Reciprocal adaptation:
differences in conversations between friends and strangers

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Abstract

Turn-taking is regarded as the most prominent aspect of conversations between the interlocutors. During the conversation, the change of "listener" and "speaker" roles keeps alternating throughout the whole discourse. Response time (i.e. gap) is the silence that occurs once the speaker changes. Previous study has investigated whether fast response times are related to social connectedness in conversations between friends and strangers. The present study aims to employ Bayesian multilevel modeling in order to investigate not only the overall difference in response times between friends and strangers, but also whether the interlocutors tend to adapt to one another's behavior during turn-taking. The dataset used for the present analysis was taken from an already existing source. The effect of reciprocal adaptation was found in friends' conversations: if the partner would take a longer time to respond in the previous turn - the participant would slow down as well. Strangers were not found to adjust to their partner's response time, moreover, both friends and strangers were found to be self-consistent with respect to self response time in the previous turn. Additional exploratory analyses are provided to investigate how other conversation aspects could influence response times in turn-taking for both friends and strangers.

Keywords: Bayesian multilevel modeling, conversations, reciprocal adaptation, response times.

Code: https://github.com/JustinaRaz/Files_BT_Cognitive_Science.git
Character count: 45 750

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Introduction

Many researchers would regard turn-taking as the most prominent aspect of conversations between two or more interlocutors (Levinson, 2016; Wiemann & Knapp, 1975). It is suggested that successful turn-taking in conversations requires the speakers to have "some form of cyclic patterning in the cognitive processes of the speaker that influences the timing of the cognitive processes of the listener", however, such "patterning" must be easily observed in the interlocutors' behavior (Wilson & Wilson, 2005, p. 961). McFarland (2001) has found that during verbal interaction, the rhythm of the listener's breathing becomes similar to the one of the speaker's. In addition, both interlocutors tend to eventually adapt to each other's speaking rate, choices of words, etc. (Brennan & Hanna, 2009). In the present study, I aim to investigate whether interlocutors verbally adjust to one another when engaged in conversations with an unfamiliar individual as opposed to a friend, and explore how response times during turn-taking changes depending on a relationship between the speakers.

Generally, when two individuals are having a conversation, one of them takes the "listener's" position by allowing the other person to speak. Once the interlocutor's turn is completed, the "listener" seamlessly transitions into the role of the "speaker". The change of role in conversations keeps alternating throughout the duration of the discourse (Wiemann & Knapp, 1975). Each interlocutor who is a part of the conversation has multiple challenges: decide the right time of when to join a conversation, predict whether the conversation partner has finished the turn or not, and decide what to say once the partner's turn has ended. Considering these challenges, the accuracy in timing becomes an important aspect of turn-taking (Wilson & Wilson, 2005).

The timing can describe two heavily researched aspects of turn-taking: *overlaps* and *silences*, which appear as interlocutors switch the roles from listener to speaker, and speaker to listener (Heldner & Edlund, 2010). According to Sacks et al. (1974), *gaps*, *lapses*, and *pauses* are the types of silences that happen during a talk. Gaps (i.e. *response times*) and lapses are the types of silences that take place once a speaker changes, with gap being shorter silence than the lapse. Pause, on the other hand, is a silence that occurs during the speaker's turn. During the turn-taking (i.e. the change of speakers), *overlaps* might happen when one of the interlocutors begins talking before the other one has finished, and although it is a frequently observed

event in natural conversations, they tend to be minimal and rare (Sacks et al., 1974; Wilson & Wilson, 2005).

Response times in turn-taking are said to be minimal as well, and on average, the length of the gap between turns is around 200 ms (Levinson, 2016). However, producing a response after the partner has ended the turn is a considerably complex difficulty for human's cognition. According to Indefrey & Levelt (2004), if words that are used in a response have been recently primed, it takes around 600 ms to actually produce the word as a response (Magyari, 2022). On the other hand, if words have not been primed, it takes over 1000 ms on average to produce it (Bates et al., 2003). In natural conversations, however, single word production might be not as common as the need to produce long and grammatically-correct sentences, meaning that the time of speech preparation might be even longer (Magyari, 2022). As language production itself is clearly a much slower process than the average response time, the interlocutor initiating the turn must predict the conclusion of the partner's ongoing turn, and plan their own response as their partner is still speaking (Levinson, 2016).

In addition to prediction, coordination between the participants is another aspect that ensures a smooth transition for turn-taking in conversations (Barr & Keysar, 2006). For coordination to be efficient, both participants adjust their behavior to align with their partner's, aiming to prevent any confusion or misinterpretations, which might arise during the talk. So far it appears that participants in conversations tend to adapt certain components of the spoken language to fit the qualities of their partners'. Study conducted by Fussell & Krauss (1992) has shown that the knowledge, which one of the speakers assumes their partner to possess, can crucially affect the way of communication between those interlocutors. The more knowledge about stimuli the partners were expected to have, the less detailed information the speaker would provide. Bell (1984) has noted that speakers tend to adapt and talk in a more formal way once their listener is thought to hold a higher social status. Moreover, individuals' speech style seems to be highly affected by the variation in their interlocutors' style (Dressler & Wodak-Leodolter, 1977). Dressler & Wodak-Leodolter (1977) suggested that once participants in a conversation talk only to close friends, they tend to stop using the communication style they would use when talking to strangers. That is, with less variation in speech style, participants' way of communication becomes similar to one another as there is no other speech style to reciprocate.

The latter two studies mark the importance of social context in communication. It is clear that people adjust their behavior depending on who they are talking with. The question that might arise now is, if social context affects communication, could it affect turn-taking in conversations? In the context of friends and strangers, Templeton et al. (2022) has investigated whether response times in turn-taking are associated with the perception of being "socially connected". Although in both strangers' and friends' conversations short response times were associated with higher degree of social connection, participants would produce long response times more often when talking to friends as opposed to strangers, and still showcase a greater degree of social connectedness (Templeton et al., 2022, 2023). In the context of friends and strangers, these results suggest a possible reciprocal association between the response times and social connectedness; when two strangers are having a conversation, the shorter response times are - the more connected they feel, and the longer response times are - the less connected they perceived to be. With friends, on the other hand, it is not the case, and although slow response times were considered to play different type of roles in friends and strangers' conversations (Templeton et al., 2023), understanding the dynamics of response times during turn-taking in different social contexts requires adjustments in methodology.

According to Kenny et al. (2020), studies, which contain an interaction between the participants, need to consider the effect of reciprocity between individuals. That is, it is important to consider not only the individual responses, but also how those responses might be influenced by the behavior of the members in a pair. Not accounting for effects of reciprocity within a pair has been a key limitation within the domain of couple therapy studies (Whittaker et al., 2022), as common analytical techniques would only consider each party separately, but not how each person from the same party might influence one another. Previous studies provide evidence that the effect of reciprocity does exist in conversations (Guydish et al., 2021). For instance, Schweitzer & Lewandowski (2013) have found that the rate at which the individuals in a conversation articulate their own words can be adjusted or influenced by the articulation pace of their partner in the previous turn. Moreover, the degree of adaptation with regards to articulation pace between the interlocutors was found to vary depending on how much each interlocutor would like one another.

As it was reported in the study by Templeton et al. (2023), there is a clear difference between turn-taking response times and social connectedness in friends' and strangers' conversations,

however, could there be differences found in how participants behave during conversations? It seems like the social context tends to influence our communication (Bell, 1984) and with time, communication style between the interlocutors becomes similar (Dressler & Wodak-Leodolter, 1977), therefore, the question is, could the effect of reciprocal adaptation be found in friends' and strangers' conversations during turn-taking? Can response times of one participant affect another participant's behavior?

In order to gain a deeper comprehension of how response times in turn-taking might be affected by social context, the present study will employ data which was collected and used in an already existing source. The data originally was acquired by Templeton et al. (2022) for investigation of the relationship between response times and social connectedness, and further reused in the follow-up study on slow response times, and how they are perceived by strangers and friends (Templeton et al., 2023). The current study aims to shed light on the actual turn-taking dynamics within friends and strangers conversations, by investigating possible reciprocal effects between partners in conversation. I will attempt to answer the two core questions of the present study, which are:

1. What is the overall difference in turn-taking response times across friends' and strangers' conversations? Do friends, or strangers, take longer to answer in a conversation once partners have finished their turn?

2. With regards to reciprocal effects, do partners tend to adjust their response times to one another? Can it be that once one member of the conversation takes longer to respond, the other one increases the response time as well, and vice versa?

Materials and methods

Participants

Before taking part in the study, each individual has provided an informed consent. As reported in the study conducted by Templeton et al. (2022), the participant cohort consisted of 66 students, equally distributed between 33 males and 33 females. In the context of conversations, participants were paired using a round-robin approach, as depicted in *Figure 1 - A*. In total, there were 6 round-robin groups, out of which 3 groups consisted only of females, and the rest 3 - only of males. Each conversation pair was composed of participants of the same gender, and each student had a conversation with 10 other same-gendered

participants from the same group. Notably, participants have been asked to indicate whether they have met their conversation partner before. As they have not, this group of participants was regarded as "strangers". During the later part of the Templeton et al. (2022) study, 22 out of 66 participants have brought 3 close friends to have conversations with. As in the original study, this group of participants will be regarded as "friends".

