

Supplementary materials of the article:

Abstract processing of syllabic structures in early infancy

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1. Coding of the familiarization phase of Experiment 1 and 2

1.1. Methodology

In an attempt to better understand the differences in direction of preference between experiments, we conducted an exploratory *a posteriori* analysis of infants' looking times during Familiarization. As described in the main text, for both experiments, the familiarization phase lasted 3 minutes, during which a list of syllables (either CVC or CCV) was played continuously. This phase was broken down into two subphases that only differed in type and location of the visual stimulus presented on the computer screens (a videoclip of slow-moving clouds or a colored rotating pinwheel). It is important to note that the HeadTurn Preference Procedure (HPP) is based on online coding of infants' looking behavior at test. The familiarization phase is typically not coded nor analyzed because it is structured in a way that the sound is not contingent to the infant's gaze (i.e., the sound keeps playing even when infants are not looking at the screen, as a sort of "passive listening"). For the present study, we designed an offline coding protocol of the familiarization phase using Datavyu (v.1.3.7) and participants' videos that were recorded as per laboratory protocol. We coded the two familiarization subphases, labelled as *Clouds* and *Training*. The coding marked the two subphases separately such that we could calculate the duration of each of them. To determine the beginning and ending of a given subphase, we used the information available in participants' recordings: the visual stimuli presented on the screens were partly visible through their reflection on two mirrors located behind the infant in the experimental room (it was thus possible to notice a change on the screens), and the auditory stimuli were audible in the recordings. For the subphase *Clouds*, we coded 1) Looking Times towards the central screen (the only screen in which the slow-moving cloud movie was played), calculated as difference between onset and offset of the cloud videoclip, and 2) Look-Away.

For the subphase *Training*, we coded 1) Looking Times towards central and lateral screens with the same rationale described for the *Cloud* subphase (except that the colored pinwheel appeared on the lateral screens too), 2) No-Look, when the infant was looking away from any screen in the room (e.g., looking around or at the ceiling, at the floor etc.), and 3) Look-Center, when the infant was looking at the central screen while the pinwheel was presented in one of the lateral screens. Point 2 and 3 were both considered as “looks away” but coded separately because infants in this phase are learning to make head-turns (which is sometimes trivial at this early age) thus they sometimes fixate the central location while figuring out the task. Related to this, in some cases, infants require some time to perform a head-turn therefore, if the transition from one screen to another was less than 500ms, it was force-coded as looking time towards the screen they were moving their head to. If the transition was longer, it was coded as a No-Look. The Total Duration of each subphase was calculated based on the onset/offset of Looking Times and the number of Look-Away. The Total Duration of Training was calculated using the time spent looking at the Correct screen only (i.e., the screen in which the pinwheel was presented). Due to the variable duration of the available recordings (max: 179.990s – min: 116.840s), we opted to use proportion of looking time instead of raw looking times to conduct the statistical analyses.

Table 1. Summary of looking times of Experiment 1 and 2 during Familiarization divided based on Condition (familiarization to CVC or CCV syllables). Proportions of looking time, and number of look-away are shown separately for each subphase (*Clouds* and *Training*).

Experiment		1	1	2	2
Condition		CCV	CVC	CCV	CVC
n. of coded videos		23	18	22	23
subphase: <i>Clouds</i> (minutes 1 and 2)	Proportion Looking Time	0,78	0,77	0,80	0,69
	n. Look-Away	10	9	8	10
subphase: <i>Training</i> (minute 3)	Proportion Looking Time	0,73	0,69	0,75	0,75
	n. No-Look	3	4	3	3
	n. Look-Center	3	2	3	2
whole Familiarization	Proportion Total Looking Time	0,77	0,74	0,78	0,71

1.2. Results

We ran analyzed the entire familiarization phase (section 1.2.1) as well as each sub-phase separately (sections 1.2.2, 1.2.3). R scripts and datasets are available at [osf](#).

1.2.1. Total familiarization phase. We ran a 2-way ANOVA with *condition* (familiarization to CVC vs. CCV) and *experiment* (Exp. 1 vs. Exp. 2) as between-subject factors. The dependent variable was the overall proportion of Looking Time (Looking Time Total / Total Duration) across the 3 minutes of familiarization. The main effects were not statistically significant (*condition*: $F(1, 82) = 2.49, p = .118, \eta^2G = .03$, *experiment*: $F(1, 82) = 0.12, p = .731, \eta^2G < .01$), nor their interaction ($F(1, 82) = 0.61, p = .437, \eta^2G < .01$). We also ran a 2-way ANOVA with the same between-subject factors (*condition*, *experiment*) and the overall number of Look-Away (Look-Away during *Clouds*; No-Look and Look-Center during *Training*) as dependent variable. Again, the main effects were not statistically significant (*condition*: $F(1, 82) = .00, p = .945, \eta^2G < .01$, *experiment*: $F(1, 82) = .96, p = .329, \eta^2G = .01$), nor their interaction ($F(1, 82) = .86, p = .357, \eta^2G = .01$). These results indicate that, during familiarization, the four groups of infants (Exp. 1 CVC, Exp. 1 CCV, Exp. 2 CVC, Exp. 2 CCV) did not differ in their looking behavior (see Figure 1).

