

Perceptual reorganization of lexical tones in German-learning infants and toddlers

Antonia Götz, Barbara Höhle
University of Potsdam



Introduction:

Perceptual Reorganization of lexical tones:

- Previous studies show inhomogeneous picture.
 - a) **Perceptual Narrowing** (Mattock & Burnham 2006; Mattock et al. 2008; Yeung et al. 2013, no toddlers tested)
 - b) **Perceptual enhancement** (Chen & Kager 2015, 2017; Hay et al. 2015 no infants tested; Ramachers et al., Tsao 2017)
 - c) **No difference across age groups** (Cabrera et al. 2015, Liu & Kager 2014, 2016)
 - d) **U-shaped effect** (Liu & Kager 2014, 2016)

Research Questions:

As previous studies used a wide range of methods (CHT Procedure, Habituation, Stimulus Alternating – Nonalternating Paradigm):

1. Does the method play a crucial role for discriminating lexical tones across several age groups?

As there is evidence for both perceptual reorganization and perceptual enhancement, as well as a U-shaped effect for a less salient tone contrast:

2. Do we find a U-shaped effect for discriminating a natural Cantonese tone contrast?

Method:

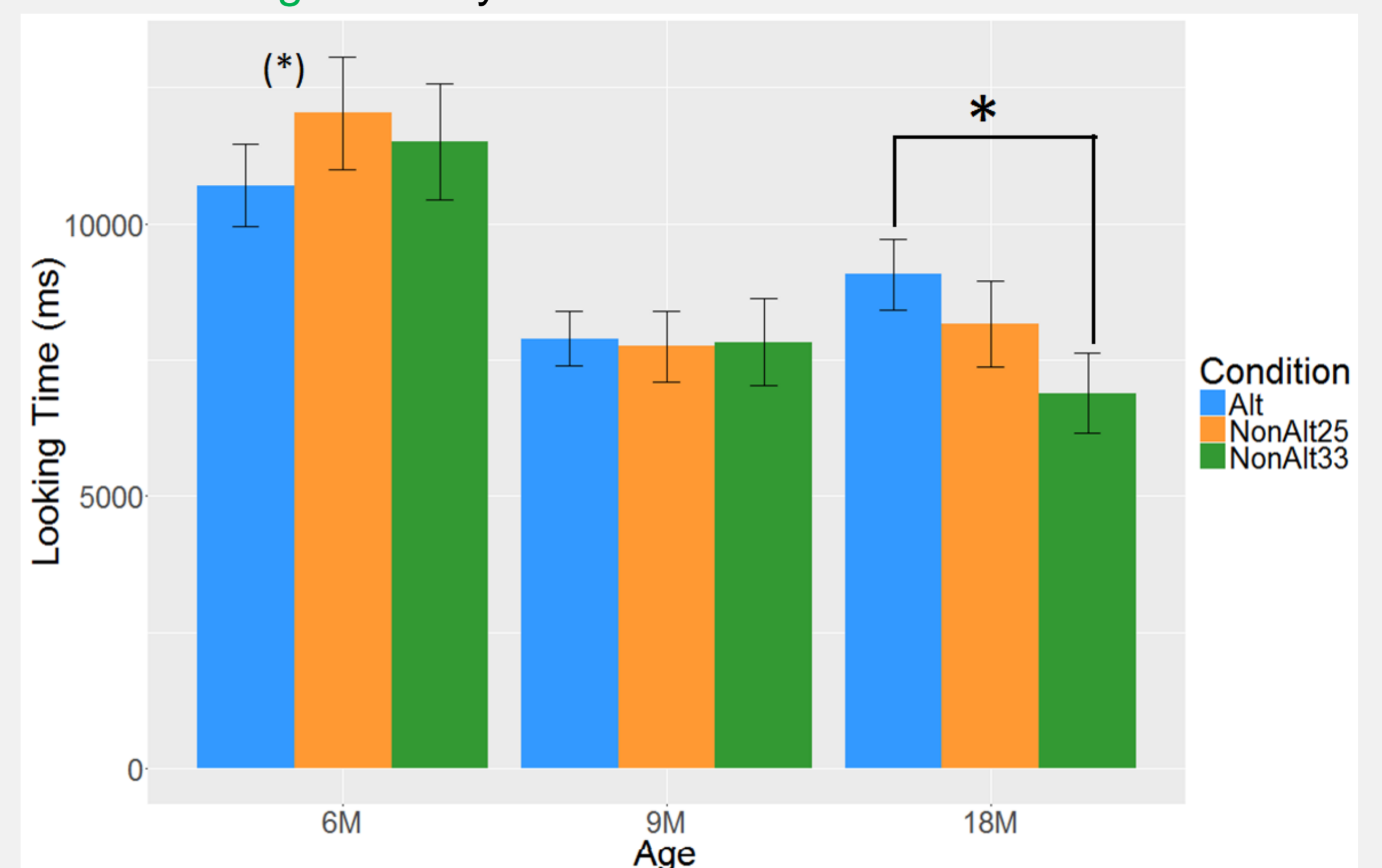
	Familiarization (see Yeung et al., 2013)	Habituation
Stimuli:	Cantonese high-rising (tone 25) vs. mid-level (tone33)	
Participants:	<ul style="list-style-type: none"> • 30 6-months-olds (M=176d) • 30 9-months-olds (M=273d) • 28 18-month-olds (M=540d) 	<ul style="list-style-type: none"> • 15 6-months-olds (M=182d) • 15 9-months-olds (M=270d)
Procedure:		
1. Phase	Tone25 or Tone33	Tone25
Criterion	Accumulation of 30s LT	LT < 50%
2. Phase	8 trials: <ul style="list-style-type: none"> • 4 Alternating (tone25 and tone33) • 2 Non-Alternating tone25 • 2 Non-Alternating tone33 	4 trials: <ul style="list-style-type: none"> • 2 Habituated (tone25) • 2 Novel (tone33)