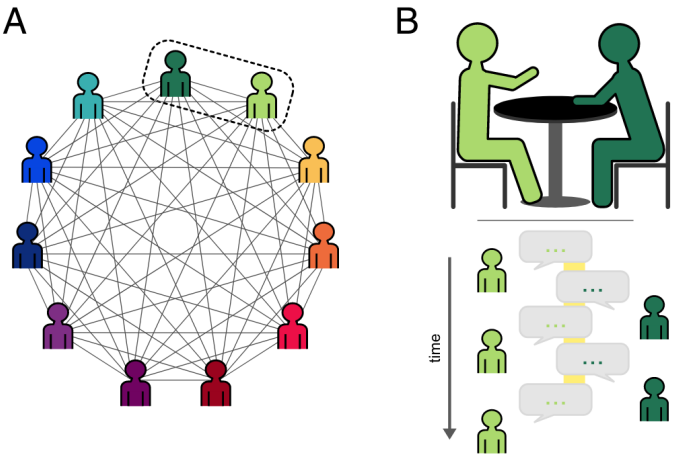

Figure 1. A: Pairing of participants. Participants were divided into 11 round-robin sub-groups. Each sub-group of participants had 10 conversations with one another, resulting in a total of 322 conversations. B: Procedure used in a study by Templeton et al. (2022). Conversations were recorded between pairs of participants. Note: Figure taken and adapted from "Fast response times signal social connection in conversation" by Templeton, E. M., Chang, L. J., Reynolds, E. A., Cone LeBeaumont, M. D., & Wheatley, T. (2022).

Procedure

The data, which is used in the present study, was collected by inviting one pair of participants at a time into an experimental facility to have an informal conversation. Each conversation has lasted for 10 minutes, with audio and video material being recorded (*Figure 1-B*). Although participants, who were strangers, could only have a conversation with someone of the same gender, participants in friends' conversations were able to pair-up and have a talk with someone of the opposite gender. Recording of conversations has taken multiple days for each participant to complete, as every individual has only been having up to three conversations per day. In total, Templeton et al. (2022) has collected 322 conversations that have been had between strangers and 65 conversations between friends.

Turn-taking and response times

An outside company has time-stamped the audio recordings of each conversation (Templeton et al., 2022). More specifically, the time of when participants have started and ended their turn has been saved to a transcript, with each transcript containing this information per conversation. All time-stamps have been provided in milliseconds. As response times are the gaps that appear during the change of speakers (Heldner & Edlund, 2010), they were computed by subtracting the end of the previous speaker's turn from the time when the next speaker has started to talk. As mentioned by Templeton et al. (2022), positive response times represent the time period during which the speakers have changed, and negative response times indicate moments of overlapping speech.

Data preprocessing

Before being able to analyze data collected by Templeton et al. (2022), it was crucial to prepare the dataset for the present analysis. The original data files contained the number of turns per conversation, identification of each speaker, the time-stamps of the beginning and the end of a turn, the length of the gap between each turn (response time) and the number of words produced by each speaker during every turn.

Preprocessing was performed using R (R Core Team, 2022). As each data file represents one conversation, all files have been combined into one, and each data file has been indexed in order to differentiate between different conversations among friends and strangers. As almost every individual has participated in conversations multiple times, an identification number has been included to represent each individual. Investigation of reciprocal adaptation requires examining how the behavior of one individual changes depending on the behavior of his/her partner. For this reason, the values of response times were adjusted in a way that every time participant X has made a turn, it would receive a respective value of participant's X previous response time, and participant X partner's previous response time. Such adjustment has been carried out with respect to the partner as well.

Modeling turn-taking in conversations

As mentioned already, Kenny et al. (2020) has suggested that once studies involve interaction between individuals, it is crucial to consider a possibility of reciprocal adaptation in the behavior of individuals who are interacting to one another. In order to account for

interdependence in the behavior between the two individuals, Kenny et al. (2020) has proposed an adaptation - dyadic analyses - to commonly used analyses which only consider the individual-level data. Dyadic analyses are certain statistical approaches that can be applied to data collected over time (Whittaker et al., 2022), and although there are specific methods to carry out such analyses, dyadic data can also be analyzed using a method of multilevel modeling (Hox & Roberts, 2011; Kenny & Kashy, 2011).

The present study will employ the framework of Bayesian multilevel modeling, as it allows modeling complex data structures (Bürkner, 2017; Veenman et al., 2023). Firstly, I will investigate the overall difference in turn-taking response times across friends and strangers conversations. According to Calabria et al. (2011), in order to explore the differences in behavior between groups in a more precise way, one should consider modeling response times on ex-Gaussian distribution. Such modeling might describe the effect of conversations between friends and strangers on response times more accurately. Moreover, past studies have already demonstrated that analysis using ex-Gaussian distribution can reveal distinctions between participant groups which regular statistics alone cannot fully explain (Balota & Yap, 2011; Calabria et al., 2011; Heathcote et al., 1991). As such, modeling response times to ex-Gaussian distribution would allow to compare differences between the groups over the whole response times' distribution, and not just in "the central tendency of the distribution" (Calabria et al., 2011, p. 2).

In the first model of the analysis, an ex-Gaussian distribution was applied to model and investigate the overall difference in turn-taking response times (RTs) across friends and strangers. The model was intended to capture two components of the RTs distribution: Gaussian (normal) and ex-Gaussian (exponential) components (Calabria et al., 2011). In terms of the Gaussian component of RTs distribution, raw RTs were conditioned on relation type between the interlocutors; the relation between the RTs and relation type was set to vary by each participant across different conversations. In terms of the exponential component of RTs distribution, RTs were conditioned on relation type between participants. The second model was set to investigate the effect of reciprocal adaptation between the partners of conversation; z-scored RTs were modeled to a Gaussian distribution, and again, conditioned on relation type. The effect of relation type on z-scored RTs was allowed to vary depending on z-scored response latencies that the partner, and participant oneself had made in the previous turn. Additionally, all these effects were allowed to vary across the participants and

for different conversations. The latter model used z-scored RTs as the goal is to investigate the differences between participants' RTs and how they deviate from the mean. Raw RTs were z-scored (rescaled) by subtracting the mean of RTs from each RT value, and dividing by RTs standard deviation.

As data collected by Templeton et al. (2023) contains information about how many words each participant has produced during their own turn, it has sparked an interest to perform additional analyses. Further investigation was set to explore what kind of effect could the partner's count of words in the previous turn have on participant X's RTs. As previously, z-scored RTs were modeled to a Gaussian distribution, conditioned on relation type between speakers. The effect of relation type was allowed to vary depending on the z-scored number of words that were produced during the partner's last turn. The relation type, and interaction between the relation type and z-scored number of words in the previous turn were further allowed to vary across all participants and different conversations.

So far it is clear that the study by Templeton et al. (2023) and its procedure has offered many intriguing ways to investigate the dynamics of response times in different social contexts (in this case, between friends and strangers). Since a great number of participants in the strangers group are also present in the friends group, one could ask: do people, who talk to the same participant, tend to behave in a similar way? An answer to such a question could build further upon the knowledge about the reciprocal adaptation between interlocutors in different contexts. Could it be that multiple strangers talking to the same participant tend to produce similar response times? Would the same hold once multiple speakers talk to the same participant, but in this case, they all would be friends? Or maybe it holds in one context but does not hold in another? To investigate, z-scored RTs were modeled to a Gaussian distribution, and conditioned on the relation type as before, and the relationship between the z-scored response latencies and the relation type was further set to vary across participants. To investigate how people behave when talking to the same participant, the relationship between z-scored RTs and relation type was allowed to vary across interlocutors - people, who had the conversations with the same participant. As in previous analyses, the overall z-scored RTs were allowed to vary across different conversations as well.

All fours models have been run in R (R Core Team, 2022) using the *brms* package (Bürkner, 2017). The code of the data preprocessing and data analysis can be found in the gitHub

repository (see the link in *Supplementary materials*). Plots, such as posterior - predictive checks, prior - posterior updates have been added to the *Supplementary materials*.

Results

Investigating differences in response times between friends and strangers

The first model was set to analyze the overall difference in response times during turn-taking between friends and strangers. Model's predictions on how response times differ between friends' and stranger's conversations are plotted in *Figure 2*.

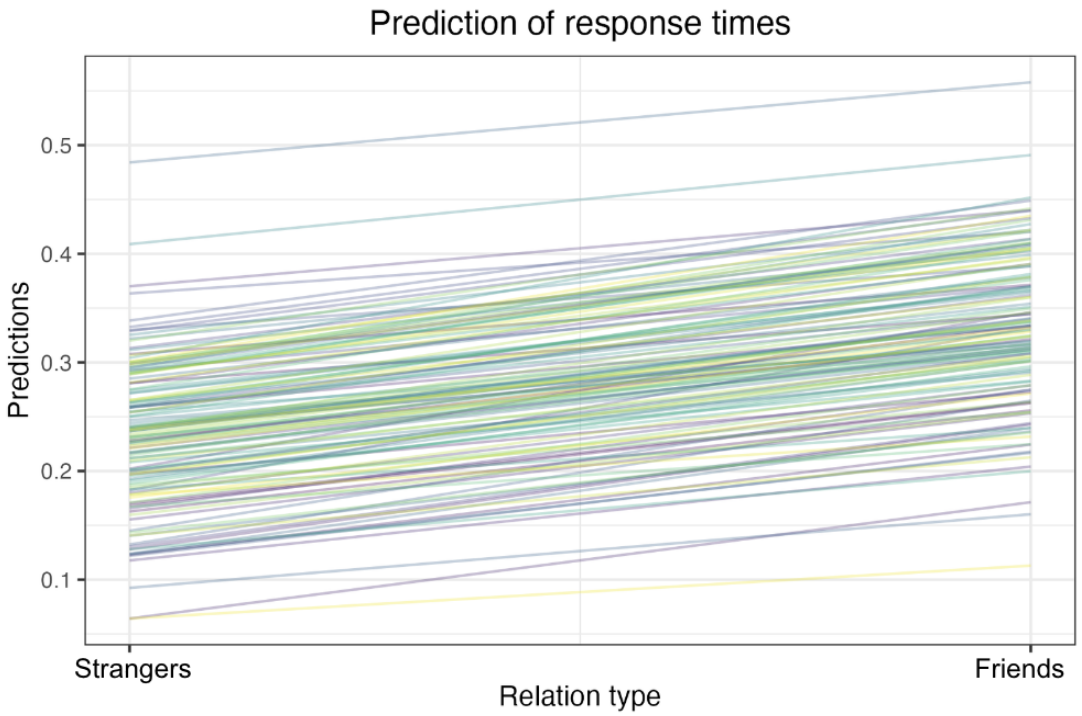

Figure 2: Prediction of response times per participant. Each line in the plot represents one individual and the predicted change in response times when talking to strangers versus friends.

