Data Request form YOUth (version 5.0, December 11, 2019)

Introduction

The information you provide here will be used by the YOUth Executive Board, the Data Manager, and the Data Management Committee to evaluate your data request. Details regarding this evaluation procedure can be found in the Data Access Protocol.

All data requests will be published on the YOUth researcher's website in order to provide a searchable overview of past, current, and pending data requests. By default, the publication of submitted and pending data requests includes he names and institutions of the contact person and participating researchers as well as a broad description of the research context.

After approval of a data request, the complete request (including hypotheses and proposed analyses) will be published. If an applicant has reasons to object to the publication of their complete data request, they should notify the Project Manager, who will evaluate the objection with the other members of the Executive Board and the Data Management Committee. If the objection is rejected, the researcher may decide to withdraw their data request.

Section 1: Researchers

In this section, please provide information about the researchers involved with this data request.

- Name, affiliation and contact information of the contact person
- Name and details of participating researchers (e.g. intended co-authors)
- Name and details of the contact person within YOUth (if any)

Contact person for the proposed study:	
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Contact person within YOUth (if any)	
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Section 2: Research context

In this section, please briefly describe the context for your research plans. This section should logically introduce the next section (hypotheses). As mentioned, please note that this section will be made publicly available on our researcher's website after submission of your request.
Please provide:

- The title of your research plan
- A very brief background for the topic of your research plan
- The rationale for and relevance of your specific research plan
- The specific research question(s) or aim(s) of your research (Please also provide a brief specification)
- A short description of the data you request

References can be added at the end of this section (optional).

Title of the study
Infants' coordinated gaze and gestures: Relating early communicative behaviours to caregiver responses and later vocabulary size

Background of the topic of your research plan, rationale, relevance (max. 500 words)
Infants already use pointing gestures from at least 12 months of age (Liszkowksi et al., 2004) and holdout gestures from at least 10 months of age (Boundy et al., 2019) with a declarative motive. In an experimental setting, these gestures were elicited from infants. The experimenter responded using one of the four reactions: 1) attending to the toy and the infant (i.e., engaging in joint attention), b) attending to the infant, c) attending to the toy, or d) ignoring the gesture completely. When the experimenter engaged in joint attention, the infants responded most often with happy expressions. In the other conditions, the infants displayed more negative expressions (e.g., frowning or getting upset), or they started banging or shaking the toy to redirect attention. Both studies conclude this indicates that infants use these gestures with a communicative purpose to request joint attention (Liszkowksi et al., 2004; Boundy et al., 2019).

Without an experimental design, it is hard to determine whether preverbal infants use gestures to share attention and interest. The best on-line marker of communicative intent is the use of gaze-checking (i.e., looking into someone's eyes) while gesturing. This method has been used to determine communicative intent in both human infants and animals (see e.g. Bates et al., 1975; Tomasello et al., 1997). Donnellan et al. (2019) found that 11-month-olds coordinate many vocalisations and gestures with eye-gaze to their caregivers. These prelinguistic behaviours are thought of as intentionally communicative (Donnellan et al., 2019). Donnellan et al. (2019) found that gaze-coordinated gestures were less strong predictors of later vocabulary than gaze-coordinated vocalisations, but of all the examined gestures, particularly showing gestures were important (Donnellan et al., 2019).

Boundy et al. (2016) examined 24 triadic interactions between infants (aged 10-13 months) and their caregivers. They found that a selection of micro-behaviours, including arm position, hand orientation, and eye-gaze, were significant predictors of infant gesture type. In addition, a raised arm position was a significant predictor of receiving a caregiver's response (Boundy et al., 2016). Boundy et al. (2016) found that 17% of infants' gestures were accompanied by vocalisations, whereas 46% of their gestures were coordinated with gaze.

Previous studies show that caregivers' immediate responses to infants' vocalisations and gestures best predict infants' later language (e.g. McGillion et al., 2013; Olson & Masur, 2015; Donnellan et al., 2019). Donnellan et al. (2019) demonstrated that caregivers respond most often to gaze-coordinated behaviours. The dyadic combination of infants' gaze-coordinated vocalisations - followed by caregiver responses - best predicted productive vocabulary in the second year of life (Donnellan et al., 2019).

The present study will examine such dyadic interactions on a larger scale. Due to the low instances in Donnellan et al. (2019)'s study, frequencies of the behaviours were calculated rather than proportions. In the large amount of YOUth data, we will be able to calculate proportions. This research may provide relevant insights in the importance of certain features of parent-child interactions, which may also inform intervention studies which address language acquisition rate among typically developing children.

The specific research question(s) or aim(s) of your research

In the data, we will automatically code the following infant behaviours:

- Gaze
    - Gaze to the caregiver's face (i.e., gaze-checking)
- Gestures
    - Pointing at an object
    - Passing an object to the parent
    - Showing an object to the parent

A gesture will be considered gaze-coordinated if gaze to the caregiver's face happens within a one-second window (i.e., from 1 second before the onset of the gesture to 1 second after the offset of the gesture), following Donnellan et al. (2019).

