

## Temporal and identity prediction in visual-auditory events

van Laarhoven, T.J.T.M.; Stekelenburg, J.J.; Vroomen, J.

*Document version:*

Publisher's PDF, also known as Version of record

*Publication date:*

2017

[Link to publication](#)

*Citation for published version (APA):*

van Laarhoven, T. J. T. M., Stekelenburg, J. J., & Vroomen, J. (2017). Temporal and identity prediction in visual-auditory events: Electrophysiological evidence from stimulus omissions. Poster session presented at 18th International Multisensory Research Forum (IMRF)., Nashville, United States.

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

### Take down policy

If you believe that this document breaches copyright, please contact us providing details, and we will remove access to the work immediately and investigate your claim.

# Temporal and identity prediction in visual-auditory events: Electrophysiological evidence from stimulus omissions

Thijs van Laarhoven, Jeroen Stekelenburg & Jean Vroomen

Brain Research Volume 1661, 15 April 2017, Pages 79–87

FULL-TEXT available at: <https://doi.org/10.1016/j.brainres.2017.02.014>

## Introduction

A rare omission of a sound that is predictable by anticipatory visual information or self-generated motion induces an early negative omission response at around 45-100 ms (oN1) and subsequent mid- and late latency omission responses (oN2, oP3) in the EEG during the period of silence where the sound was expected.<sup>[1,2]</sup>

It was previously suggested that such omission responses are primarily driven by the identity of the anticipated sound.<sup>[3]</sup> Here, we examined the role of *temporal* prediction in conjunction with *identity* prediction in the evocation of the auditory oN1, oN2 and oP3.

A video of an actor performing a single hand clap (Figure 1) containing reliable anticipatory information about both the identity and onset of the sound served as a reference condition.

In two additional conditions, we varied either the auditory onset (relative to the visual onset) or the identity of the sound across trials in order to hamper temporal and identity predictions.

Regular visual-auditory trials were interspersed with unpredictable sound omissions. Neural activity associated with visual-to-auditory predictions was acquired from these *silent* trials.

## Method

**Participants**  
N = 27 (23 female, all neurotypical)  
Mean age 19.93 (SD = 2.40)

**Stimuli**  
Hand clap video + sound of a hand clap or 100 different environmental sounds (e.g. a doorbell or a car horn)

**Experimental conditions**

1. NATURAL timing of hand clap sound
2. RANDOM-TIMING of hand clap sound -250 to 320 ms relative to visual onset
3. RANDOM-IDENTITY of 100 different environmental sounds with natural timing

88% regular visual-auditory trials 1232 / condition  
12% sound omission (silent) trials 168 / condition<sup>[3]</sup>



