Linguistic preference outcompetes alignment as a predictor for assessing others' cooperativeness

Theresa Matzinger[1,2], Marek Placiński[1], Adam Gutowski[1], Mariusz Lewandowski[1], Przemyslaw Zywiczynski[1], Sławomir Wacewicz[1]

[1] Department of English and American Studies, University of Vienna
[2] Center of Language Evolution Studies, Nicolaus Copernicus University Toruń

Corresponding author: Theresa Matzinger, theresa.matzinger@univie.ac.at

Abstract

An important quality to assess in others is their cooperativeness. Since linguistic communication requires a high degree of cooperation between interaction partners, we hypothesized that people use linguistic markers in their partners' speech as a proxy of their cooperativeness in other tasks. Specifically, we predicted that participants would prefer syntactically similar conversation partners as cooperation partners in a monetary game. We found that, indeed, participants preferably selected syntactically similar conversation partners as cooperation partners, but only when the participants could communicate using their naturally preferred constructions. In contrast, when participants were forced to communicate using dispreferred constructions, they rather cooperated with those partners that matched their natural preference than with those that matched their overt linguistic use. This suggests that general linguistic alignedness, which is a potential indicator of group membership and may be associated with in-group cooperation benefits such as reputation, reciprocity and normative behavior, is a more important predictor of cooperation partner choice than dynamic alignment, which can be regarded as a first cognitive investment in the cooperation or a signal of out-groups showing the willingness to adapt. This has important implications for communication in intercultural settings where members of diverse linguistic groups negotiate cooperative actions.

Keywords: linguistic alignment, syntactic alignment, cooperation, linguistic preference, behavior, linguistic similarity

1. Introduction

Humans are unique in having the capacities to both communicate linguistically and cooperate to an exceptional degree (Connor, 2010). The main overall aims of this paper are to explore potential causal relations between language and cooperation, to understand how such interactions may shape human social behavior, and to offer clues to the cognitive mechanisms behind those two traits. This may help to get a better understanding of the (co-)evolutionary emergence of linguistic and cooperative behavior.

Language and cooperation are closely related. In particular, language unlocks a rich inventory of mechanisms for maintaining and strengthening cooperation: on the one hand, it facilitates cooperative action through verbal planning and coordination (Gärdenfors, 2004), raises the costs of non-cooperation by spreading the track record of individuals via gossip (e.g. Dunbar, 1996; Henrich & Henrich, 2007), and allows for the verbal construction of institutional norms to punish defectors (e.g. Searle, 1995). On the other hand, linguistic similarities and differences can indicate one's group of origin, and in-groups

tend to cooperate more with one another than with out-groups (Balliet et al., 2014; Hewstone et al., 2002). This is why language use can induce both cooperation and conflict (see esp. Cohen, 2012).

Still, even within linguistically homogeneous groups, there is a potential for linguistic variance. For instance, over the course of a conversation, speakers may choose to use words or grammatical constructions that are different from or similar to the ones that their interlocutors use. This gradual convergence of interlocutors on the same linguistic choices is commonly known as alignment (Pickering & Garrod, 2004) and has been found to influence (or be sensitive to) factors such as conflict, pro-social behavior, power and status (e.g. Lev-Ari & Peperkamp, 2017). Those relations suggest that linguistic alignment may also promote cooperation between interactants, which is an interesting possibility that has not yet been systematically explored. In this paper, we aim to fill this gap by experimentally testing whether linguistic similarities, specifically structural similarities, have the potential to foster cooperative tendencies in individuals.

1.1 Cooperation and overall behavioral similarities

Several traits have been found to foster cooperative tendencies in humans, amongst them being behavioral similarities that exist on a group level (from now on referred to as *alignedness*) as well as behavioral similarities that develop and change during individual interactions (from now on referred to as *alignment*; Henrich & Henrich, 2007).

Alignedness may be one important cooperation-supporting mechanism because the degree of overall behavioral similarity can indicate group membership since it is naturally greater with ingroups than outgroups. There are several reasons why cooperation is more effective and more stable within social groups. For example, choosing to collaborate selectively with in-group members is likely to help both in reducing the costs as well as increasing the benefits of the interaction. Within groups, costs are reduced due to a lower risk of defection. This is, for instance, because within close-knit groups, individuals' track record can be spread more easily than outside of groups where interaction opportunities are less frequent. This is why individuals will be less likely to defect within groups (e.g. Dunbar, 1996).

Benefits are increased, for example, because within groups, cooperation can increase inclusive fitness due to genetic relatedness (Hamilton, 1964a; Hamilton, 1964b). In addition, within groups, there is a higher potential for reciprocity and individuals are more likely to share common goals. Also, favorable track-records will spread more easily within groups, which is why in-group members will be more inclined to cooperate. In addition, many groups require their members to internalize cooperative norms. Group members usually cooperate following those norms, making cooperation more efficient, whereas non-cooperators are punished according to the norms (Henrich & Boyd, 2001). This is why it is beneficial to reliably recognize group members, and thus potentially good cooperation partners.

The idea that behavioral similarity enhances cooperation is further supported by the cultural group selection model (Boyd & Richerson, 2002), theories regarding group identity (e.g. Tajfel & Turner, 1979), and biological markets theory (Noë & Hammerstein, 1994), which motivates selectively choosing cooperative partners (Barclay, 2016). In addition, tag-based models of cooperation (e.g. Axelrod et al., 2004) claim that an individual's propensity to engage in cooperative behavior is often triggered by their ability to detect certain observable features (or tags) in others, and suggest that often simple mutual similarity is sufficient as such a tag. Tag-based cooperation has been shown to be potentially stable in several simulation studies (e.g. Riolo et al., 2001; Axelrod et al., 2004; Shultz et al., 2009). Thus, overall, collaborative interaction is easier and smoother within groups and with similar individuals, leading to increased efficiency and thus a greater gross benefit of cooperation.

Alignment, i.e. the gradual convergence of interactants on similar behaviors, may foster cooperation because people might use it as a proxy for others' willingness and aptitude to adapt and cooperate. This might not only happen for conscious or high-effort behavioral alignment but also for subconscious or

low-effort behavioral alignment (see esp. the review in Wacewicz et al., 2017). "Low-level behavioral similarity" (Wacewicz et al., 2017) refers collectively to a host of phenomena—described in the literature as alignment, accommodation, attunement, resonance, or synergy—whereby the bodily behavior of interactants becomes progressively more similar in form (mimicry) or more coordinated in timing (synchrony). Importantly, "low-level" indicates phenomena over which interactants have no or little direct volitional control, which is why they cannot be easily faked by defectors or substandard cooperators. Thus, such convergence on low-level behavioral similarities is important in establishing and maintaining cooperation.

This is supported by a sizable body of evidence. For example, there is developmental evidence for the tendency for synchrony and mimicry to enhance cooperative and altruistic behavior (Malloch & Trevarthen, 2009). 14-month-olds showed an increased tendency to help the experimenter collect accidentally dropped objects after bouncing to music in synchrony with the experimenter (Cirelli et al., 2014), and 18-month-olds were more cooperative when being imitated (Carpenter et al., 2013). In adults, low-level nonverbal phenomena such as mutual eye gaze or gentle touch were shown to affect prosociality in public goods games (Kurzban, 2001). Also, mimicry and synchrony have been found to have an effect on helping behavior and general prosocial behavior (van Baaren et al., 2004; Wiltermuth & Heath, 2009). Furthermore, movement coordination occurring spontaneously during conversation was found to promote cognitive coordination, and in turn promoted cooperative communication (Shockley et al., 2003).

