On what happens in speech and gesture when communication is unsuccessful

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Introduction

Repeated references in successful communication are often reduced, at the acoustic level (e.g. Bard et al. 2000), at the lexical level (e.g. Clark & Wilkes-Gibbs 1986), and at the gestural level (e.g. de Ruiter et al. 2012, Galati and Brennan 2014, Gerwing and Bavelas 2004, Hoetjes et al. 2011, Masson-Carro et al. 2014).

The question is what happens in repeated references when communication is not successful, indicated by negative addressee feedback.

While it is known that after negative feedback, speech rate is reduced and prosodic effort increases (e.g., Krahmer et al. 2002, Lieberman, 1963, Oviatt et al., 1998), very little is known about the effect of negative feedback on gesture production (with Holler & Wilkin, 2011, as a notable exception).

We study the influence of negative feedback on the production of repeated multimodal Dutch referring expressions. We focus on gesture rate and aspects of gesture form.

Method
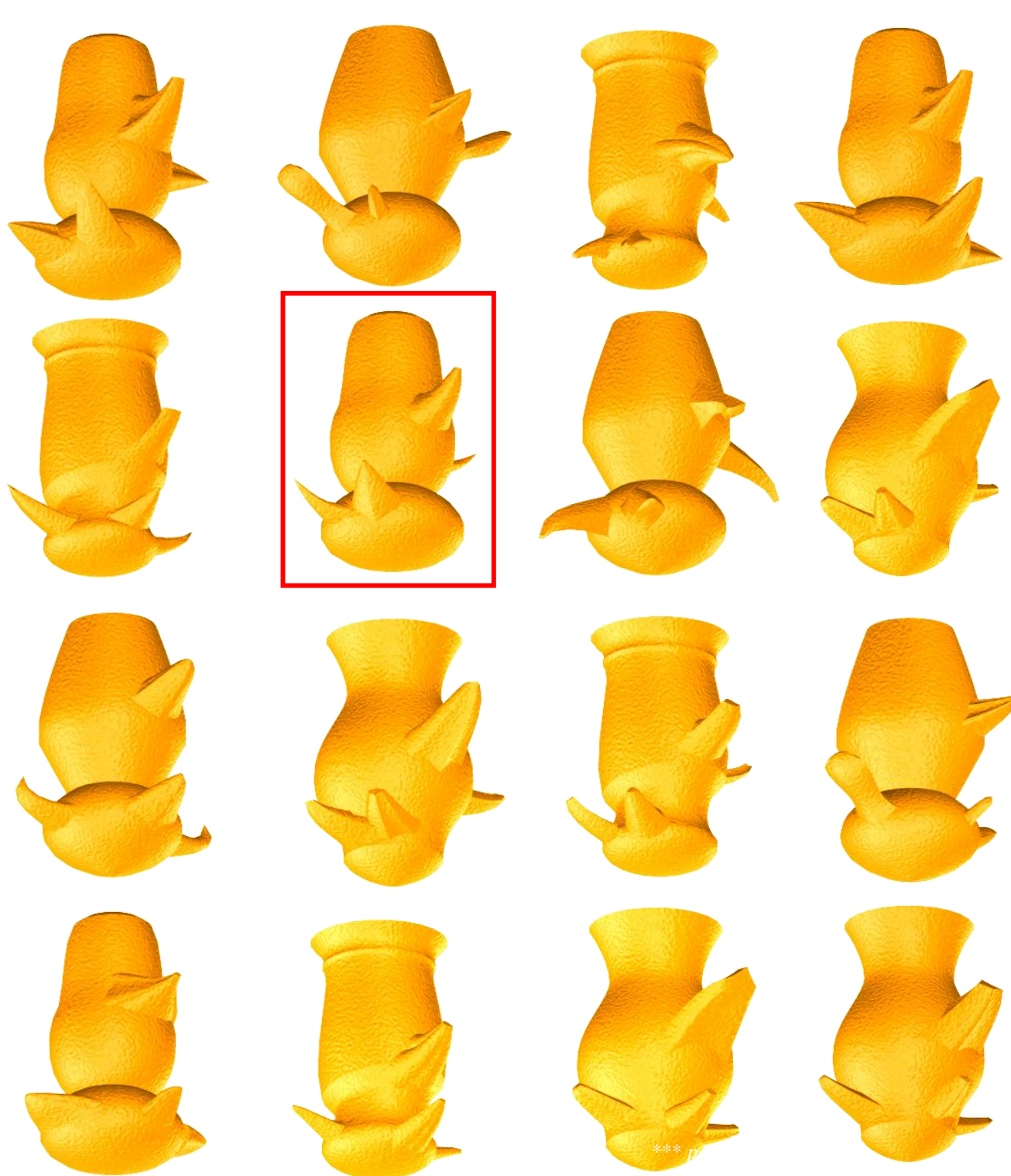
Director-matcher task, using the same general setup as in Hoetjes et al. 2011.