Predicted response times have revealed the overall estimated difference in RTs between both groups; according to the model, RTs are longer in friends' conversations compared to conversations between strangers. This effect seems to be not only general across the whole sample, but also applicable to every participant.

The results with respect to the majority of response times (Gaussian component) suggest that once friends are having a conversation, response times on average tend to be longer

compared to when two strangers are talking (friends: 0.33 s, 95% CIs 0.29 s, 0.37s; strangers: 0.23 s, 95% CIs 0.21 s, 0.26 s). Running a hypothesis testing has shown strong evidence for such difference (0.1 s, 95% CIs 0.06 s, 0.13 s, Evid. Ratio = Inf). With respect to longer pauses (exponential tail of the distribution), similar results hold. In this case as well, strangers tend to be faster at responding overall (-1.39 s, 95% CIs -1.42 s, -1.36 s) than friends (-0.82 s, 95% CIs -0.86 s, -0.79 s). Results of the hypothesis testing have again shown strong evidence that there is a difference between strangers' and friends' overall response times (0.57 s, 95% CIs 0.53 s, 0.6 s, Evid. Ratio = Inf). The results plotted below show a general difference of response times between strangers' and friends' groups (see *Figure 3*).

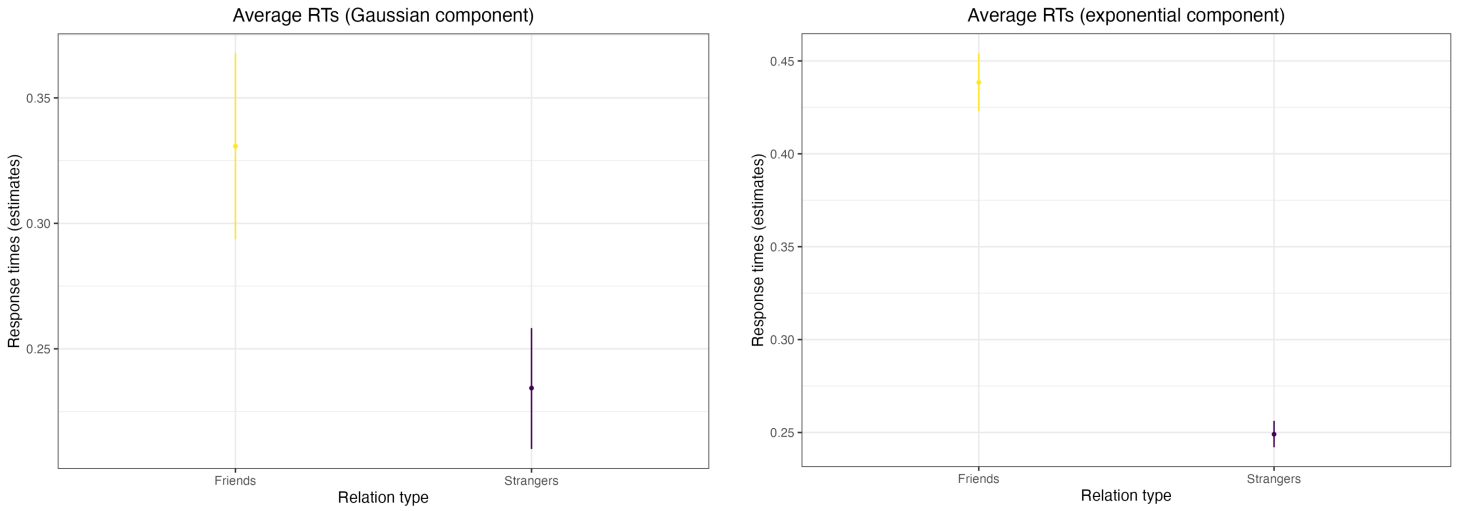

Figure 3: Average response times (RTs) of Gaussian and exponential components of RT distribution with 95% CIs.

Investigating reciprocal adaptation between friends and strangers

The second model was set to analyze the effect of reciprocity between conversation partners in groups of friends and strangers. When the effect of relation type on response times was allowed to also depend on participants' and their partners' response times in the previous turn, RTs in conversations between friends have been shown to become way slower (0.13 s, 95% CIs 0.06 s, 0.20 s), and faster once the conversations are being had between strangers (-0.01 s, 95% CIs -0.06 s, 0.03 s). When friends are having a conversation, interlocutors tend to adjust the timing of turn-taking to the one of the partner's (0.06 s, 95% CIs 0.03 s, 0.08 s). Therefore, if a partner takes longer to respond in a conversation, friends tend to slow down as well. In contrast, when conversing with strangers, interlocutors do not adjust their own

response times to their partners' prior turn-taking behavior (0.00 s, 95% CIs -0.01 s, 0.01 s; *see Figure 4*). Running a hypothesis testing has also shown great evidence for such a difference (0.06 s, 95% CIs 0.03 s, 0.08 s, Evid. Ratio = Inf).

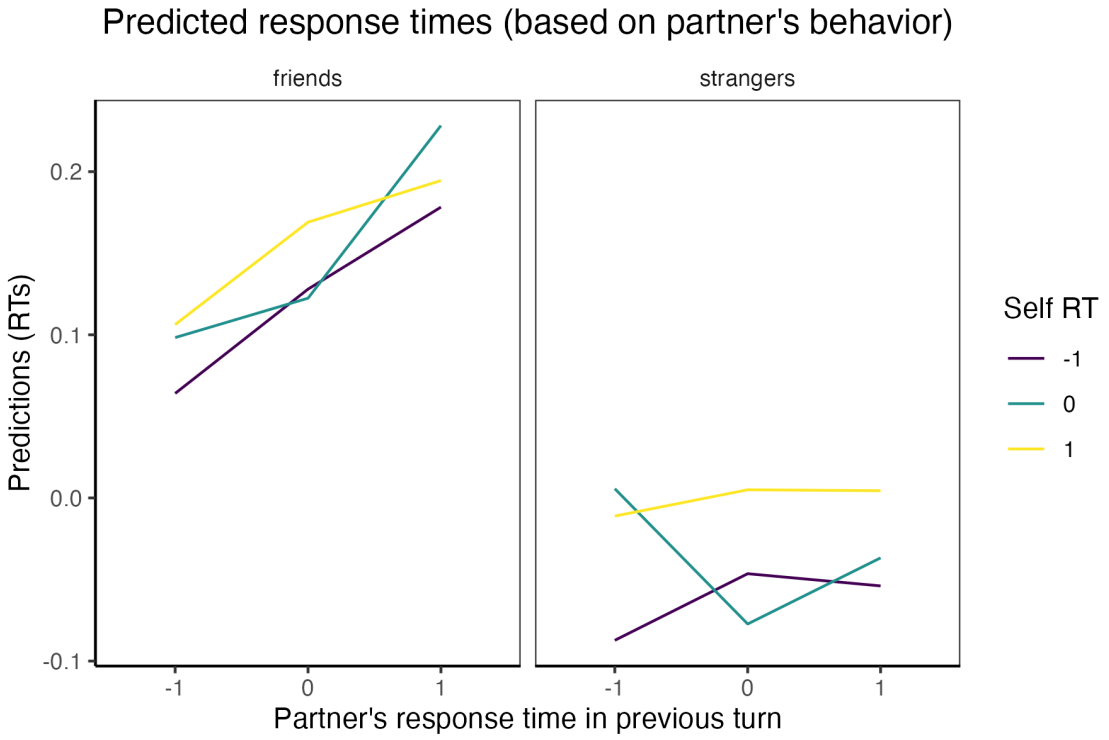

Figure 4: Participants' response times (RTs) based on the partner's RT in the previous turn. The y-axis represents RTs in seconds. The x-axis represents a partner's RTs in units of standard deviation; the further from the mean (0) to the right - the longer partner's RT, the further from the mean to the left - the shorter partner's RT. It also applies to the scale on the right-most side of the figure for participant's self RT in the previous turn. Each line shows how general prediction of response times changes with respect to the participant's self RT in the previous turn.

Furthermore, in both friends and strangers conversations, participants have shown a similar turn-taking behavior with respect to their own response times in the previous turn. It was found that once interlocutor's own response time in prior turn is a bit longer than usual, on average it becomes 20 ms longer in the next turn (friends: 0.02 s, 95% CIs 0.00 s, 0.04 s; strangers: 0.02 s, 95% CIs 0.01 s, 0.03 s; *see Figure 5*). High degree of similarity in the behavior between friends and strangers was also shown with hypothesis testing (0.00s, 95% CIs -0.03 s, 0.02 s, Evid. Ratio = 51.03). Additional hypothesis testing was performed to investigate the overall difference in participants' behavior of adaptation; how differently do participants tend to adapt to their partner's behavior as opposed to their own? In friends' conversations, the effect of partner's RT in the previous turn on participant's future RT is

stronger than participant's self-consistency with respect to self RT in the previous turn (0.04 s, 95% CIs 0.01 s, 0.06 s, Evid. Ratio = 56.14). However, the opposite result was found for strangers; strangers only adjust their response times to themselves (self RT) and not others, therefore the effect of the adjustment to their partner compared to themselves is negative (-0.02 s, 95% CIs -0.03 s, -0.01 s).

