

## INTRODUCTION

- Many cochlear implant (CI) listeners show word-learning deficits relative to their normal-hearing (NH) peers<sup>1,2,4</sup>.
- CI listeners face challenges in phonetic processing which may contribute to their word-learning deficits.
- Viewing a talker's lips move can also improve speech perception for NH and CI listeners<sup>3,4,6</sup>.
- Additionally, learning from multiple talkers improves word learning by allowing listeners to extract that acoustic cues that are relatively constant, leading to robust representations of word forms.
- Little is known whether learning from multiple talkers improves word-learning for CI listeners and whether CI listeners fixate to the mouth of a talker more than NH listeners when learning new words.

## PURPOSE OF STUDY

### Aim 1:

Assess whether CI listeners fixate to the mouth of a talker more than NH listeners when learning new words

### Aim 2:

Determine whether learning from multiple talkers improves word learning in adults CI listeners

## METHODS

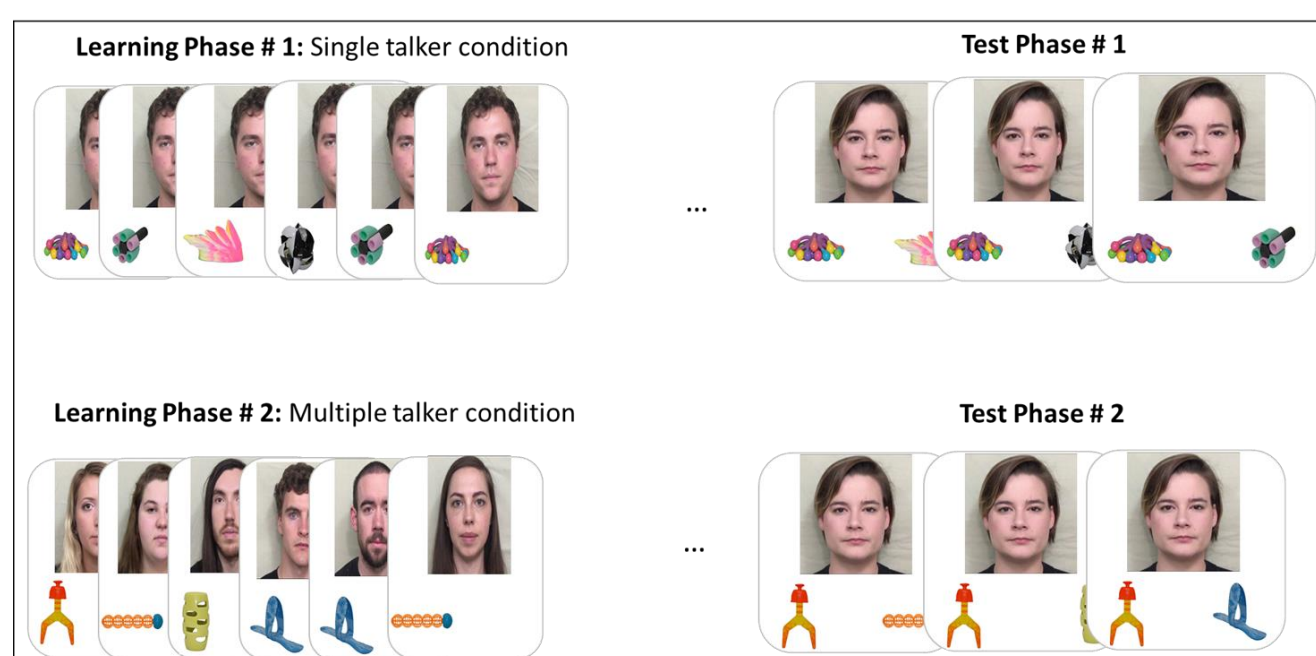
**Participants:** 17 adult CI listeners; ages 19-70  
8 age-matched adult NH listeners  
(data collection still in progress)

**Stimuli:** 8 English nonwords paired with novel objects

Objects	1	2	3	4	5	6	7	8
Words	/dita/	/gita/	/foma/	/voma/	/nodi/	/lodi/	/pibu/	/tibu/
Word Sets	word set 1				word set 2			

### Procedure:

- Learning phase:** Participants were taught novel word-object pairings from a single talker or from 6 different talkers (multiple talkers)
  - order of training phases were counterbalanced between participants
- Test phase:** Participants were tested on ability to learn word-object pairings in a two-alternative forced-choice task
  - Easy trials:** target and distractor object labels differed by several speech categories (e.g. dita vs foma)
  - Hard trials:** target and distractor object labels differed by a single feature (e.g. dita vs gita)



