

# Effects of hearing impairment and background noise on turn-taking-related gaze patterns in face-to-face communication

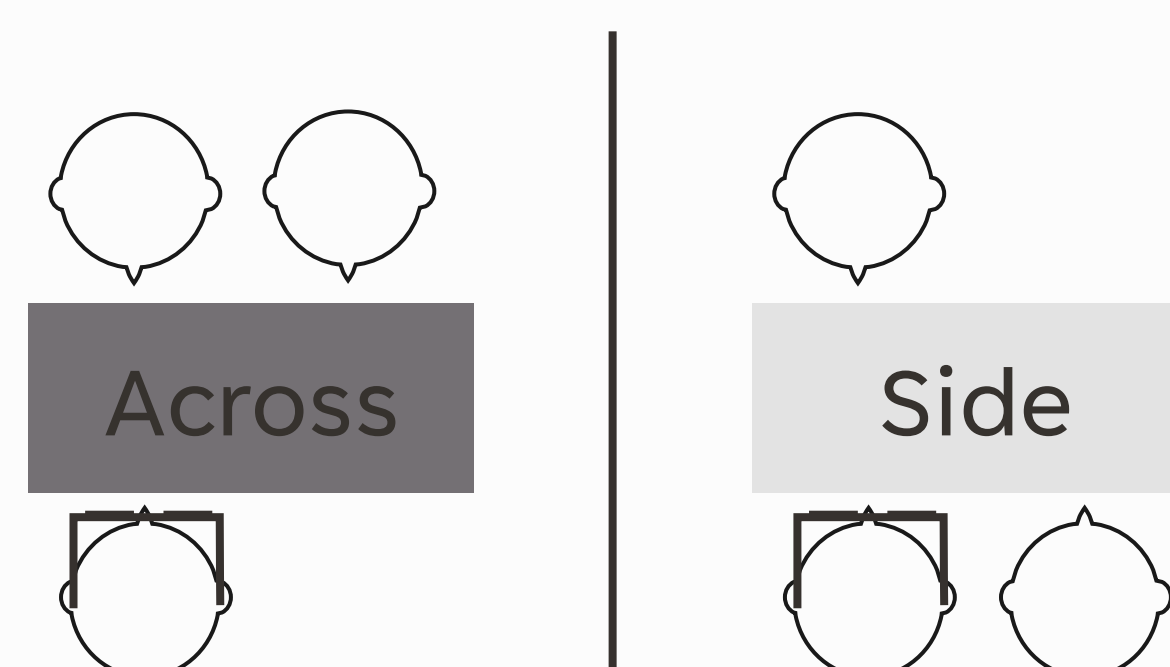
## → Introduction

During conversations, gaze gathers visual information support comprehension, signal engagement and manage turn-taking. Especially at the end of a turn, gaze patterns can predict the next talker: listeners indicate their intent to take the floor at the current speaker and talkers use gaze to hand over the next turn.

How do these gaze patterns change, when noise and hearing impairment create a bigger need to support degraded speech by visual information?

