



# Multimodal verb input to children with and without hearing impairment

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## Background

Embodied theories of language point to a direct link between language and action [1]. Accordingly, there is evidence to support the idea that the sensorimotor experience of action promote linguistic knowledge [2], [3], [4]. Of particular importance is how this link might be leveraged by normally hearing (NH) and hearing impaired (HI) infants.

Focussing predominantly on NH infants, research suggests that caregivers perform their actions in temporal synchrony with language and this may aid infants in discovering the relationships between words and referents [5]. Recently, researchers began to explore the multimodal behaviours used around verbs [6], [7]. Still, research on HI infants is scarce, yet very much needed. Due to the mismatch of hearing status between hearing parents and HI infants it is important to understand the ways in which the multimodal input might be adapted [8]. Additionally, existing research on the frequency of parents' use of multimodal cues in interactions with their HI children has produced inconsistent findings.

## Research Questions

1. Do caregivers accompany the production of their verbs with multimodal behaviours?
2. Does the frequency of multimodal verb input depend on the infant hearing status?
3. Is the input driven by the caregivers' actions? Or those of the infants'?

## Method

### Data Coding

- ▶ Ambrose [9] CHILDES video corpus
- ▶ 13 dyads from the NH group (m = 6; f = 7); Age  $M = 13.50$  ( $SD = 0.13$ )
- ▶ 13 dyads from the HI group (m = 6; f = 7); Age  $M = 13.78$  ( $SD = 0.51$ )

### Data Coding

A 6-min-interval was selected for data coding in the middle of the video recording (minutes 12:00-18:00). Data were coded using ELAN.

▶ **Verbs** : state vs. action

▶ **Multimodal verb episodes**: +/- 3 second before or after a verb

▶ **Action corresponding to verb**

- ▶ Caregiver led
- ▶ Child led

Code	Definition	Example
Depictive	<ul style="list-style-type: none"> <li>caregiver models the action described by the verb</li> <li>caregiver physically moves the infant into performing the action</li> <li>infant performs an action which the caregiver labels with the associated verb</li> </ul>	<ul style="list-style-type: none"> <li>"Let's <i>put</i> the doll in the crib" whilst putting the doll in the crib</li> <li>"<i>Jump</i>" while lifting the infant up</li> <li>"<i>Shake</i>" while infant shakes a toy</li> </ul>
Other	<ul style="list-style-type: none"> <li>Verb-relevant action performed by caregiver or child which does not directly model the action described by the verb</li> <li>Includes pointing unless accompanied by the verb <i>point</i> and object manipulation</li> </ul>	<ul style="list-style-type: none"> <li>Caregiver states "<i>look here</i>" whilst pointing at a picture</li> <li>While infant picks up a book caregiver states "<i>shall we read some of that?</i>"</li> </ul>