**Measurement:** High-speed eye-tracking (SR Eyelink 1000 Hz) was used to measure eye movements to target and mouth over time

### Aim 1: Gaze behavior during learning (learning phases)

Proportion of looks to the mouth =  $\frac{\text{time spent looking at mouth}}{\text{time spent looking at target, mouth, or eyes}}$   
for learning trials only

### Aim 2: Learning from multiple talkers (test phases)

Proportion of looks to the target (accuracy) =  $\frac{\text{time spent looking at target object}}{\text{time spent looking at target or distractor}}$   
for test trials only

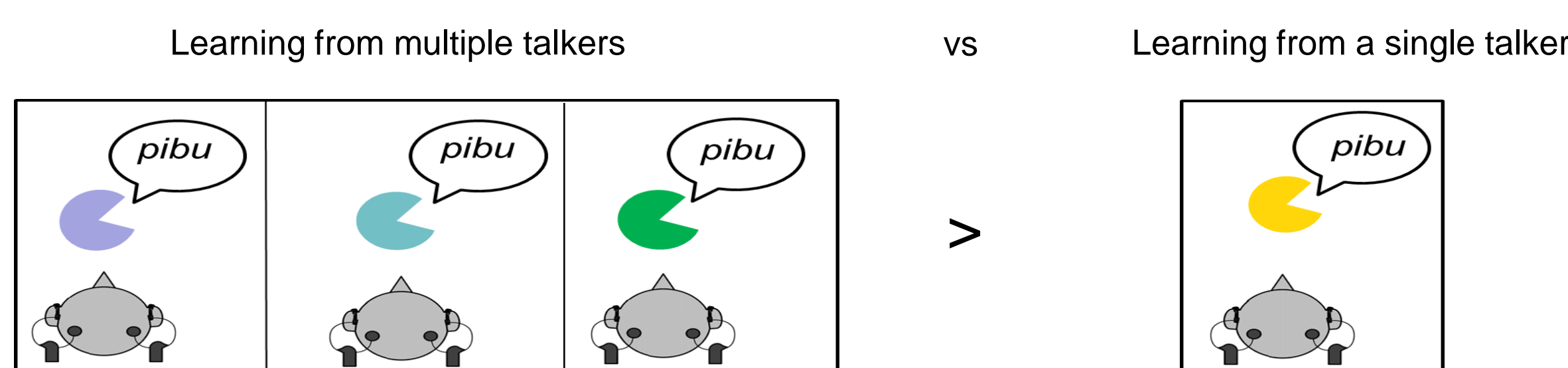
## PREDICTIONS

### Aim 1: Gaze behavior during learning



The visual domain provides more reliable and salient cues for CI listeners than the auditory domain

### Aim 2: Learning from multiple talkers



Talker variability will allow listeners to tune into the relatively invariant acoustic cue

