time participants were  
185 presented with the box version of the task. As in study 2, we employed eight boxes in  
186 which the target could land.