Figure 1. Screen capture of the video used in all experimental conditions

scan for VIDEO

## Results

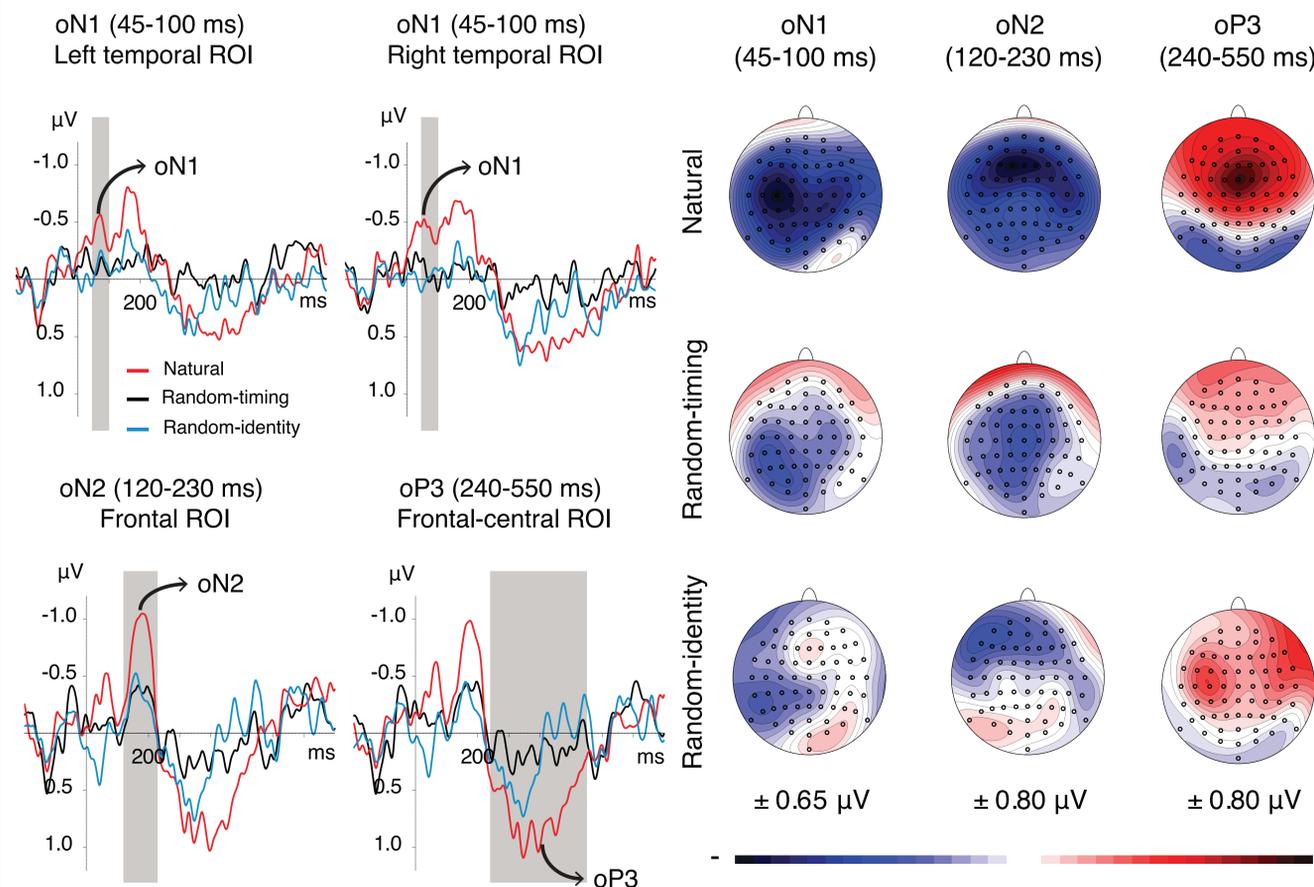


Figure 2. Direct comparison of the grand average omission-ERPs recorded at the regions of interest (ROI) showing maximal activity in the denoted time-windows. Omission responses were corrected for visual activity via subtraction of the visual-only waveform and collapsed over electrodes in each ROI.

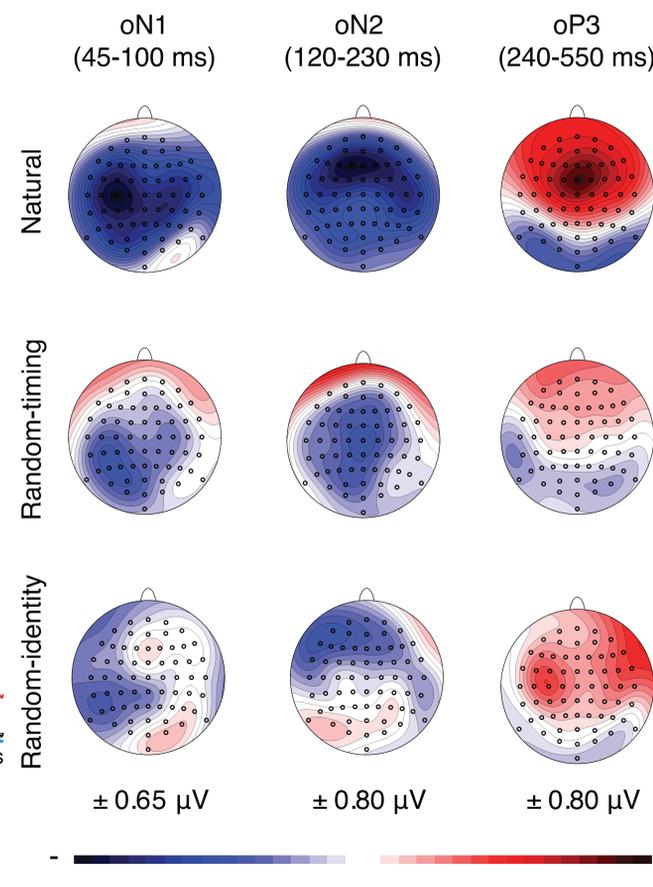


Figure 3. Scalp potential maps of the grand average visual-corrected omission responses.

## Conclusions

Relative to a natural context with correct auditory timing and identity, the oN1 and subsequent oN2 and oP3 components were abolished when either the timing or the identity of the sound could not be predicted reliably from the video.

This indicates that precise predictions of *timing* and *identity* are *both* essential elements for inducing an oN1, oN2 and oP3.

### References

1. SanMiguel, I., Widmann, A., Bendixen, A., Trujillo-Barreto, N., & Schroger, E. (2013). Hearing silences: human auditory processing relies on preactivation of sound-specific brain activity patterns. *The Journal of Neuroscience*, 33(20), 8633-8639. doi: 10.1523/JNEUROSCI.5821-12.2013
2. Stekelenburg, J. J., & Vroomen, J. (2015). Predictive coding of visual-auditory and motor-auditory events: An electrophysiological study. *Brain Research*, 1626, 88-96. doi: 10.1016/j.brainres.2015.01.036
3. SanMiguel, I., Saupé, K., & Schroger, E. (2013). I know what is missing here: electrophysiological prediction error signals elicited by omissions of predicted "what" but not "when". *Frontiers in Human Neuroscience*, 7, 407. doi: 10.3389/fnhum.2013.00407

scan for FULL-TEXT

### Contact information

- Thijs van Laarhoven
- t.j.t.m.vanlaarhoven@tilburguniversity.edu
- linkedin.com/in/tvanlaarhoven

