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Interacting With Multiple Partners Improves Communication Skills

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Abstract

Successful communication is important for both society and people's personal life. Here we show that people can improve their communication skills by interacting with multiple others, and that this improvement seems to come about by a greater tendency to take the addressee's perspective when there are multiple partners. In Experiment 1, during a training phase, participants described figures to a new partner in each round or to the same partner in all rounds. Then all participants interacted with a new partner and their recordings from that round were presented to naïve listeners. Participants who had interacted with multiple partners during training were better understood. This occurred despite the fact that the partners had not provided the participants with any input other than feedback on comprehension during the interaction. In Experiment 2, participants were asked to provide descriptions to a different future participant in each round or to the same future participant in all rounds. Next they performed a surprise memory test designed to tap memory for global details, in line with the addressee's perspective. Those who had provided descriptions for multiple future participants performed better. These results indicate that people can improve their communication skills by interacting with multiple people, and that this advantage might be due to a greater tendency to take the addressee's perspective in such cases. Our findings thus show how the social environment can influence our communication skills by shaping our own behavior during interaction in a manner that promotes the development of our communication skills.

Keywords: Communication; Social networks; Joint action

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1. Introduction

Successful communication is essential for cooperation and progress. When it fails, it can have fatal consequences. For example, miscommunication has led to multiple fatal aviation accidents (Cushing, 1994), and it has been involved in 30% of malpractice claims in the United States (Crico Strategies, 2015). The present study investigated whether explaining information to multiple different people improves the clarity of the explanations. Many of us have had the experience that the second time we give a lecture, we do it better than the first time. By the third time, we explain things to our audience even better. One might think that this is due to practice or to receiving specific feedback from the audience. The present studies investigate whether explaining information to different people improves how well we explain it, even when the amount of practice and the input we receive from the audience are held constant.

Recent findings have revealed how the social properties of our environment influence our communication skills by influencing the distributional properties of our input. For example, 14-month-old infants can learn that /buk/ and /puk/ are two different words, and therefore that /b/ and /p/ are two different phonemes, if they hear multiple speakers produce these words, but not if they hear a single speaker produce the words the same number of times (Rost & McMurray, 2009, 2010). Similar benefits of exposure to multiple speakers have been found in second language acquisition and foreign-accent adaptation (Barcroft & Sommers, 2005; Bradlow & Bent, 2008; Lively, Logan & Pisoni, 1993). The positive effects of exposure to multiple people have been found to extend to real-world social interactions. In particular, having larger real-life social networks has been shown to lead to better phonological and semantic skills, and computational simulations suggest that this benefit is mostly due to the greater variability that exists in input from multiple speakers (Lev-Ari, 2016, 2018).

However, aside from providing diversity in input, social environments may also shape our own output, as having more interaction partners implies a greater need to adapt to multiple others. We propose that interacting with multiple others influences how we communicate in a manner that promotes our communicative ability in general. That is, interacting with multiple others might make us better at conveying information in a manner that would be better understood by others, and it might make us better at adapting our communication to different types of addressees, especially unfamiliar ones. Understanding this route of influence would transform our current models of communicative development which focus on received input without sufficiently considering the environment's influence on us as active learners.

1.1. Perspective taking of similar and dissimilar others

There are several reasons to predict that interaction with multiple partners would improve someone's ability to convey information clearly to someone new. Key among them is the possibility that communication with multiple others might make us better communicators by increasing our tendency to take perspective. In general, we rely more

on our own self-knowledge and perspective with similar than different others (Robbins & Krueger, 2005). For example, people are more likely to generalize their thirst to others when these others share their political attitudes than when they do not (O'Brien & Ellsworth, 2012). Such generalization from self can impair communication as people differ from each other. Assuming that another person shares our knowledge or associations when they do not could lead us to communicate in a manner that is vague or unclear. One type of situation that tends to increase people's awareness of potential differences between them and others and thus increase their perspective taking is when they need to interact or reason about the behavior of unfamiliar others, and especially outgroup members. For example, German participants demonstrated better perspective taking when reasoning about the behavior of Turkish versus German individuals (Todd, Hanko, Galinsky, & Mussweiler, 2011). People also demonstrate better perspective taking when interacting with strangers rather than with friends (Savitsky, Keysar, Epley, Carter, & Swanson, 2011). These advantages during interaction with unfamiliar or dissimilar others have been argued to be due to a tendency to shift toward a global processing style when encountering something unfamiliar (Förster, Liberman, & Shapira, 2009; Woltin, Corneille, & Yzerbyt, 2012). Interacting with more people is likely to involve interacting with more unfamiliar people as well as with more people who are dissimilar to us. Therefore, interacting with multiple people is likely to increase our tendency to take perspective.

