

Tactical use of multimodal communication by six-month-old human infants

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Theoretical framework

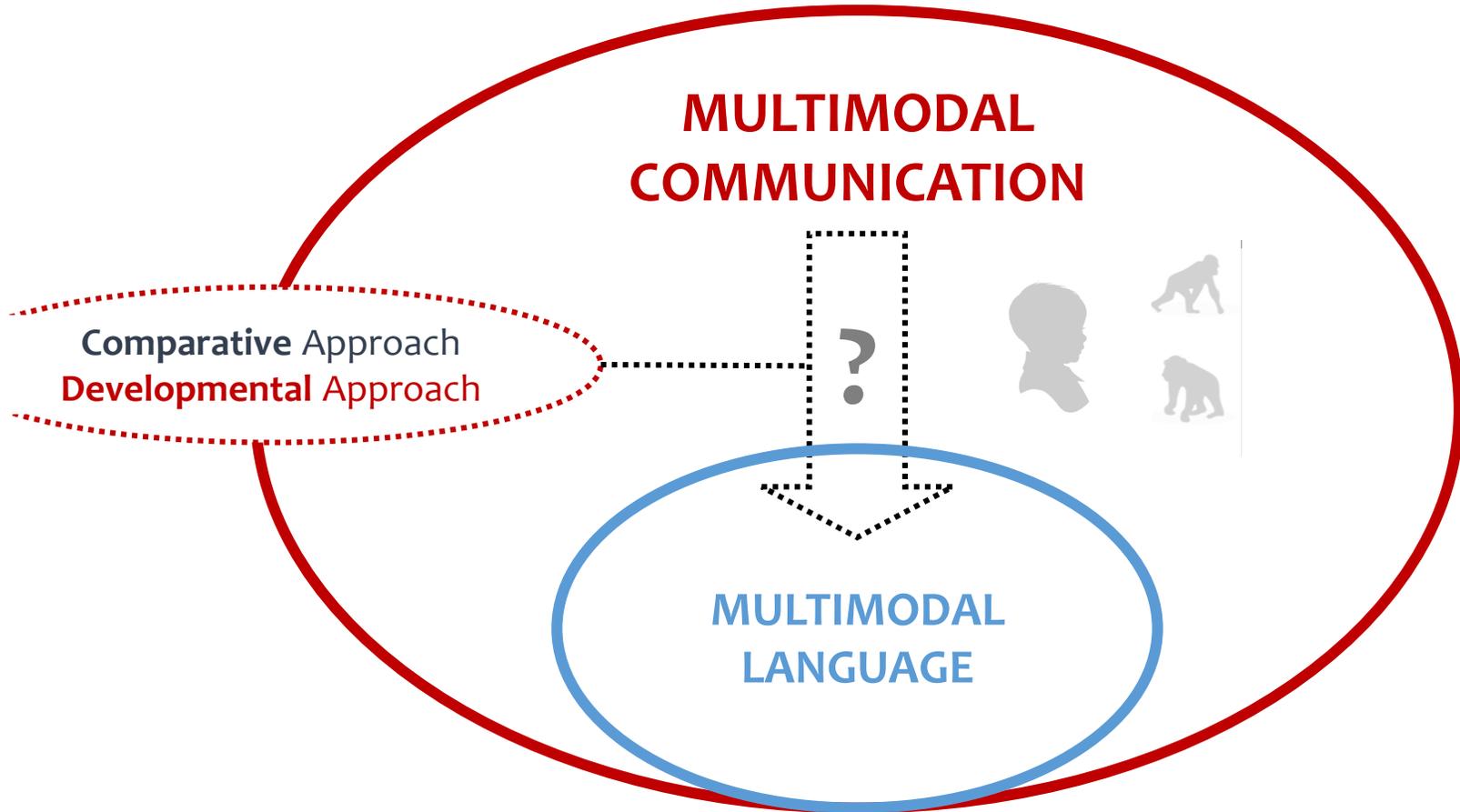
INTENTIONALITY

Comparative Approach
Developmental Approach

**MULTIMODAL
COMMUNICATION**



**MULTIMODAL
LANGUAGE**



INTRODUCTION

Intentional communication

Proto-conversations by the means of visual signals (body movements) according to the recipient's interaction

(Nakata & Trehub, 2004; Scola, Bourjade, & Jover, 2015)

Pointing and triadic interaction:
Intentional gestural communication

(Beuker et al., 2013; Camaioni, Perucchini, Bellagamba, & Colonnesi, 2004; Carpenter et al., 1998; Liszkowski, Brown, Callaghan, Takada, & Vos, 2012)

Reorganization of emerging speech with existing gestures

(Goldin-Meadow & Alibali, 2013; Guidetti, Fibigerova, & Colletta, 2014; Iverson & Goldin-Meadow, 2005)



0

5

7

8

9

11

12

14

Infant's age (months)

Babbling showing **prosodic precursors** temporally aligned with body movements

(Esteve-Gibert & Guellaï, 2018)

Vocalisations synchronized with gestures and pointings
Intentional vocal communication

(Aureli et al., 2017; Esteve-Gibert & Prieto, 2013; Grünloh & Liszkowski, 2015)

Bimodal utterances

Legend

- Visual signals development
- Acoustic signals development
- Bimodal communication step just before linguistic phase

INTRODUCTION

Intentional communication

Proto-conversations by the means of visual signals (body movements, eye gaze) to the recipient's interaction

INTERACTION

(Nakata & Trehub, 2004; Scola, Bourjade, & Jover, 2015)

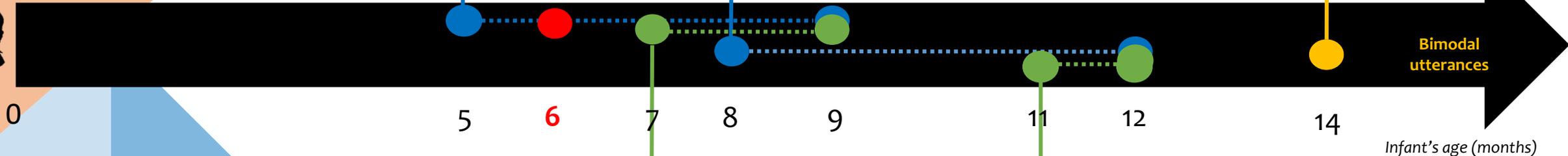
Pointing and triadic interaction: Intentional communication

VISUAL ATTENTION

(Beuker et al., 2013; Camaioni, Perucchini, Bellagamba, & Colonnesi, 2004; Carpenter et al., 1998; Liszkowski, Brown, Callaghan, Takada, & Vos, 2012)

Reorganization of emerging speech with existing gestures

(Goldin-Meadow & Alibali, 2013; Guidetti, Fibigerova, & Colletta, 2014; Iverson & Goldin-Meadow, 2005)



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Vocalisations synchronized with gestures and pointings

Intentional vocal communication

(Aureli et al., 2017; Esteve-Gibert & Prieto, 2013; Grünloh & Liszkowski, 2015)

Legend

- Visual signals development
- Acoustic signals development
- Bimodal communication step just before linguistic phase

+ DISTANCE

(cf. Falk, 2004)