# The role of talker variability and audiovisual speech on word learning in cochlear implant listeners

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## RESULTS

### Aim 1: Eye gaze behavior during learning (learning phases)

#### Proportion of looks to mouth

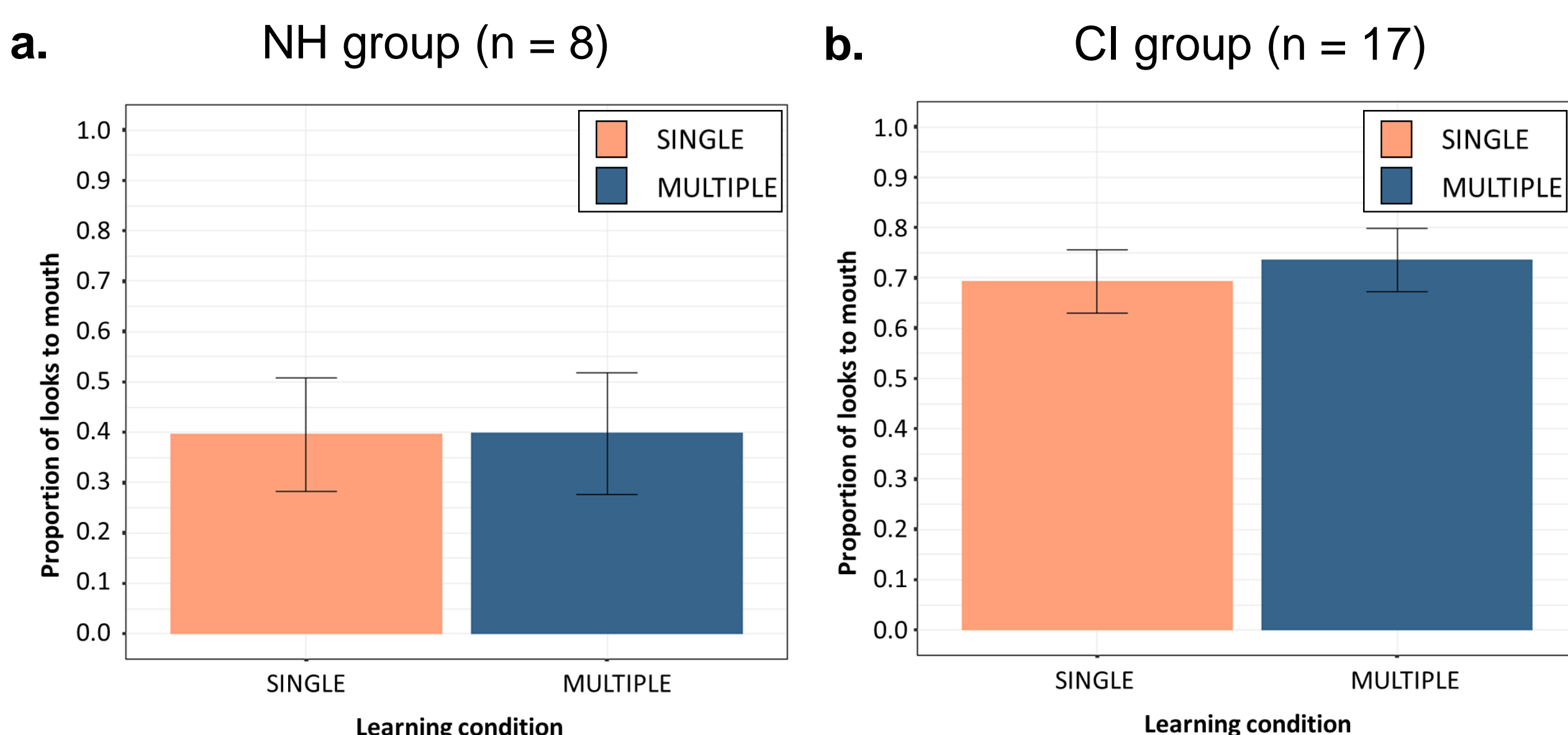


Fig 1. Average proportion of looks to mouth during learning phases for a) NH group and b) CI group. Error bars represents standard error (SE).