References:

- Cabrera, L., Tsao, F.-M., Liu, H.-M., Li, L.-Y., Hu, Y.-H., Lorenzi, C., & Bertoncini, J. (2015). The perception of speech modulation cues in lexical tones is guided by early language-specific experience. *Frontiers in Psychology*, 6, 1290.
- Chen, A., Stevens, C. J., & Kager, R. (2017). Pitch Perception in the First Year of Life, a Comparison of Lexical Tones and Musical Pitch. *Frontiers in Psychology*, 8.
- Chen, A., & Kager, R. (2015). Discrimination of Lexical Tones in the First Year of Life. *Infant and Child Development*.
- Cristia, A., Seidl, A., Singh, L., & Houston, D. (2016). Test-Retest Reliability in Infant Speech Perception Tasks. *Infancy*.
- Hay, J. F., Graf Estes, K., Wang, T., & Saffran, J. R. (2015). From flexibility to constraint: The contrastive use of lexical tone in early word learning. *Child Development*, 86(1), 10–22.
- Liu, L., & Kager, R. (2014). Perception of tones by infants learning a non-tone language. *Cognition*, 133(2), 385–394.
- Liu, L., & Kager, R. (2016). Perception of tones by bilingual infants learning non-tone languages. *Bilingualism: Language and Cognition*, 1–15.
- Mattock, K., & Burnham, D. (2006). Chinese and English infants' tone perception: Evidence for perceptual reorganization. *Infancy*, 10(3), 241–265.
- Mattock, K., Molnar, M., Polka, L., & Burnham, D. (2008). The developmental course of lexical tone perception in the first year of life. *Cognition*, 106(3), 1367–1381.
- Ramachers, S., Fikkert, P., & Gussenhoven, (n.d.). Perception of the East-Limburgian Dutch lexical tone contrast by Dutch 6-to-12-month old infants.
- Tsao, F.-M. (2017). Perceptual Improvement of Lexical Tones in Infants: Effects of Tone Language Experience. *Frontiers in Psychology*, 8. <https://doi.org/10.3389/fpsyg.2017.00558>
- Yeung, H. H., Chen, K. H., and J. F. Werker (2013). When Does Native Language Input Affect Phonetic Perception? The Precocious Case of Lexical Tone. *Journal of Memory and Language*, 68, 123–139.