In addition to the relation between low-level behavioral alignment and cooperation as such, it is interesting to pay attention to a number of variables such as "trust", "liking" and "rapport" that can be considered psychological proxies for cooperation. For example, mimicry of mannerisms, such as shaking one's foot in response to foot-shaking performed by one's conversational partner, leads to increased rapport (Chartrand & Bargh, 1999; van Baaren et al., 2004; Ashton-James et al., 2007). Also, both conscious and nonconscious synchronized activities promote social bonding as well as prosociality by viewing fellow interactants as more similar to oneself (Lakens & Stel, 2011; Miles et al., 2009), being well disposed towards each other (Dijksterhuis & Bargh, 2001) and more inclined to behave altruistically (Valdesolo & DeSteno, 2011). Synchronized movement increases reported affiliation (Hove, 2008; Hove & Risen, 2009), even when actual interaction is replaced by computer-generated patterns (Launay et al., 2013). Thus, behavioral alignment fosters not only cooperation itself but also traits that support cooperation.

While the positive influence of general behavioral alignedness and bodily behavioral alignment on cooperation is well-established, less is known about the influence of linguistic behavior on cooperation. We will review some evidence for links between linguistic similarity, in-group membership, and cooperation in the following section.

1.2 Cooperation and linguistic similarities

In analogy to overall behavioral alignedness and alignment, one can also distinguish two different manifestations of linguistic similarity: *linguistic alignedness* i.e. using similar linguistic choices from the outset, and *linguistic alignment* i.e. converging on similar linguistic choices over the course of an interaction. Both have the potential to foster cooperation.

The main reason why linguistic alignedness may enhance cooperation is that speaking a similar language is an indicator of group membership and that all of the above-discussed advantages of cooperation with group members apply. Other culturally transmitted traits such as dress code, hairstyle, eating habits, interests, or behavioral norms can also signal group membership (Henrich & Henrich, 2007). However, linguistic traits such as native language, accent, and dialect have been posited to be particularly effective (see e.g. Nettle & Dunbar, 1997; Roberts, 2008).

Cohen (2012) has proposed a tag-based model of cooperation specifically involving the accents of language users, suggesting that "linguistic cues inherent in speech accent, or patterns of intonation and phonology, harbor special potential as reliable tags for the orientation of social and cooperative preferences among strangers" (p. 592). Cohen (2012) offers a detailed account of how one's speech accent fulfills the criteria of salience, individual's property, comparability, honesty, cost-effectiveness, discriminability, dynamism, anciency, universality, and early acquisition – which all together make it a reliable cue of group membership and of cooperation partner quality.

Those links between linguistic alignedness, group membership, and cooperation apply to linguistic similarity on a large scale, such as speaking the same native language, accent, or dialect. However, linguistic alignedness can also happen on a smaller scale such as on the syntactic or lexical level, meaning that people share preferences for certain grammatical constructions or word choices. It has not yet been explored if alignedness on those subtler levels of linguistic communication can serve as a group marker and might in turn influence cooperation.

In contrast to linguistic alignedness, linguistic alignment can only partially happen on the level of native language, accent, or dialect because spontaneously adapting to a language, accent, or dialect without prior experience is in most cases too cognitively demanding. Therefore, the main areas of interest when it comes to linguistic alignment are small-scale similarities and differences, such as alignment on the syntactic or lexical level. Such linguistic alignment may be a potential trigger for cooperation.

1.3 Linguistic alignment

Linguistic alignment can be defined as the convergence of phonological, lexical, and syntactic choices as well as their semantic interpretation in dialogue (Pickering & Garrod, 2004). Though this definition is generally agreed upon (Doyle & Frank, 2016; Branigan et al., 2010; Weatherholtz et al., 2014), the processes leading to that convergence are a cause of contention between different areas of linguistics. As a result, we can identify (at least) two general approaches explaining the occurrence of alignment: mechanistic and socially-driven ones.

The mechanistic approach towards alignment emerged in psycholinguistic research (Bock, 1986; Branigan et al., 1995) and attempts to frame the convergence of linguistic expressions as a product of priming. From this perspective, alignment is beyond conscious control of interlocutors, and its primary role is to facilitate mutual comprehension (Pickering & Garrod, 2004). The basic mechanism leading to alignment – priming – operates at all levels of linguistic representation, including the phonological, lexical and structural levels.

Alternatively, alignment can be viewed as an effect of socially-driven processes. In that case, linguistic convergence is modulated by other factors on top of language processing, and can by itself influence social processes. Certain studies suggest that alignment in various forms can be used to manage and mitigate social distance (Giles & Powesland, 1975), signal social status and power (Danescu-Niculescu-Mizil et al., 2012; Lev-Ari & Peperkamp, 2017), manage conflict (Weatherholtz et al., 2014), or induce pro-social behaviors (Kulesza et al., 2014). Based on these observations, alignment cannot be fully accounted for solely on the basis of mechanistic priming, but social factors need to be considered as well. A greater degree of alignment also appears to influence the perception of the interlocutor, in that the other is perceived more positively when they align more (Schoot et al., 2016). Further, it induces greater generosity (van Baaren et al., 2003) and affects interpersonal bonds, acting as "social glue" (Lakin et al., 2003). It is therefore reasonable to expect that similar relations may hold between linguistic alignment and cooperative behavior.

1.4 Research questions, hypotheses and predictions

Because previous research indicates that overall low-level behavioral similarity can induce cooperative behavior between individuals, we investigate whether linguistic similarity can also promote cooperation. Here, we focus on one clearly defined instance of linguistic similarity, namely syntactic similarity, and hypothesize that individuals are more likely to cooperate with others who are syntactically similar to them.

To test this, we conducted an online experiment, in which study participants communicated with others about ditransitive events in a picture-description task (cf. Bock, 1986). The ditransitive events could be described by either using a prepositional dative construction (e.g. "The agent gives the object to the recipient"), or a double object construction (e.g. "The agent gives the recipient the object"). This variation in constructions gave rise to two communicative situations: one where the communication partners used syntactic constructions that were aligned with the ones used by the participants, and another one where the communication partners did not align with the participants. We predicted that participants would prefer those partners as cooperation partners in a subsequent cooperation game that had previously communicated using the same syntactic construction as the participants.

A secondary aim of our study was to explore if people prefer linguistically similar conversation partners as cooperation partners because of more deeply entrenched personal preferences for certain linguistic patterns, or because of preferences on a more superficial mechanistic level that are e.g. caused by priming. To test this, we tested two groups of participants: the first group (from now on, the *preference group*) could communicate using their own naturally preferred constructions, whereas the second group (from now on, the *dispreference group*) was forced to communicate using the construction opposed to their natural preference. This means that for half of the participants, the syntactically similar partners accommodated to the participants' preferred construction (i.e. they displayed alignedness) and for the other half, the syntactically similar partners accommodated to the participants' dispreferred construction (i.e. they displayed alignment).