#### CI group: Individual differences in eye gaze behavior during learning

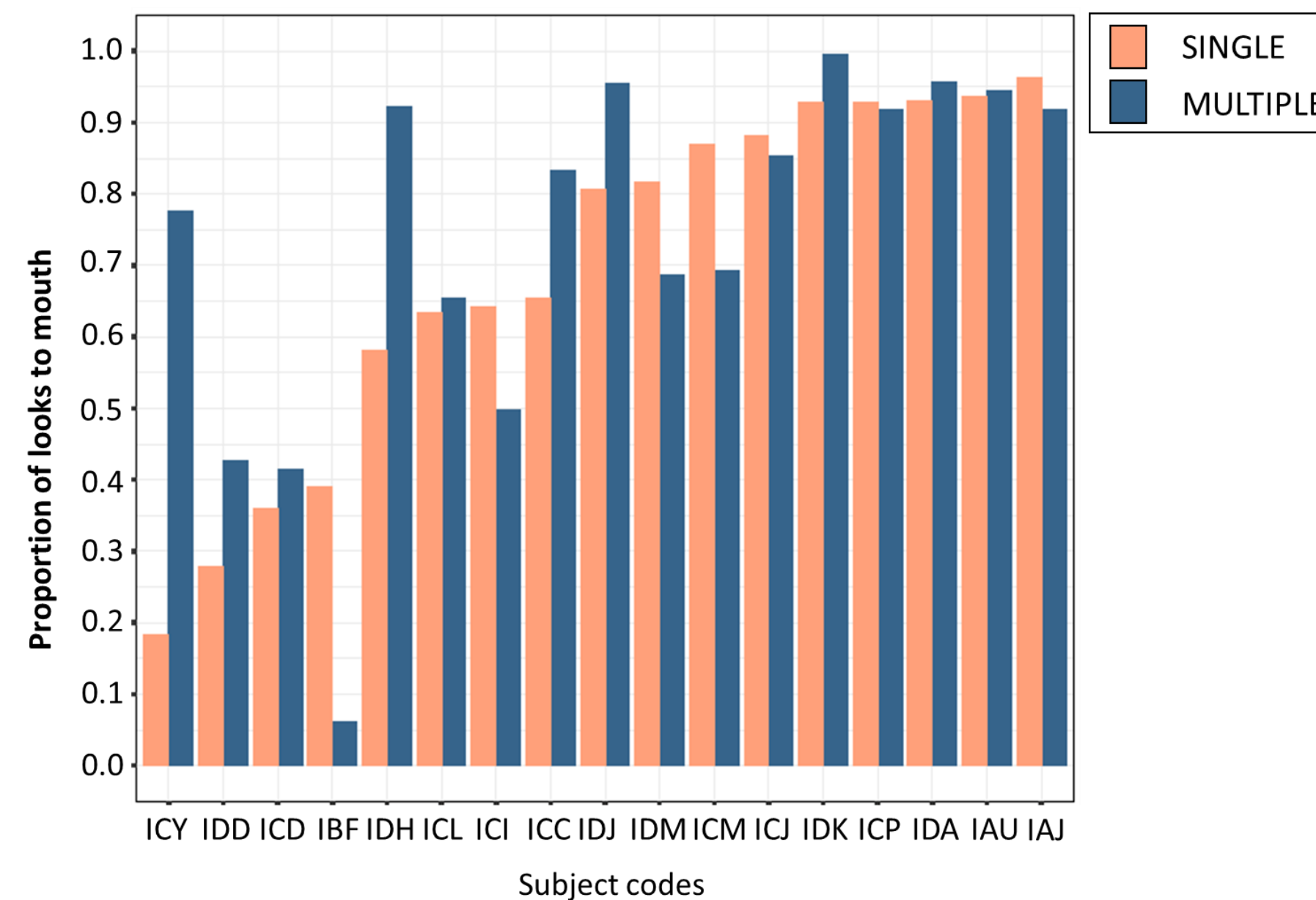


Fig 2. Variability in fixations to the mouth within CI group.