Research question

Six-month-old
human infants
Multimodal
communication

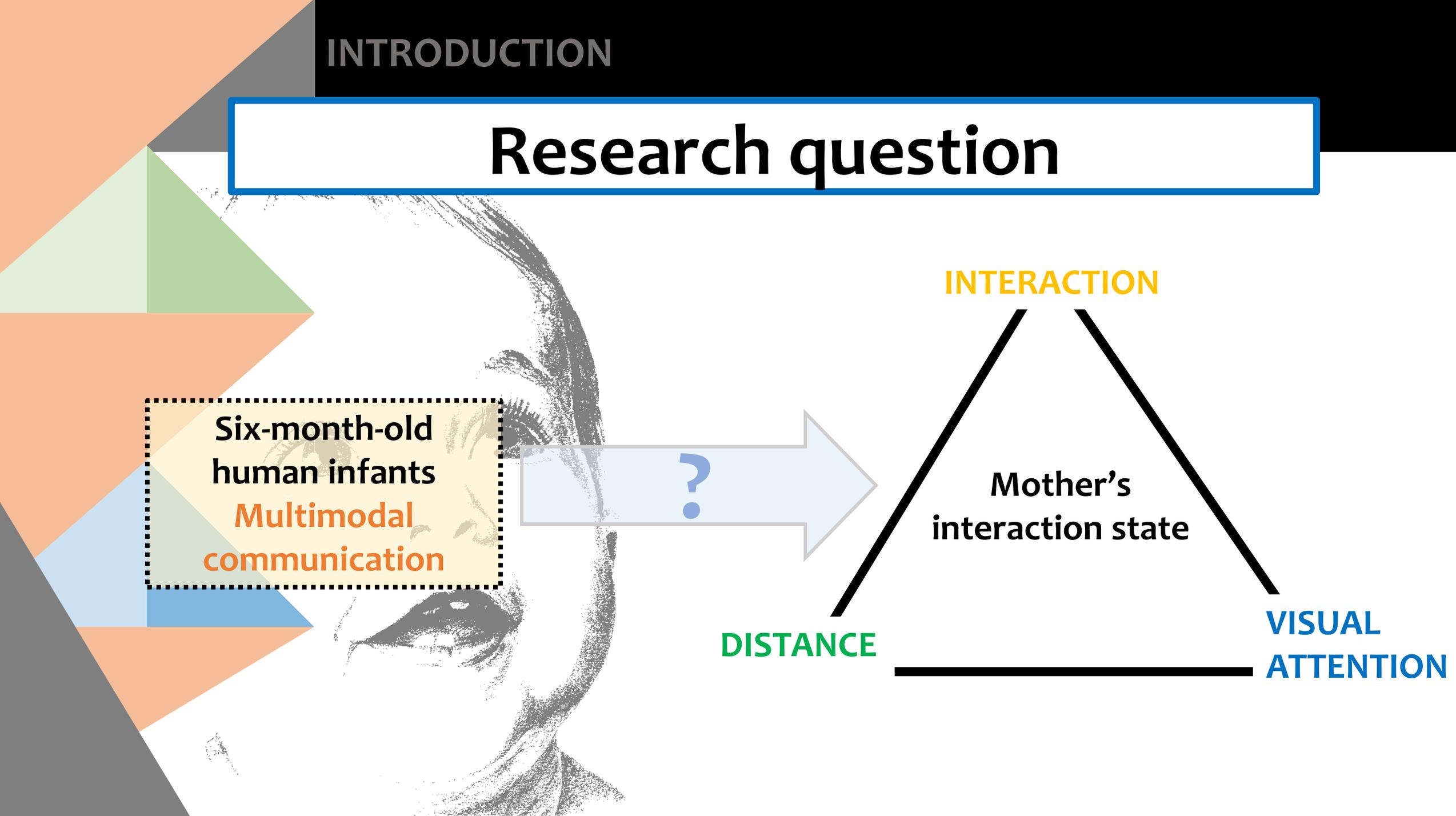


INTERACTION

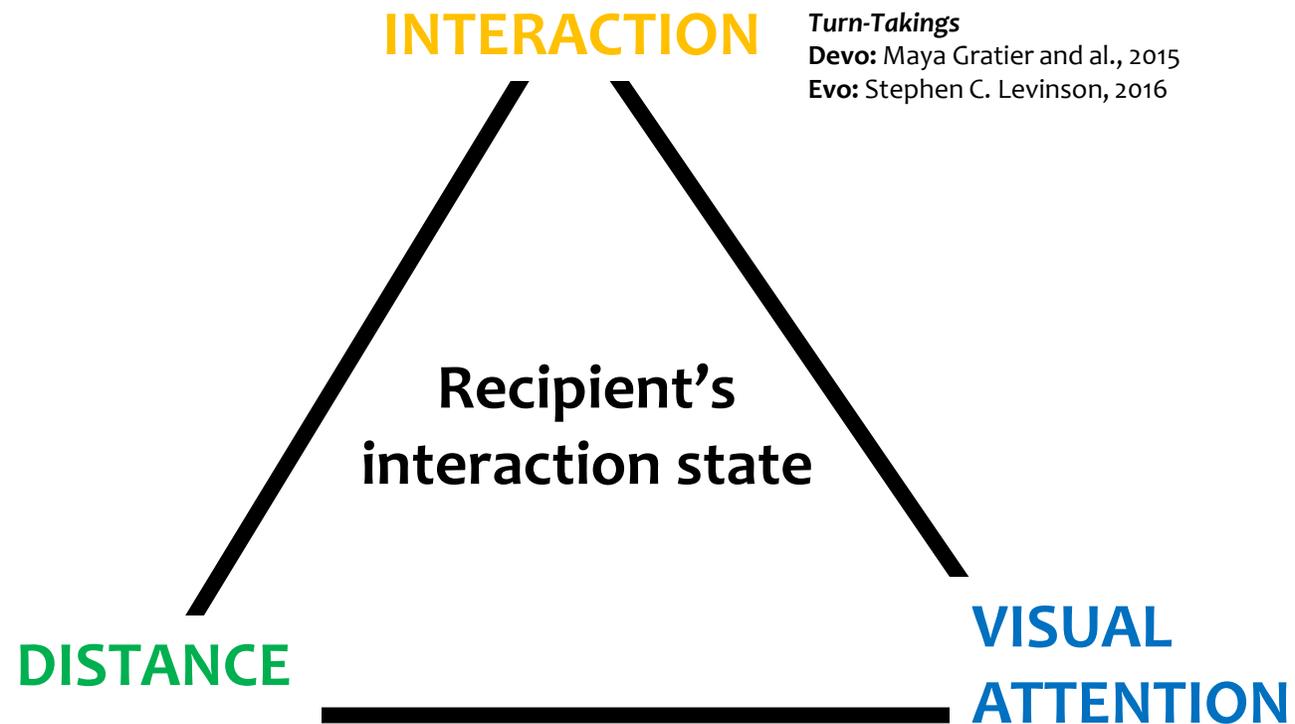
Mother's
interaction state

DISTANCE

VISUAL
ATTENTION



Previous studies



Turn-Takings

Devo: Maya Gratier and al., 2015

Evo: Stephen C. Levinson, 2016

Falk, 2004

Evo-Devo: *Putting-the-baby-down*

Devo: Wu & Gros-Louis, 2017; Igalada et al., 2015; Liszkowski, Albrecht, Carpenter, & Tomasello, 2008;

Evo: Bourjade et al., 2014; Leavens et al., 2004a, Hopkins et al., 2007;

Predictions

VISUAL ATTENTION

INTERACTION

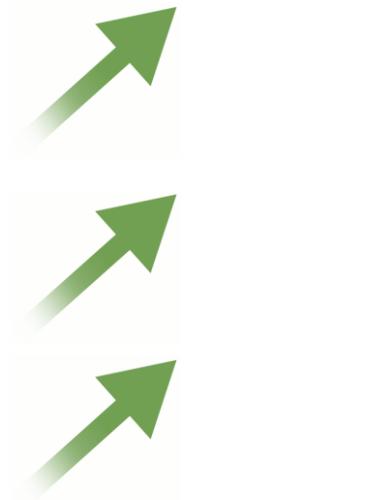
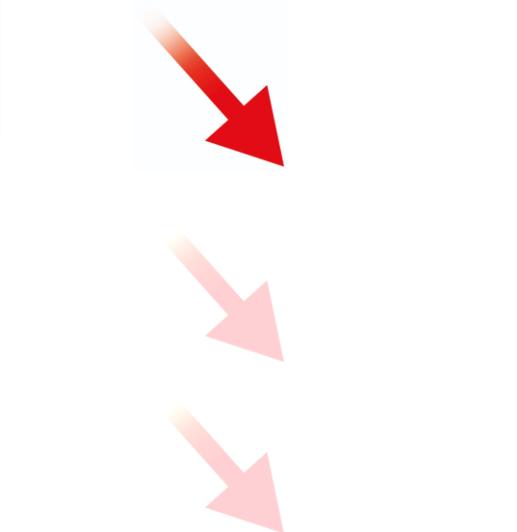
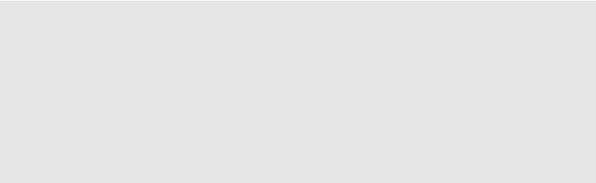
DISTANCE

All signals

Acoustic signals

Visual signals

Tactical use of sensory modalities



(Wu & Gros-Louis, 2017; Igalada et al., 2015; Liszkowski, Albrecht, Carpenter, & Tomasello, 2008; Bourjade et al., 2014; Leavens et al., 2004a, Hopkins et al., 2007;)

(Maya Gratie and al., 2015; Stephen C. Levinson, 2016)

(Falk, 2004)