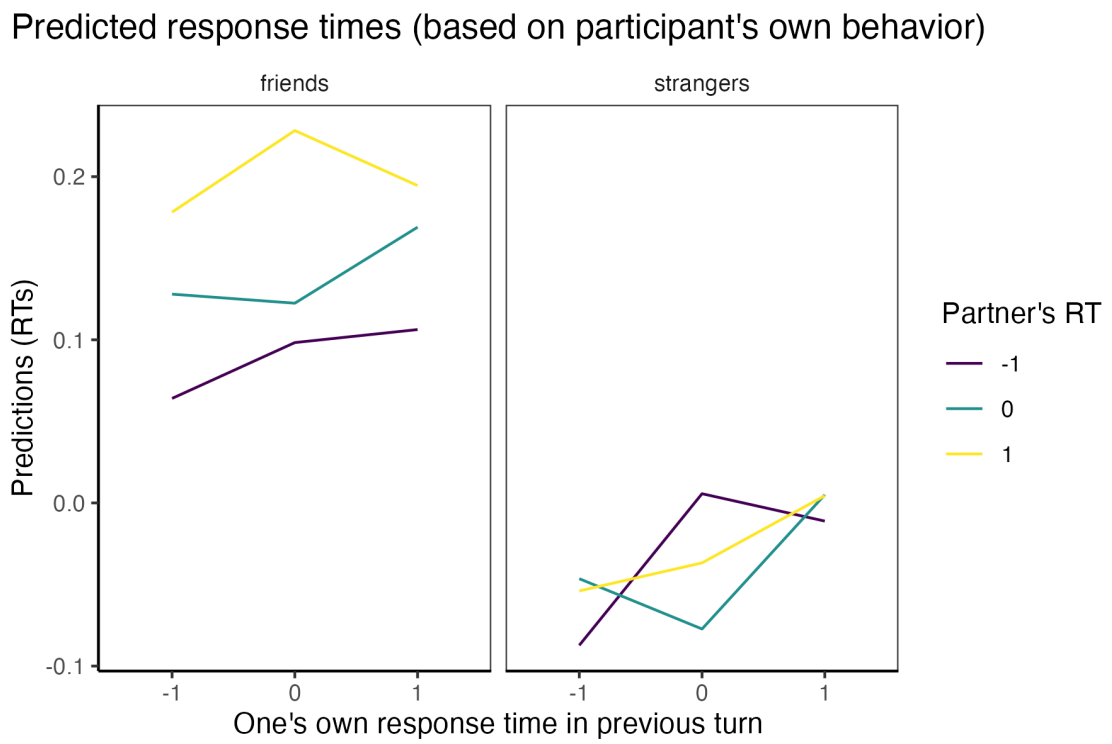

Figure 5: Participants' response times (RTs) based on their self RT in the previous turn. The y-axis represents RTs in seconds. The x-axis represents self RTs in units of standard deviation; the further from the mean (0) to the right - the longer one's own RT, the further from the mean to the left - the shorter one's own RT. It also applies to the scale on the right-most side of the figure for partner's RTs in the previous turn. Each line shows how general prediction of response times changes with respect to the partner's RT in the previous turn.

Investigating the effect of word count on response times

Additional analysis and a model was created to explore whether the number of words that the partner has produced in the previous turn could affect the participant's response time beyond the effects already observed. Consistent with prior analyses, conversations involving friends exhibit extended than usual response times in contrast to conversations with strangers, where response time on average becomes shorter than usual (friends: 0.15 s, 95% CIs 0.09 s, 0.21 s; strangers: -0.01 s, 95% CIs -0.05 s, 0.02 s; difference: 0.17 s, 95% CIs 0.11 s, 0.22 s, Evid. Ratio = Inf). The number of words that were produced during the last interlocutor's turn was

found to predict response time in both friends and strangers' conversations. The greater number of words produced during the last turn, the faster participants would respond (friends: -0.07 s, 95% CIs -0.11 s, -0.03 s; strangers: -0.1 s, 95% CIs -0.13 s, -0.08 s). Running a hypothesis testing has shown that the difference in the effect of the word count on response times between friends and strangers is pretty marginal (-0.03 s, 95% CIs -0.07 s, 0 s, Evid. Ratio = 0.05), suggesting that the number of words in the previous turn has a similar effect on RTs, no matter the type of relation between the participants (*see Figure 6*).

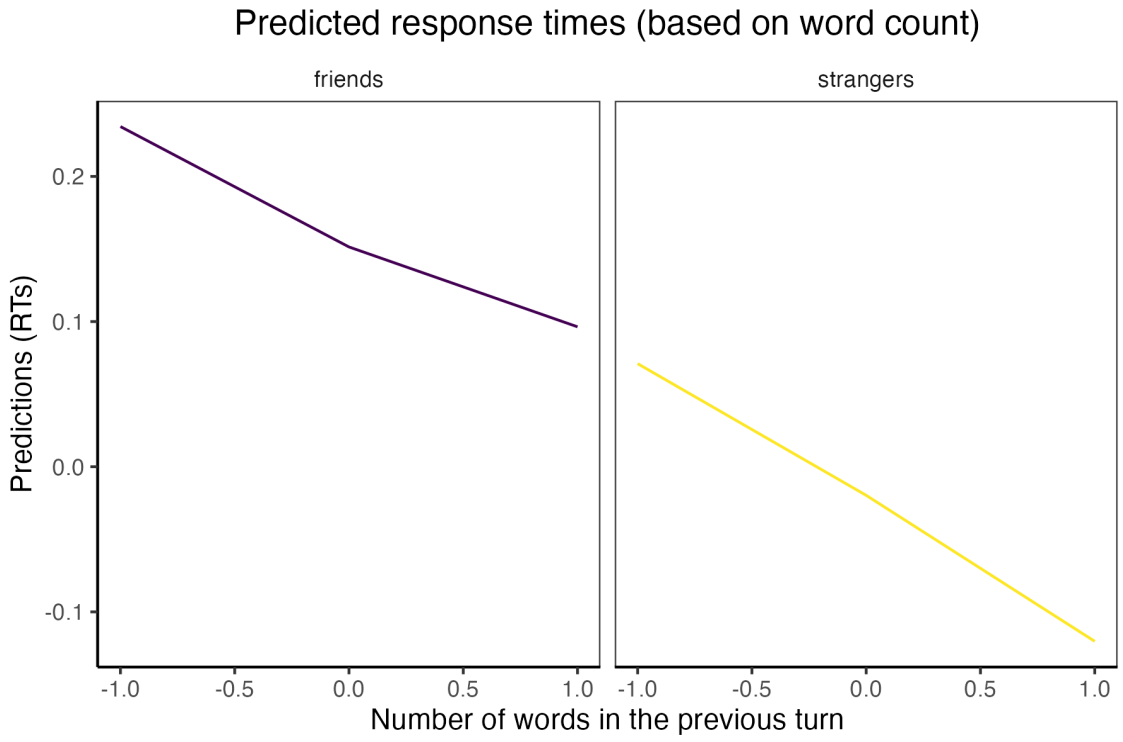

Figure 6: Participants' response times (RTs) based on how many words in the previous turn their partner has produced. The x-axis represents the number of words in units of standard deviation; the further from the mean (0) to the right - the greater number of words the partner has produced in a previous turn, the further from the mean to the left - the less words have been produced. The Y-axis represents predicted RTs in seconds. Each line shows how general prediction of response times changes with respect to the word count in the previous turn.

Investigating behavioral similarities among interlocutors with a common participant

Due to the design of the study (round-robin approach), each participant had a conversation with multiple people, moreover, 22 participants had additional conversations with each of their friends. The final model was set to explore further and investigate a possibility of

reciprocity effect across multiple individuals, and analyze whether individuals, who talk to the same participant, tend to have any similarities in how fast they respond and take turns. The results of the model suggested once again that friends in general tend to slow down in responding when talking to one another (0.22 s, 95% CIs 0.12 s, 0.32 s), and strangers tend to take turns more quickly (-0.01 s, 95% CIs -0.07 s, 0.05 s). Furthermore, the results suggest that there is some variability in RTs of interlocutors who had a conversation with the same participant (friends: 0.19 s, 95% CIs 0.13 s, 0.25 s; strangers: 0.16 s, 95% CIs 0.13 s, 0.19 s). Predicted RTs for all interlocutors in a dataset are visualized in *Figure 7*. Although variability in RTs is greater for friends than for strangers, both groups show some degree of similarity in interlocutors' RTs.

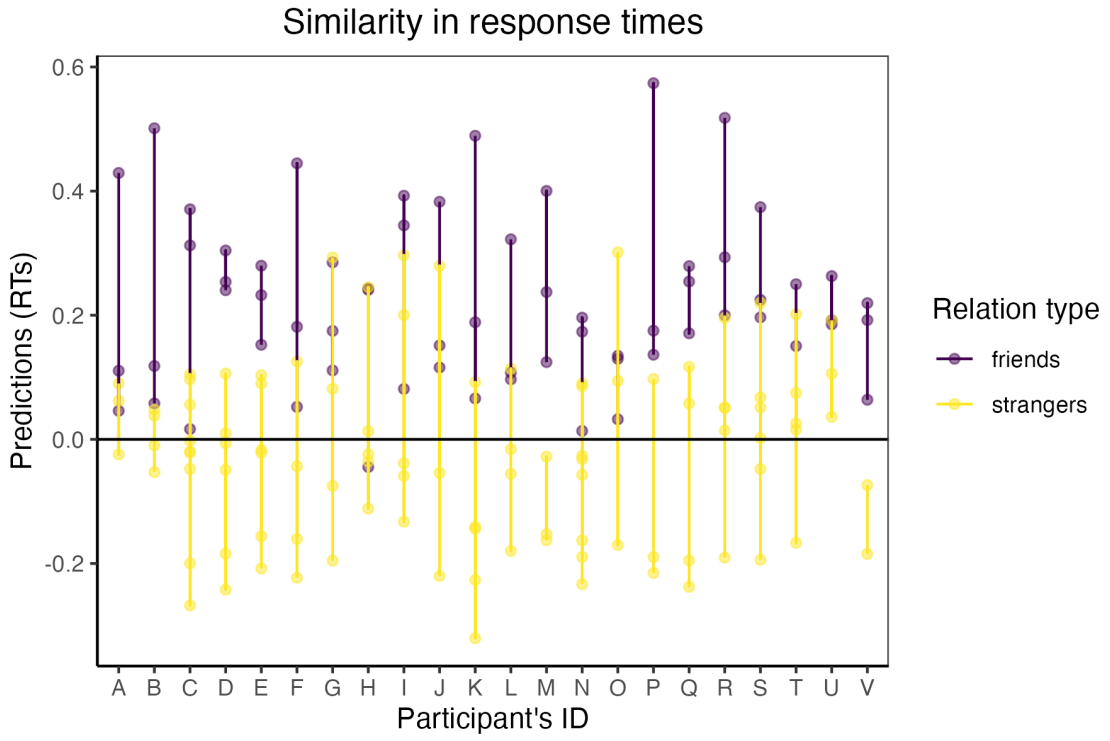

Figure 7: Similarities among the interlocutors who had a conversation with the same participant. The x-axis represents the participants who had a conversation with a stranger and a friend. Y-axis represents each interlocutor's average predicted response times (in seconds).