If linguistic similarity leads to people being perceived as more cooperative because of a deeply entrenched preference for a particular linguistic variant, we predict that the positive effect of linguistic similarity on cooperation partner choice will only surface in the preference group, i.e. in the participants that can communicate using their naturally preferred constructions. In contrast, the positive effect of linguistic similarity is not expected to show up in the dispreference group, where communication partners are aligned with a variant that participants are forced to use in the experiment but would not naturally use themselves.

In contrast, if linguistic similarity leads to people being perceived as more cooperative because of similarities on a superficial mechanistic level, the positive effect of linguistic similarity on cooperation partner choice is predicted to surface irrespective of whether participants have a natural preference for the variant used by their partners. Thus, the effect is expected to show up in both the preference and the dispreference group.

2. Methods

2.1 Procedure and Experimental Conditions

The experiment consisted of three phases that are described in more detail below: the preference testing phase, the interaction phase, and the cooperation game.

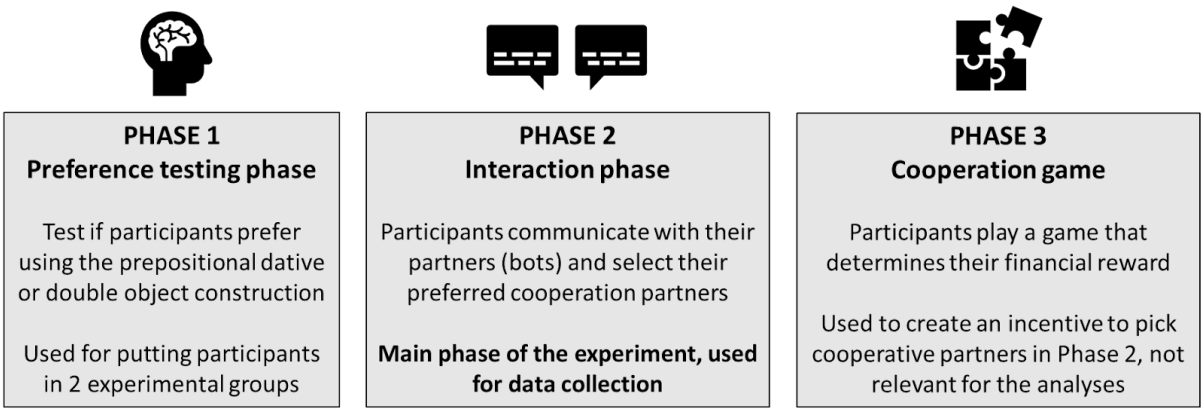


Figure 1. Overview of the experimental procedure

2.2.1 Preference testing phase

In the first phase, the preference testing phase, participants were shown a cartoon depicting a ditransitive event with an agent (e.g. a vet) lending an object (e.g. a hammer) to a recipient (e.g. a singer, Fig. 1). The participants had to choose in a forced-choice task from a set of four given sentences the one that, in their opinion, described the picture best. Two of the presented sentences were semantically correct but differed in the syntactic construction used to describe the ditransitive event: the prepositional dative construction (e.g. "The vet lends the hammer to the singer.") vs. the double object construction (e.g. "The vet lends the singer the hammer."). The other two sentences were semantically incorrect and served as distractors (e.g. "The singer lends the hammer to the vet." and "The singer lends the vet the hammer."). The order of the four presented sentences was randomized.

When the participants picked a semantically wrong sentence, they were told to revise their choice to a semantically correct one. When the participants chose one of the two semantically correct options, we recorded the chosen construction, i.e. the prepositional dative or the double object construction as the participants' preferred one. This preference for a particular syntactic construction was used to assign the participants to one of two experimental groups in the next step of the experiment, the interaction phase.

In addition to measuring the participants' preference for a particular ditransitive construction, the preference testing phase also served the purpose of familiarizing the participants with the experiment. To the participants, this task was introduced as a "training phase", i.e. they were unaware that their grammatical preferences were determined during that phase.

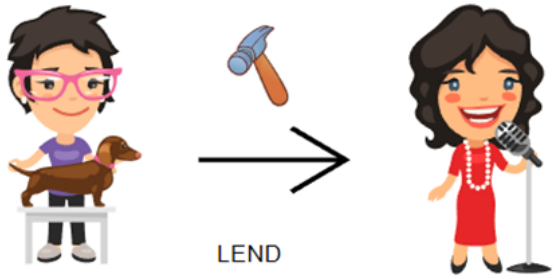


Figure 2. Example of a cartoon that participants had to describe in the experiment.

2.2.2 Interaction phase

The second phase of the experiment, the interaction phase, consisted of 15 trials that each comprised a picture-description task followed by a partner choice task (cf. Branigan et al., 2000). In each trial, the

participants described a cartoon showing a ditransitive event (Fig. 2a) to other players that they believed to be other participants but that were in fact pre-programmed bots. The participants described the cartoon by choosing the semantically correct sentence from a set of four sentences, out of which three were semantically wrong distractors. In this task, one half of the participants, the so-called *preference group*, got to choose from sentences that described the picture with their previously determined preferred syntactic construction. The other half of the participants, the so-called *dispreference group*, got to choose from sentences that described the picture with the syntactic construction contrary to the one that they had picked in the preference testing phase (i.e. participants that preferred the prepositional dative construction got to choose from sentences using the double object construction, and vice versa).

The participants were made to believe that their descriptions were used by the other players to identify the correct picture in a set of many. After picture identification, the fictive other players sent back their selected picture together with a description of the picture in their own words. To make it appear more plausible for the participants that they were playing with other human players and that there was some variation in their partners' answers, the fictive interaction partners had just seven seconds to finish this task (Fig. 2b).

Finally, participants were shown the selected pictures and written descriptions of two other randomly chosen fictive partners and picked their preferred partner for a subsequent cooperation game in a two-alternative-forced-choice task (Fig. 2c). They made their choices based on how well they thought the partners had performed in the picture identification and description task. Participants were made to believe that the program would automatically calculate their preferred cooperation partner across all 15 trials in this phase.

This partner choice task was our main task of interest and included our experimental conditions: the test condition, the control condition, and the scam condition. In the *test condition*, one of the fictive interaction partners answered with a syntactic construction aligned with the one used by the participant, and the other interaction partner answered with a syntactic construction non-aligned with the one used by the participant (6 trials). Both partners had picked the correct picture and their answers were semantically correct. We randomized which construction was shown on the left and right sides of the screen. We predicted that in the test condition, participants would choose the aligned partner as their preferred partner for the cooperation game.

In the *control condition*, the two displayed pictures and sentences were identical (3 trials with both partners using the double object construction, and 3 trials with both partners using the prepositional dative construction) and semantically correct. We predicted that in this condition, participants would choose their preferred partners randomly.

In the *scam condition* (3 trials), only one of the fictive partners had picked the correct picture and replied with a semantically correct sentence, whereas the other fictive partner had picked a wrong picture and replied with a sentence containing spelling mistakes. We predicted that in this condition, participants would choose the semantically correct partner without spelling mistakes as their preferred cooperation partner. The scam condition was used to assess participants' attention during the experiment.