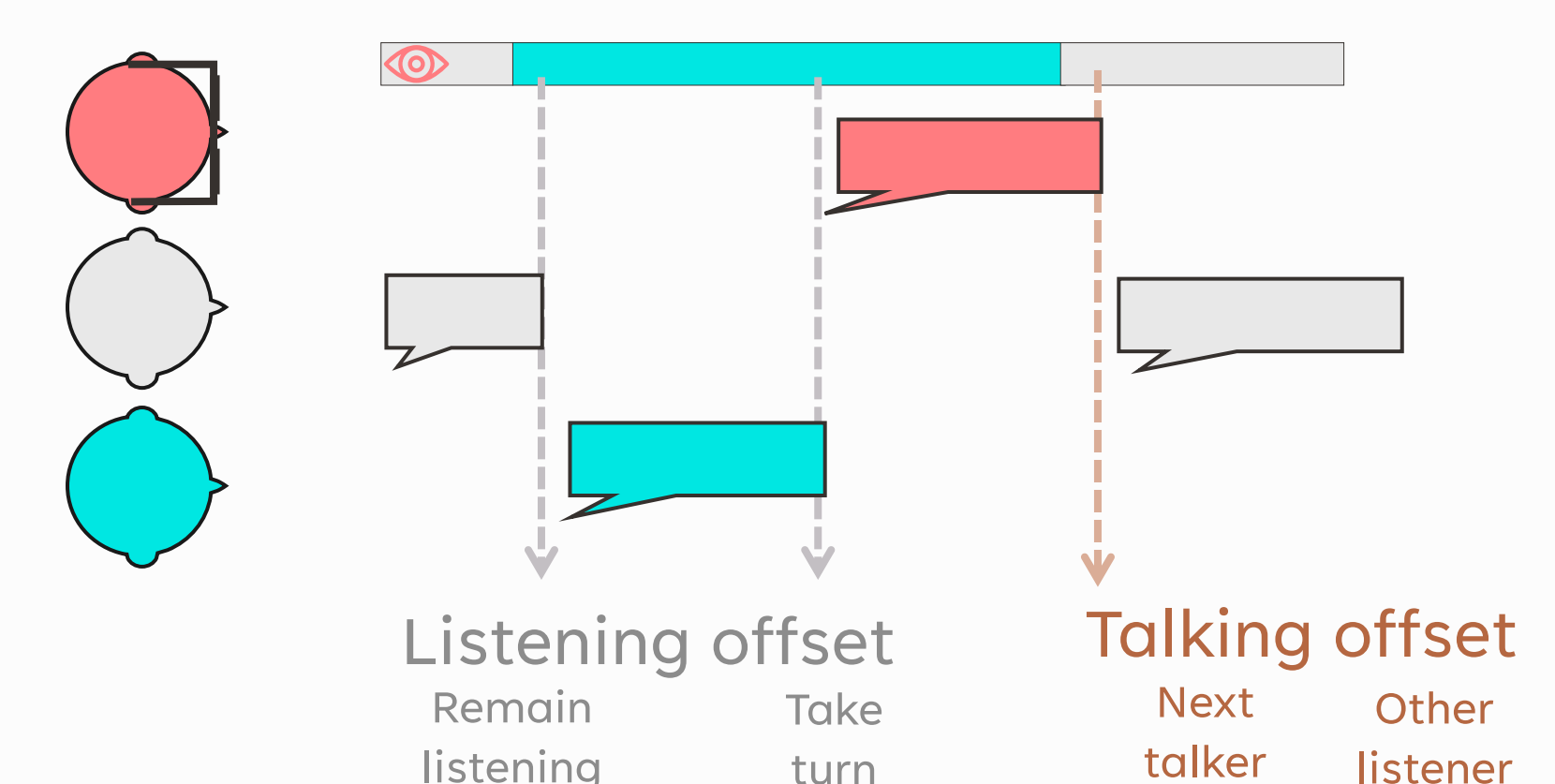
## → Participants and Setup

- 12 triads of colleagues/acquaintances: 2 normal hearing (NH) + 1 hearing impaired (HI) wearing own hearing aids
- 5-minute free conversations in a cafeteria during (noise) and outside (quiet) lunch hours
- Participants were seated at a long table in two different seating arrangements (across and side)