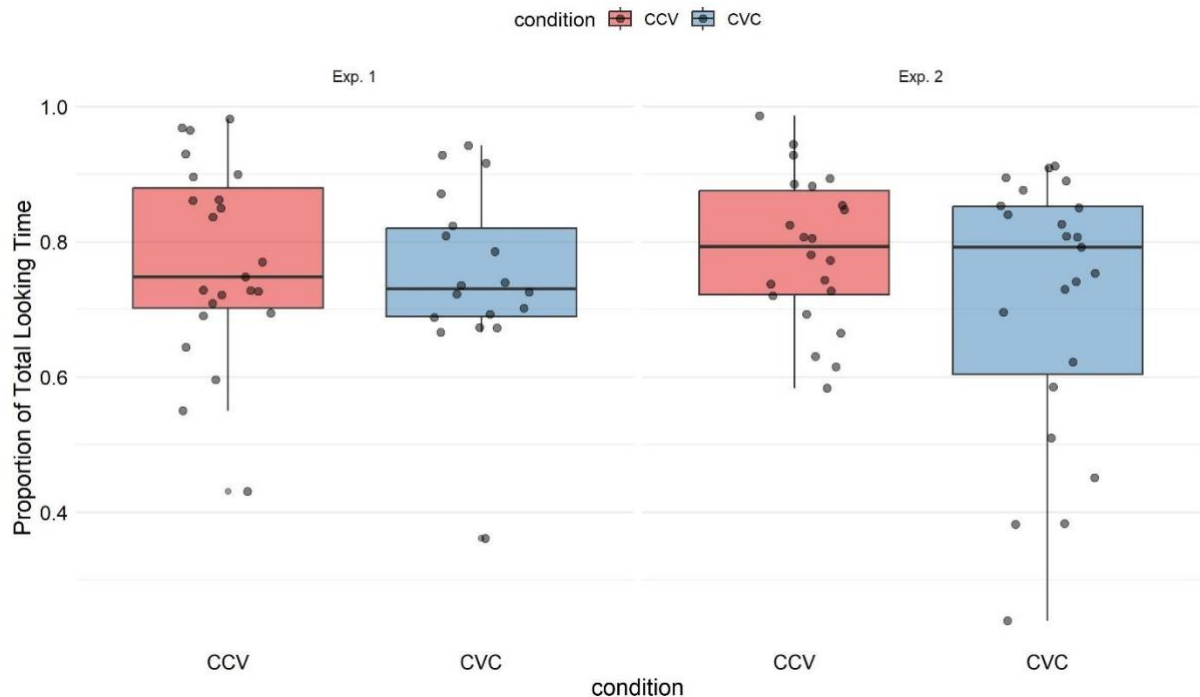


Figure 1. Average proportions of looking times during familiarization in each condition are shown separately for Experiment 1 and 2. Red boxplots represent average proportion of looking times of infants in the CCV conditions. Blue boxplots represent the average proportion of looking times of infants in the CVC conditions. Dots indicate individual data.

1.2.2. Subphase: *Clouds* (minutes 1 and 2 of Familiarization). We ran a 2-way ANOVA with *condition* (familiarization to CVC vs. CCV) and *experiment* (Exp. 1 vs. Exp. 2) as between-subject factors. The dependent variable was the proportion of Looking Time (Looking Time Clouds / Total Duration Clouds). Main effects were not statistically significant (*condition*: $F(1, 82) = 2.00, p = .161, \eta^2G = .02$, *exp*: $F(1, 82) = 0.52, p = .473, \eta^2G < .01$), nor their interaction ($F(1, 82) = 1.23, p = .270, \eta^2G = .01$). We also ran a 2-way ANOVA with the same between-subject factors (*condition*, *experiment*) and the number of Look-Away as dependent variable. Main effects were not statistically significant (*condition*: $F(1, 82) = .03, p = .856, \eta^2G < .01$, *experiment*: $F(1, 82) = .62, p = .435, \eta^2G < .01$), nor their interaction ($F(1, 82) = 1.26, p = .264, \eta^2G = .02$). These results indicate that all groups of infants across experiments behaved similarly during the first 2 minutes of the familiarization phase, when the list of syllables was presented in conjunction with the cloud videoclip played on the central screen (see Figure 2).