The first trial was always a scam trial, and the presentation of all other trials was randomized. The order of cartoons was pseudo-randomized across conditions.

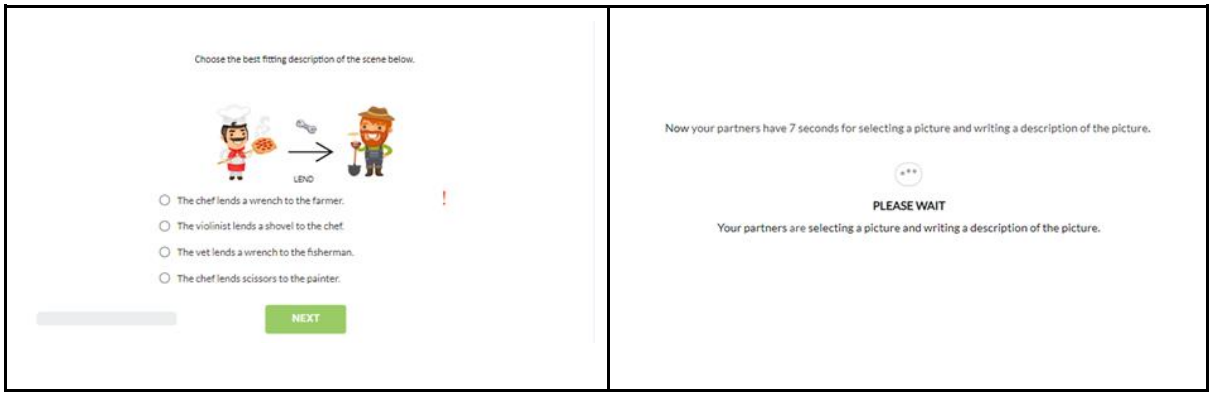


Figure 3. Snapshots of the experimental interface: A. participants describe a cartoon, B. participants wait for their fictive partners' response

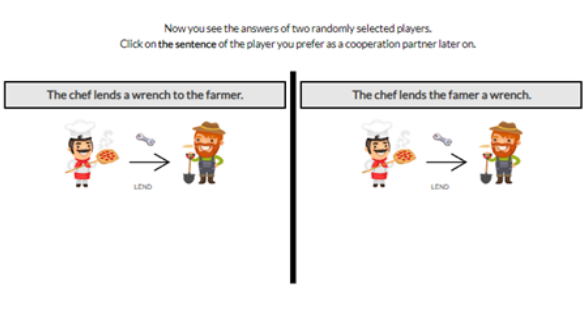
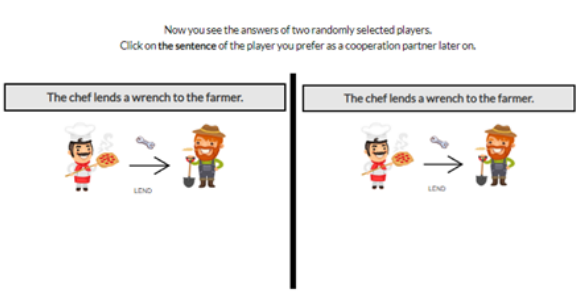
Condition	**Example**	**Prediction**
Test		Participants will preferably select the aligned partner as a cooperation partner.
Control		Participants will select their preferred cooperation partners randomly.
Scam		Participants will preferably select the partner that chose the correct picture, described the correct picture and made no spelling mistakes.

Figure 4. Snapshots of the experimental interface in the three experimental conditions and respective predictions.

2.2.3 Cooperation game

To motivate the participants to choose cooperative partners in the interaction phase, they were told at the beginning of the experiment that, in the end, they would play a cooperation game with their preferred partner, the success of which would determine the exact amount of their financial reward for participation. Determining the exact amount of their financial reward was the only purpose of the cooperation game, and it was not relevant to any of our variables of interest. In the cooperation game, participants and their fictive partners had to change the color of sixteen squares displayed on the screen by clicking on them. The fictive partner's moves in the game were pre-programmed, and the participant had to change the color of the remaining squares within 15 seconds to get the extra reward.

2.3 Participants and Setting

We tested 100 participants (47 female, 45 male, 8 other; mean age: 35.15 ± SD 13.16 years), who were all native speakers of English. We did not make any restrictions regarding the variety of English spoken. Participants were recruited via the crowdsourcing platform Prolific and were rewarded with £ 1.0 for their participation. To increase the participants' motivation to choose their cooperation partners carefully, we provided an additional bonus payment of £ 0.5 for those participants that successfully completed the cooperation task within the set time limit of 15 seconds. 57 participants succeeded and received this bonus payment.

For all participants, the experiment was administered via the experiment platform Labvanced (Finger et al., 2017). Participants received a link to the experiment and completed the experiment on their own devices. After the experiment, participants completed a short questionnaire asking for information about their attention to their partners' language use and their reasons for their partner's choices. At the end of the questionnaire, participants were debriefed, were cleared up on the fact that they had played with bots instead of real partners, and were informed about the possibilities to receive further information about the study.

In total, the experiment lasted about 12 minutes per participant. Participants had the opportunity to drop out from the experiment at any time without consequences. The study protocol was approved by the Ethics Committee of the University of Vienna (reference number: 00569), and all participants gave their informed consent in accordance with the Declaration of Helsinki.

2.4 Stimulus Material

The individual cartoon characters and objects were purchased from a commercial online cartoon database and were then pasted together to create scenes depicting ditransitive actions. All characters were clearly identifiable by their professions and associated items in the cartoons (e.g. astronaut, architect, or chef). All objects were common tools or household items. Thus, participants were able to easily identify the correct descriptions of the scenes.

All scenes depicted actions in which a person transferred an object to another person. In order to minimize the influence of subcategorization bias, we queried the British National Corpus (Burnard, 2007) via Sketch Engine (www.sketchengine.eu/) for the occurrence of main verbs often used in psycholinguistic studies (*give, hand, lend, loan, offer, post, sell, send, show* and *throw*) in either prepositional dative or double object constructions. Our query revealed that the ratio of the frequency of these two constructions is closest to 1 (185 prepositional datives and 259 double objects) for *lend*, which we subsequently chose as the main verb in our study.

2.5 Analyses

To analyse whether participants' partner choices were influenced by the partners' syntactic similarity and by the participants' syntactic preference, we fitted a Generalized Linear Mixed Effects Model (Baayen, 2008) with a logit link function (McCullagh & Nelder, 1989). *Condition* (with the levels "test" and "control") and *participant group* (with the levels "preference group" vs. "dispreference group"), as well as their interaction, were included as fixed effects into the model. Additionally, we included a random intercept effect of *participant* in the model. The dependent variable in our model was whether the participants had chosen their partners according to our prediction (with the levels "yes" and "no"). Responses were coded as matching our prediction when participants chose the aligned partner in the test trials and a randomly pre-defined partner in the control trials. The sample size of this model was 1200 data points (100 individuals tested on 2 conditions with 6 trials each), 637 of which were partner choice responses that matched our prediction. We used the *preference group* and the *control condition* as reference levels in the model. The model was fitted in R (version 4.2.1; R Development Core Team, 2018), using the function *glmer* of the R-package *lme4* (version 1.1-30; Bates et al., 2015).