The second element is the response to the infant's gesture. The dyadic combination of an infant's gesture and a caregiver's response seems the best predictor of later vocabulary size (Donnellan et al., 2019). Donnellan et al. (2019) hypothesized that this is because caregivers usually give direct, semantically contingent responses that help the child discover more information about the object.

Immediately following any infant's gesture, we will automatically code all caregiver's bodily/gestural responses:

- Gestural response
    - Pointing at an object
    - Passing an object to the infant
    - Showing an object to the infant
- Caregiver's gaze to the infant's face (i.e., gaze-checking)
- Caregiver's body orientation (either turning towards the infant or leaning closer)

In addition, we will examine events in the seconds immediately after the infants' gestures. We will determine whether the caregiver gives a direct, semantically contingent vocalised reply, in addition to any gestural response. This allows us to determine whether such replies are indeed more frequent after gaze-coordinated gestures and whether the frequency of such replies positively correlates to later vocabulary development, as suggested by Donnellan et al. (2019).

These data will give us information on the multimodal non-verbal communication of both infants and caregivers, and additionally, it provides us with new information regarding the dyadic combinations of actions and reactions. The data will reveal which infant's gestures are most likely met with a caregiver's response and whether gaze-checking indeed increases the chance of receiving a response. All these individual and dyadic behaviours at infant age 10 months can be investigated as potential predictors of later vocabulary at 2-4 years of age.

Summary of the data requested for your project: Please indicate which data you request to answer your research question.

Rondom 0 – 10 months:

- Parent-Child Interaction videos
- Questionnaires:
    - Mother: Demographics
    - Father: Demographics
    - Parent about child: Language situation; Language development

Rondom 3:

- Peabody Picture Vocabulary Task results
- Questionnaires:
    - Parent about child: Language situation; Language development

The behaviours will be coded in the parent-child interaction videos at age 10 months. At this age, infants have been found to have started using gestures with communicative intent (see Boundy et al., 2019). The questionnaires on the caregivers' demographics will be used for controls (e.g., to control for social economic status and the language environment, which are known influencers of later vocabulary).

To see whether the behavioural measures relate to the child's later vocabulary, the Peabody Picture Vocabulary Task results at the "Rondom 3" wave will be used. In addition, the questionnaire on the child's language situation at "Rondom 3" will again be used to control for the child's language environment. The N-CDI (Language development) questionnaire results will be used as an additional vocabulary size measure.

In sum, behavioural measures in the parent-child interaction videos at infants' age 10 months (Rondom 0) will be used to predict later vocabulary (PPVT & N-CDI) at age 2-4 (Rondom 3).

References (optional)

Bates, E., Camaioni, L., & Volterra, V. (1975). The acquisition of performatives prior to speech. *Merrill-Palmer Quarterly of Behavior and Development*, 21(3), 205-226.

Boundy, L. , Cameron-Faulkner, T. and Theakston, A. (2019). Intention or attention before pointing: Do infants' early holdout gestures reflect evidence of a declarative motive? *Infancy*, 24, 228-248.

Boundy, L. , Cameron-Faulkner, T. and Theakston, A. (2016). Exploring early communicative behaviours: A fine-grained analysis of infant shows and gives. *Infant Behavior & Development*, 44, 86-97.

Donnellan, E, Bannard, C, McGillion, ML, Slocombe, KE, Matthews, D. Infants' intentionally communicative vocalizations elicit responses from caregivers and are the best predictors of the transition to language: A longitudinal investigation of infants' vocalizations, gestures and word production*. Dev Sci.* 2019;e12843.

Liszkowski, U., Albrecht, K., Carpenter, M., & Tomasello, M. (2008). Infants' visual and auditory communication when a partner is or is not visually attending. *Infant Behavior and Development*, 31, 157–167.

McGillion, M. L., Herbert, J. S., Pine, J. M., Keren-Portnoy, T., Vihman, M. M. & Matthews, D. E. (2013). Supporting early vocabulary development: what sort of responsiveness matters. *IEEE Transactions on Autonomous Mental Development*, 5 (3), 240-248.

Olson, J., & Masur, E. (2015). Mothers' labeling responses to infants' gestures predict vocabulary outcomes. *Journal of Child Language*, 42(6), 1289-1311.

Tomasello, M., Call, J., & Gluckman, A. (1997). Comprehension of novel communicative signs by apes and human children. *Child Development*, 68, 1067-1080.

Section 3: Hypotheses

In this section, please provide your research hypotheses. For each hypothesis:

- Be as specific as possible
- Provide the anticipated outcomes for accepting and/or rejecting the hypothesis

Hypotheses
Hypotheses: 1. Infants' gestures (as defined above, viz. pointing at object; passing object to caregiver; showing object) are frequently coordinated with eye-gaze to caregivers, suggesting communicative intent. 2. Caregivers respond, either verbally or non-verbally, most frequently to infants' gaze-coordinated gestures (as compared to non-gaze-coordinated gestures). This dyadic combination (of infant gaze-coordinated gesture and caregiver reaction) is a significant predictor of later vocabulary. 3. From all caregiver responses, a verbal, semantically contingent response by the caregiver will be the best predictor of later vocabulary size.