Table 1: Action codes

## Results

### Verbs

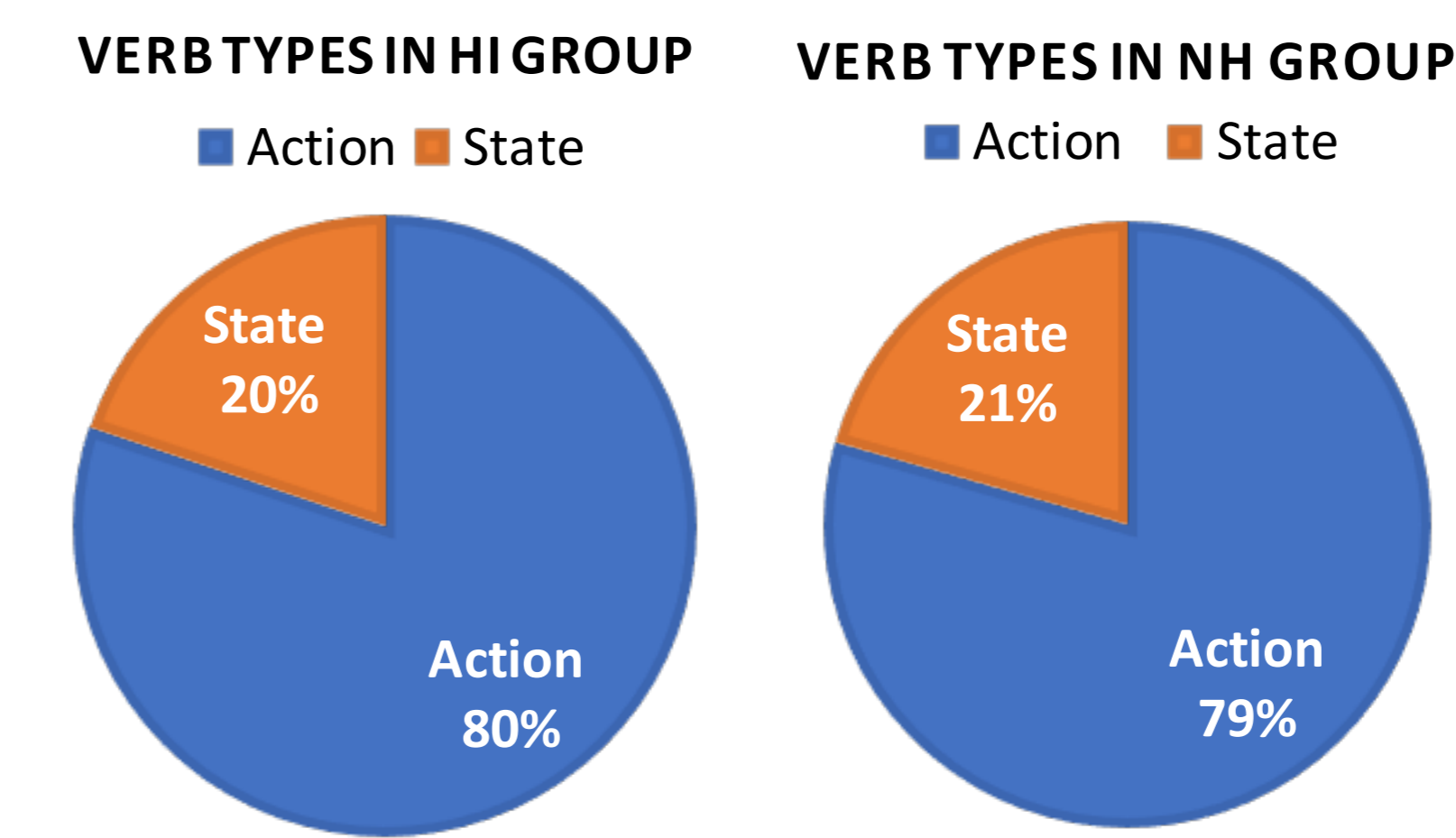
We collected a total number of 1227 verbs across all the dyads. Out of the total verbs 52 were uncodable, leaving a total number of 1175 verbs. Overall we found no group differences in the use of verbs.

	HI group	NH group
	$M$ ( $SD$ )	$M$ ( $SD$ )
Verb count	41.38	48.92
Type-token ratio	.40 (.14)	.43 (.13)