To test the overall significance of *condition* (i.e. its main effect and its potential interaction with the *participant group*) on partner choice, we used a likelihood ratio test to compare our full model to a null model that did not include *condition* and its interaction with *participant group* but only the random intercept of *participant* (R function *anova*; Dobson, 2002). To obtain the p-values for the effects of the individual model predictors, we used the R-package "lmerTest" (version 3.1-3; Kuznetsova et al., 2017).

To assess the goodness-of-fit of our model, we calculated the marginal and conditional R^2 for our full model (Nakagawa & Schielzeth, 2013). The marginal R^2 (R^2_m) indicates the variance explained by the total of the fixed effects, and the conditional R^2 (R^2_c) indicates the variance explained by the total of the fixed and random effects. Thus, these measures assess the effect size of the full model. We calculated R^2_m and R^2_c using the *r.squaredGLMM* function from the "MuMIn" package, using the "theoretical" method (Bartón, 2018).

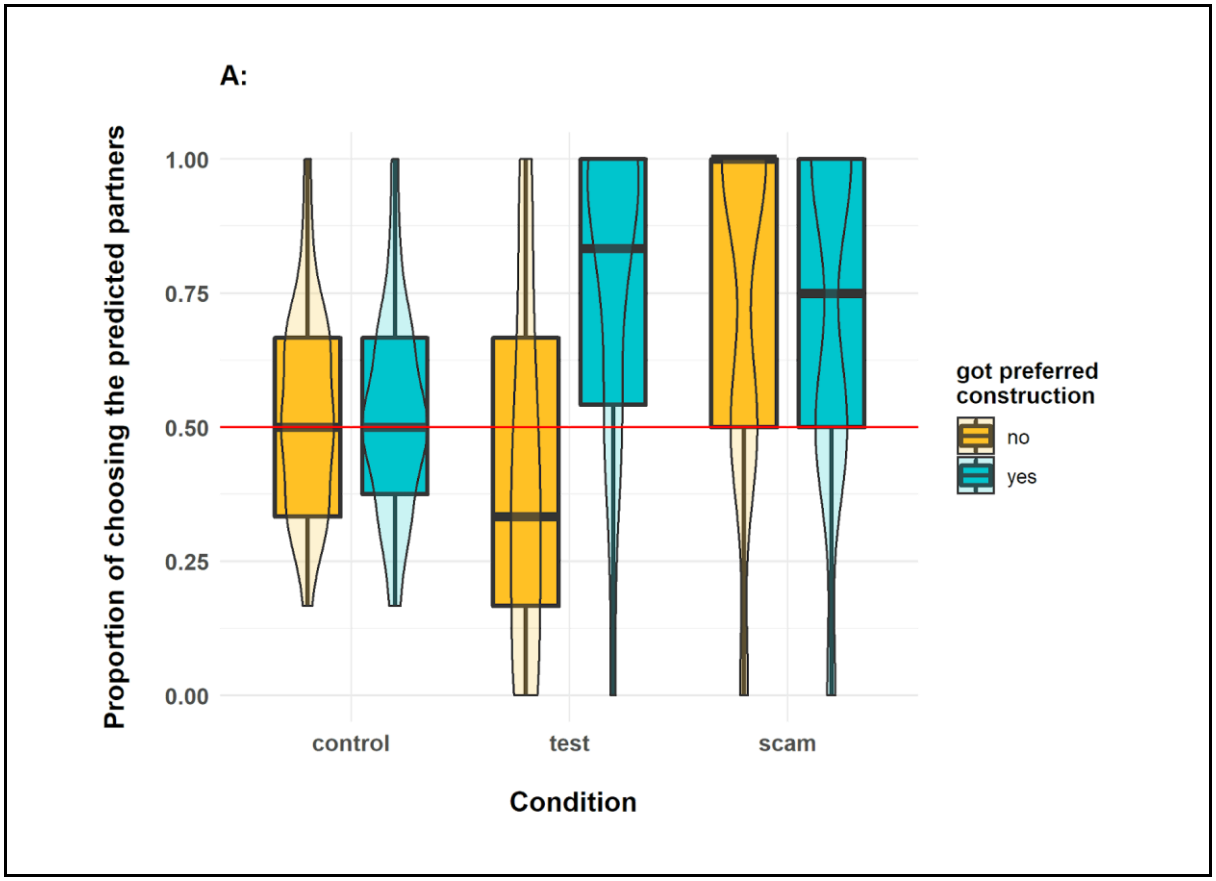
We preregistered all hypotheses, study protocols, and analyses, including provisional R files, on the Open Science Framework (Preregistration date: 20 Dec, 2022; https://osf.io/2qrnm/?view_only=ea88f2734f744ba8bf3bf60c3d9eb53d).

3. Results

The comparison of the full model and the null model revealed an effect of condition, participant group, or their interaction on partner choice (likelihood ratio test: $\chi 2 = 84.99$, $df = 3$, $p < 0.001$; effect size for the full model: $R^2_m = 0.11$, $R^2_c = 0.20$). More precisely, the full model showed that the interaction effect of condition and participant group was significant, which indicates that participants performed differently in the test and control condition, depending on whether they got to use their preferred syntactic construction or not (Tab. 1: model results). Specifically, as predicted, in the control condition, participants chose their partners randomly (Fig. 3A, Fig. 3B: 95% confidence intervals including 50% of choosing the predicted partner). In the test condition, participants chose their partners significantly differently from chance (Fig. 3A, Fig. 3B: 95% confidence intervals do not include 50%). However, only participants in the preference group, i.e. participants who could use their preferred syntactic constructions, preferred the aligned partners as cooperation partners as we had predicted (95% confidence interval above 50%, ranging from 69.00% to 85.00%). In contrast, against our prediction, participants in the dispreference group, i.e. participants who were forced to use a syntactic construction different from their naturally preferred one, did not preferably choose the aligned partners as cooperation partners (95% confidence interval below 50%, ranging from 31.53% to 49.80%). Instead, they chose to cooperate with those partners that used a syntactic construction aligned with their personal preference.

Table 1. Results of the linear mixed model exploring the effects of pause condition and participant group on cooperation partner choice in a 2-alternative-forced choice task. The table reports estimated model coefficients (Estimate), standard errors (SE) and p-values (p).