Section 4: Methods

In this section, you should make clear how the hypotheses are tested. Be as specific as possible. Please describe:

- The study design and study population (Which data do you require from which subjects?)
- The general processing steps (to prepare the data for analysis)
- The analysis steps (How are the data analysed to address the hypotheses? If possible, link each description to a specific hypothesis)
- Any additional aspects that need to be described to clarify the methodological approach (optional)

Study design, study population and sample size (e.g. cross-sectional or longitudinal; entire population or a subset; substantiate your choices)
To answer the questions, a two wave longitudinal study will be conducted. The dyadic behaviours will be examined using the parent-child interactions at the age of 10 months (Rondom 0). The vocabulary size of the same children will be examined using the PPVT and N-CDI around 2-4 years of age (Rondom 3). We are planning to automatically code the dyadic behaviours in the videos, therefore we would like to use the entire set of participants included in the Rondom 3 wave that is currently available. A large sample size will allow us to study these interactions on a large scale.

General processing steps to prepare the data for analysis
The main researcher will code a subset of videos manually. These videos will be coded for the above-mentioned gestures, gazes, and responses. Affiliated researcher Ronald Poppe will develop the software to automatically code these behaviours using computer vision and pattern recognition algorithms. The work will extend on current efforts in the VIABLE project, to facilitate automated coding of individual and dyadic behaviours. Agreement between the two annotations on the manually coded subset will provide a measure for the quality of the automated coding, and the existence of biases. We will manually code the behaviours for which there is insufficient agreement. In addition to the nonverbal responses, the main researcher will manually check the seconds after the infant produced any gesture to examine whether the caregiver gave a direct vocal response, in addition to any automatically coded bodily response. These responses can either be coded as semantically contingent or non-contingent. Following

Donnellan et al. (2019), an utterance will be coded as contingent if its semantic content relates to the attentional state of the infant in the 5 seconds before the onset of the utterance. If there is no linguistic or non-linguistic (i.e. gesture, body orientation) response following an infant's gesture, the response will be coded as ignored.

Specific processing and analysis steps to address the hypotheses

For the automated coding of bodily behaviours (gestures and body orientation), we build on state-of-the-art 2D (OpenPose) or 3D (VideoPose) body pose estimation software. In the VIABLE project that currently runs at Utrecht University by affiliated researcher Ronald Poppe, a pipeline is developed to measure and screen body pose data from YOUth video. We will use the results of the project. If the initial results are insufficiently accurate, indicated by significant noise and/or missing data, we will employ an approach where body pose estimated from multiple cameras (up to four in the current YOUth setup) are combined into a single estimate. Initially, we will use head orientation as a proxy for gaze. Based on the time-series of body poses of both infant and parent, we develop pattern recognition algorithms to code the interactive behaviours.

By calculating proportions of these behaviours (all infants' gestures and gazes and caregivers' verbal and non-verbal responses), we will be able to determine whether it is indeed the case that most infant's gestures are combined with eye-gaze to the caregiver's face (hypothesis 1). This also allows us to determine whether gaze-coordinated gestures are most often met with a caregiver's response, as opposed to gestures without gaze (hypothesis 2). Statistical analyses will then determine which behaviours are predictors of the child's later vocabulary size. This will be calculated for the infant's use of gestures, gaze-coordinated gestures, and the combination of an infant gesture and a caregiver response. We expect the dyadic combination of a gesture and a response to be the best predictor of later vocabulary (hypothesis 2). By additionally distinguishing between verbal and non-verbal caregiver responses, further analyses will also reveal whether contingent verbal responses form the best predictors of later vocabulary (hypothesis 3), or whether any type of caregiver response is equally beneficial.

Additional methodological aspects (optional)

Section 5: Data request

In this section, please specify as detailed as possible which data (and from which subjects) you request.

Data requested

Rondom 0 – 10 months:
• Parent-Child Interaction videos (of all participants currently available who have returned for the "Rondom 3" wave)
• Questionnaires:
  ○ Mother: Demographics
  ○ Father: Demographics
  ○ Parent about child: Language situation; Language development
 	
Rondom 3:
• Peabody Picture Vocabulary Task results (of same participants)
• Questionnaires: Parent about child: Language situation; Language development

Data request for the purpose of:

☒ Analyses in order to publish
☐ Analyses for data assessment only results will not be published)

Publication type (in case of analyses in order to publish):

☒ Article or report
☐ PhD thesis

Would you like to be notified when a new data lock is available?

☒ Yes
☐ No

Upon approval of a data request, the complete request will be made publicly available on our researcher's website by default.

Do you agree with publishing the complete request on our researcher's website after it is approved?

☒ Yes
☐ No. Please provide a rationale