### Time course data for learning phases

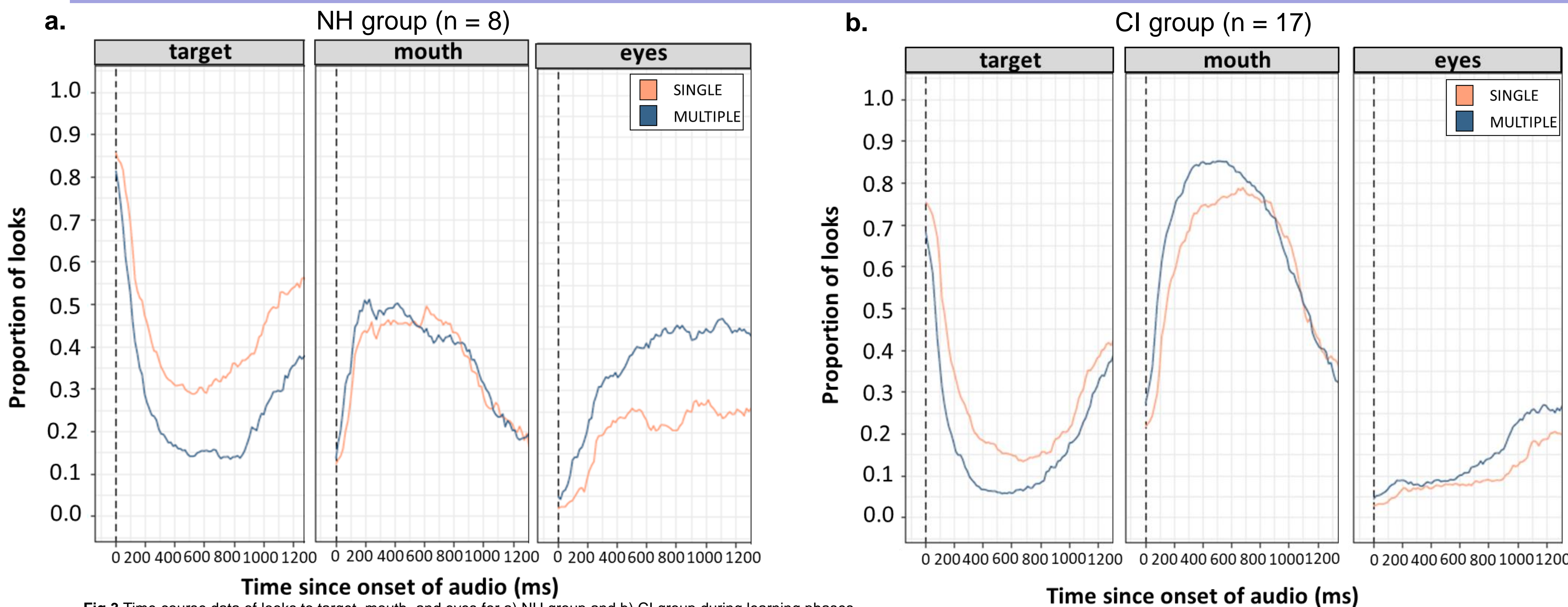


Fig 3. Time course data of looks to target, mouth, and eyes for a) NH group and b) CI group during learning phases.