Table 2: Verb use across groups

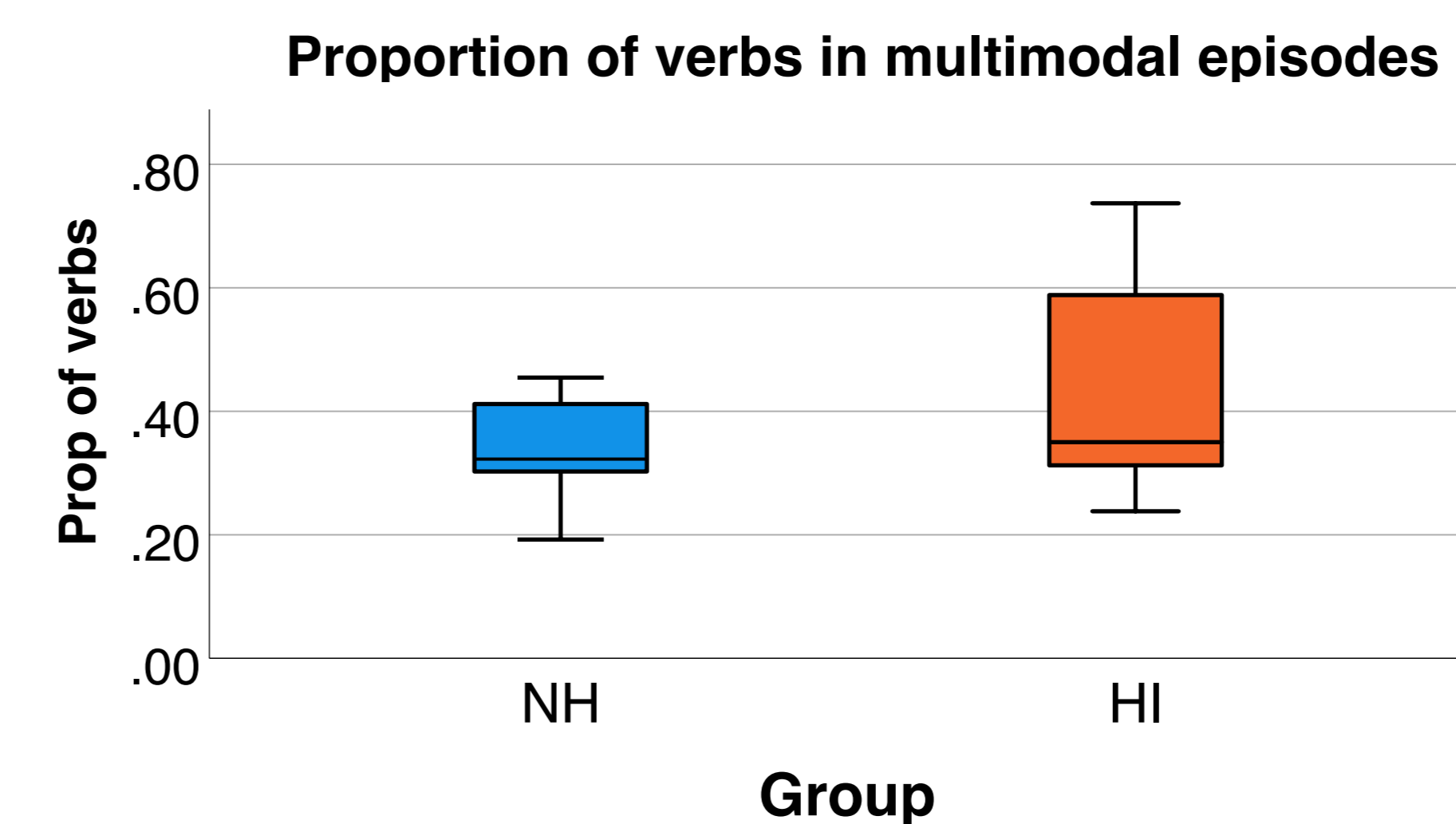
### Verb Types

- **State**: e.g., like, want, feel, figure out
- **Action**: e.g., eat, go, take, pull, give, dance



### Multimodal Verb Episodes

We found that a big proportion of caregivers' spoken verbs were accompanied by synchronous multimodal behaviours: HI group:  $M = 43%$ ,  $SD = 17%$ ; NH group:  $M = 34%$ ,  $SD = 8%$ .



### Type of Multimodal Behaviour

A mixed ANOVA showed a significant main effect for type of multimodal behaviour ( $F(1, 24) = 33.841$ ;  $p < .001$ ;  $\eta = .585$ ) such that depictive cues were used more frequently than other cues. This effect was found in each group separately as well: NH:  $t(12) = 4.199$ ;  $p = .001$ . HI:  $t(12) = 4.026$ ;  $p = .002$