Discussion

In the present study, it was attempted to uncover further insights about the turn-taking dynamics in conversations between friends and strangers. The study design by Templeton et al. (2022) and the collected data have offered many ways in how this could be achieved. The

core of this study was to investigate how different, overall, response times are between friends and strangers, and whether participant's behavior during the turn-taking could affect their partner's behavior accordingly. Other additional analyzes have been targeted to reveal how another aspect, such as the number of words in the previous turn, can affect people's RTs during turn-taking. Additionally, it was investigated whether the effect of reciprocity can also be found in how similar RTs are among the interlocutors who talk to the same participant.

General results and differences in response times between friends and strangers

General results for friends' and strangers' average estimated response times are shown in Table 1. Based on all four models it is clear that on average, friends tend to be slower at responding during conversations than strangers. It seems that such turn-taking behavior might manifest in infants as early as 4-months of age (Jaffe et al., 2001).

	Group	Estimate	Lower 95% CI	Upper 95% CI
Model 1	Friends	0.33 (-0.82 exponential)	0.29	0.37
	Strangers	0.23 (-1.39 exponential)	0.21	0.26
Model 2	Friends	0.13	0.06	0.20
	Strangers	0.00	-0.06	0.03
Model 3	Friends	0.15	0.08	0.22
	Strangers	-0.01	-0.06	0.03
Model 4	Friends	0.22	0.12	0.32
	Strangers	-0.01	-0.07	0.05

Table 1: Average RT esimates for each participant group across all models.

Model 1 was set to investigate the overall difference in RTs during turn-taking in friends' and stranger's conversations. Estimates of the model were used to predict participants' response times when talking to a stranger, and how it would change when talking to a friend. As the results in *Figure 3* show, every individual was predicted to produce faster response times (on average) when talking to a stranger, and respond slower when talking to a friend. Most importantly, this effect was found to be applicable to every individual of the sample, and not just a sample-general effect. It also complements Templeton et al. (2022, 2023) findings

regarding differences in RTs among friends and strangers - there are less long gaps in conversations between strangers than friends.

According to the Gaussian component of model 1, the average estimate of RT is 0.33 s for friends', and 0.23 s for strangers' conversations, suggesting that on average strangers are 100 ms faster to respond than friends. The left plot in *Figure 2* showcases the 95% confidence intervals (95% CIs) for each estimate, suggesting that there is more variability in average RTs in conversations between friends than strangers, and no overlap in 95% CIs suggests a clear difference in RTs between the two groups. The results with respect to the exponential component of RT distribution follow a similar pattern, however, the difference in average long pauses between strangers and friends is greater, see the right plot of *Figure 2*. In this case, the average difference in overall RTs between the two groups is around 190 ms - almost twice as big as the difference in mean RTs of the Gaussian component. This difference is also depicted by the 95% CIs in the right-side plot of *Figure 2.* Again, as the 95% CIs are far from overlapping among the both groups, it suggests a great and clear difference in how fast participants tend to respond based on their relationship. Both Gaussian and exponential components of RT distribution have captured the difference in turn-taking between strangers and friends, however, when the whole RTs distribution was taken into account (Fitousi, 2020), the difference between the two groups becomes more considerable.

Reciprocal adaptation

The second model has provided the results for the core question of the present study - whether there is an effect of reciprocal adaptation between the individuals who are having a conversation. As mentioned before, once the partner takes a longer time to respond during turn-taking, friends tend to adjust their own response time and slow down too. On the other hand, it is not the case for the conversations between strangers - participants in the conversation generally do not adapt to their partner's behavior of turn-taking. Participants, however, were found to adapt to their own response times in the previous turn and be consistent in how fast they respond, no matter the relation type between them; if participant's RT was slower than usual, during the next turn-taking instance it was predicted to be slower even more.

Figures 4 and 5 showcase more detailed findings on how the partner's and participant's self RT in the previous turn can affect participant's RT for future turn. In terms of friends'

conversations, these findings are visualized in the left plots of both figures. Both plots suggest that the partner's and self RT in previous turn can predict the participant's RT in friends' conversations, and that partner's RT has a generally stronger effect. More specifically, when a partner's RT becomes longer, so does the participant's following RT; if the partner is generally faster to respond, the participant's RT changes only slightly - depending on self RT in previous turn. In terms of strangers, the opposite effect holds. Both, *Figure 4 and 5*, show how different predicted RTs are compared to the ones of friends'. As friends tend to slow down, strangers show an effect of no adjustment or be generally faster to respond. Both right-side plots in *Figure 4 and 5* show how almost no adjustment in participant's RT is predicted with respect to partner's RTs, and how participant slows down only when self RT's in previous turn become longer.

Additional analyses

The third and fourth models have provided further insights about how other conversation aspects might affect response times. The focus of the third model was to investigate whether the number of words in the previous turn, namely, the amount of words the partner has produced, can affect participant's RT. *Figure 6* showcases the model's predictions for both friends' and strangers' conversations. Although general differences in RTs between the two groups hold, the effect of word count on friends' and strangers' RTs is close to the identical: the more words the partner has produced during previous turn, the faster both, strangers and friends, would respond and vice versa. According to Corps et al. (2018), there is a possibility that a long partner's turn might consist of more turn-completion points, which might provide participants with more clues on how to begin the response earlier.

The fourth model was set to investigate the effect of reciprocity a bit further; since participants show some type of adjustment with respect to their partner or themselves, could it be that once multiple interlocutors have a conversation with the same participant, their RT adjusts in the way so that it becomes similar among the interlocutors themselves? The RT predictions of model 4 are plotted in *Figure 7*. The figure contains predicted response times only for those participants, who had a conversation with both friends and strangers. The number of interlocutors for each participant is the same as in the original dataset. According to the plot, there is some similarity in interlocutors' behavior during turn-taking when talking to the same participant: it is clear that predicted response times generally tend to be close to one another. The figure also depicts the overall difference in response times between the two

groups: when talking to friends, RTs tend to be slower, however, when talking to strangers, RTs are considerably faster.

Limitations and future research

The present study was conducted to re-analyse data, collected by Templeton et al. (2022), in order to investigate the dynamics of response times during turn taking not on individual, but dyadic level. This way it is possible to understand the differences between the participant groups in a more thorough way. Although results have revealed important aspects of turn-taking dynamics in conversations between friends and strangers, it is crucial to consider some possible limitations.

Firstly, the data set contains 322 conversations between strangers and only 65 between friends. Having more data from friends' conversations could provide more statistical validity and power; more observations from friends could increase the reliability of model estimates and more accurate RT predictions. For instance, having more conversations with friends could affect the predicted variability in RTs across the interlocutors (*Figure 7*). Secondly, although pairs of participants in conversations between strangers have been matched by gender, friends' conversations were not. For this reason, it might be that the dynamics in RTs might be affected not only by social context, but also by gender differences. It seems like gender-differences in communication do exist (Reeder, 1996), and therefore once this aspect is controlled in one group of participants, it might be useful to also control in the other.

Future research, of course, should consider gender-differences in turn-taking, and investigate whether the effect of reciprocity holds to the same degree for males and females. In addition to gender-differences, the data set consisted of students' conversation recordings; in the future studies, it could be interesting to investigate whether turn-taking style changes with age. With respect to the study, conducted by Templeton et al. (2022), one should further investigate whether the effect of reciprocity between the pairs of participants is linked to the perceived social connectedness among friends and strangers. Such answers would provide a deeper understanding of how communication patterns can influence the overall outcome of conversation in specific social contexts.

Conclusion

In the present study I have investigated response time differences during turn-taking in conversations between friends and strangers. The final results suggest that in general, friends are slower in taking turns than strangers. In friends' conversations, participants were found to adapt to their partners: when the partner takes a longer time to respond than usual, participants slow down as well. The opposite was found in conversations between strangers: strangers were found to not adapt to their partner. In both groups of participants, interlocutors were found to be self-consistent; they tend to adjust their response time with respect to how fast they have responded in the previous turn. Additional analyses have further provided valuable insights about how other aspects of conversation can be related to response times during turn-taking: greater number of words produced in the partner's previous turn was found to make the participant respond faster in the following turn. Moreover, the effect of reciprocal adaptation can also be seen in the similarity of turn-taking behavior among the interlocutors who talk to the same participant. More research with greater participant size is needed to investigate the later finding in more depth.