### Aim 2: Learning from multiple talkers (test phases)

#### Overall mean accuracy

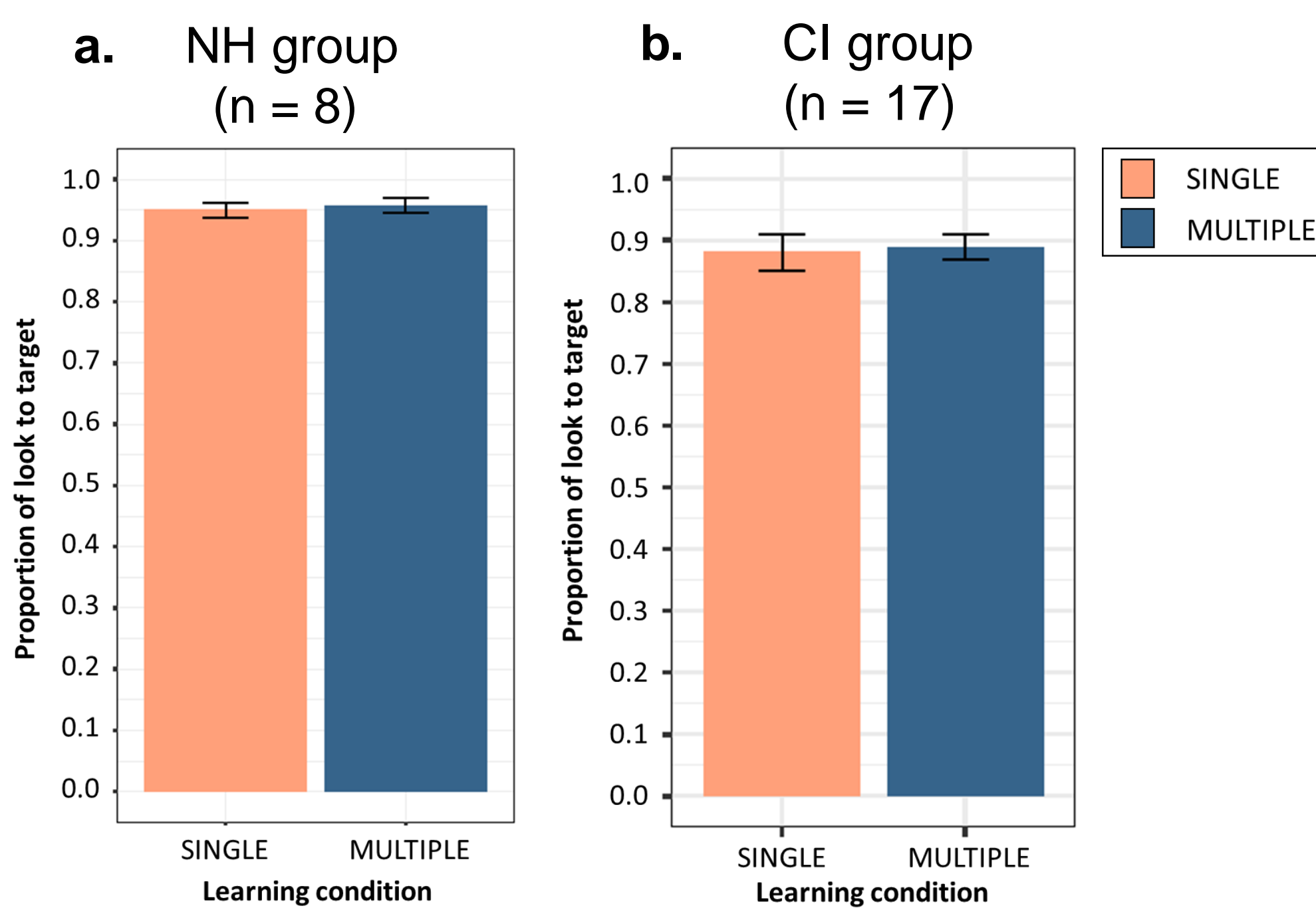


Fig 4. Proportion of looks to target (Accuracy) for a) NH group and b) CI group after learning from a single talker or from multiple talkers. Error bars represent SE.

#### Interaction between test difficulty and learning condition

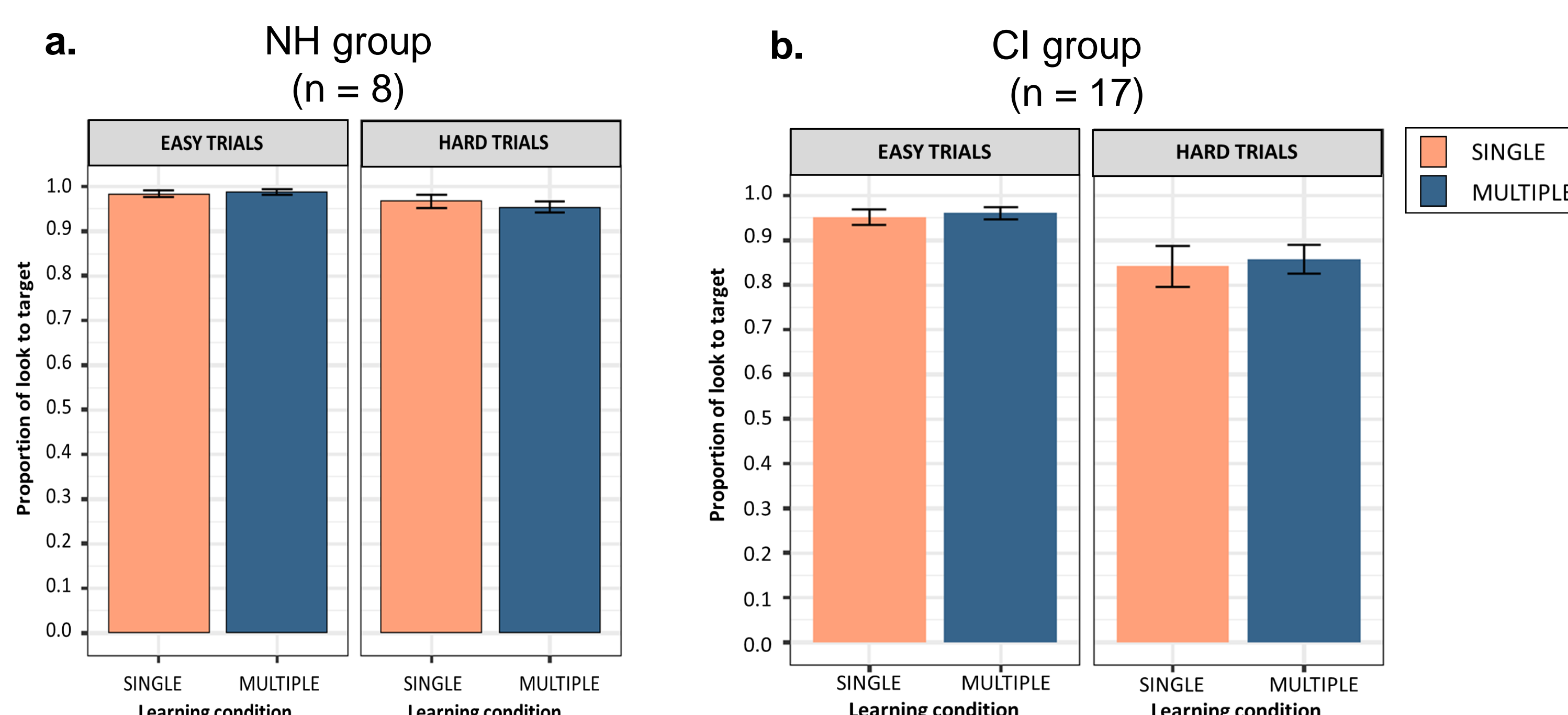


Fig 5. Accuracy on easy vs hard trials for a) NH group and for b) CI group. Error bars represent SE.