Participants

Sample size

**18 mother-infant
dyads**
(10 boys, 8 girls)



Infant age

6 months old

Place

**BabyLab of Aix-Marseille
University**

Experimental Set-Up

2 distances

Close

0,5 meter



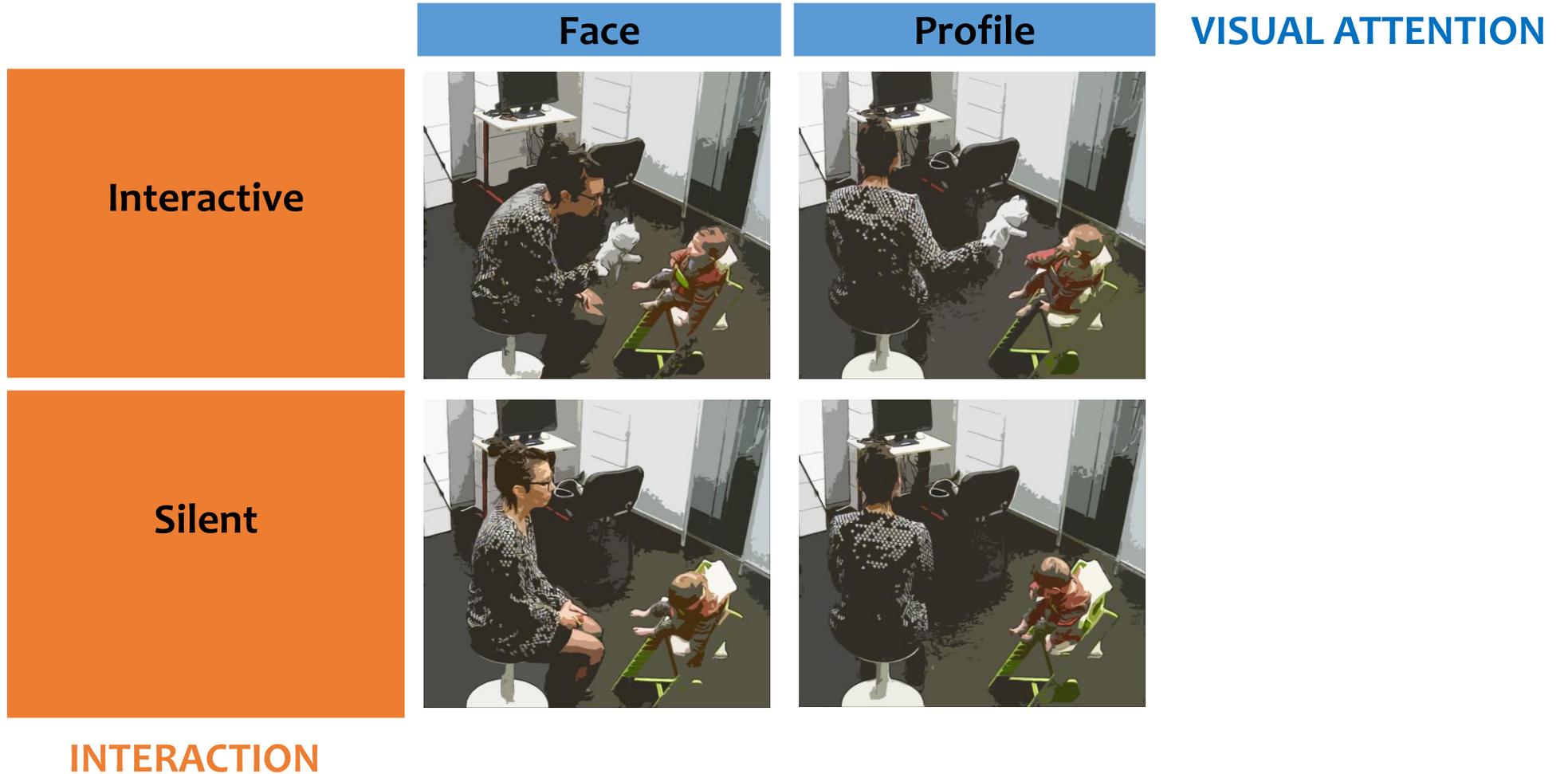
Far

2 meters

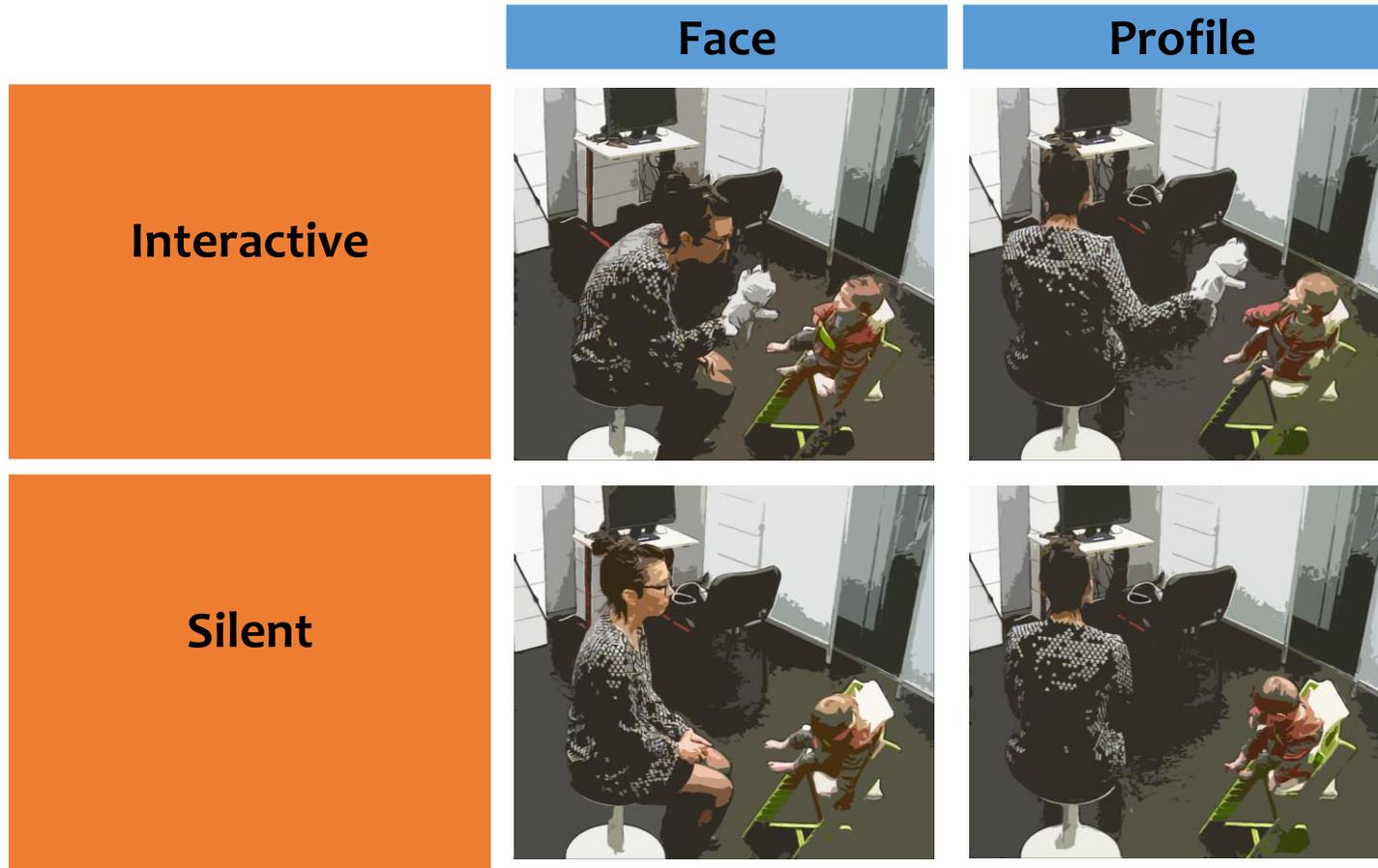


Puppet glove
(for interaction conditions)

Experimental procedure



Experimental procedure



VISUAL ATTENTION

30 seconds

X 2 distances

INTERACTION



Behavioral coding

Multimodal repertoire

Visual signals

Facial expression

Unspecified

(Cohen's $k = 0.85$)

Body movement

Circular movement of the limbs

Stretch

Sway

(Cohen's $k = 0.74$)

Acoustic signals

Oral sounds

Non-vocal oral sound

Protophone

Cry

(Cohen's $k = 0.65$)

Acoustic gesture

Unspecified

(Cohen's $k = 0.72$)