Results: Familiarization

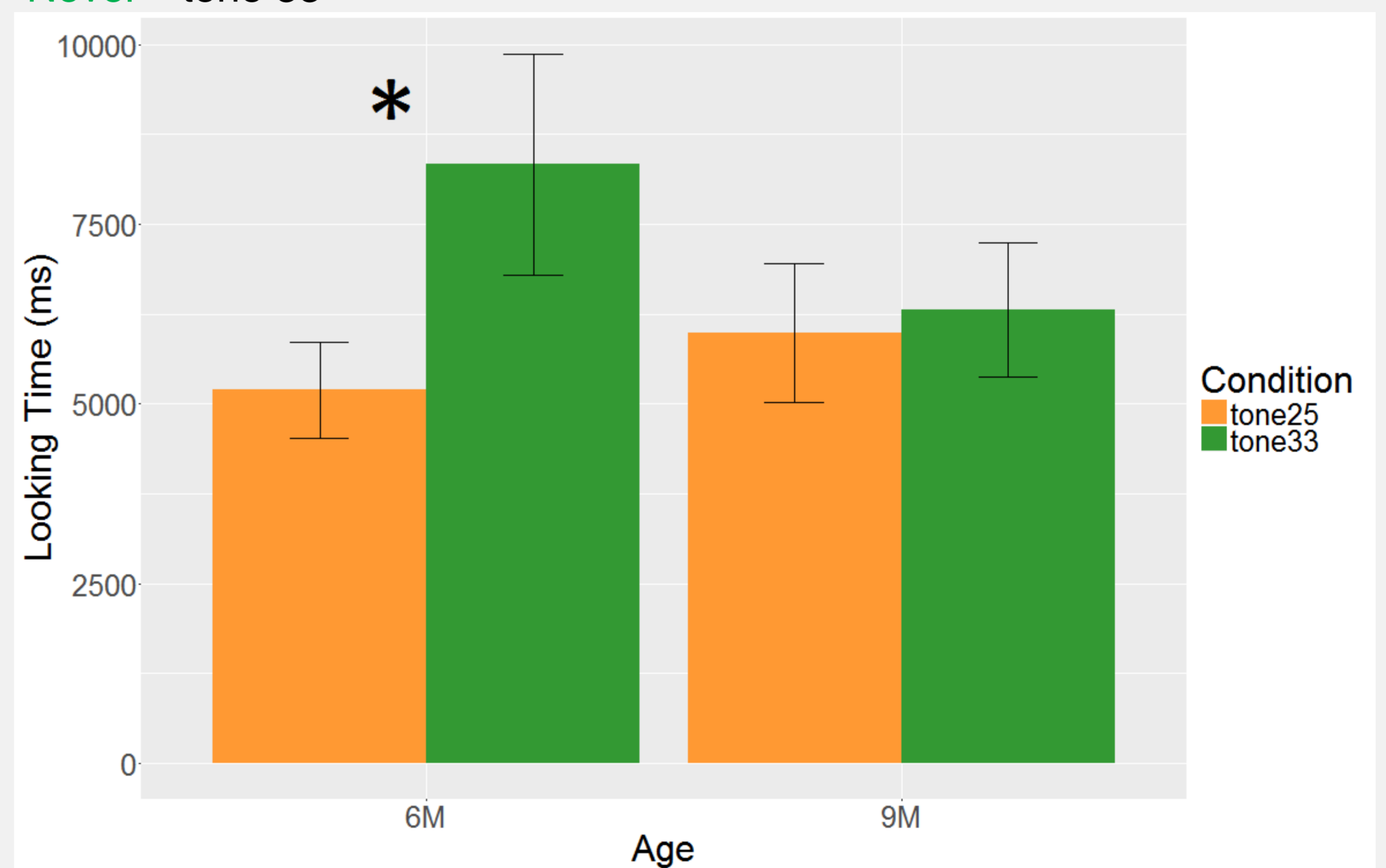
- Perception of Cantonese lexical tones by 6- and 9- and 18-months-olds
- **Alternating** = high rising and mid level tones
- **NonAlternating25** = only high rising tones
- **NonAlternating33** = only mid level tones



- Model comparison: best model with condition x age; no better fit when familiarization included ($p=0.73$)
- 6-months-olds show weak discrimination between Alternating and NonAlternating25 $t=1.677$, $p=0.09$; 18-months-olds discriminate between Alternating and NonAlternating33 $t=-2.077$, $p=0.03$; 9-months-olds show no effect for discrimination

Results: Habituation

- Perception of Cantonese lexical tones by 6- and 9 months-old infants
- **Habituated** = tone 25
- **Novel** = tone 33



- Only 6-months-olds show discrimination between novel (tone33) and habituated tone (tone25): $t=2.00$; $p=0.04$; effect size $d=0.521$; 9-months-olds show no effect for discrimination between the novel and habituated tone: $t=0.283$, effect size $d=0.031$

Conclusion:

- 6-months-olds German-learning infants show stronger discrimination effect for the habituation in comparison to the familiarization paradigm
 - Previous meta-analysis (Cristia et al., 2016) revealed in general higher effect sizes for habituation than for familiarization paradigms
 - Habituation task is more infant controlled than familiarization tasks; eventually more appropriate to test discrimination especially for younger age groups
- In a familiarization paradigm only 18-months-olds show discrimination abilities for the lexical tone contrast