Full Model	**Estimate**	**SE**	**p**
Intercept	-0.10	0.15	
Condition_Test	1.40	0.19	< 0.001
ParticipantGroup_Dispreference	-0.02	0.21	0.905
Condition_Test: ParticipantGroup_Dispreference	-1.68	0.26	< 0.001



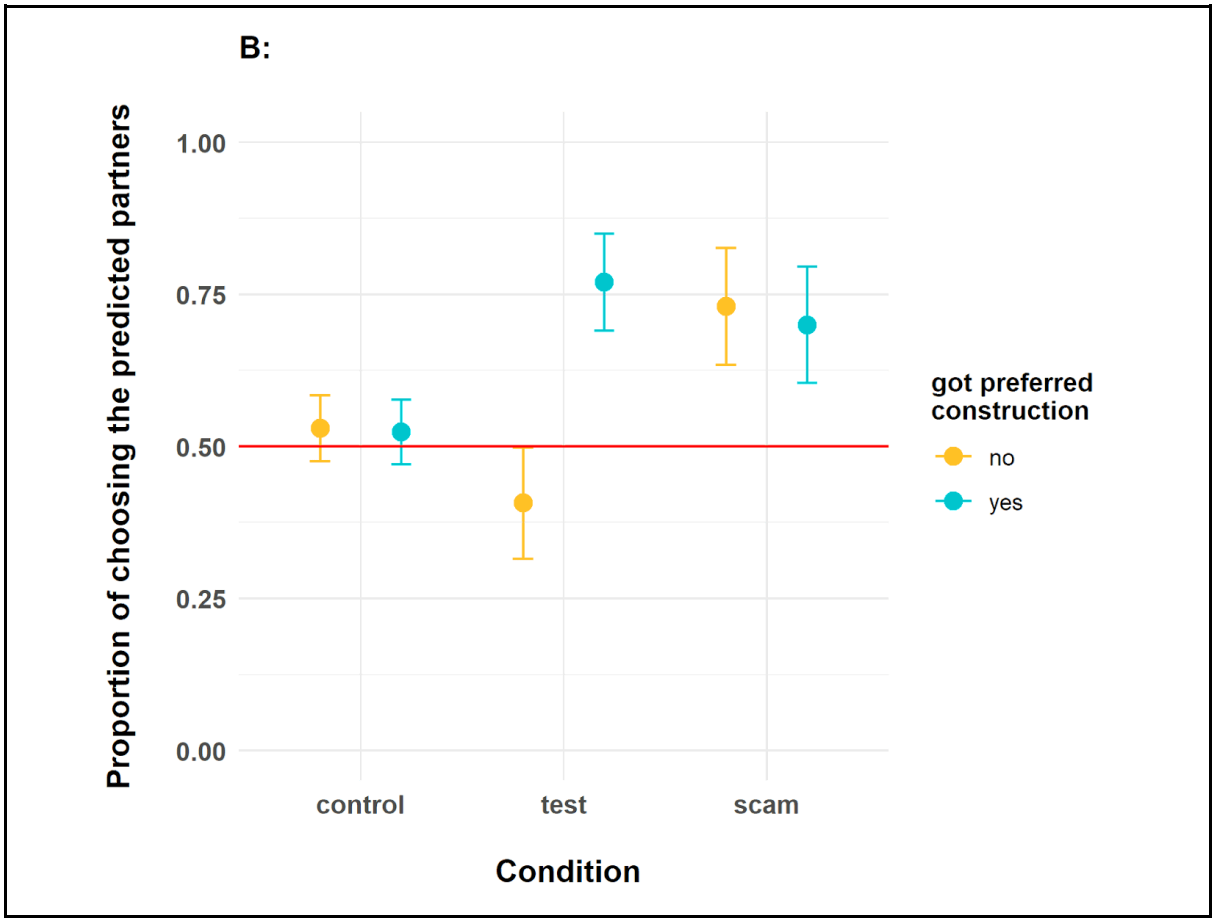


Figure 5: Proportions of choosing the predicted partner (i.e. the aligned partner in the test condition, a random partner in the control condition and the correct partner in the scam condition; see Fig. 4) in the three experimental conditions A. Boxes depict medians and quartiles, whiskers depict minimum and maximum values, and black dots depict outliers. Violin shapes around the boxes depict the distribution of the ratings. The width of the violin shapes at a given y coordinate corresponds to the number of ratings in this region. Note that, when evaluating the speakers' knowledge, confidence and willingness, participants used the full range of the rating scale. B. Mean and 95% confidence intervals of participants' responses. Non-overlapping confidence intervals indicate significant differences between the groups. Confidence intervals that do not overlap with 0.5 indicate significant differences from chance performance (Cumming & Finch, 2005).

4. Discussion

In this study, we focused on one aspect of the relation between language and cooperation, namely the influence of linguistic similarity on inducing cooperative behavior: we tested whether structurally similar interlocutors were more often picked as partners in a cooperative game than those who were not similar. Overall, the results are in line with our prediction that syntactically similar communication partners are selected as cooperation partners more frequently than dissimilar ones. In addition, they shed light on the underlying cognitive mechanisms that might have led to those partner choice patterns.

In the preference group, where participants could communicate using their naturally preferred syntactic constructions, they chose the linguistically aligned interlocutor significantly more often as a cooperation partner than the non-aligned one. Since in real-life settings, people mostly use their naturally preferred constructions, this effect is likely to also occur in real-life encounters outside of experimental contexts. In contrast, in the dispreference group, where participants were forced to communicate using a

dispreferred syntactic construction, they chose the non-aligned partner more frequently than the aligned one. Since people rarely use dispreferred constructions in real-life contexts, this result is not directly transferable to real-life settings but rather serves to understand if participants value alignment or alignedness more when making their partner choices.

This is because in the two groups, linguistic similarity may come about because of different underlying mechanisms. In the preference group, using the same construction as the participant could result either from naturally sharing the participant's preference (alignedness, i.e. overall similarity between the verbal behavior of speakers, see section 1.2) or from dynamically aligning to their choice (alignment, i.e. a more transient processes by which the verbal behavior of speakers becomes more similar over time, see section 1.3). In the dispreference group, however, choosing the same construction as the participant means either that the partner does not share the participant's natural linguistic preference (which the participant was prevented from using; non-alignedness), or that the partner dynamically aligns with the participant's language use (alignment). Thus, in the dispreference group, linguistic similarity can only emerge because of alignment, and not alignedness. Since in the dispreference group, linguistically similar interlocutors were chosen as cooperation partners significantly below chance, this indicates that participants favored speakers who matched their actual natural preference rather than their overt linguistic use.

Although alternative explanations are possible, the most parsimonious interpretation of this pattern of results is that *linguistic alignedness is a more important predictor for cooperation partner choice than alignment*. That is, linguistic similarity predicts the choice of a cooperation partner when this similarity results from a deeply entrenched preference for a particular linguistic variant, but not necessarily when the linguistic similarity in question remains on a mechanistic level and may result from priming. This suggests that linguistic similarity in a single interaction is interpreted as a reliable indicator of group allegiance (see sections 1.1 and 1.2), rather than as a first investment in the cooperation. Thus, the potential benefits of in-group cooperation, such as reciprocity or behavior according to group norms (e.g. Heinrich & Boyd, 2001; Dunbar, 1996; Hamilton, 1964a; Hamilton, 1964b), seem to outweigh the potential benefits of initial investments such as the signaled willingness to cooperate, to adapt to the partner or to integrate into a new group (e.g. Wacewicz et al., 2017).

Our results are in line with observations from modeling and experimental studies which investigated the role of egocentricity in the spreading of communication variants and referring labels. In a simulation that modeled the propagation of communication variants in a population, egocentricity – defined as the preference of self-produced over other-produced variants – turned out to be an inhibitory effect on the convergence of a population on the same communication variants (Tamariz et al., 2014). Similar results were obtained in experiments: participants tended to rely on self-produced referential expressions more than other-produced expressions (Knutsen & Le Bigot, 2014), indicating the role of egocentricity in dialogue.