Multimodal Combinations



Data analysis

**Generalized Linear
Mixed Models**

All signals

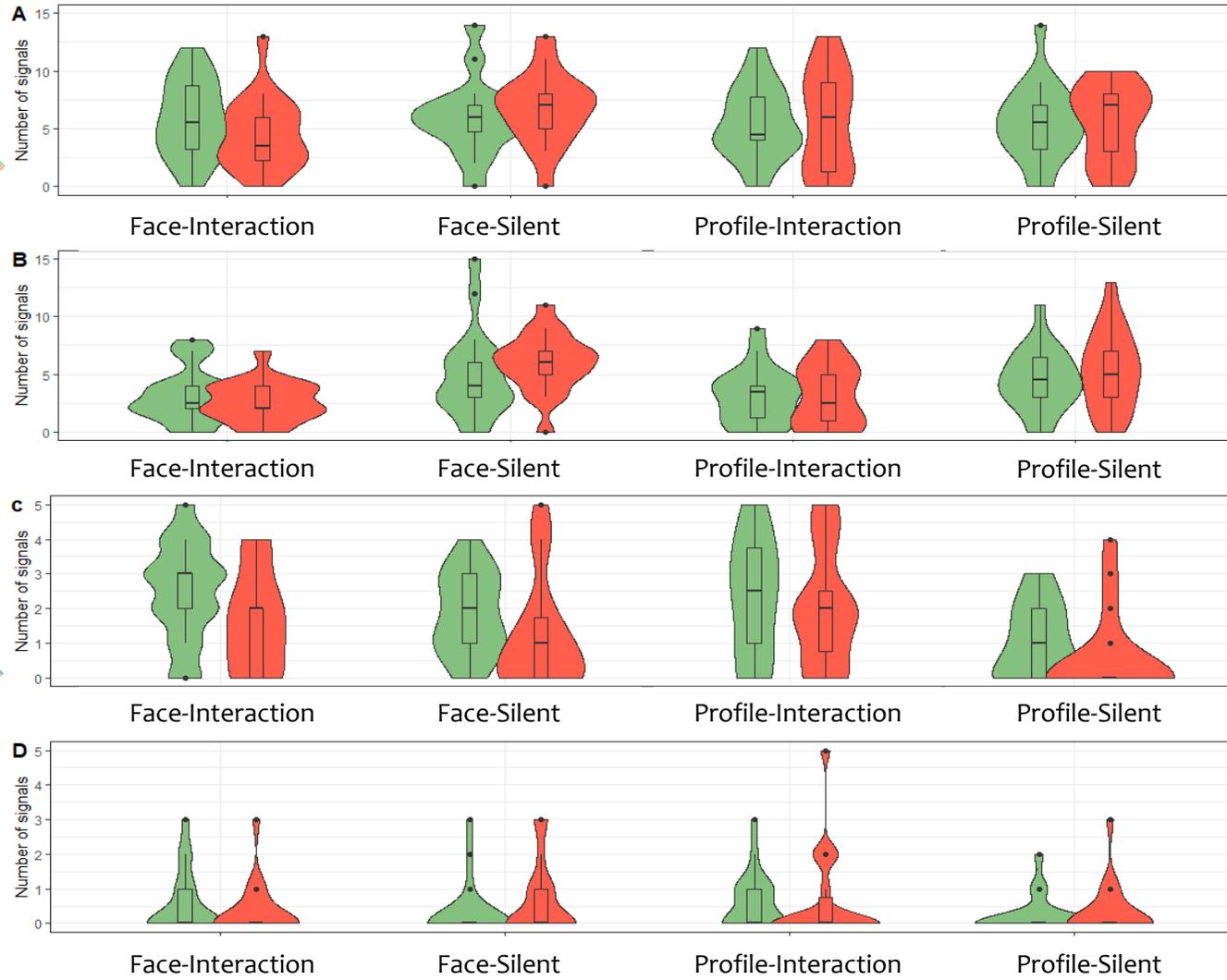
Acoustic signals

Visual signals

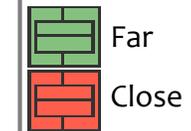
Multimodal
Combinations

RESULTS

- A. All signals
- B. Acoustic signals
- C. Visual signals
- D. Multimodal combinations



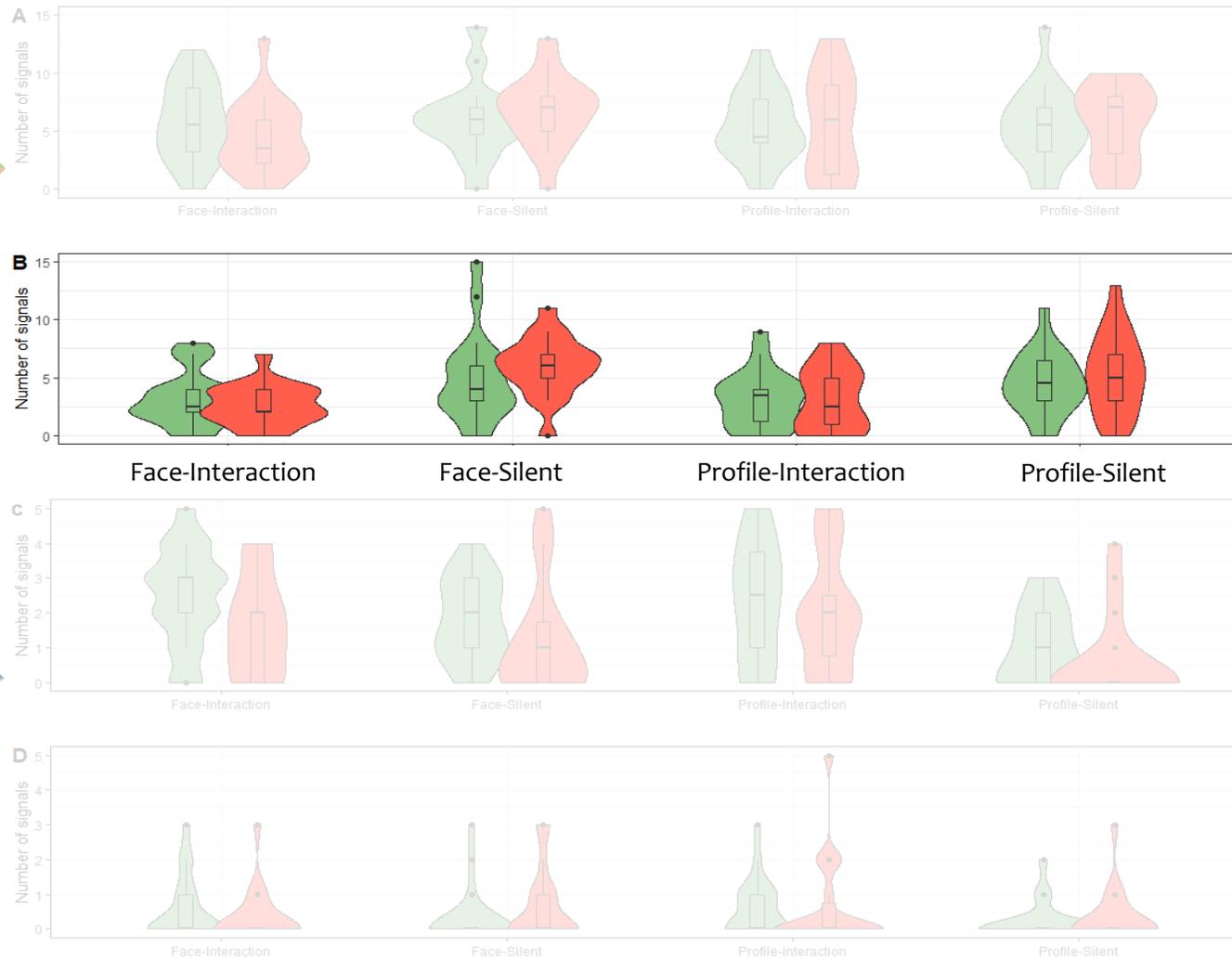
Distance



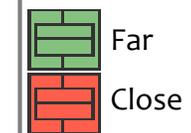
RESULTS

Acoustic unimodal communication

- A. All signals
- B. Acoustic signals**
- C. Visual signals
- D. Multimodal combinations

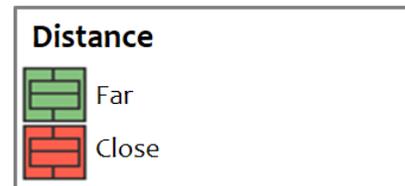
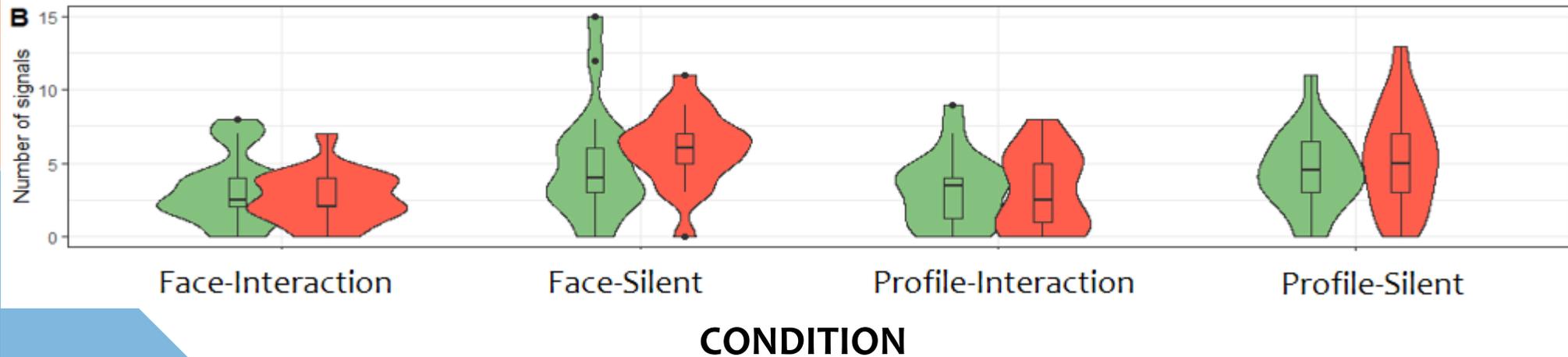