#### CI group: Individual differences in performance in test phases

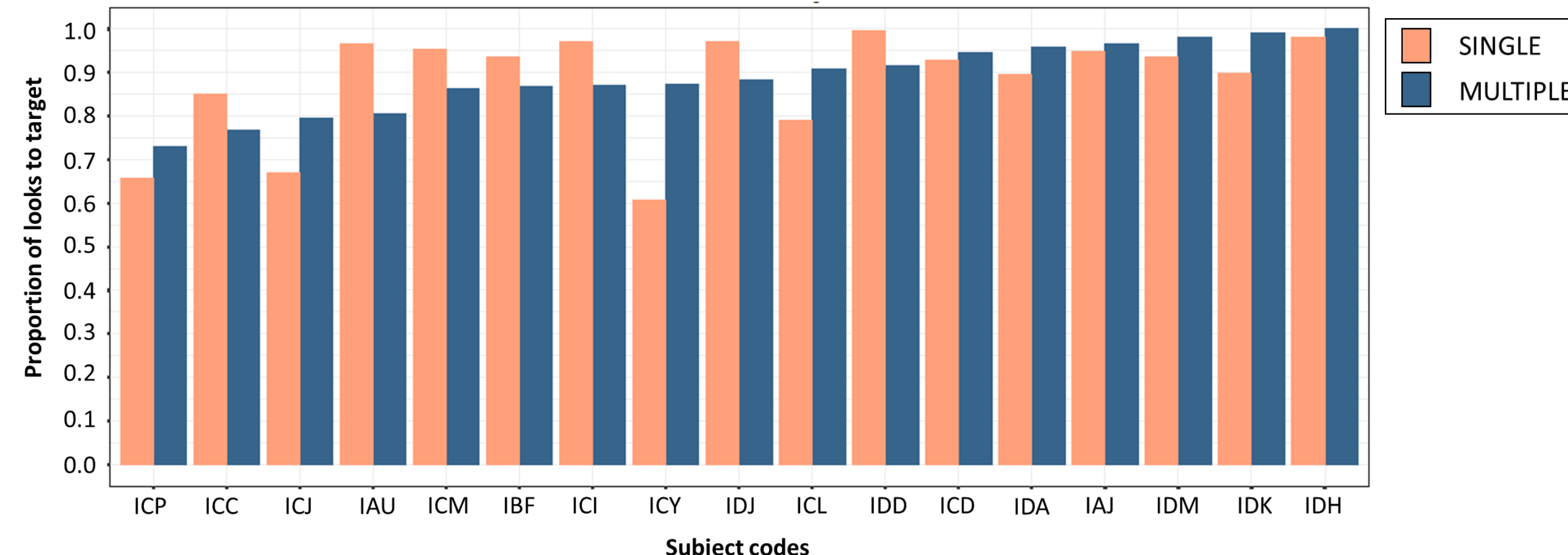


Fig 6. Variability in performance between CI participants on test trials.

- No benefit in learning from multiple talkers for NH and CI groups (Fig. 4a&b)
- CI group: better performance on easy trials compared to hard trials (Fig. 5b)
- NH group perform slightly better on hard trials compared to CI group (Fig. 5a&b)
- Majority of CI participants perform similarly in test phases after learning from single talker or multiple talkers (Fig. 6)

## SUMMARY & CONCLUSIONS

- During the learning phases, the majority of fixations were to the mouth for the CI listeners compared to the NH listeners, suggesting that CI listeners rely heavily on visual domain to extract relevant linguistic information.
- On average, CI listeners tend to fixate less to the mouth when learning from a single talker than from multiple talker. This suggest that when the talker remains constant, CI listeners may become attuned to the speaking characteristics of a talker and thereby, rely less heavily on visual cues. Further analyzes will use growth curve analysis to examine differences in time course data for the proportion of looks to the mouth in the learning phase
- On average, there was no benefit in learning from multiple talkers for both CI and NH adult listeners. This might be attributed to the fact that adults have reached proficiency in their native language and do not require variability in their acoustic environment to form robust representations of newly spoken words.

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