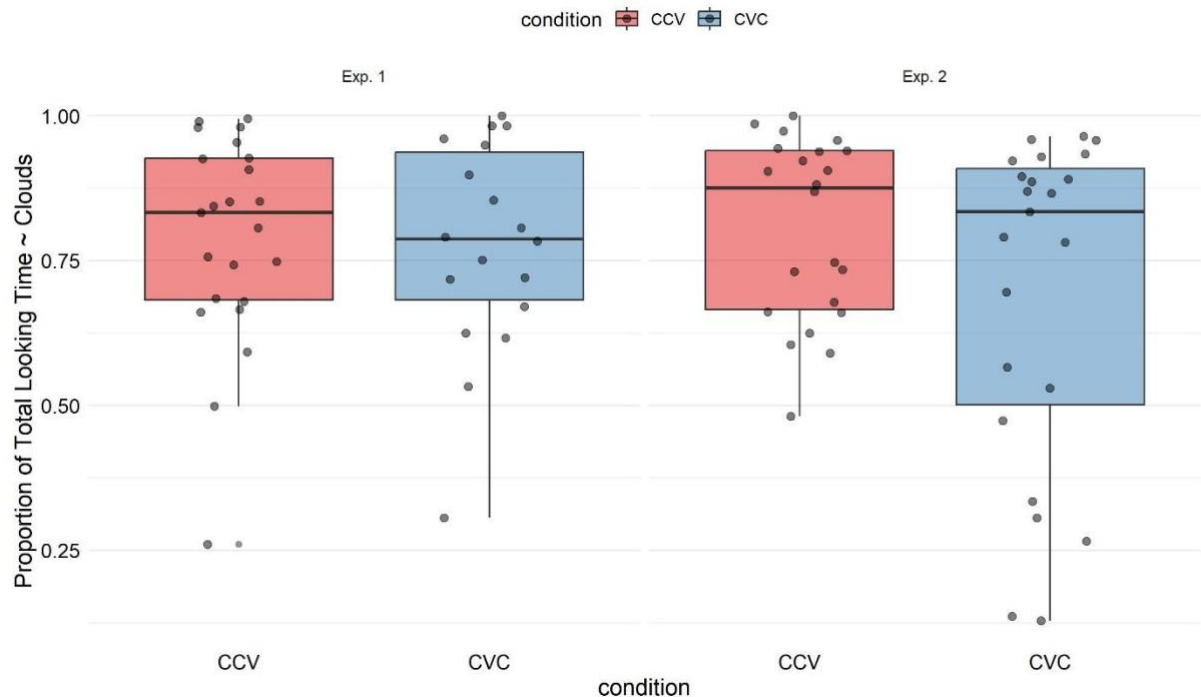


Figure 2. Average proportions of looking times during the first 2 minutes of familiarization (subphase *Clouds*) in each condition are shown separately for Experiment 1 and 2. Red boxplots represent the average proportion of looking times of infants in the CCV conditions. Blue boxplots represent the average proportion of looking times of infants in the CVC conditions. Dots indicate individual data.

1.2.3. Subphase: *Training (minute 3 of Familiarization)*¹. We ran a 2-way ANOVA with *condition* (familiarization to CVC vs. CCV) and *experiment* (Exp. 1 vs. Exp. 2) as between-subject factors. The dependent variable was the proportion of Looking Time at the correct screen, where the pinwheel was displayed (Looking Time Correct Screen Training / Total Duration Training). The main effects were not statistically significant (*condition*: $F(1, 82) = .36, p = .551, \eta^2G < .01$, *experiment*: $F(1, 82) = .96, p = .330, \eta^2G = .01$), nor their interaction ($F(1, 82) = .29, p = .589, \eta^2G < .01$). We also ran a 2-way ANOVA with the same between-subject factors (*condition*, *experiment*) and the number of No-Look as dependent variable. Again, the main effects were not statistically significant (*condition*: $F(1, 82) = 2.68, p = .105, \eta^2G = .03$, *experiment*: $F(1, 82) = .20, p = .659, \eta^2G < .01$), nor their interaction ($F(1, 82) = 1.17, p = .282, \eta^2G = .01$). Lastly, we ran a 2-way ANOVA with the same between-

¹ We also ran the same analyses but including the time spent looking at the Central Screen while no stimulus appeared as Looking time. The results were very similar as all the effects were not significant. We do not report the results for the sake of brevity. The same applies to the analyses considering all the familiarization data together.

subject factors (condition, experiment) and the number of Look-Center as dependent variable. Main effects were not statistically significant (*condition*: $F(1, 82) = 2.34$, $p = .130$, $\eta^2G = .03$, *experiment*: $F(1, 82) = .42$, $p = .521$, $\eta^2G < .01$), nor their interaction ($F(1, 82) = .35$, $p = .557$, $\eta^2G < .01$). Similarly to what found in the Clouds subphase, these results show that all groups of infants across experiments behaved similarly during the last minute of familiarization (subphase *Training*; see Figure 3).