Our study comes with a few limitations that could be addressed in future studies. For example, in our study, participants communicated with their partners via selecting sentences from a set of given options. While this has the advantage that communication is carefully controlled, participants might identify less with prespecified linguistic constructions than with descriptions that they write on their own. This may affect how emotionally engaged they are and how they interpret their partners' responses. Thus, to make the task more realistic, a future study could include a chat, where participants can type the individual picture descriptions manually. This would also consider that participants' linguistic preferences may differ, depending on the picture they are describing.

In addition, a future study could focus on teasing apart the effects of alignedness and alignment in a more direct way, by testing communication in longer stretches of interaction. Such a study could investigate differences in cooperation partner choice between partners who are linguistically aligned from the start of the interaction (as a potential signal of group membership) and those who gradually align during the conversation (as a potential signal of a first investment and of willingness).

In general, investigations of alignment have received more attention (e.g. Pickering & Garrod 2004; Branigan et al., 2007, Branigan et al., 2010) than those of alignedness, or the comparison of those two types of linguistic similarity. The outcome of our study suggests that this comparison merits more research, both theoretical and empirical. For example, it is an exciting challenge to disentangle from the existing literature, particularly from the literature on the evolutionary roots of human sociality (e.g. Kenrick, 2012; Van den Bergh, 2018; Mesoudi, 2009), cultural markers of both similarity and dissimilarity that have linguistic character. Experimental studies could then identify which elements of linguistic behavior, such as lexis, syntax or style, have the largest impact on the interpretation of alignedness and alignment. Finally, another promising line of research is to find out about the relationships between linguistic and non-linguistic forms of alignedness and alignment in multimodal communication.

5. Conclusion

Our study addresses potential causal relationships between linguistic similarity and cooperation. An important aspect that our study contributes to the discussion is the finding that linguistic similarity promotes cooperative tendencies in humans. However, it is crucial to distinguish the underlying mechanisms how this similarity comes about: people seem to cooperate with those interactants that share their linguistic preferences from the start rather than with those who dynamically align throughout an interaction. This opens up further avenues of research on the (co-)evolutionary links between language and cooperation and has implications for gaining a better understanding of decision making in groups such as stakeholder decisions in diverse linguistic settings.

6. Acknowledgements

We thank Vanja Vukovic and Magdalena Schwarz for help with collecting references and with writing an initial version of the introduction.

7. Funding information

TM was supported by a mobility fellowship of Nicolaus Copernicus University Toruń and a Post-doc Track stipend from the Austrian Academy of Sciences. MP was supported by the Polish National Science Center (NCN) under grant agreement UMO-2019/33/N/HS2/00541. PŻ was supported by the Polish National Science Centre (NCN) under grant agreement UMO-2017/27/B/HS2/00642. SW was supported by the Polish National Science Center (NCN) under grant agreement UMO-2019/34/E/HS2/00248.

7. References

Ariely, D., Bracha, A., & Meier, S. (2009). Doing good or doing well? Image motivation and monetary incentives in behaving prosocially. *American economic review*, *99*(1), 544-555.

Ashton–James, C., Van Baaren, R. B., Chartrand, T. L., Decety, J., & Karremans, J. (2007). Mimicry and me: The impact of mimicry on self–construal. *Social cognition*, *25*(4), 518–535.

Axelrod, R., Hammond, R. A., & Grafen, A. (2004). Altruism via kin-selection strategies that rely on arbitrary tags with which they coevolve. *Evolution*, *58*(8), 1833–1838.

Baayen, R. Harald. 2008. Analyzing Linguistic Data. Cambridge: Cambridge University Press.

Balliet, D., Wu, J., & De Dreu, C. K. (2014). Ingroup favoritism in cooperation: a meta-analysis. *Psychological bulletin*, *140*(6), 1556.

Barclay, P. (2016). Biological markets and the effects of partner choice on cooperation and friendship. *Current Opinion in Psychology*, *7*, 33–38.

Bargh, J. A., & Chartrand, T. L. (1999). The unbearable automaticity of being. *American psychologist*, *54*(7), 462.

Barton, K. (2018). MuMIn: multi-model inference. R package. *Cran-R*, *1*, 289-290. https://cran.r-project.org/package=MuMIn.

Bates, Douglas, Martin Mächler, Benjamin M. Bolker, and Steven C. Walker. (2015). Fitting Linear Mixed-Effects Models Using Lme4. Journal of Statistical Software 67: 1–48.

Bock, J. K. (1986). Meaning, sound, and syntax: Lexical priming in sentence production. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *12*(4), 575.

Boyd, R., & Richerson, P. J. (2002). Group beneficial norms can spread rapidly in a structured population. *Journal of theoretical biology*, *215*(3), 287–296.

Branigan, H. P., Pickering, M. J., Liversedge, S. P., Stewart, A. J., & Urbach, T. P. (1995). Syntactic priming: Investigating the mental representation of language. *Journal of Psycholinguistic Research*, *24*, 489–506.

Branigan, H. P., Pickering, M. J., McLean, J. F., Cleland, A. A. (2007). Syntactic alignment and participant role in dialogue. *Cognition*, *104*(2), 163-197.

Branigan, H. P., Pickering, M. J., Pearson, J., & McLean, J. F. (2010). Linguistic alignment between people and computers. *Journal of pragmatics*, *42*(9), 2355–2368.

Branigan, H. P., Pickering, M. J., Stewart, A. J., & McLean, J. F. (2000). Syntactic priming in spoken production: Linguistic and temporal interference. *Memory & Cognition*, *28*(8), 1297–1302.

Burnard, L. (2007). Reference guide for the british national corpus (xml edition). http://www. natcorp. ox. ac. uk/XMLedition/URG.

Carpenter, M., Uebel, J., & Tomasello, M. (2013). Being mimicked increases prosocial behavior in 18-month-old infants. *Child development*, *84*(5), 1511–1518.

Cirelli, L. K., Wan, S. J., Johanis, T. C., & Trainor, L. J. (2018). Infants' use of interpersonal asynchrony as a signal for third-party affiliation. *Music & Science*, *1*, 2059204317745855.

Cohen, E. (2012). The evolution of tag-based cooperation in humans: The case for accent. *Current Anthropology*, *53*(5), 588–616.

Connor, R. C. (2010). Cooperation beyond the dyad: on simple models and a complex society. *Philosophical Transactions of the Royal Society B*, *365*(1553), 2687–2697.

Cumming, G., & Finch, S. (2005). Inference by Eye: *Confidence Intervals and How to Read Pictures of Data* . *American Psychologist*, *60*(2), 170–180.

Danescu-Niculescu-Mizil, C., Lee, L., Pang, B., & Kleinberg, J. (2012). Echoes of power: Language effects and power differences in social interaction. In *Proceedings of the 21st international conference on World Wide Web*, 699–708.

Dijksterhuis, A., & Bargh, J. A. (2001). The perception–behavior expressway: Automatic effects of social perception on social behavior.

Dobson, A. (2002). An Introduction to Generalized Linear Models. Boca Raton: Chapman and Hall.

Doyle, G., & Frank, M. C. (2016). Investigating the sources of linguistic alignment in conversation. In *Proceedings of the 54th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, 526–536.