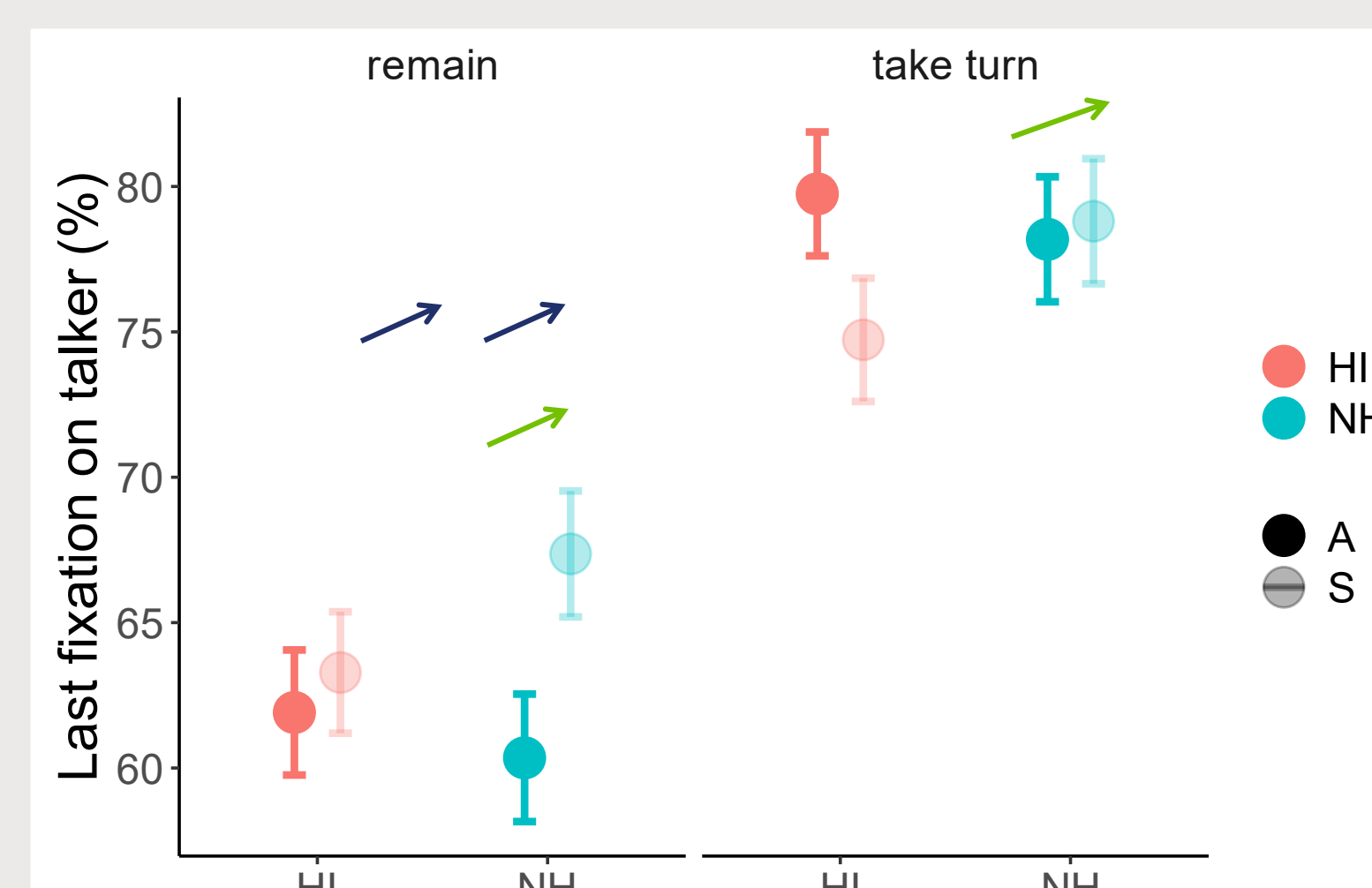
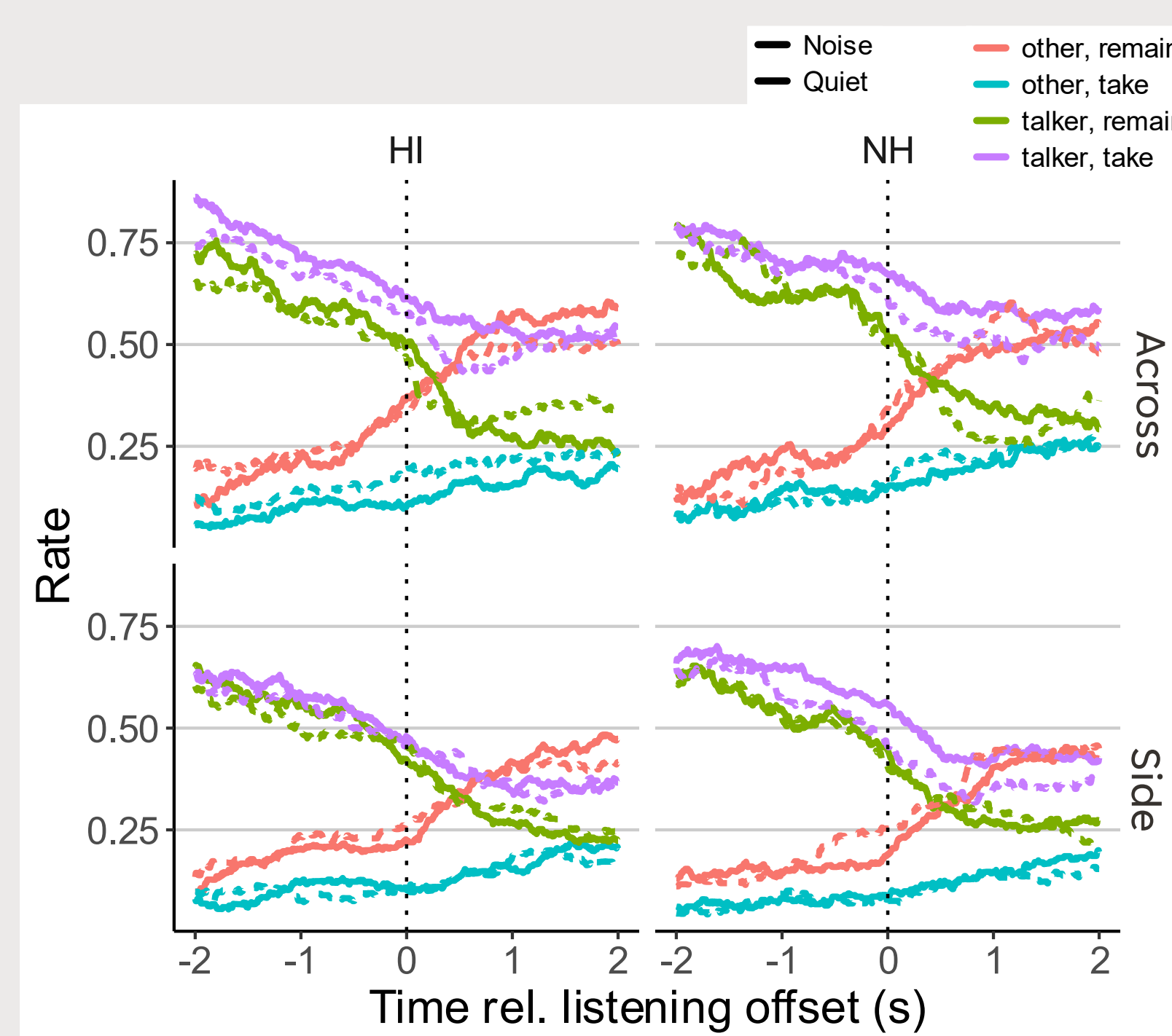