1) Director (N=38) describes target object
2) Confederate matcher determines which object was described
3) Sound indicates whether matcher chose correct object or not (this is the feedback)
4) After sound for incorrect object identification (negative feedback): director redescribes the target object until the matcher has located it

Four objects had to be described three times in a row: so twice after negative feedback

Results

Production experiment

	Initial (SE)	Second (SE)	Third (SE)
Speech rate	2.1 (.05)	1.9 (.05)	1.7 (.05)
Number of gestures	3.3 (.49)	2.6 (.38)	3.3 (.52)
Gesture rate	**4.1 (.67)**	**4.8 (.79)**	**5.3 (.74)**
Gesture duration	1.1 (.07)	1.2 (.09)	1.1 (.06)
Gesture size	2.9 (.10)	2.9 (.09)	2.9 (.09)
Number of hands	1.5 (.06)	1.4 (.06)	1.3 (.05)
Stroke repetition	**.33 (.06)**	**.50 (.10)**	**.55 (.09)**

Speech rate: $F_1(2,72) = 30.61$, $p < .001$, $\eta_p^2 = .460$; $F_2(2,9) = 18.19$, $p < .01$, $\eta_p^2 = .802$; $minF'(2,22) = 11.40$, $p < .001$
Gesture rate: $F_1(2,72) = 7.1$, $p < .01$, $\eta_p^2 = .165$; $F_2(2,9) = 4.8$, $p < .05$, $\eta_p^2 = .516$, $minF'(2,24) = 2.86$, $p = .07$
Stroke repetition: $F_1(2, 54) = 3.24$, $p = .06$, $\eta_p^2 = .107$; $F_2(2,9) = 13.64$, $p < .05$, $\eta_p^2 = .752$; $minF'(2,62) = 2.61$, $p = .08$

Precision judgment experiment

Which gesture do you think is the most precise?

Initial gesture, produced before feedback
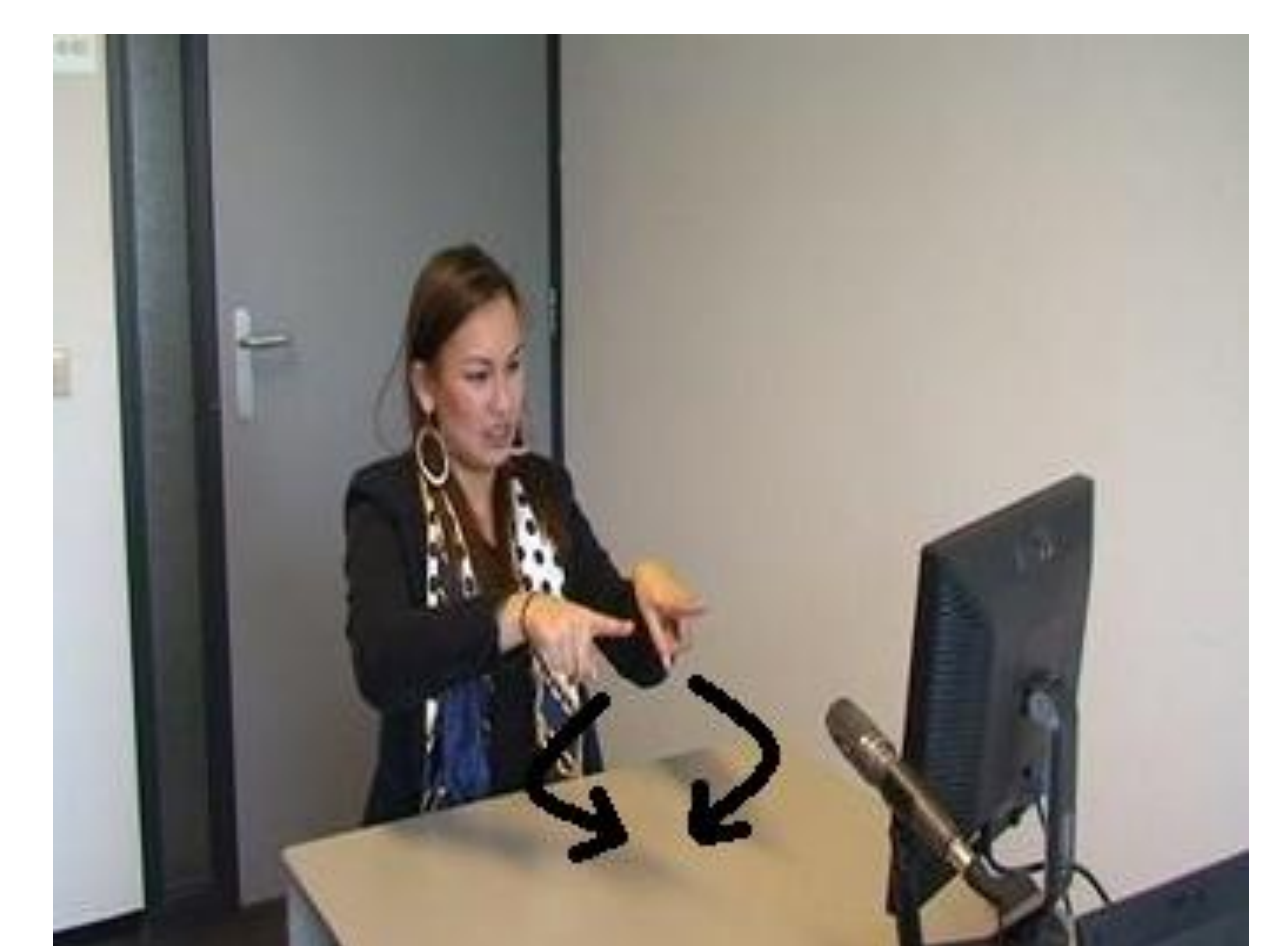
Repeated gesture, produced after negative feedback

