OSF Preregistration Template from AsPredicted.org

Data collection

Have any data been collected for this study already? Note: 'Yes' is a discouraged answer for this preregistration form.

No, no data have been collected for this study yet.

Hypothesis

MAIN QUESTION: Does observed communicative context bias infants to encode surface features supporting learning about object kinds (i.e., object identity), over spatial-temporal information (i.e., object location)? We will measure infants' looking time response in an outcome phase after they have seen two adults looking at an object in a previous action phase. The adults either look at the object together after previous mutual eye contact (communicative context) or they look at it individually without sharing mutual eye contact (non-communicative). In the subsequent outcome phase, infants will see one of three different outcomes: the object they had just seen in the action phase (no change, baseline), the object they had just seen but at a novel position (location change), or a new object (identity change). By manipulating (a) the third-party communicative context and (b) features of the object in the subsequent outcome phase, we aim to examine whether observed communicative context biases infants to encode surface features supporting learning about object kinds (i.e., object identity) over spatial-temporal information (i.e., object location). This would be in line with the communication-induced genericity memory bias, which has been demonstrated in first-party interactive settings and according to which a communicative context biases infants to learn culturally relevant kind-generalizable information about novel objects (Yoon, Johnson, & Csibra et al., 2008; Okumura, Kobayashi, & Itakura, 2016; but see Silverstein, Gliga, Westermann, & Parise, 2018).

HYPOTHESES: We will compare infants' looking times for outcomes containing an unexpected change (location or identity) with baseline outcomes containing no change at all (no change). According to the logic that infants tend to look longer at events that violate their expectations, the following general hypotheses are made: 1) If infants look longer at the change outcomes compared with the no-change baseline, we assume that they have retained information about that feature in memory (comparison to baseline). 2) If infants find one type of unexpected change more interesting or surprising than another (location or identity), we assume that they will respond with increased attention, that is, longer looking times to this outcome (comparison between outcomes). Based on the previous literature, the following result patterns would indicate a communication-induced genericity memory bias: 1) In communicative joint attention scenes: Infants should show an identity bias, that is, increased looking times at identity over location changes and compared to the baseline (in line with Yoon et al., 2008; Okumura et al., 2016). 2) In non-communicative scenes, two patterns would be indicative for a communication-induced memory bias: Infants should (a) either show a location bias, that is, increased looking times at location changes over identity changes and compared to the baseline or (b) they should show both a location and identity bias, that is, increased looking times at location changes and identity changes compared to baseline, with no difference between conditions. (a) would be in line with Yoon et al. (2008), who found a double dissociation of identity and location memory biases in their study: longer looking at identity change than no-change after communicative scenes and longer looking at location change than no-change after non-communicative scenes. (b) would be in line with Okumura et al. (2016) who found both a location and an identity bias in the non-communicative scenes of their study (see also adult literature by Marno et al., 2014, 2016).

Dependent variable

Infants will be presented with a screen-based violation of expectation task (12 test trials, 2 familiarization trials). Each trial will consist of three phases (Okumura et al., 2016): an action phase (15s), a delay phase (5s) and an outcome phase (15s or until the infant looks away for 2 consecutive seconds). Before the action phase and the outcome phase, an attention-grabbing sequence will be presented to centralize the infant's gaze. All dependent variables will be measured by using eye tracking. 1) Action phase: Infants are introduced to a novel object either in a third-party communicative context (two adults turning toward one another, establishing eye contact before shifting their gaze mutually to a visible object) or a non-communicative social context (two adults turning away from one another, looking at the object individually). The action phase begins and ends with a schematic curtain opening and closing during one second each. The movement of the curtain is accompanied by attention-getting sounds to attract the infant's attention. 2) Delay phase: The scene is occluded by the curtain. 3) Outcome phase: The curtain opens again during one second with sound and the object either appears at the same location where infants had seen it before (no change, baseline), at a novel location (location change), or the object will be replaced by a novel object (identity change). As the main dependent variable related to infants' object processing, we will measure infants' looking times in the outcome phase. In line with Okumura et al. (2016), we will calculate our main analysis based on the total looking duration at the screen. As a measure of total looking duration, we will use the cumulative length of all fixations within the screen AOI, beginning at the first frame of the curtain opening and ending when the infant looks away for 2 seconds or after 15 seconds elapse. To implement the 2-second look-away criterion, we will monitor the time intervals between consecutive screen fixations. If the time interval is longer than 2000 ms, the trial will end and only the data upon this timepoint will be included. Note: The main difference between our measure of total looking time and the measure applied by Okumura et al. (2016) is that Okumura and colleagues coded infants' looking behavior manually based on video recordings. In our study, in contrast, we will use eye tracking technology to measure infants' looking times automatically. The aim of the here described data processing approach is to increase comparability with the previously used manual coding approach (by considering looking times at the entire screen) while using a fixation-based standard measure of looking times typically applied in studies using eye tracking technology.