Distance



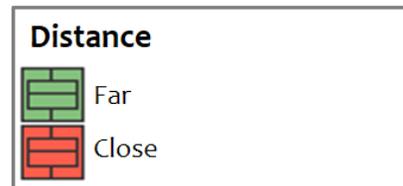
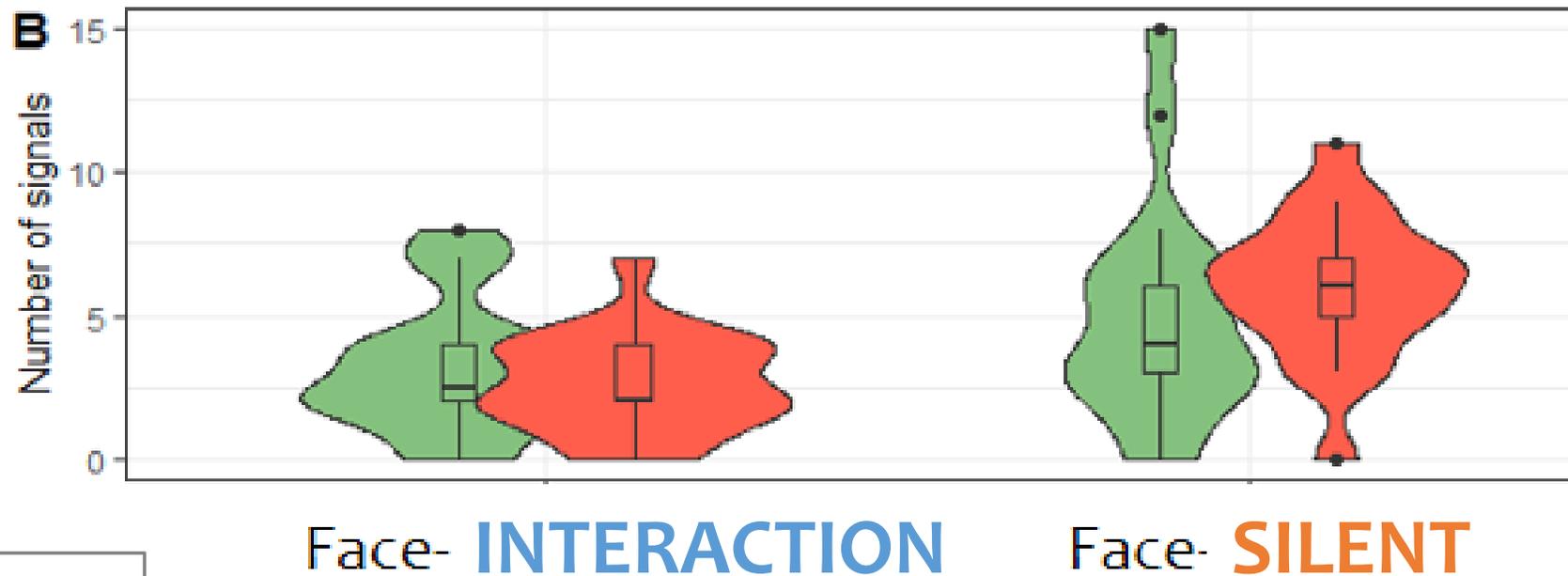
RESULTS

Acoustic unimodal communication



RESULTS

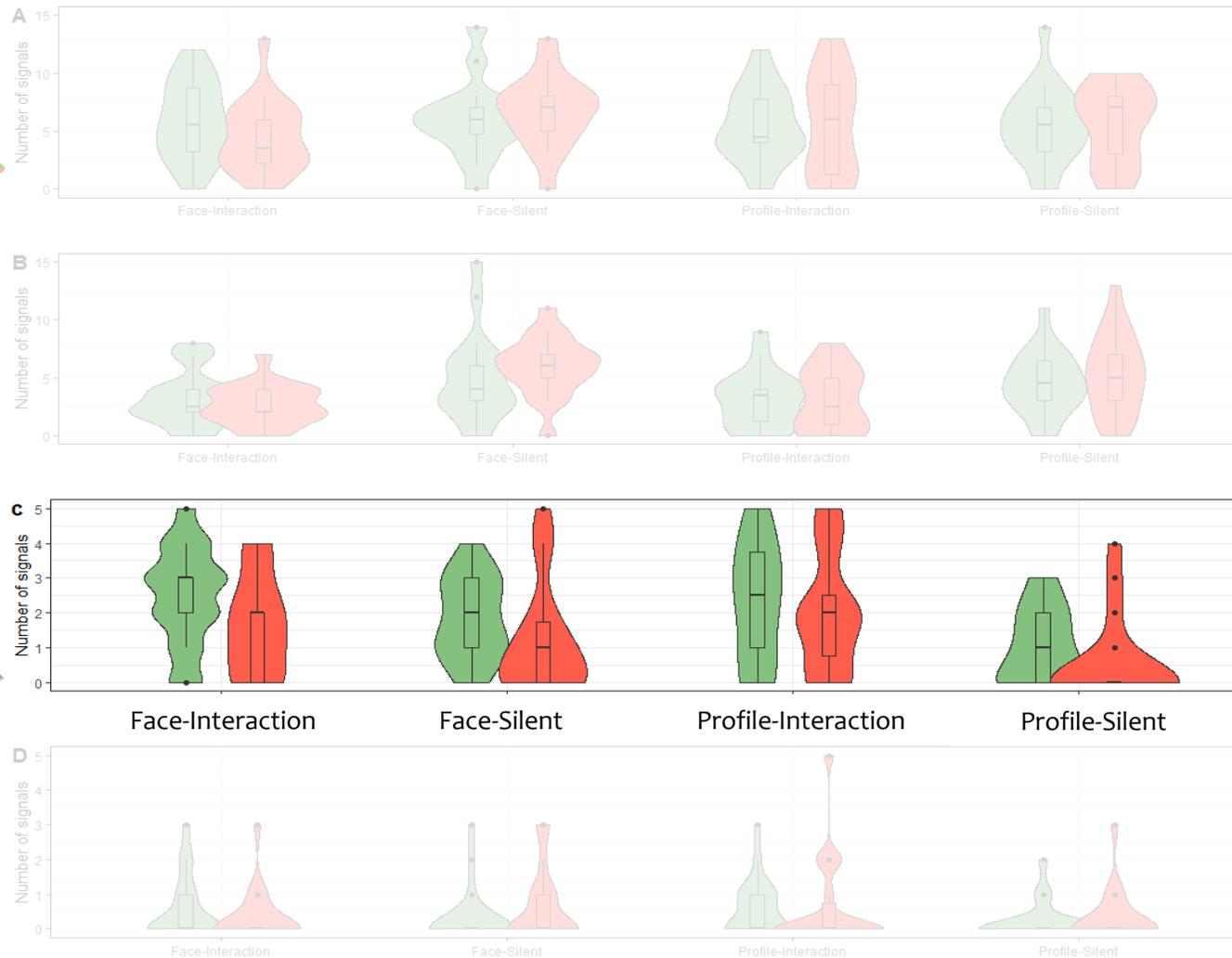
Acoustic unimodal communication



RESULTS

Visual unimodal communication

- A. All signals
- B. Acoustic signals
- C. Visual signals
- D. Multimodal combinations