Dunbar, R. (1996). Grooming, Gossip and the Evolution of Language. Cambridge: Harvard University Press.

Finger, H., Goeke, C., Diekamp, D., Standvoß, K., & König, P. (2017). LabVanced: a unified JavaScript framework for online studies. https://www.labvanced.com/.

Gärdenfors, P. (2004). Cooperation and the evolution of symbolic communication. In K. Oller & U. Griebel (Eds.). *The Evolution of Communication systems*. Cambridge: MIT Press, 237-256.

Giles, H., & Powesland, P. F. (1975). *Speech style and social evaluation*. Academic Press.

Hamilton, W. D. (1964a). The genetical evolution of social behaviour I. *Journal of Theoretical Biology* 7(1), 1–16.

Hamilton, W. D. (1964b). The genetical evolution of social behaviour II. *Journal of Theoretical Biology* 7(1), 17–52.

Henrich, J., & Boyd, R. (2001). Why people punish defectors: Weak conformist transmission can stabilize costly enforcement of norms in cooperative dilemmas. *Journal of theoretical biology*, *208*(1), 79–89.

Henrich, N., & Henrich, J. P. (2007). *Why humans cooperate: A cultural and evolutionary explanation*. Oxford University Press.

Hewstone, M., Rubin, M., & Willis, H. (2002). Intergroup bias. *Annual review of psychology*, *53*(1), 575–604.

Hove, M. J. (2008). Shared circuits, shared time, and interpersonal synchrony. *Behavioral* and Brain Sciences, 31(1), 29–30.

Kenrick, D. (2012). Evolutionary theory and human social behavior. In Van Lange, P. A. M., Kruglanski, A. W. & Higgins, E. T. (Eds.) *Handbook of Theories of Social Psychology: Volume 1*. Thousand Oaks: SAGE Publications, 11-31.

Knutsen, D., & Le Bigot, L. (2014). Capturing egocentric biases in reference reuse during collaborative dialogue. Psychonomic Bulletin & Review, 21, 1590–1599.

Kulesza, W., Dolinski, D., Huisman, A., & Majewski, R. (2014). The echo effect: The power of verbal mimicry to influence prosocial behavior. *Journal of Language and Social Psychology*, *33*(2), 183–201.

Kurzban, R. (2001). The social psychophysics of cooperation: Nonverbal communication in a public goods game. *Journal of Nonverbal Behavior*, *25*, 241–259.

Kuznetsova, A., Brockhoff P. B. , & Christensen R. H. (2017). lmerTest Package: Tests in Linear Mixed Effects Models. Journal of Statistical Software 82: 1–26.

Lakens, D., & Stel, M. (2011). If they move in sync, they must feel in sync: Movement synchrony leads to attributions of rapport and entitativity. *Social Cognition*, *29*(1), 1–14.

Lakin, J. L., Jefferis, V. E., Cheng, C. M., & Chartrand, T. L. (2003). The chameleon effect as social glue: Evidence for the evolutionary significance of nonconscious mimicry. *Journal of nonverbal behavior*, *27*, 145–162.

Launay J., Dean, R. T. & Bailes, F. (2013). Synchronization Can Influence Trust Following Virtual Interaction. *Experimental Psychology*, *60*(1), 53–63.

Lev-Ari, S., & Peperkamp, S. (2017). Language for $200: success in the environment influences grammatical alignment. *Journal of Language Evolution*, *2*(2), 177–187.

Malloch, S., & Trevarthen, C. (2009). Communicative musicality. *Exploring the basis of human*.

McCullagh, P., & Nelder, J. A. (1989). *Generalized linear models*. London: Chapman and Hall.

Mesoudi A. (2009). How cultural evolutionary theory can inform social psychology and vice versa. *Psychological Review*, *116*(4), 929-952.

Nakagawa, S., & Schielzeth, H. (2013). A general and simple method for obtaining R2 from generalized linear mixed-effects models. *Methods in ecology and evolution*, *4*(2), 133–142.

Nettle, D., & Dunbar, R. I. (1997). Social markers and the evolution of reciprocal exchange. *Current Anthropology*, *38*(1), 93–99.

Noë, R., & Hammerstein, P. (1994). Biological markets: supply and demand determine the effect of partner choice in cooperation, mutualism and mating. *Behavioral ecology and sociobiology*, *35*, 1–11.

Pickering, M., & Garrod, S. (2004). The interactive-alignment model: developments and refinements. *Behavioral and Brain Sciences*, *27*(2), 212-225.

R Development Core Team. 2018. R: A Language and Environment for Statistical Computing. Vienna: R Foundation for Statistical Computing.

Riolo, R. L., Cohen, M. D., & Axelrod, R. (2001). Evolution of cooperation without reciprocity. *Nature*, *414*, 441–443.

Roberts, G. (2008). Language and the free-rider problem: An experimental paradigm. *Biological Theory*, *3*, 174–183.

Schoot, L., Heyselaar, E., Hagoort, P., & Segaert, K. (2016). Does Syntactic Alignment Effectively Influence How Speakers Are Perceived by Their Conversation Partner? *Public Library of Science (PLoS)*.

Shultz, T. R., Hartshorn, M., Kaznatcheev, A. (2009). Why is Ethnocentrism More Common Than Humanitarianism. *Proceedings of the 31st Annual Conference of the Cognitive Science Society*, 2100–2105.

Shockley, K., Santana, M. V., & Fowler, C. A. (2003). Mutual interpersonal postural constraints are involvesd in cooperative conversation. *Journal of Experimental Psychology: Human Perception and Performance*, *29*(2), 326.

Searle, J. R. (1995). The Construction of Social Reality. Free Press.

Tamariz, M., Ellison, T. M., Barr, D. J., & Fay, N. (2014). Cultural selection drives the evolution of human communication systems. *Proceedings of the Royal Society B: Biological Sciences*, *281*(1788), 20140488.

Turner, J. C., Brown, R. J., & Tajfel, H. (1979). Social comparison and group interest in ingroup favouritism. *European journal of social psychology*, *9*(2), 187–204.

Valdesolo, P., & DeSteno, D. (2011). Synchrony and the social tuning of compassion. *Emotion*, *11*(2), 262.

Van Baaren, R. B., Holland, R. W., Kawakami, K., & Van Knippenberg, A. (2004). Mimicry and prosocial behavior. *Psychological science*, *15*(1), 71–74.

Van Baaren, R. B., Holland, R. W., Steenaert, B., & Van Knippenberg, A. (2003). Mimicry for money: Behavioral consequences of imitation. *Journal of Experimental Social Psychology*, *39*(4), 393–398.

Van den Bergh, J. (2018). *Human Evolution beyond Biology and Culture: Evolutionary Social, Environmental and Policy Sciences*. Cambridge: Cambridge University Press.

Wacewicz, S., Żywiczyński, P., & Chiera, A. (2017). An evolutionary approach to low-level conversational cooperation. *Language Sciences*, *63*, 91–104.

Weatherholtz, K., Campbell-Kibler, K., & Jaeger, T. F. (2014). Socially-mediated syntactic alignment. *Language Variation and Change*, *26*(3), 387–420.

Wiltermuth, S. S., & Heath, C. (2009). Synchrony and cooperation. *Psychological science*, *20*(1), 1–5.