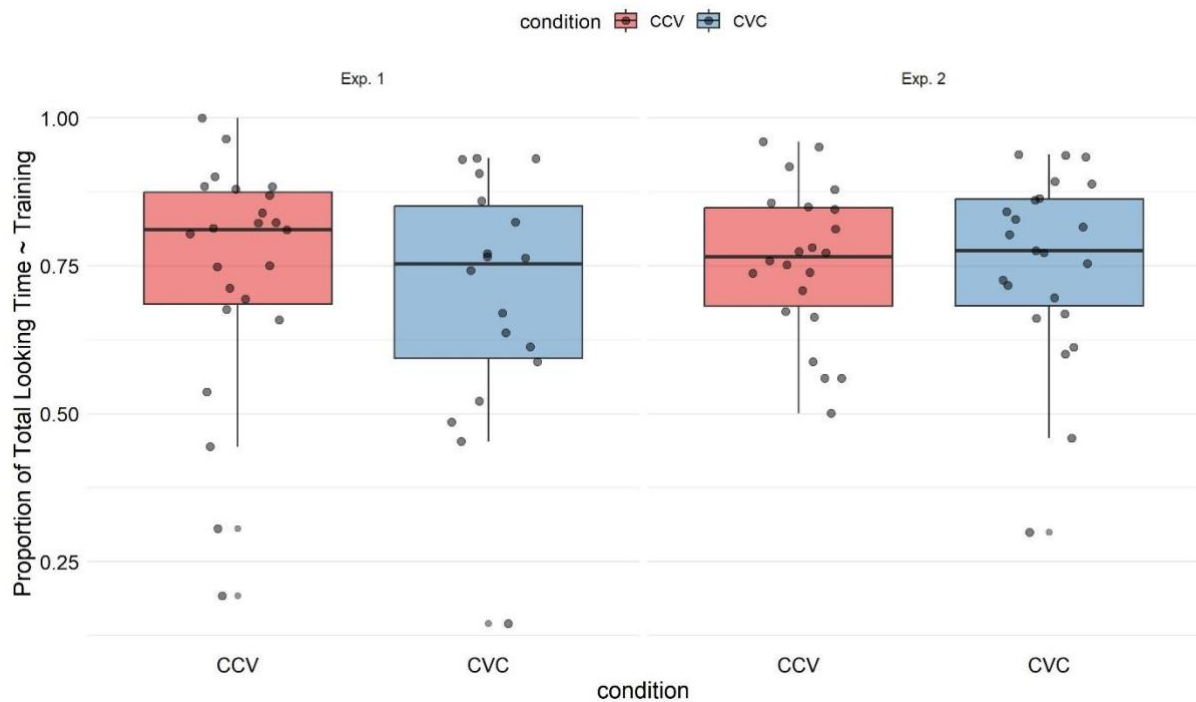


Figure 3. Average proportions of looking times during the last minute of familiarization (subphase *Training*) in each condition are shown separately for Experiment 1 and 2. Red boxplots represent the average proportion of looking times of infants in the CCV conditions. Blue boxplots represent the average proportion of looking times of infants in the CVC conditions. Dots indicate individual data.

1.3. Discussion

We developed an offline coding protocol of the familiarization phase of Experiment 1 and 2. We conducted exploratory analyses of the entire 3-min familiarization phase as well as for each subphase (*Clouds*: minutes 1-2. *Training*: minute 3) using proportions of looking time at the screens while the lists of syllables were played. Results show no differences across conditions and experiments, suggesting that our test results (i.e., significant differences in discrimination at test between CVC and CCV conditions in both experiments) did not emerge a priori, and were likely due to

learning occurring at familiarization. As mentioned earlier, the HPP paradigm is not designed for neither online nor offline coding of the familiarization phase, contrary to methods like eye-tracking, for instance, in which the constant contingency between visual and auditory stimuli allows to keep track of looking times and shifts in gaze every few milliseconds throughout the experiment (which was not necessary for the original aims and hypothesis of our research). In spite of that, we were able to generate a solid offline coding protocol that we hope could be useful for future research.