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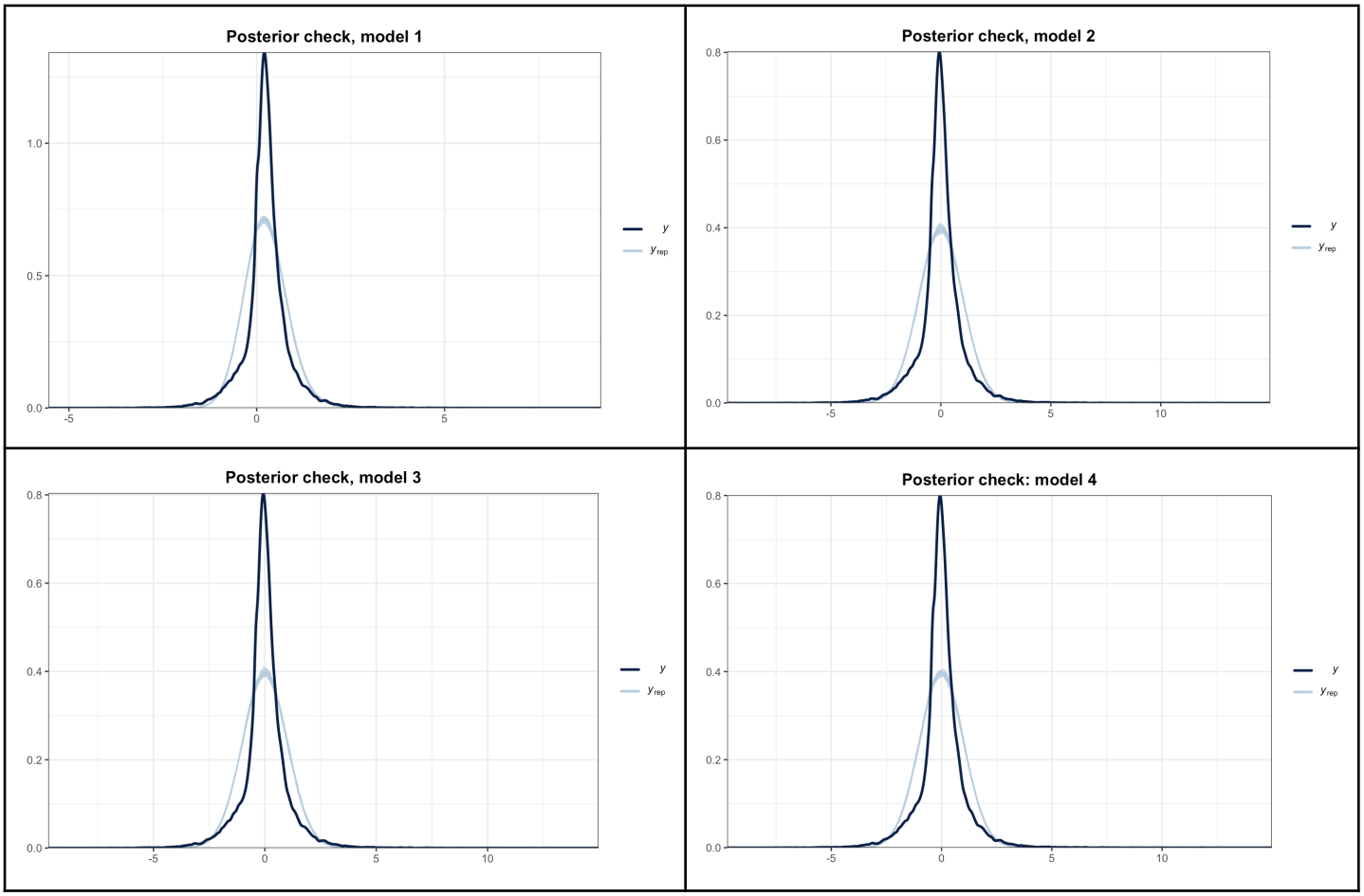
Supplementary materials

Data preprocessing and analysis:

Files of the data preprocessing and analysis can be found in the following link: https://github.com/JustinaRaz/Files_BT_Cognitive_Science.git

Actual data was taken from the *Supplementary materials* of Templeton et al. (2022) paper.

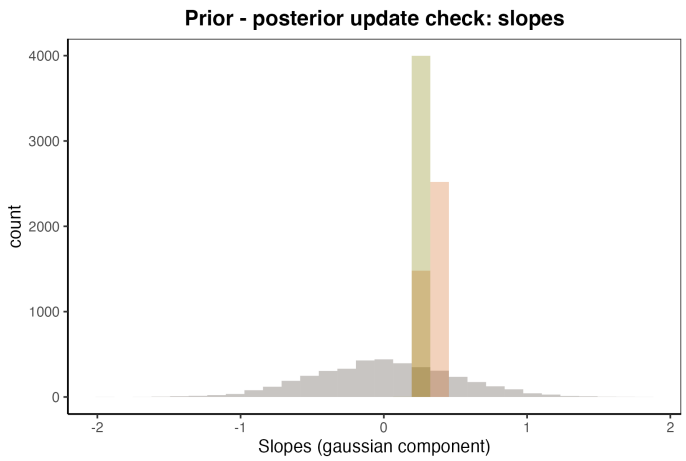
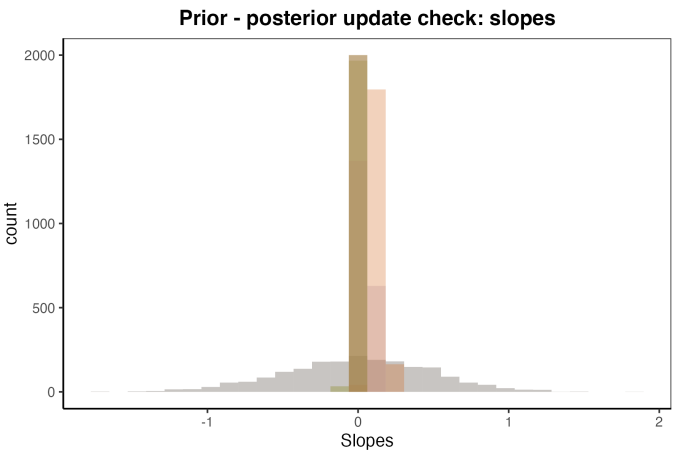
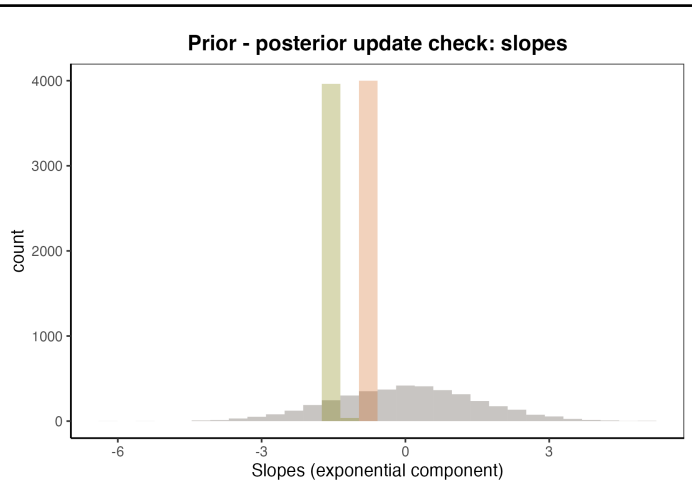
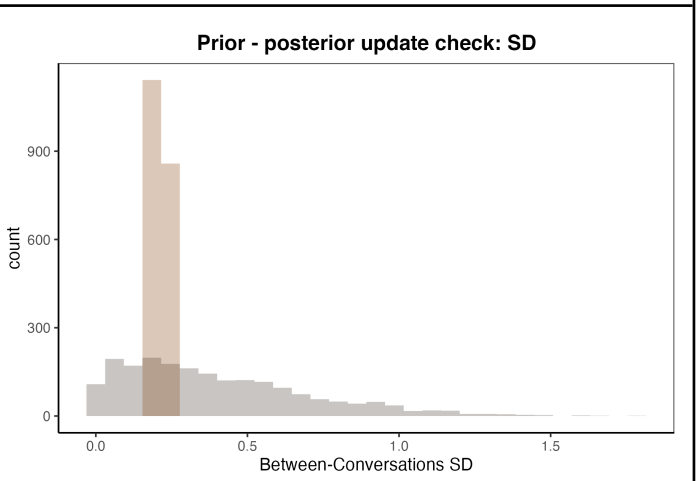
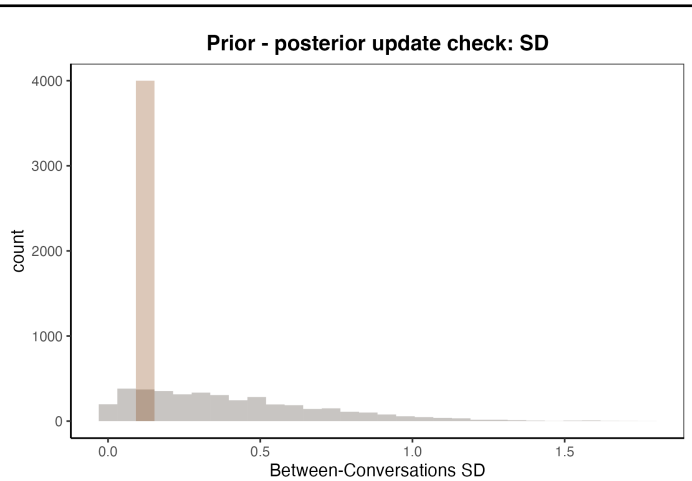
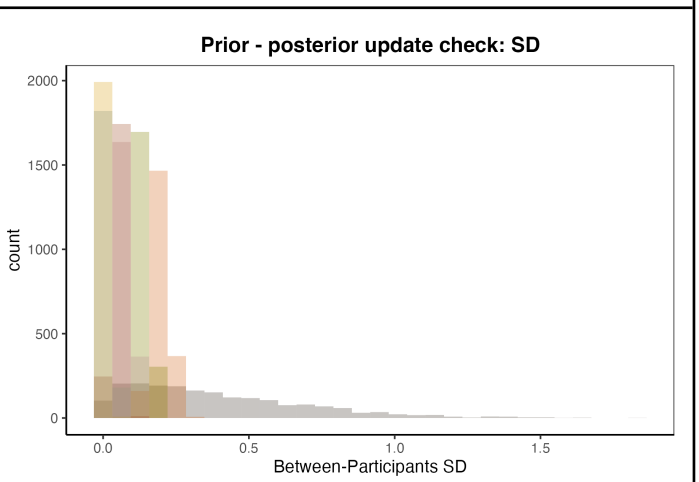
Posterior checks:

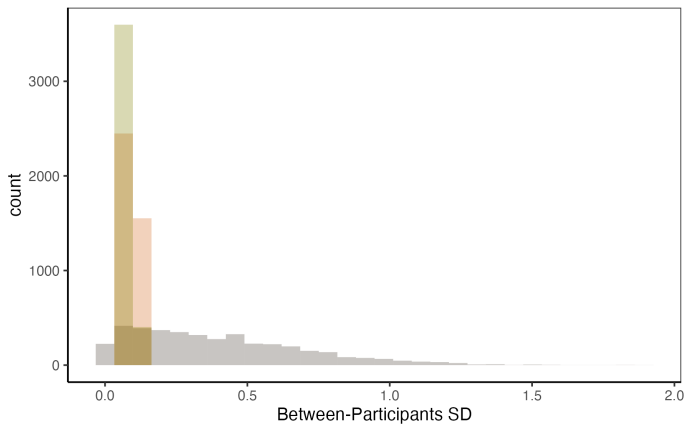


Supplementary Figure 1: posterior checks for each of the models. The grey distributions represent posterior-predictive checks, the black distributions - real data.