People might benefit not only from interacting with people who differ from them but also from interacting with people who differ from each other. Children growing up in a multilingual environment exhibit better perspective taking than those growing up in a monolingual environment (Fan, Liberman, Keysar, & Kinzler, 2015), presumably because of the exposure to speakers who differ from each other in the knowledge they possess. Interacting with others who differ in the knowledge they share with us is likely to trigger frequent needs to adjust. The heterogeneity of individuals' interaction partners is likely to increase when the number of interaction partners increases, providing yet another trigger for those interacting with more people to increase their general tendency to take their interlocutors' perspective. Greater perspective taking should, in turn, improve the clarity and suitability of their explanations.

1.2. Message clarity with different audiences

Prior research shows that messages are better understood by addressees than by overhearers (Schober & Clark, 1989) because addressees participate in the process of establishing meaning. Interestingly, overhearers of such interactions still show superior comprehension to listeners of monologues. That is, participants who listened to a director instructing a matcher how to order tangram figures were better able to order the tangram figures correctly than those who listened to a director instructing how to order tangram figures in a monologue (Fox Tree, 1999). Fox Tree interpreted this finding as potentially being due to the integration of two perspectives, the director's and the addressee's, in the dialogue, whereas only one perspective was used in the monologue. The greater the number of perspectives that contribute to message formulation, the more likely it is to be

clear to others. That said, another study that compared the comprehensibility of messages created by two versus three interacting partners failed to find a difference (Atkinson, Mills, & Smith, 2018).

Research conducted on communication at the community level provides indirect support for this idea that the more people there are, the more perspectives there are, and consequently the clearer the messages that the group formulates. For example, Garrod and Doherty (1994) tested isolated dyads and groups of alternating dyads play a maze game. They found that most groups of alternating dyads converged on the same manner of location expressions, presumably because it is the one that is the easiest to learn and understand. In contrast, dyads whose members never interact with other partners showed variability in the manner of communication that they converged on, presumably, because there was less pressure to create a manner that would be transparent to all perspectives. Similarly, larger groups have been shown to create more systematic languages (Raviv, Meyer, & Lev-Ari, 2019) and an examination of real-world languages shows that languages spoken by larger communities are more codable (Majid et al., 2018).

Prior research then suggests that larger groups create clearer messages. Here we ask whether experience of interacting with multiple partners can lead one to become a better communicator. That is, we ask whether a speaker with more varied communicative experience would be better able to communicate to someone new than someone with equal amount but less varied communicative experience. Furthermore, prior literature on the clarity of messages created by multiple partners argues that the benefit of messages created by multiple partners is due to the collaborative nature of meaning making. That is, the messages are argued to be clearer because they are shaped by multiple partners rather than one. We agree that partners' contribution to message formulation shaped their comprehensibility. Here we ask whether experience with multiple partners, even when they do not contribute to message formulation, can still improve how clearly a speaker communicates by influencing their behavior during communication.

To conclude, research has thus far shown that interacting with multiple partners could improve communication skills by shaping the distributional properties of the input we receive. Research has also shown that messages formed by larger groups tend to be clearer. There are reasons to hypothesize that interaction with multiple partners can improve our communication skills by changing our behavior during interaction in a manner that promotes improvement. This possibility, however, has never been tested. Experiment 1 tests whether interacting with multiple partners improves communication skills, namely, whether people who interact with more others become better at conveying information in a manner that would be better understood by unfamiliar others. Experiment 2 takes a first step at examining the mechanism by which it does so.