## → Recordings

- Speech recorded from headset microphones for all participants
- Eye-tracking (Invisible, Pupil labs) from one participants at the time (NH or HI)
- For the 2 conversations were recorded for each condition (quiet/noise, HI/NH wearing eye-tracking glasses, a person sitting Across/Side)



## → Gaze at Listening Offset:

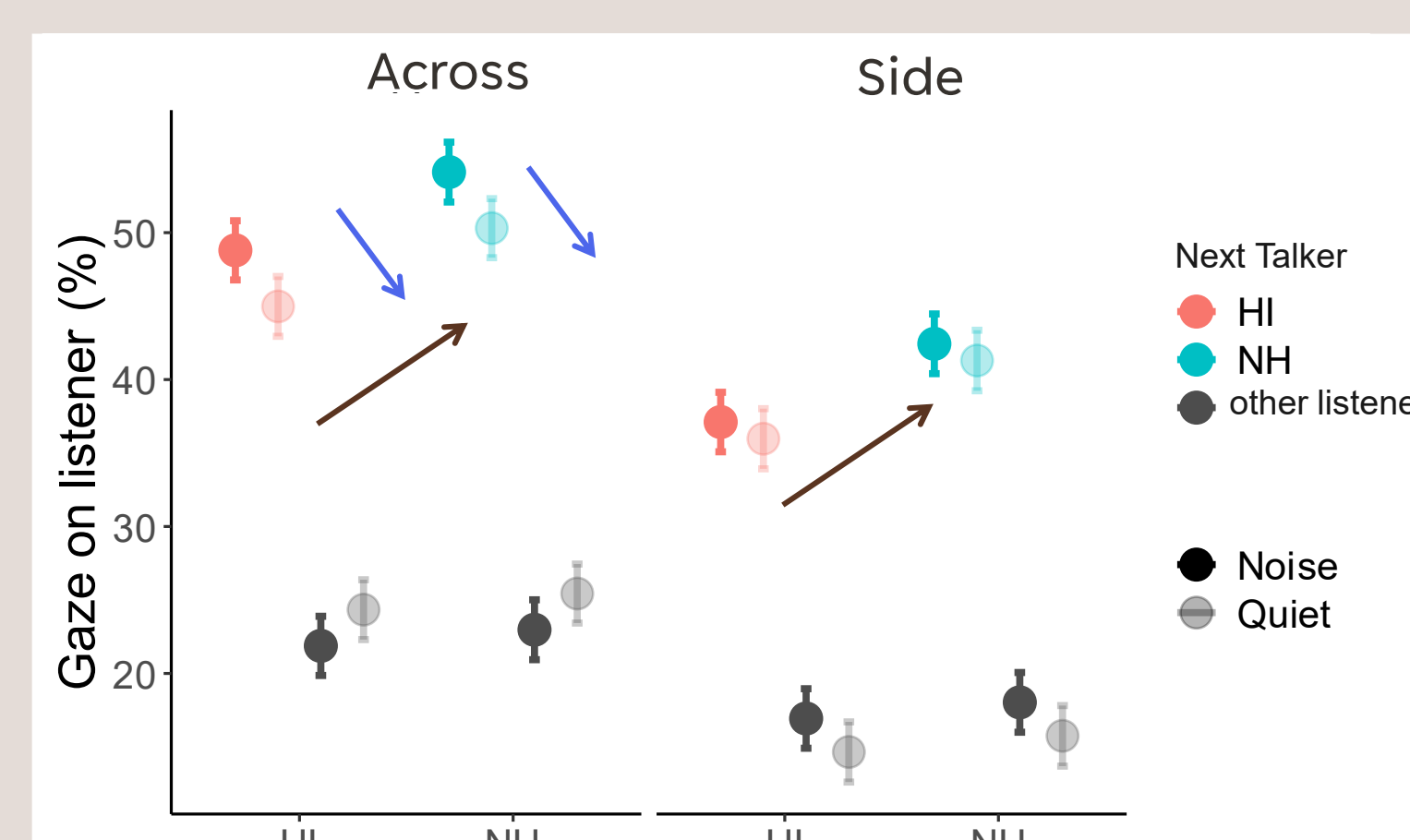
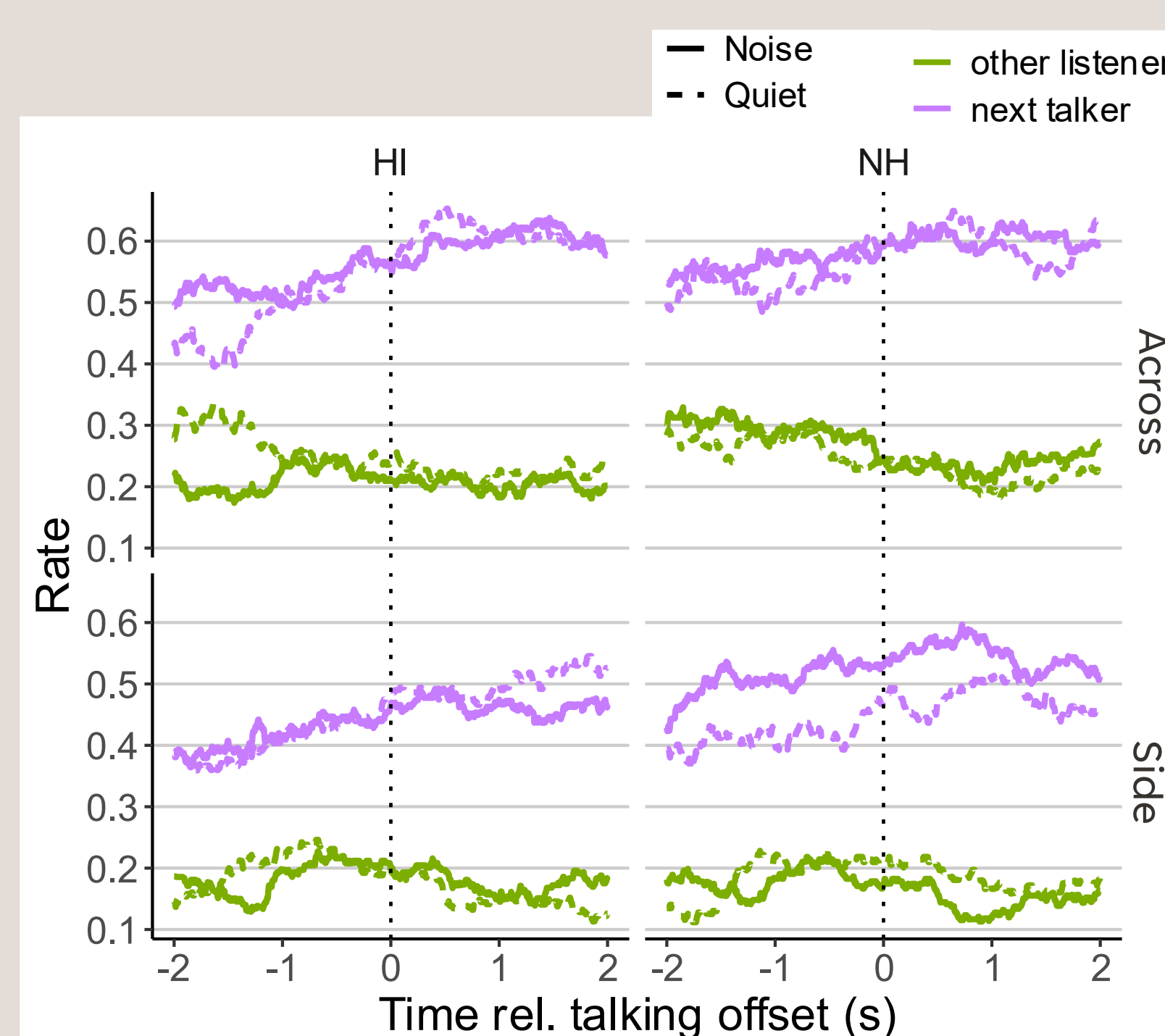