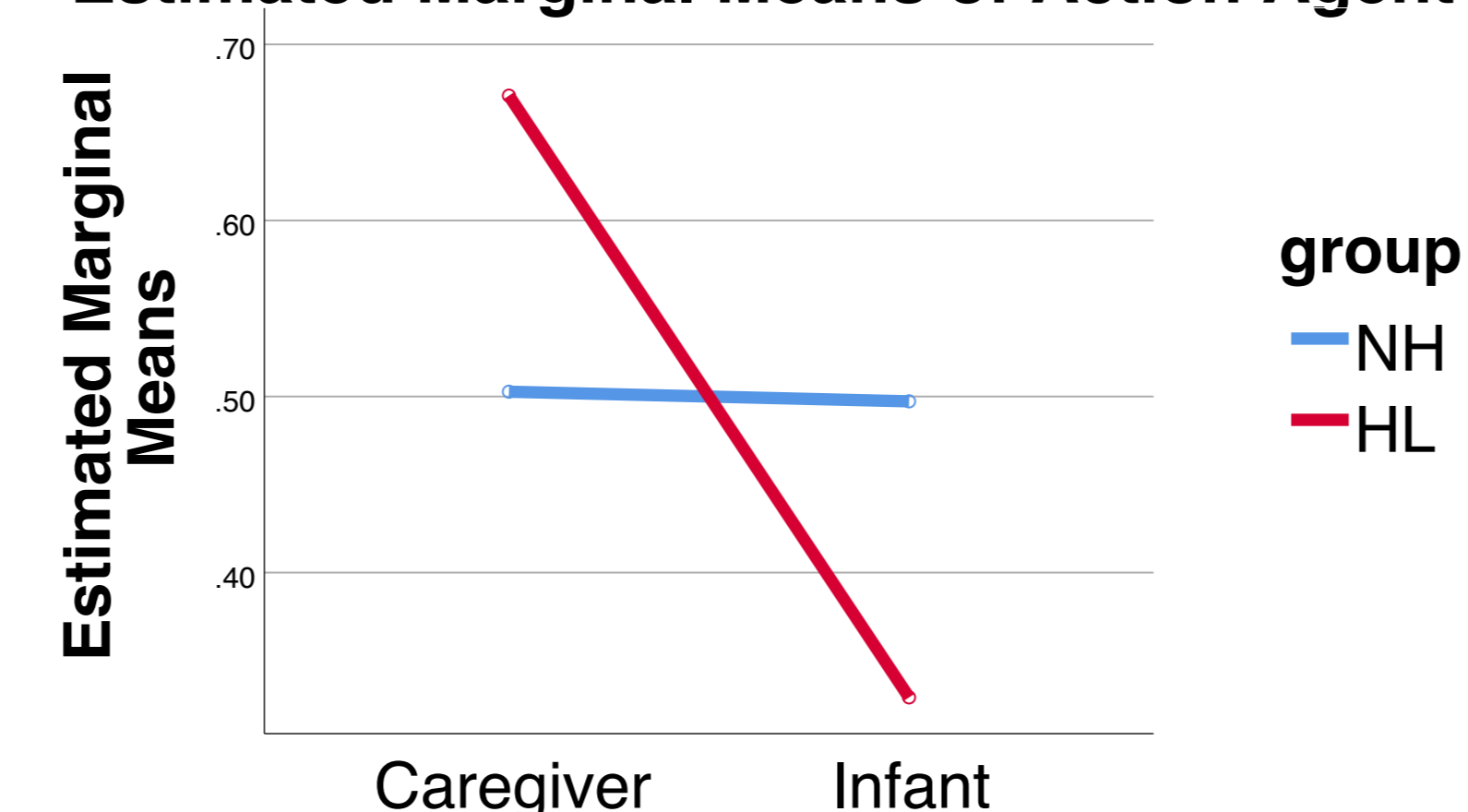
	HI group	NH group
	$M$ ( $SD$ )	$M$ ( $SD$ )
Depictive	69% (17%)	70% (17%)
Other	31% (17%)	30% (17%)

Table 3: Type of multimodal cues across groups

### Caregiver vs. infant led

We found a significant main effect for agent ( $F(1, 24) = 4.982$ ,  $p < .035$ ;  $\eta = .172$ ): caregiver-led multimodal behaviours ( $M = 59%$ ,  $SD = 21%$ ) were used significantly more than infant-led ( $M = 41%$ ,  $SD = 21%$ ) ( $p = .035$ ). We also found a significant Group\*Agent interaction effect ( $F(1, 24) = 4.673$ ;  $p < .041$ ;  $\eta = .163$ ) indicating that this effect was driven by the HI group.

### Estimated Marginal Means of Action Agent



	HI group	NH group
	$M$ ( $SD$ )	$M$ ( $SD$ )
Caregiver	67% (23%)	50% (16%)
Infant	33% (23%)	50% (16%)
Pairwise Comparisons	$t(12) = 2.683$ ; $p = .020$	$t(12) = .061$ ; $p = .952$

Table 4: Action agent across groups

## Conclusions

- Our results suggest caregivers of NH and HI infants employ similar strategies when producing verbs in their input.
- Parents in both groups used a comparable number of verbs and of comparable complexity. The verbs used by parents across groups were predominantly action verbs; state verbs were used less by both groups.
- Parental multimodal strategies were frequently used with NH and HI infants. In both groups, caregivers predominantly performed actions that depicted the meaning of spoken verbs and these language-action events were in a tight temporal relationship with each other.
- Yet the two groups also differed; caregivers of HI infants used multimodal labelling more frequently when using verbs that referred to their own actions rather than their infants'.

### Next Steps

- Further elaborate the analysis of the types of action verbs used to further systematically describe the multimodal verb input across Groups
- Investigate the role of gaze in potentially regulating differences between caregiver and infant led multimodal input
- Analyse infants responses to the multimodal input and its development across time.

## References

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