WHERE DOES DISFLUENCY COME FROM? YOUR EYES MAY GIVE A CLUE!

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To reveal the underlying cause of disfluency, several authors attempted to relate the pattern of disfluencies to difficulties at specific levels of production, using a Network Task (Fig. 1). In this paradigm, participants describe a route through a network of pictures. This allows for the manipulation of the items to create difficulties at specific stages (e.g. conceptual generation) while holding others constant (e.g. lexical selection). There is however a consensus that disfluencies are multi-factorial (Clark & Fox Tree, 2002). To disentangle disfluency related to word preparation from others, we combined this paradigm with eye-tracking. We manipulated lexical and grammatical selection difficulty (similarly to Hartsuiker & Notebaert, 2010).

In Experiment 1, 19 native Dutch speakers performed 20 networks. In Experiment 2, 20 native Dutch speakers performed 20 networks that were controlled to only have short lines. In both experiments, we analyzed: self-corrections, silent pauses, filled pauses, prolongations, gaze-onset-to-name-onset interval, number of fixations, anticipatory gazes, and late gazes, related to each picture. Linear-mixed effects models were performed with items' name agreement (low/high), gender (neuter/common), and their interaction as fixed effects. Additionally, we examined whether, by contrast, the manipulated difficulty could be predicted based on the pattern of disfluency or eye-movements associated with it, using multivariate pattern analyses (MVPA, Haynes & Rees, 2006). In experiment 1, we also analyzed the effect of network configuration (short/long line preceding a picture) on disfluency and eye-movements.

In both experiments, low name agreement items induced longer gaze duration prior naming, more self-corrections and silent pauses than high name agreement items, while common gender items elicited more prolongations than neuter gender items. MVPA demonstrated that lexical selection difficulty is predictable from disfluency and eye-movement data patterns (Fig. 2). Additionally, the monitoring of eye-movements showed that not all disfluencies were related to speech encoding. In Experiment 1 for example, participants spent less time gazing at a picture when it was preceded by a long line, while producing more pauses. This implies that they used this configuration to inspect other areas than the upcoming picture.

We replicated the finding that lexical access difficulties elicit self-corrections and pauses (Hartsuiker & Notebaert, 2010). We also showed that, similarly to picture naming (Meyer, Sleiderink, & Levelt, 1998), viewing times vary with word preparation difficulties during connected-speech production. Additionally, eye-tracking provided information about the underlying mechanisms of disfluency, beyond difficulties related to speech encoding.

Clark, H. H., & Fox Tree, J. E. (2002). Using uh and um in spontaneous speaking. *Cognition*, *84*(1), 73–111.

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Meyer, A. S., Sleiderink, A. M., & Levelt, W. J. M. (1998). Viewing and naming objects: eye movements during noun phrase production. *Cognition*, *66*(2), B25–B33.

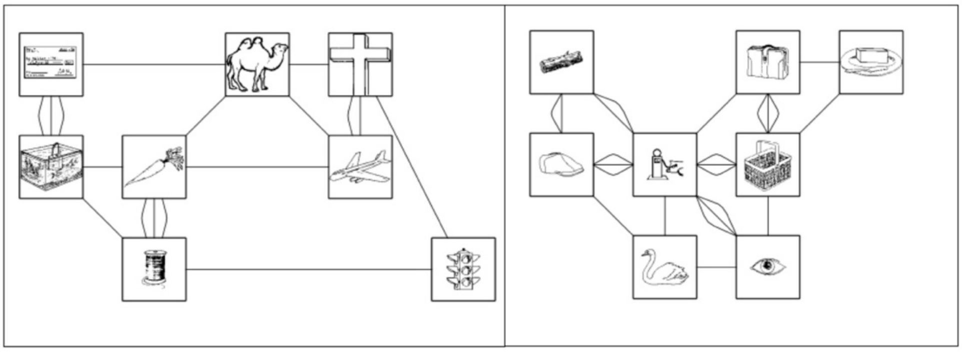

Figure 1. Example of a network for Experiment 1 (left) and Experiment 2 (right). A route through the network was indicated by a moving red dot that traversed the network in 42 seconds.

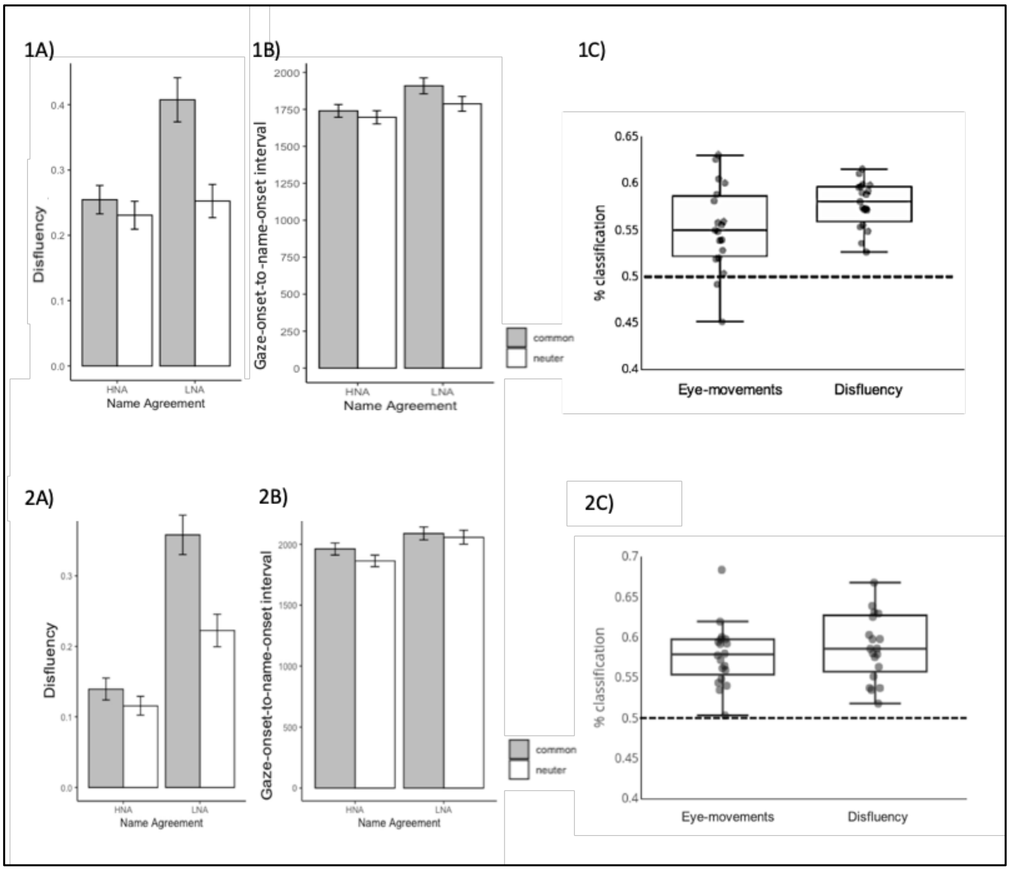

Figure 2. Results for 1) Experiment 1 and 2) Experiment 2.
A) Proportion of total disfluency; B) gaze-onset-to-name-onset interval (in ms) depending on name agreement and gender; C) Classification accuracies for each participant for identifying name agreement of the items based on eye-movements or disfluency. The dashed line represents chance level. Each dot represents classification accuracy for a single participant.
HNA: High Name Agreement; LNA: Low Name Agreement.