Prior - posterior update checks:

Prior - posterior checks

Model 1	Model 2
	
	
	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1000
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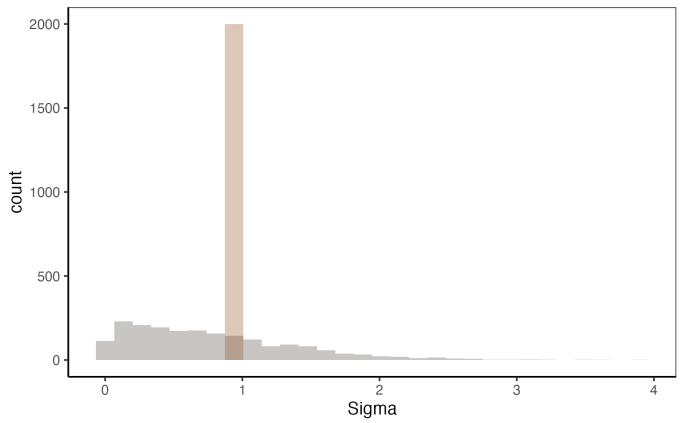
0.0
0.5
1.0
1.5
2.0
Between-Participants SD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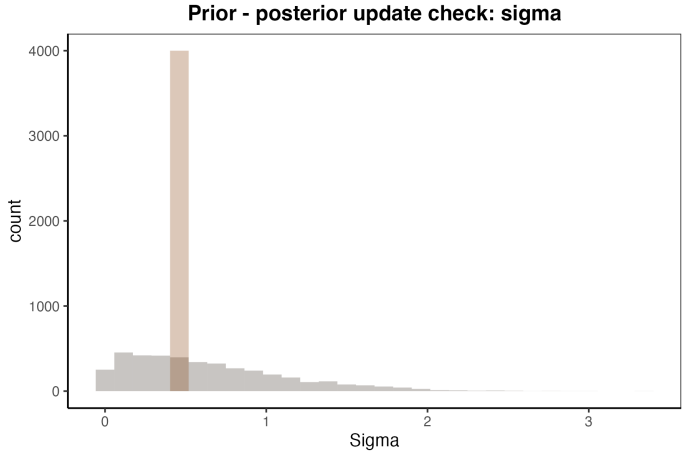
1500
1000
500
0
0
1
2
3
4
Sigma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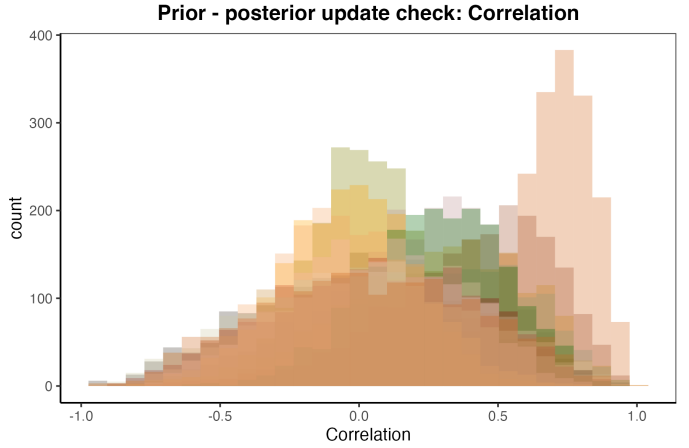
3000
2000
1000
0
0
1
2
3
Sigma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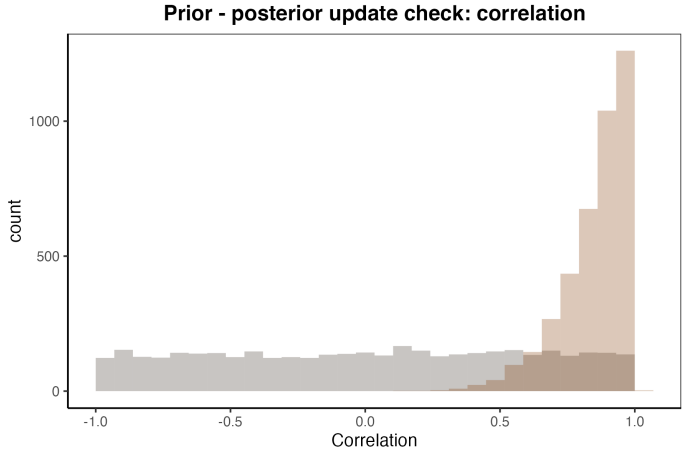
300
200
100
0
-1.0
-0.5
0.0
0.5
1.0
Correlation