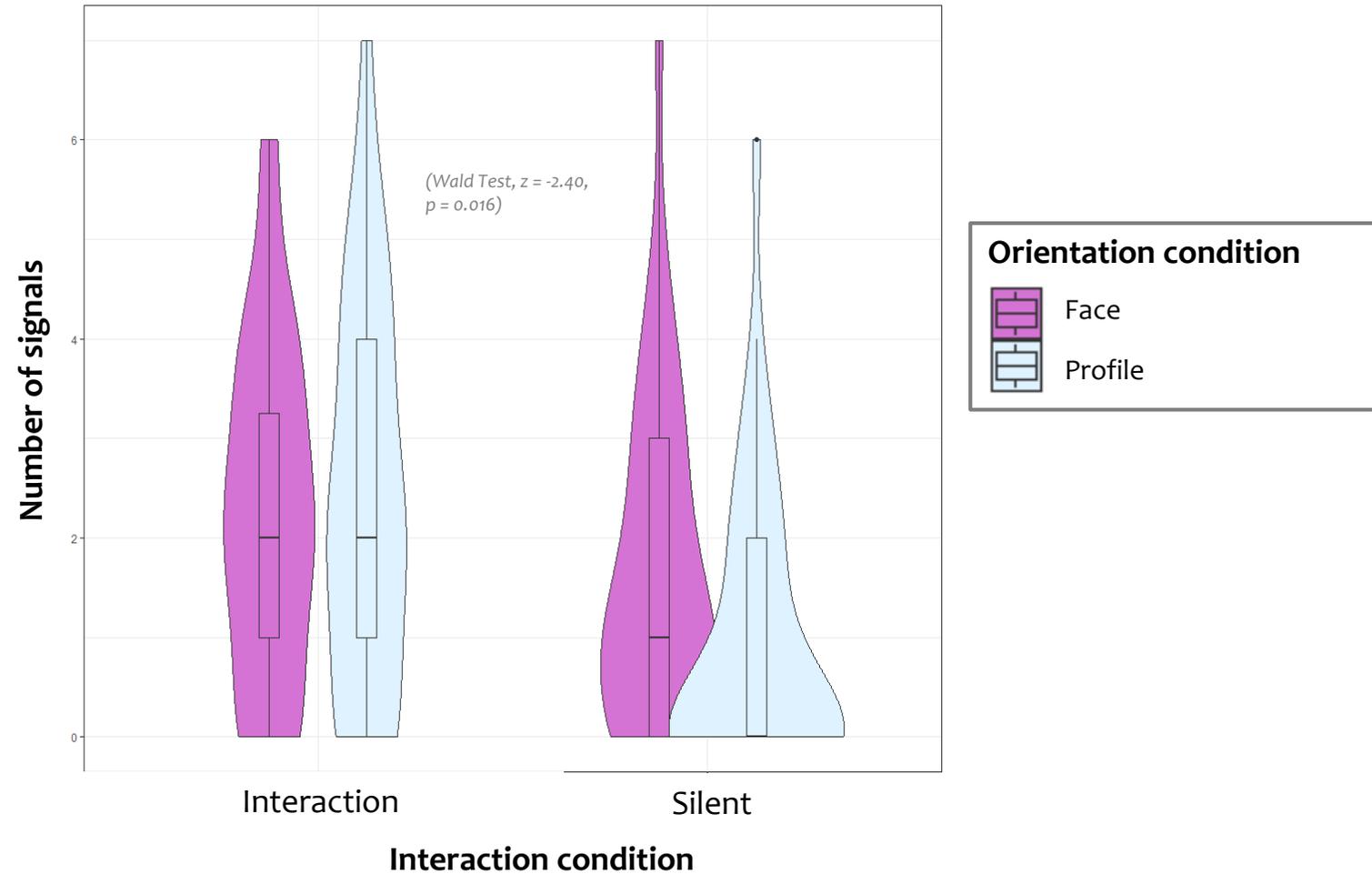
Distance

- Far
- Close

RESULTS

Visual unimodal communication

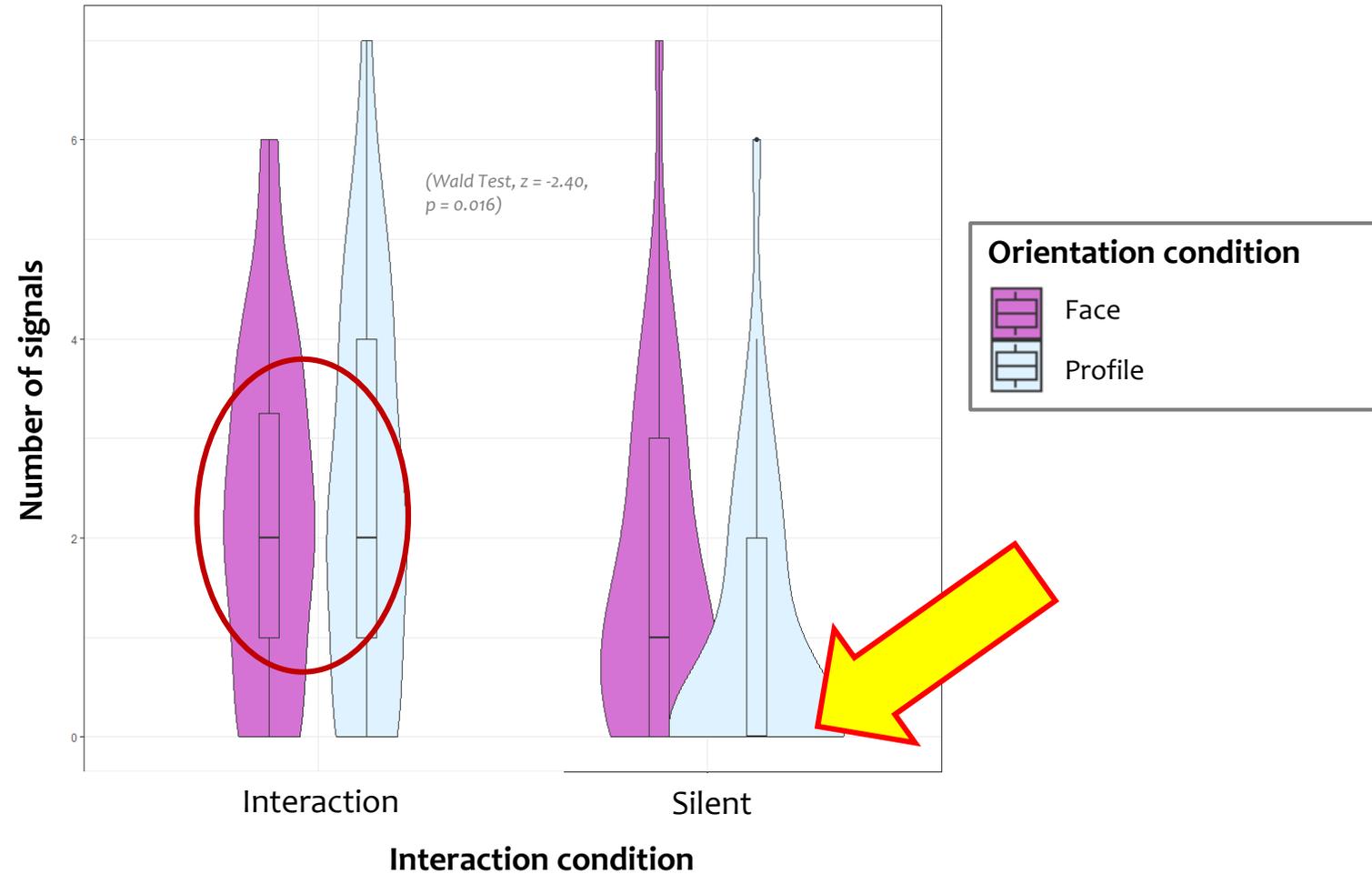
Number of visual signals



RESULTS

Visual unimodal communication

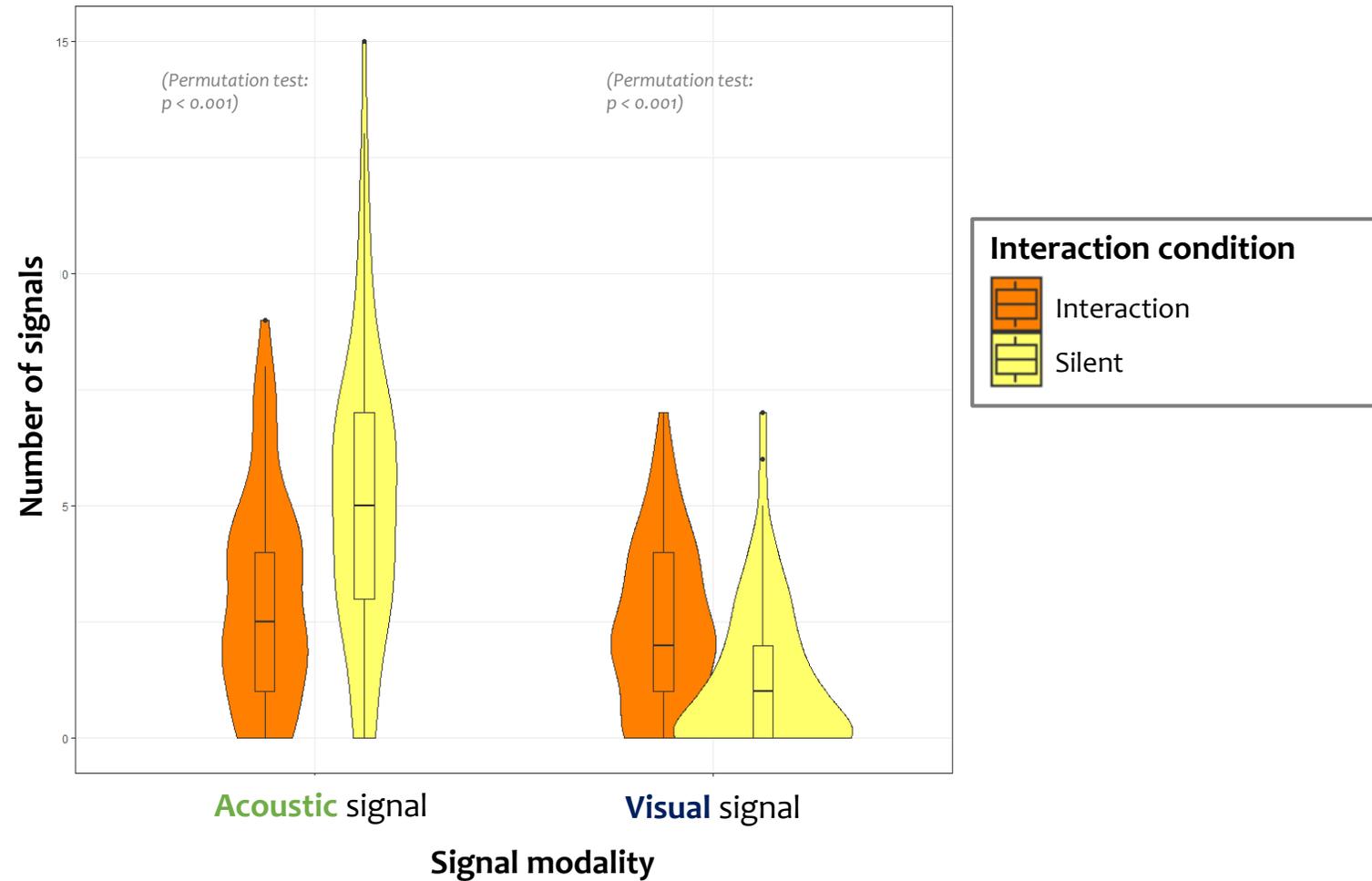
Number of visual signals



RESULTS

Tactical use of sensory modalities

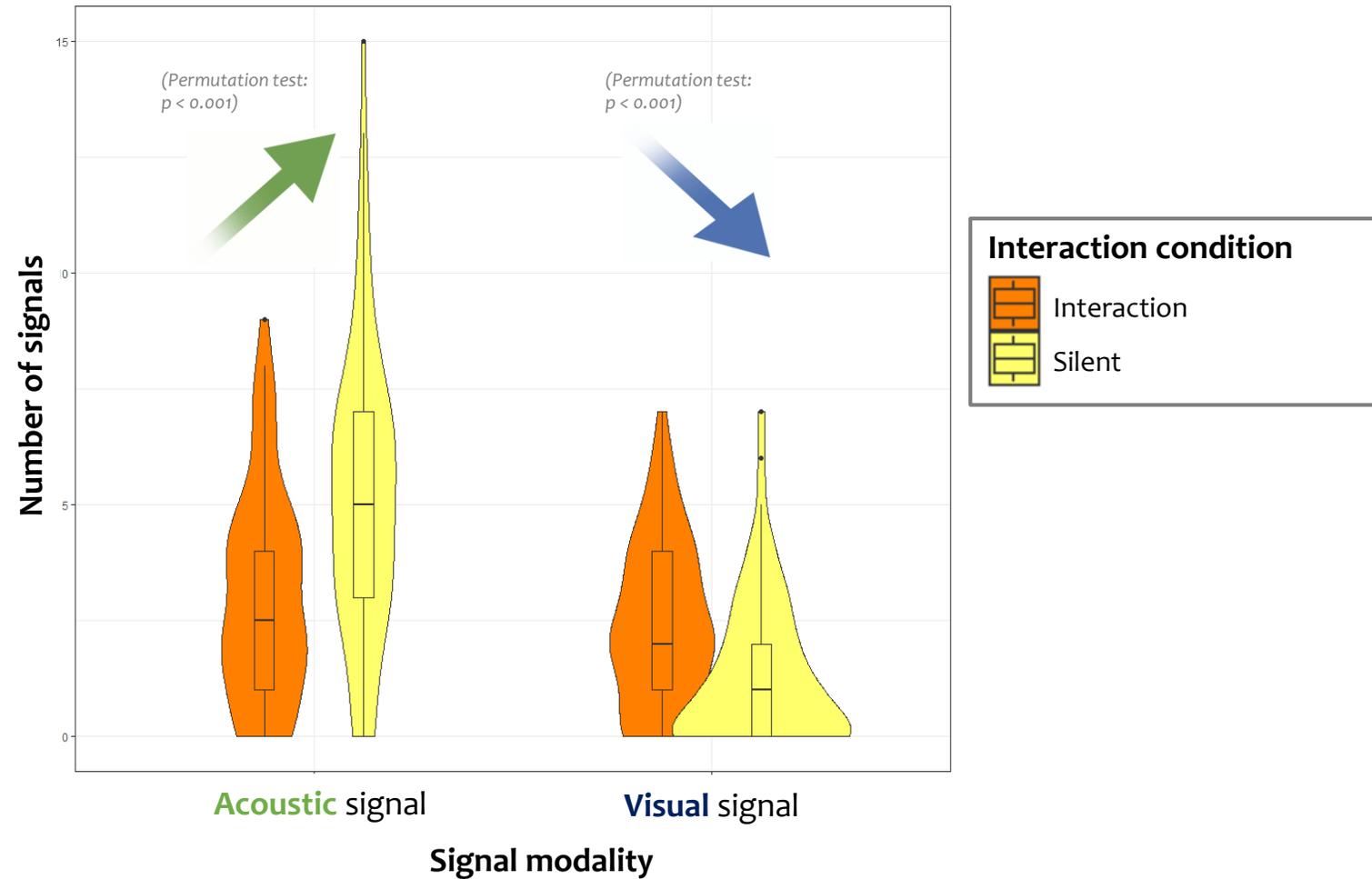
Number of signals per signal modality