2. Experiment 1

To investigate the hypothesized benefit of communicating with multiple others, we created a tangram communication task and manipulated the number of interaction partners

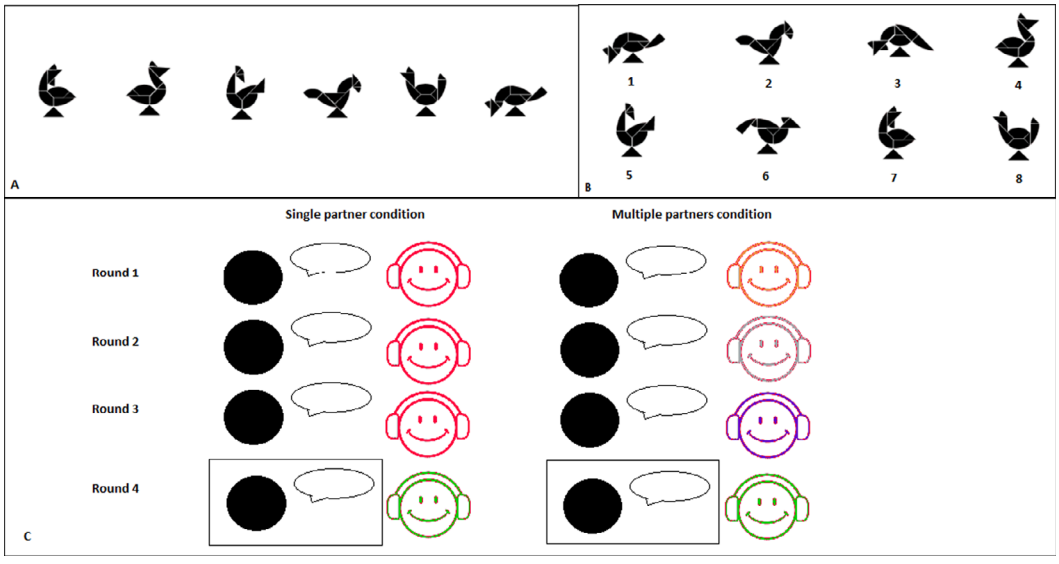

Fig. 1. Illustration of the stimuli and procedure. Describers saw sets of six tangram chicken (A). Matchers saw a larger set of tangram chicken that included the figures on the describer's screen as well as two distractors. All figures were numbered (B). Panel 1C illustrates the design of the Descriptions Collection phase. In the Single Partner condition, describers described the tangram chicken to the same partner for three rounds. In the Multiple Partners condition, describers described the tangram chicken to a different partner on each of the first three rounds. In both conditions, describers described tangram chicken to a new partner in the fourth round. Recordings from the fourth round (indicated by a rectangle) were used in the Experimental Phase (not illustrated).

that participants had. We minimized the input participants received from their interaction partners to control for input variability. We then tested whether the explanations of participants who had interacted with multiple partners are better understood than the explanations of those who had interacted with a single partner. The experiment was composed of two phases, a Descriptions Collection Phase and an Experimental Phase. During the Descriptions Collection Phase, participants played a communication game with either one partner for several rounds or with a different partner in every round. The communication partners were not allowed to provide feedback beyond indicating their comprehension, thus controlling for potential differences in input variability. In the last round, all participants played with a new partner, and recordings of participants' descriptions from this round were presented to naive participants in the Experimental Phase (see Fig. 1). The recordings that were used in the Experimental Phase were therefore always from rounds in which participants interacted with a new interaction partner so that participants' goals and shared history with their partners were the same across conditions. We tested whether naïve participants understood the descriptions of those who had interacted with multiple partners better than the descriptions of those who had interacted with a single partner.

2.1. Methods

2.1.1. Participants

In all, 96 native Dutch speakers participated in the Descriptions Collection Phase, 48 in the Multiple Partner condition, and 48 in the Single Partner condition. Participants were randomly assigned to the role of describer or matcher, such that in both conditions half of the participants were describers, and half were matchers. In all, 87 Dutch speakers participated in the Experimental Phase of the experiment. This phase had a within-participants design and so all participants participated in both the Multiple Partners and Single Partner condition. The number of participants in the Experimental Phase was determined based on the difference between performance in the Multiple Partners versus Single Partner conditions in the Descriptions Collection Phase. We estimated that in the Experimental phase this difference would be smaller because in the Description Collection phase the difference may have been driven by improvement in both describers' and matchers' behavior, and in the Experimental Phase we intentionally eliminate matchers' contribution to the improvement. Our estimate indicated that a sample size of 80–90 participants would be appropriate.

