Does syntactic alignment predict cooperation? A corpus study of the prisoner's dilemma

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1. Introduction

The cooperative nature of human communication is widely accepted as a fact at least since Grice (1975; but also Clark, 1996). In this study, we investigate whether structural alignment correlates with cooperative behaviour. Some evidence suggests that structural alignment is sensitive to extralinguistic factors such as power (Danescu-Niculescu-Mizil et al., 2012) or status (Lev-Ari & Peperkamp, 2017). However, whether structural alignment itself increases the propensity to cooperate remains unexplored, although some studies point to the fact that lexical imitation leads to prosocial behaviour (van Baaren et al., 2004). Here, we aim to test whether structural alignment affects decisions in a cooperative task.

2. Data

This study uses text transcripts from *Golden Balls* (2007–2009), a TV show in which four contestants play four rounds of a game, voting out one player until only two remain. In the final round of the game, the two contestants can either split the jackpot (divide evenly) or steal it (claim for oneself) at the end of the game. Mutual splitting is better than mutual stealing (each contestant receives

half of the jackpot vs nothing), but stealing while the other participant splits ensures the biggest payoff for the defecting contestant. This payoff structure makes the game formally equivalent to the Prisoner's Dilemma, the game format traditionally used in behavioral economics to model cooperation (Rapoport, 1989). Importantly for the aim of this study, the contestants make their decision based solely on previous interaction with each other.

3. Method and results

Seventeen *Golden Balls* transcripts were parsed for constituency structure with the use of CoreNLP probabilistic context free grammar parser (Manning et al., 2014). These trees were subsequently transformed into production rules (of the form NP → Det N). Unary and lexical productions were removed from the dataset. In total, we obtained 71078 productions. The productions were then automatically annotated for repetitions, and any repetition of a production rule was considered a case of syntactic alignment. Repetitions arising from lexical overlaps were removed from the analysis. We controlled for pre-established linguistic similarity by applying a sliding window and considering the span of 50 previous productions. To test our hypothesis, we fit a GLMM model with alignment as the predictor and contestants' decision (split vs steal) as the outcome variable. We found a positive relation between alignment and cooperation ($\beta = 0.05$, $p = 0.03$).

4. Discussion

The results of our study suggest that syntactic alignment correlates with cooperation in the real world. This is consistent with the interpretation that structural alignment may be a sort of low-level signal/cue that truthfully informs about an individual's disposition to cooperate (Wacewicz et al., 2017) – possibly because structural alignment is difficult to fake (Bargh & Chartrand, 1999). Alternatively, alignment might convey a degree of similarity with others, which has also been shown to promote cooperation (McNeill, 1995).

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References

Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception–behavior link and social interaction. *Journal of Personality and Social Psychology, 76*(6), 893–910.

Clark, H. H. *Using Language.* Cambridge: Cambridge University Press.

Danescu-Niculescu-Mizil, C., Lee, L., Pang, B., & Kleinberg, J. (2012). Echoes of Power... In *Proc 21st Int. Conference on World Wide Web* (pp. 699–708). Association for Computing Machinery.

Grice, H. P. (1975). Logic and conversation. In P. Cole, & J. Morgan (Eds.), *Syntax and Semantics* (pp. 41-58). New York: Academic Press.

Lev‐Ari, S., Heugten, M., & Peperkamp, S. (2017). Relative difficulty of understanding foreign accents as a marker of proficiency. *Cognitive Science, 41*(4), 1106–1118.

Manning, Christopher D., Mihai Surdeanu, John Bauer, Jenny Finkel, Steven J. Bethard, and David McClosky. 2014. The Stanford CoreNLP Natural Language Processing Toolkit. *Proceedings of the 52nd Annual Meeting of the Association for Computational Linguistics: System Demonstrations*, 55–60.

McNeill, W. H. (1995). *Keeping Together in Time: Dance and Drill in Human History*. Harvard University Press. https://doi.org/10.2307/j.ctvjf9wq6

Rapoport, A. (1989). Prisoner's Dilemma. In: Eatwell, J., Milgate, M., Newman, P. (eds) *Game Theory* (pp. 199–204). Palgrave Macmillan, London. https://doi.org/10.1007/978-1-349-20181-5_23

Wacewicz S., Żywiczyński P., Chiera, A. (2017). An evolutionary approach to low-level conversational cooperation. *Language Sciences 63*, 91–104. https://doi.org/10.1016/j.langsci.2017.01.005

van Baaren, R. B., Holland, R. W., Kawakami, K., & van Knippenberg, A. (2004). Mimicry and Prosocial Behavior. Psychological Science, 15(1), 71–74. https://doi.org/10.1111/j.0963-7214.2004.01501012.x