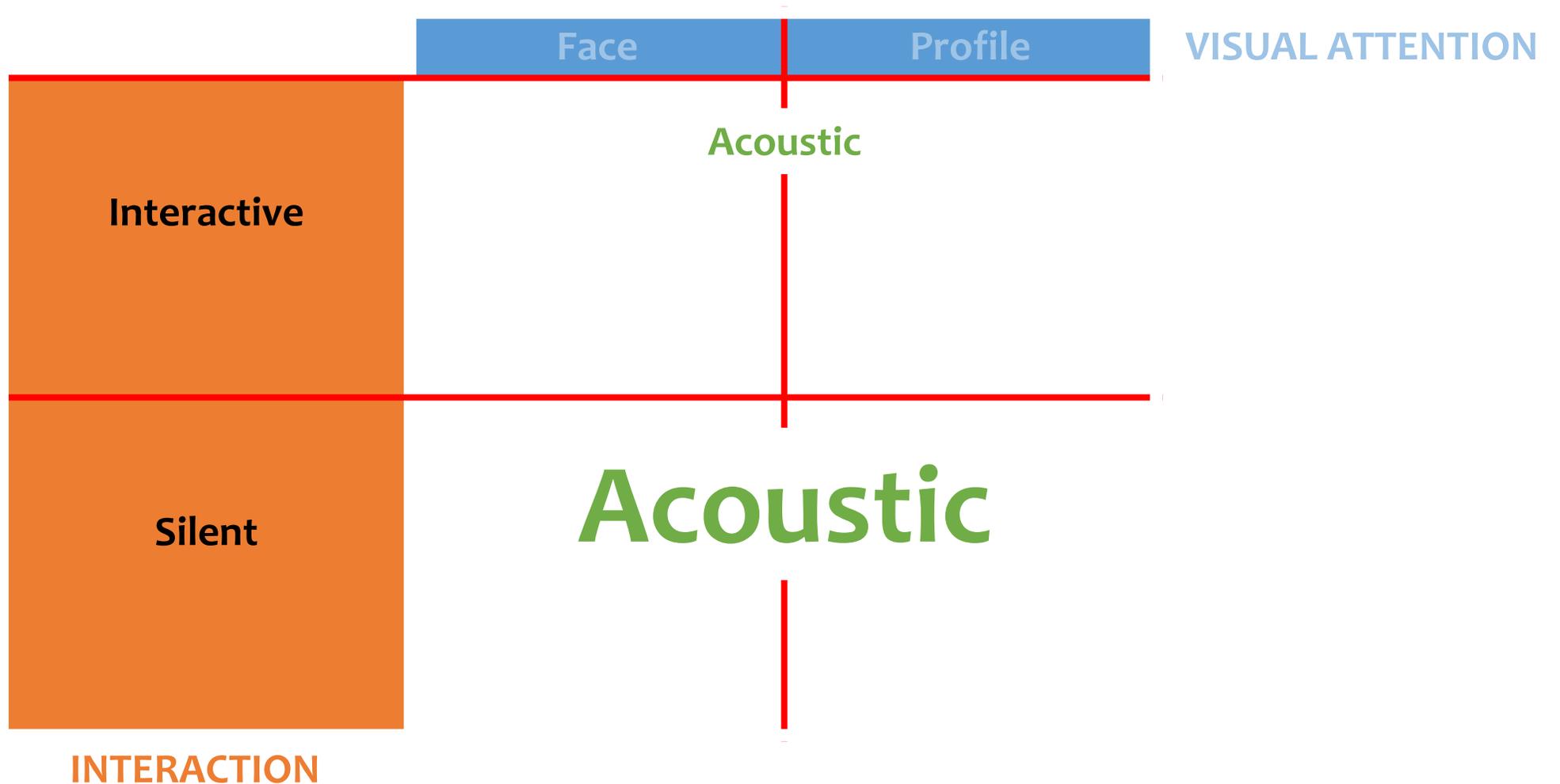
RESULTS

Tactical use of sensory modalities

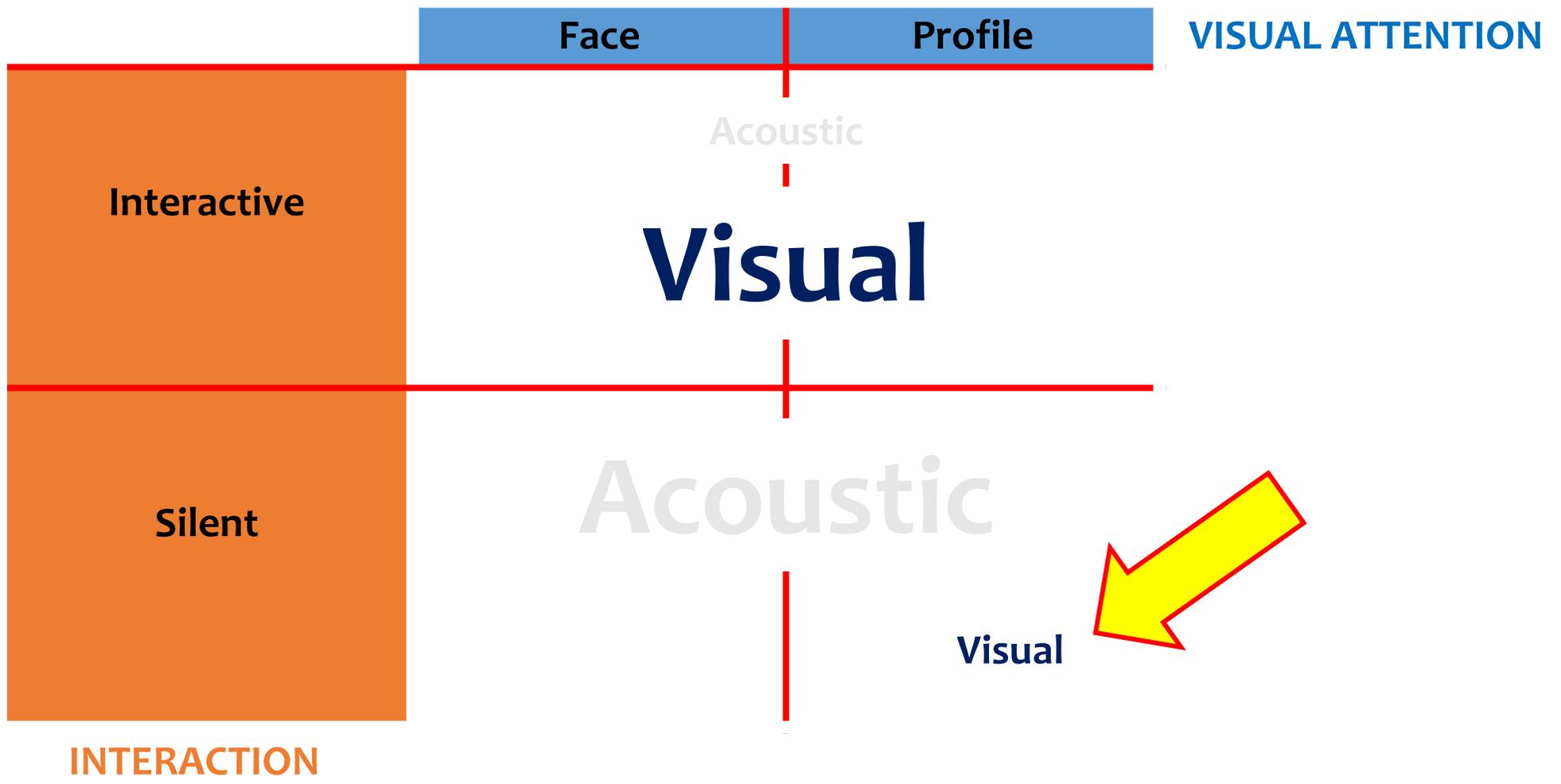
Number of signals per signal modality



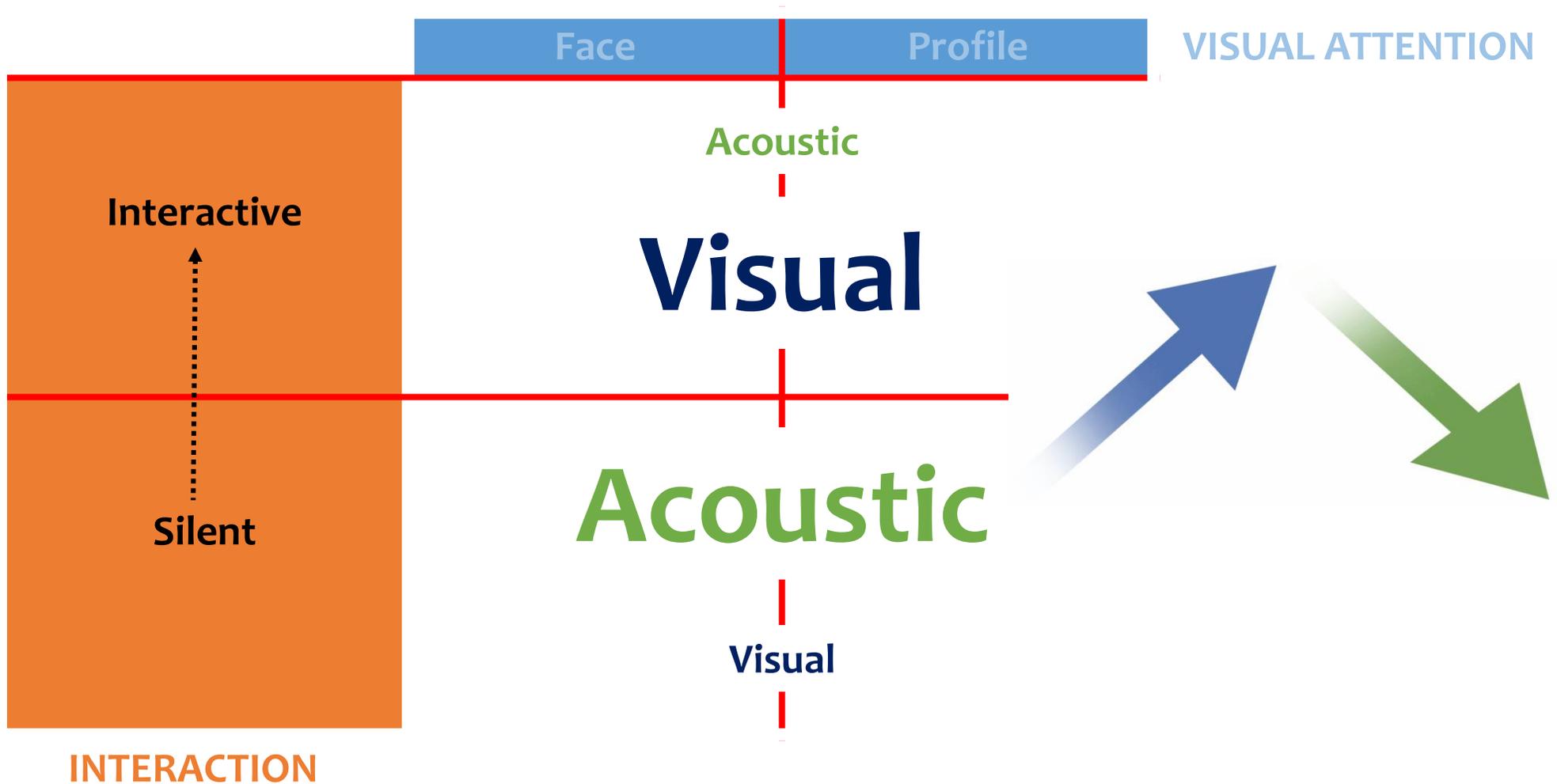
Sum-up of results



Sum-up of results



Sum-up of results



CONCLUSION

Callback

Six-month-old
human infants
Multimodal
communication



INTERACTION

Mother's
interaction state

DISTANCE

VISUAL
ATTENTION



CONCLUSION

Synthesis

Acoustic signals

Visual signals

Multimodal
Communication

VISUAL ATTENTION	INTERACTION	DISTANCE
NO	YES	NO
YES But...	YES But...	NO
NO	YES	NO

CONCLUSION

Take home message

INTERACTION

ORIENTATION

DISTANCE



**6 months-old
human infant**

PREDICTOR

of **INTENTIONAL MULTIMODAL
COMMUNICATION**

Acknowledgments



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Thank you for your attention