Prior - posterior update check: correlation
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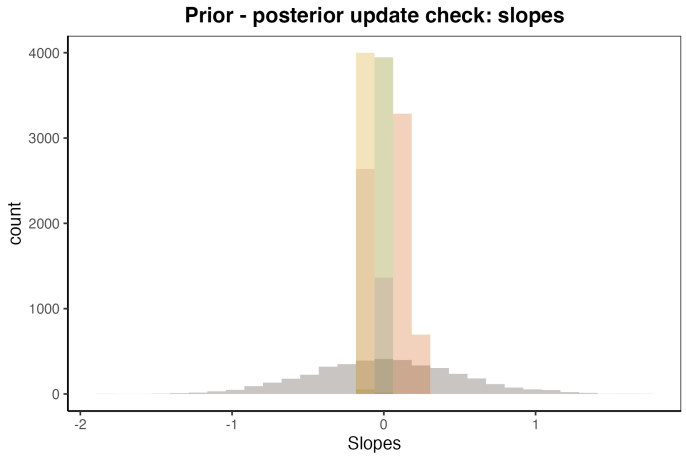
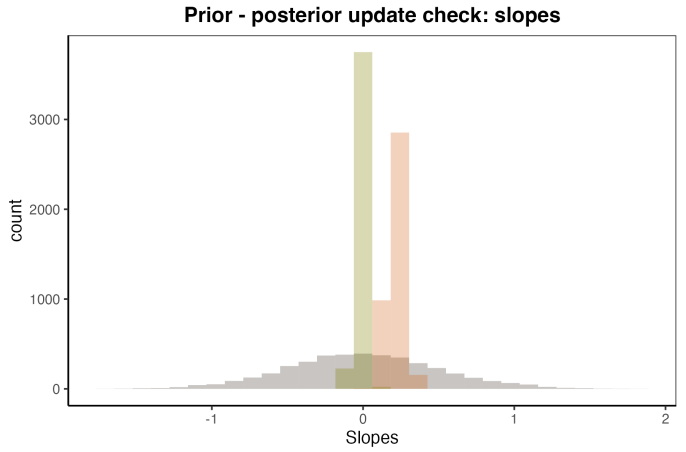
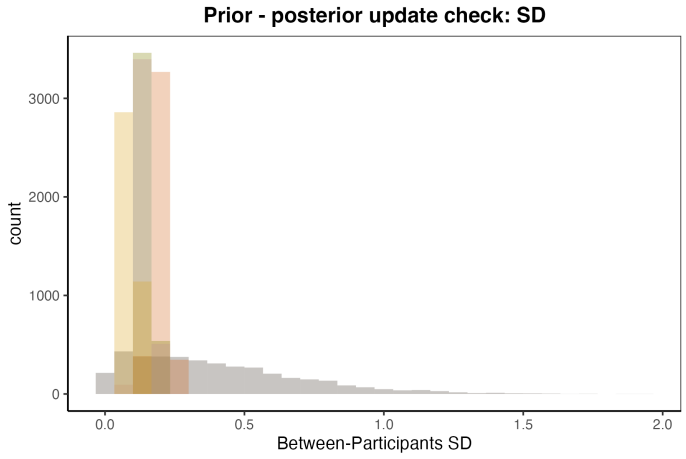
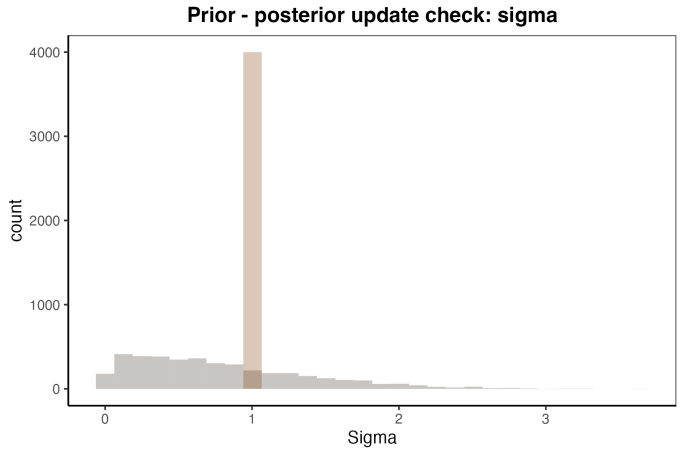
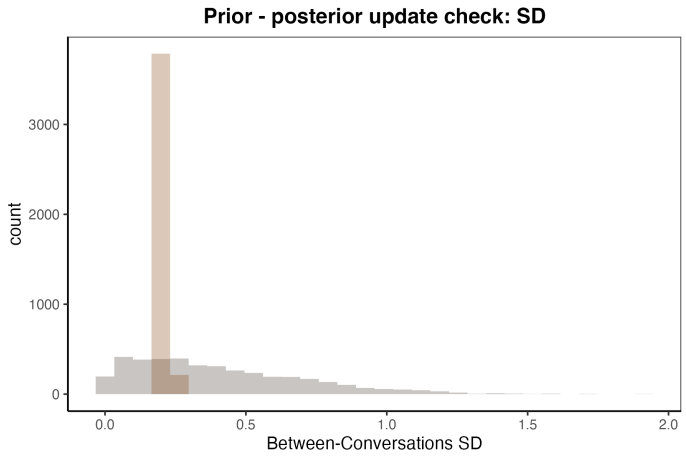
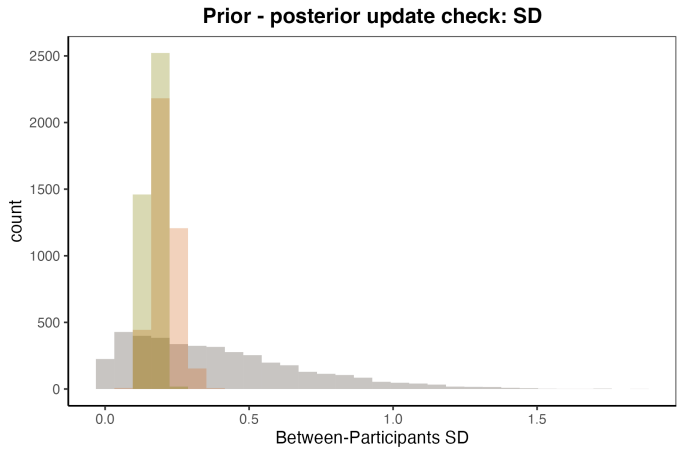
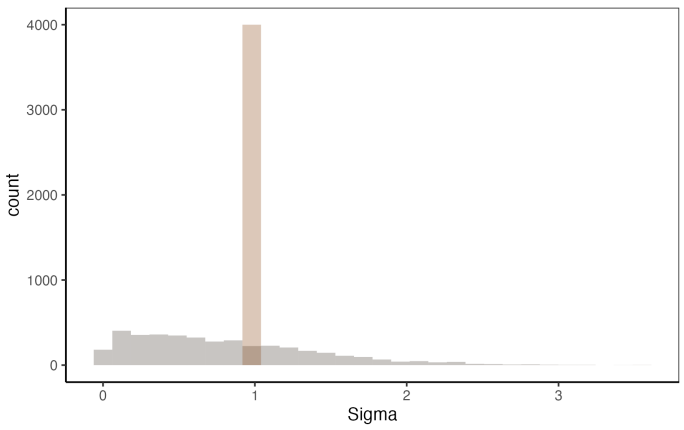
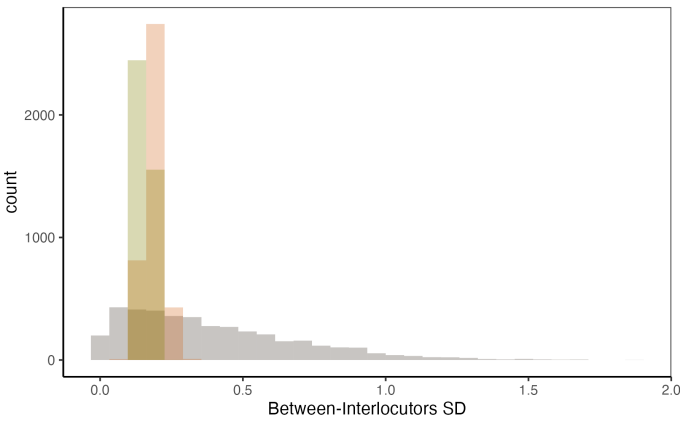
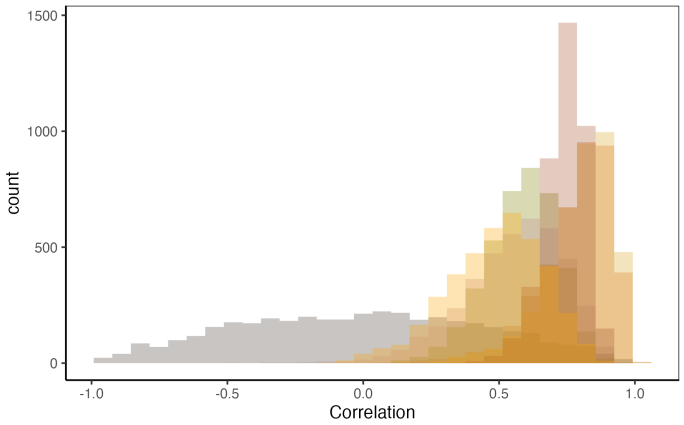
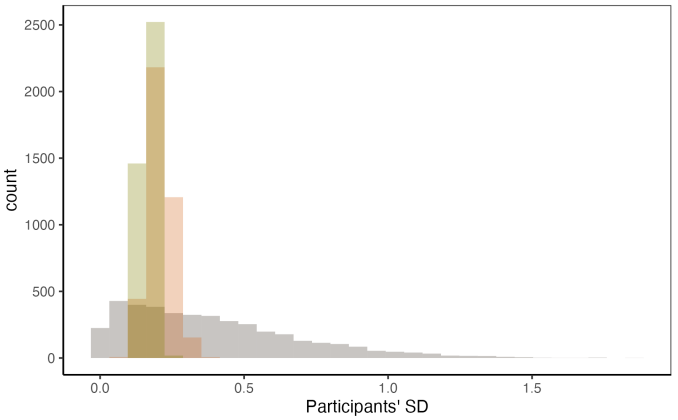
500
0
-1.0
-0.5
0.0
0.5
1.0
Correlation

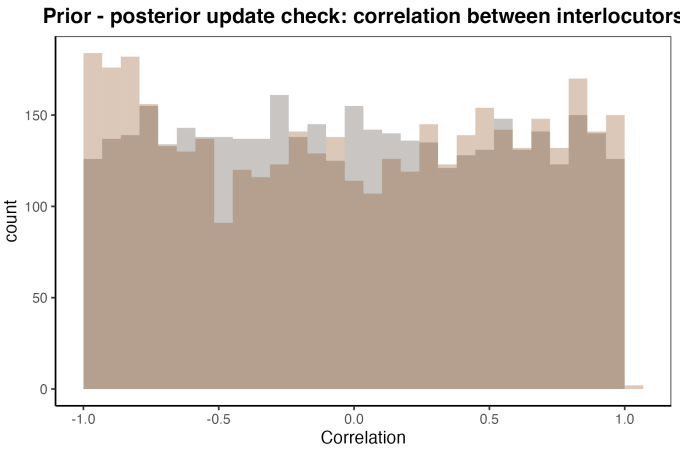
Model 3	Model 4
	
	
	

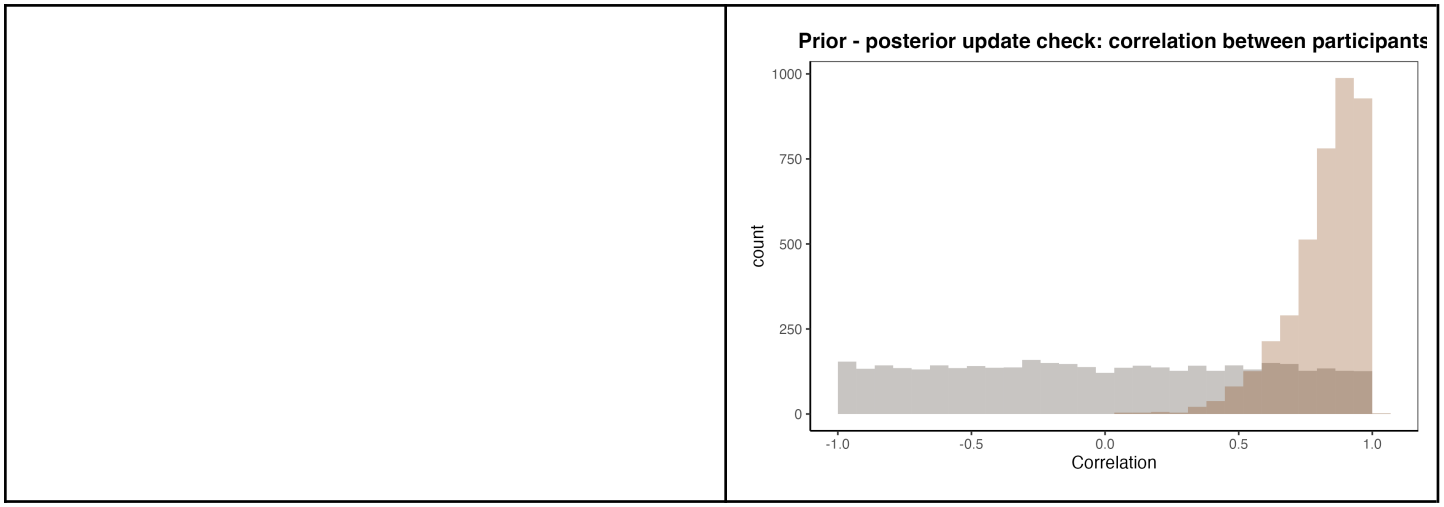

Prior - posterior update check: sigma
count
Sigma


Prior - posterior update check: SD
count
Between-Interlocutors SD


Prior - posterior update check: Correlation
count
Correlation


Prior - posterior update check: SD
count
Participants' SD


Prior - posterior update check: correlation between interlocutors
count
Correlation



Supplementary Figure 2: Prior-posterior update checks for each model.