Conditions

How many and which conditions will participants be assigned to?

TEST TRIALS: Six test conditions will be tested within subjects: Based on a 2x3 design, we will manipulate (a) the relationship between the actors in the action phase regarding their communicative context (communicative referential or non-communicative referential), and (b) the object in the outcome phase (no change, identity change, location change). Each infant will see two trials per test condition, resulting in a total number of 12 test trials. PRETEST TRIALS: In addition to the test trials, infants will be presented with two pretest trials (analogous to the familiarization trials in Okumura et al., 2016; Yoon et al., 2008). The purpose of the pretest trials is to familiarize infants with each of the two dyads, with the action-occlusion-outcome structure of the test trials and with the two object positions. We are not planning to analyze the eye tracking data in this phase. In the action phase of the two pretest trials, two actors turn toward (face-to-face) or away from one another (back-to-back) before they look away from a visible object. In contrast to the action phase in the test trials, there will be no referential looking to the object involved in the action phases of the pretest trials. Post occlusion outcomes during pre-test trials include no change in the object's location or identity (see also Okumura et al., 2016; Yoon et al., 2008).

Analyses

To investigate infant's violation of expectation response as a function of third-party social context (communicative referential, non-communicative referential) and object outcome (no change, identity change, location change), we will compare the fit of two generalized linear mixed models (GLMM) to the data from the test trials using likelihood ration tests: a full model and a reduced model (see below). In line with Okumura et al. (2016), we will include the total looking duration to the screen after object reveal as the dependent variable in both models (gamma distributed, see note in the end of this section).

MAIN FIXED EFFECTS FULL MODEL: The full model will include two interactions as main fixed effects: the interaction between the binary fixed effect variable social context (communicative referential: 1/0) and the binary location change variable (1/0), as well as an interaction between the binary fixed effect variable communicative context and the binary identity change variable (1/0). MAIN FIXED EFFECTS

REDUCED MODEL: The reduced model includes communicative context and outcome as main fixed effect variables. Social context will be included as a binary variable (communicative referential: 1/0) and outcome will be included as two binary dummy variables (location change: 1/0; identity change: 1/0, no change condition: represented by the intercept). All factors will be tested within subjects. In both models, we will include fixed effect control variables for trial number (1-12), trial number within condition (1-2), and object position (up or down). We will include a full random effect structure in both models. Note: We are planning to use a non-normal distribution based on the assumption that looking time responses typically follow a right-skewed distribution (Csibra, Hernik, Mascaro, Tatone & Lengyel, 2016). To determine which non-normal distribution would be most appropriate for our expected looking time response measure (gamma or lognormal), we fitted maximum likelihood estimates of lognormal and gamma distributions to the raw data in each of the six conditions by Okumura et al. (2016). We assumed that the distribution of the data by Okumura et al. would represent a valid estimation of the expected distribution of our response measure given that the authors manipulated the same factors and used conceptually the same outcome measure. The comparison revealed that the gamma distribution had a higher likelihood in five out of the six conditions would therefore provide a better overall fit to the Okumura data compared to a loglinerar distribution. This is in line with a recent infant looking time study by Simkovic & Träuble (2021) showing that compared to Weibull, lognormal and normal distribution, the gamma distribution shows the best fit in terms of log-likelihood and mean absolute error and the best predictive performance.
Outliers and Exclusions

