



# Visualizing natural language interaction for conversational in-vehicle information systems to minimize driver distraction

Michael Braun<sup>1,2</sup>  · Nora Broy<sup>1</sup> · Bastian Pfleging<sup>2,3</sup> · Florian Alt<sup>2,4</sup>

Received: 19 March 2018 / Accepted: 13 March 2019  
© Springer Nature Switzerland AG 2019

## Abstract

In this paper we investigate how natural language interfaces can be integrated with cars in a way such that their influence on driving performance is being minimized. In particular, we focus on how speech-based interaction can be supported through a visualization of the conversation. Our work is motivated by the fact that speech interfaces (like Alexa, Siri, Cortana, etc.) are increasingly finding their way into our everyday life. We expect such interfaces to become commonplace in vehicles in the future. Cars are a challenging environment, since speech interaction here is a secondary task that should not negatively affect the primary task, that is driving. At the outset of our work, we identify the design space for such interfaces. We then compare different visualization concepts in a driving simulator study with 64 participants. Our results yield that (1) text summaries support drivers in recalling information and enhances user experience but can also increase distraction, (2) the use of keywords minimizes cognitive load and influence on driving performance, and (3) the use of icons increases the attractiveness of the interface.

**Keywords** Human–computer interaction · Natural language interfaces · Automotive user interfaces

[Click here for online access](#)

---

✉ Michael Braun  
michael.bf.braun@bmw.de

Nora Broy  
nora.nb.broy@bmw.de

Bastian Pfleging  
b.pfleging@tue.nl

Florian Alt  
florian.alt@unibw.de

- <sup>1</sup> BMW Group Research, New Technologies, Innovations, Munich, Germany
- <sup>2</sup> LMU Munich, Munich, Germany
- <sup>3</sup> Eindhoven University of Technology, Eindhoven, Netherlands
- <sup>4</sup> Bundeswehr University, Munich, Germany

Published online: 19 March 2019