Repeated gestures were chosen to be the most precise in 53% of all cases, $p = .053$

Conclusion

Gesture rate increased in repeated references after negative feedback. Gesture form also increased after negative feedback: more repeated strokes within a gesture and more precise gestures. Our results are generally consistent with Holler and Wilkin (2011).

In short, speakers rely relatively *more* on gesture and put *more* effort in their gesture production in references produced after negative feedback, unlike what was found previously for successful repeated references.

References

Bard, E. G., Anderson, A. H., Sotillo, C., Aylett, M., Doherty-Sneddon, G., & Newlands, A. (2000). Controlling the intelligibility of referring expressions in dialogue. *Journal of Memory and Language, 42*, 1-22.
Clark, H., & Wilkes-Gibbs, D. (1986). Referring as a collaborative process. *Cognition, 22*, 1-39.
de Ruiter, J. P., Bangerter, A., & Dings, P. (2012). The interplay between gesture and speech in the production of referring expressions: Investigating the trade-off hypothesis. *Topics in Cognitive Science, 4*(2), 232–248.
Galati, A., & Brennan, S. (2014). Speakers adapt gestures to addressees' knowledge: implications for models of co-speech gesture. *Language, Cognition and Neuroscience, 29*(4), 435-451.
Gerwing, J., & Bavelas, J. (2004). Linguistic influences on gesture's form. *Gesture, 4*, 157-195.
Hoetjes, M., Koolen, R., Goudbeek, M., Krahmer, E., & Swerts, M. (2011). GREEBLES Greeble greeb. On reduction in speech and gesture in repeated references. In L. Carlson, C. Hoelscher & T. F. Shipley (Eds.), *Proceedings of the 33rd Annual Conference of the Cognitive Science Society* (pp. 3250-3255). Boston: Cognitive Science Society.
Holler, J., & Wilkin, K. (2011). An experimental investigation of how addressee feedback affects co-speech gestures accompanying speakers' responses. *Journal of Pragmatics, 43*, 3522–3536.
Krahmer, E., Swerts, M., Theune, M., & Weegels, M. (2002). The dual of denial: Two uses of disconfirmations in dialogue and their prosodic correlates. *Speech Communication, 36*, 133-145.
Lieberman, P. (1963). Some effects of semantic and grammatical context on the production and perception of speech. *Language and Speech, 6*(3), 172-187.
Masson- Carro, I., Goudbeek, M., & Krahmer, E. (2014). On the automaticity of reduction in dialogue: Cognitive load and repeated multimodal references. In P. Bello, M. Guarini, M. McShane & B. Scassellati (Eds.), *Proceedings of the 36th Annual Meeting of the Cognitive Science Society*. Quebec City: Cognitive Science Society.
Oviatt, S., MacEachern, M., & Levow, G.-A. (1998). Predicting hyperarticulate speech during human-computer error resolution. *Speech Communication, 24*, 87-110.