Children will be generally excluded in case of (a) technical errors with the eye tracking soft- or hardware, (b) inaccuracy or failure of calibration, or (c) premature birth (< 37 weeks of gestation). Moreover, participants will only be included in the analysis if (d) they provide valid data in both pretest trials and at least one trial per test condition after being filtered according to the following criteria: A trial is considered as “valid” if the infant has looked at least for the duration of one fixation at the object during the outcome phase (see note in the end of this section), and if they have paid visual attention to the central parts of the video for at least one fixation (see also Thiele et al, 2021). As central parts, we count the looking-to-object (or away-from-object) phase and at least one of the face-to-face (or back-to-back) phases preceding a referential object look, excluding the motion sequences. We will report valid trial statistics for each of the six cells resulting from the 2x3 study design. Note: We decided to use infants’ fixation to the object (instead of to the screen) as inclusion criterion in the outcome phase to make sure that all included infants can also be included in the additional analysis relying on gaze data in the object AOI.

Sample Size

We aim to include valid data from N = 36 infants between 9.0 and 10.0 months of age. The aimed sample size was based on a simulation-based power analysis using the raw data by Okumura and colleagues (2016) to estimate the effect sizes. We assumed that the data by Okumura et al. would represent a valid basis for estimating the effect sizes in our study given that the authors manipulated the same factors and used conceptually the same outcome measure. Due to data base restrictions, we might have to include infants who deviate a couple of days from our inclusion criterion. The criteria for "valid data" are described in section "Outlier and Exclusions". Data that has to be excluded from the final analyses due to these criteria will be replaced by additionally tested participants. In case of another corona-driven lockdown, we may stop data collection even if we did not collect valid data of 36 infants.

Other

(1) GENERAL NOTE: We use the study by Okumura et al. (2016) as main reference for decisions such as the timing of the stimuli, the overall procedure of the task, inclusion criteria, sample size, and main dependent measure. This is because the study design by Okumura and colleagues (in contrast to Yoon et al., 2008 or Silverstein et al., 2019) focuses on gaze cues only and, as such, is most comparable with the current study design.

(2) TRIAL ORDER TEST PHASE: The experiment will be designed in a way that each infant sees the first trial of all 6 test conditions in the first half of the test trials (test trials 1-6). The 12 experimental trials will be presented in 4 blocks with 3 trials each. Within a given block, each trial presents a different outcome (location change, no change, identity change). After every block, infants will be presented with a 4-second kaleidoscope video with a soothing melody to maintain their attention (see also Thiele et al., 2021). Counterbalancing in the first test trial block (test trials 1-3): We will counterbalance the order of outcome and communicative context conditions during the first block across infants in the way that an equal number of infants sees an identity change first, no change first, and location change first (factor outcome). An equal number of children sees a trial of the communicative condition first or a trial of the non-communicative control (factor communicative context). Order of trials in the remaining test trial blocks (test trials 4-12): The order of outcome and communicative context conditions in the remaining three blocks will be pseudo-randomized. No outcome or communicative context condition will occur more than twice in a row. TRIAL ORDER PRETEST PHASE: We will counterbalance the order of the two communicative context conditions and the positioning of the object during the pretest phase across infants. This way, an equal number of infants will see the practice trial of the face-to-face pretest condition first and the practice trial of the back-to-back pretest condition first. Moreover, an equal number of infants will see the object at the upper screen position first and at the lower screen position first.