2.1.2. Stimuli and procedure

Descriptions collection phase: In all, 48 tangram figures resembling chicken were used as stimuli (see Fig. 1). All figures were composed of the same geometrical shapes. Figures were grouped in sets of 8. On each trial, the describer saw a row of six of the eight figures of the set and the matcher saw all eight figures in a different order across two rows. On the matcher's screen, a number appeared below each tangram figure. The internal order in which the figures in the set were ordered for the matcher and for the describer was randomized per trial. Each round consisted of six trials, and trials differed in the figures they contained. The order of the trials was randomized.

Describers' goal was to describe the tangram figures they saw such that the matchers would be able to identify them from the larger set of figures and indicate their order. Participants were instructed to be as accurate and as fast as possible, with a time limit of 2.5 min per trial. Matchers were instructed that they should let the describer know if they identified the figure or required more information but that they were not allowed to provide descriptions or ask specific questions. They were also told that they were allowed to ask the describer to repeat what they had said, repeat the describer's words themselves, or indicate that they did not understand. Once Matchers understood the description, they typed the number underneath the figure on their screen. At the end of each trial, participants saw the accuracy for their trial, that is, how many of the six figures were identified correctly. Participants' interactions were recorded. All participants played for four rounds. In the Multiple Partners condition, participants played with a different partner in each round. In the Single Partner condition, participants played with the same partner for the first three rounds, and played with a new partner in the fourth round.

Experimental phase: Comprehension accuracy in the Descriptions Collection Phase depended on the performance of both describers and matchers. To isolate the quality of the describers' performance from that of the matchers', recordings of the descriptions in the last round of the Descriptions Collection Phase were played to naïve participants in the Experimental Phase. The figures presented on the screen were the same as those that the matcher in the Descriptions Collection Phase had seen on the screen while listening to the describer. To ensure that every participant in the Experimental Phase was exposed to stimuli that are representative of each condition and of each describer, and that participants were not exposed to any describer more than once, one set of recordings was used for all participants in the Experimental Phase. This set included 30 recordings, 15 of each condition, such that no describer featured more than once. We used matchers' comprehension accuracy in the Descriptions Collection Phase to ensure that these recordings were representative of each describer and of the conditions as a whole: For each describer, we selected an average description, that is, a description whose comprehension accuracy in the Descriptions Collection Phase was around the pair's median for that round. Likewise, the average comprehension accuracy for the total set of descriptions per condition was representative of the average accuracy for that condition in the Descriptions Collection Phase. The recordings were edited to remove any comments made by the matcher during the interaction, except for the final acknowledgment of understanding each figure (*OK*, *got it*, etc.), that marked the end of one description and the beginning of the next. Additionally, three descriptions, one from each of the first three rounds in the Descriptions Collection Phase, were used as practice trials. Those descriptions were of different describers than those in the test descriptions.

Participants identified tangram figures according to the recorded instructions. Their display and task were identical to those of the matchers in the Descriptions Collection Phase. Participants started with three practice trials, and then listened to the 30 test descriptions from both conditions in random order.

The study followed the ethics procedure of the Max Planck Institute for Psycholinguistics.