Estimated marginal means (+/- standard error) for the liner mixed model fitted to the data from each turn:  
last fixation on talker (yes/no) ~ Noise + Hearing \* Side+  
Action(remain/take turn) \* Side + (1|subjID)

When taking the next turn people look more at current talker, than if they remaining listening because gaze shift to upcoming (other) talker before listening offset.

- Hearing:Side,  $p = 0.04$  (Side,  $p = 0.03$ )
  - Side : NH look more at current talker than HI
  - In side condition, HI gaze is less predictive of the current talker
- Action:Side,  $p = 0.02$  (Action,  $p < 0.001$ )
  - When remaining listening, all look more at current talker in the side condition
  - Shifting gaze is more effortful in side condition so people don't shift gaze as readily
  - Gaze avoidance (to indicate not wanting next turn) is less reliable in the side condition

## → Gaze at Talking Offset



Estimated marginal means (+/- standard error) for the liner mixed model fitted to the data from each turn:  
Gaze on listener ~ Noise \* Side \* Person (other listener/ next Talker) +  
Hearing \* listener + (1|subjID)

Seconds prior to a turn end, the talker look more to the next talker than towards the other listener

- Person:Hearing,  $p = 0.04$  (Person,  $p < 0.001$ )
  - NH look more at next talker than HI
  - Gaze is more predictive of upcoming talker for NH than HI
- Noise:Side:Person,  $p = 0.02$  (Side,  $p < 0.001$ )
  - All look more to the next talker in noise relative to quiet when conversation partners sit across
  - Gaze is more predictive of upcoming talker in noise, but only when conversation partners sits across from them

## → Conclusion

At talking offset, gaze is a good indicator of who will be talking next. At listening offset, gaze away from the current talker indicates continued listening.

Despite introducing communication difficulties, increase noise and hearing impairment does not directly affect gaze behaviour

Contrary to previous studies, we find that relative to HI, NH gaze more towards

- the current talker when a conversation partner sits on the side
- the next talker at the end of their own turn

Having one conversation partner on the side, rather than both sitting across, generally result in less gaze towards any conversation partner. Gaze towards the next talker is increased in noisy condition only when both conversation partners are sitting across from the current talker.

Unexpectedly, increased communication difficulty did affect gaze patterns; seating position of the conversation partners affected the gaze behavior more than increased noise and impaired hearing.