(3) OBJECTS TEST PHASE: We will use 16 pictures of abstract toys as objects in the test phase. The objects have been collected for a study by Wahl, Michel, Pauen, & Hoehl (2013). Out of the 16 objects, 12 objects will be presented as familiar objects in the action phase, and 4 additional objects as novel objects in the outcome phase of the identity change conditions. Each of the 16 objects will be presented in all six conditions across participants. In the identity change condition, each object will serve as familiar object in the action phase and as new object in the outcome phase across participants. OBJECT POSITION TEST PHASE: The position of the object in the action phase (up or down) will be counterbalanced within child and factor in a way that each infant sees the object in the action phase equally often at the upper screen position or the lower screen position in all three outcomes and both social contexts. Across infants, an equal number of infants sees the object in the action phase at the upper screen position on the first test trial and on the lower screen position on the first test trial. OBJECTS PRETEST PHASE: In addition to the 16 objects in the test phase, we will use two objects in the videos of the pretest phase. Across participants, each of the two objects will occur equally often in the communication practice trial and the non-communication practice trial. OBJECT POSITION PRETEST PHASE: The object position in the action phase will be counterbalanced across infants in a way that over all infants an object appears equally often at the lower and upper screen position. We will counterbalance across infants at which screen position the object appears on the first pretest trial. The object location within the two practice trial conditions will be quasi-randomized in a way that the object appears at both screen positions across infants. Each individual infant sees the object at both screen positions during the two pretest trials (upper and lower screen position).

(4) ACTORS TEST PHASE: Every child sees two dyads of female actors (dyad 1 and dyad 2). One dyad performs in all six trials of the two communicative conditions and the other dyad performs in all six trials of the no eye contact conditions. Across participants, each of the two dyads will serve equally often as communicative dyad and as non-communicative dyad. ACTORS PRETEST PHASE: The face-to-face dyad in the pre-test phase performs the communicative referential trials in the test trials, and the back-to-back dyad performs the non-communicative referential trials in the test trials (analogously to Yoon et al., 2008).

(5) ADDITIONAL ANALYSES TEST PHASE:

ACTION PHASE: We are planning to explore condition differences in infants' gaze pattern during the action phase further by comparing infants' looking times at the objects and the actors in the across conditions. Moreover, we are planning to explore the relation between infants' looking times at the objects during the action phase with their subsequent looking time response in the outcome phase.

OUTCOME PHASE: We are planning the following analyses in addition to the main analysis.

(A) TOTAL LOOKING TIME AT THE OBJECT: First, we will repeat our analysis focusing on infants' total looking times to the object as a measure of overt visual attention to the object (rather than focusing on their looking times to the overall screen). Analogously to the processing steps and criteria in the main analysis, "total looking time to the object" will be defined as the cumulative length of all fixations within the object AOI, beginning at the first frame of the curtain opening and ending when the infant looks away for 2 seconds or after 15 seconds elapse. We will adjust the 2-second look-away criterion as "look-away from the object" for this analysis, monitoring the time intervals between two consecutive object fixations. If the time interval is longer than 2000 ms, the trial will end and only object fixations upon this timepoint will be included.

(B) FIRST LOOK: Second, we are planning to repeat our main analysis based on the duration of infants' first look at the object before any looks away. This is in line with the main analysis by Yoon et al. (2008), who "chose to measure duration of first looks rather than total looking times because when an infant looks away from the screen, he/she has no evidence of the continuing existence of the object". To increase the comparability with the manual coding procedure by Yoon et al., we will define a look at the object as the time interval between the first fixation in the object AOI and the end of the last fixation within the same AOI, including the duration of saccades between fixations. The first look ends when a gaze sample with coordinates outside the object AOI is detected or when the latency between two consecutive object fixations is more than 3 SDs longer than the median of a child's gaze shift latency within the object AOI during all object looks over all outcome trials (assuming that the child must have looked away in this case). Note: Due to the restrictions resulting from the eye tracking based measure of looking times, our first look measure differs from the measure by Yoon et al. (2008) in that it does not focus on looks at the entire screen but instead, and more specifically, on direct looks at the visible object. The reason for this narrower focus on overt attentional looks at the object is that, compared to Yoon et al.'s manual coding procedure, the currently planned automatic eye tracking approach complicates determining the end timepoint of the first look (i.e., the moment when the child stops looking at the screen). Without any additional recording of the infant's face, it requires information about gaze samples outside the target AOI in the eye tracking data to capture that the infant's gaze has left the screen. If we would use the entire screen as target AOI, we would reduce the availability of such no-target gaze samples, as "no-target" would be equivalent to "no-screen" gaze samples which are indistinguishable from missing values (NAs) due to look-aways or recording errors. Even though the eye tracker principally records gaze data outside the screen if within the trackable range, those data are rarely recorded and poor in accuracy and precision because they lay outside the calibrated area. In our approach, using the object AOI as target area, the remaining screen area exclusive of the object AOI provides us with a relatively bigger trackable area increasing the detection of "no-target" gaze samples. To accommodate for the remaining risk that the first look may end with a look-away from the screen without the outwards moving saccade being detected by the eye tracker, we have decided for an additional time criterion accounting for an individual's saccade speed during their looks at the object. This criterion relied on the median rather than the mean latency, as the median latency is less affected by outliers (e.g., caused by missing values) and therefore more robust compared to the mean latency.

(6) Depending on the testing situation due to Covid-19, we will test an additional sample of infants in a separate study, investigating the influence of communicative cues in a first-party context. We may analyze and compare data of both studies in one data set.

REFERENCES

Csibra, G., Hernik, M., Mascaro, O., Tatone, D., & Lengyel, M. (2016). Statistical treatment of looking-time data. Developmental psychology, 52(4), 521.

Marno, H., Davelaar, E. J., & Csibra, G. (2014). Nonverbal communicative signals modulate attention to object properties. Journal of Experimental Psychology: Human Perception and Performance, 40(2), 752.

Marno, H., Davelaar, E. J., & Csibra, G. (2016). An object memory bias induced by communicative reference. Acta psychologica, 163, 88-96.

Okumura, Y., Kobayashi, T., & Itakura, S. (2016). Eye contact affects object representation in 9-month-old infants. PloS one, 11(10), e0165145.

Silverstein, P., Gliga, T., Westermann, G., & Parise, E. (2019). Probing communication-induced memory biases in preverbal infants: Two replication attempts of Yoon, Johnson and Csibra (2008). Infant Behavior and Development, 55, 77-87.

Šimkovic, M., & Träuble, B. (2021). Additive and multiplicative probabilistic models of infant looking times. PeerJ, 9, e11771.

Thiele, M., Hepach, R., Michel, C., and Haun, D.B.M. (in press). Observing others' joint attention increases 9-month-old infants' object encoding. Developmental Psychology

Wahl, S., Michel, C., Pauen, S., & Hoehl, S. (2013). Head and eye movements affect object processing in 4-month-old infants more than an artificial orientation cue. British Journal of Developmental Psychology, 31(2), 212-230.

Yoon, J. M., Johnson, M. H., & Csibra, G. (2008). Communication-induced memory biases in preverbal infants. Proceedings of the National Academy of Sciences, 105(36), 13690-13695.

Name

Investigating the communication-induced memory bias in the context of third-party social interactions. In this study we use a screen-based violation of expectation (VOE) paradigm to investigate whether 9-month-old infants process qualitatively different information about novel objects when an object is introduced in a third-party communicative referential versus non-communicative referential context. In 12 test trial videos, an object will be shown together with two adults (action phase). The communicative context between the two actors will be manipulated in a way that they either look at the object together after previous mutual eye contact (communicative context) or they look at it individually without sharing mutual eye contact at any point (non-communicative context). After each video, the scene will be occluded before it reveals one of three different outcomes: the object infants had just seen in the action phase (no change, baseline), the object they had just seen but at a novel position (location change), or a new object (identity change). By manipulating both the third-party communicative context and features of the object in the subsequent outcome phase, we aim to examine whether observed communicative context biases infants to encode surface features which support learning about object kinds (i.e., object identity) over spatial-temporal information (i.e., object location).
Finally

No response
Other

No response