2.2. Results and discussion

2.2.1. Descriptive observations

Our main hypothesis regards how well naïve listeners were able to understand the descriptions provided by participants in the Multiple Partners versus Single Partner condition. Before reporting the main analysis over performance in the Experimental Phase, however, we provide participants' performance throughout the Descriptions Collection Phase in order to provide a better understanding of the main results. Fig. 2 plots the performance across the three training rounds and the fourth test round in the Descriptions Collection Phase. It seems that in the Multiple Partners condition, participants improved across rounds, such that by the final test round, all were relatively well understood. In contrast, in the Single Partner condition, performance rose from the first to the second

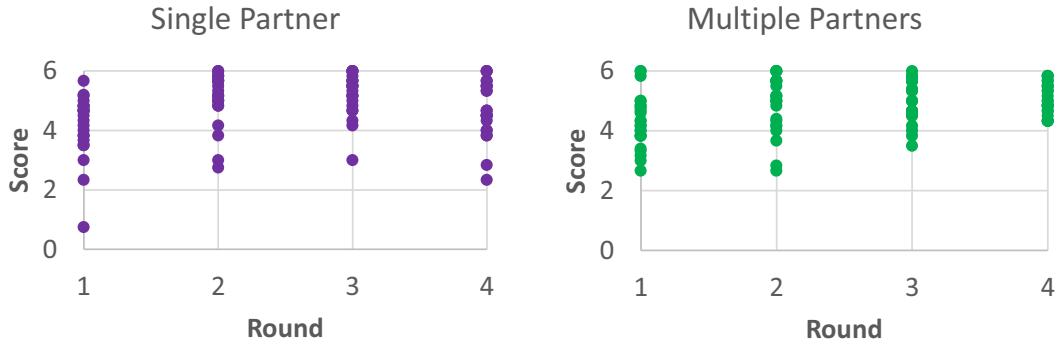

Fig. 2. Participants' average score per round during the three training rounds and the last test round in the Descriptions Collection Phase.

round, and this better performance was maintained and perhaps even slightly improved in the third round, but when interaction partners changed in the test round, performance seems to have dropped. It also seems that there was greater variation in performance across dyads in the Single Partner condition than in the Multiple Partners condition, suggesting that some speakers were able to adapt, whereas others struggled. At the same time, these patterns should be treated with caution, since performance in these rounds reflects not only the quality of participants' description but also listeners' performance, and the listeners in the two conditions were different. The main analysis reported in the Primary Results section avoids this issue by having the same naïve participants listen to describers from both conditions.

To better illustrate the manner by which descriptions varied from each other, we provide in Table 1 an example of one description by a particularly good describer from the Multiple Partners condition and one description by a particularly poor describer from the Single Partner condition. Impressionistically, good describers tended to pick out a small set of characteristics that are sufficient for distinguishing between figures and focused on them. Poor describers, in contrast, seem to have provided more comprehensive details, and their manner of descriptions seem to have been more idiosyncratic across trials. Further research, however, is required to objectively quantify these aspects and empirically attest these observations.

2.2.2. Primary results

To test whether describers in the Multiple Partners condition communicated better than describers in the Single Partner condition, we ran a logistic mixed effects model on participants' accuracy for each described figure in the Experimental Phase using lme4 package (Bates, Mächler, Bolker, & Walker, 2015) in R (R Core Team, 2016). The model included Condition as a fixed factor, and Participants and Items as random variables. The random structure included both intercepts and a by-participants slope for Condition. As predicted, results showed that participants were more accurate in their responses to

Table 1
Translation of a description by a particularly poor describer from the Single Partner condition and a particularly good describer from the Multiple Partners condition. Both descriptions are from the final test round

Particularly Poor Describer	Particularly Good Describer
On the left side it looks to the left, the bird. It has a triangle as beak and a . . .. neck that is not so long. The triangle that it stands on in particular has its longest side on the bottom. It has a very short tail that looks like a chicken tail. There's a small half circle, another half circle and on the upper side also a half circle and as if the top half circle disappears behind the head . . ..And the first half circle is not fully a half circle there is also a triangle . . . That is on the left side, these are the pieces. That piece is a bit half circle-like and afterwards a triangle and then it continues straight	Now you have a head on the left side up as a regular triangle that points upwards to the right with a crest on top. The tail is on the right side

describers from the Multiple Partners condition than in their responses to describers from the Single Partner condition ($\beta = 0.5680$, $SE = 0.2504$, $z = 2.269$, $p < .03$; see Fig. 3).

2.2.3. *Exploratory analyses*

The results of Experiment 1 confirm that communicating to multiple partners improves individuals' ability to express themselves clearly. As listeners did not provide the describers with contentful input, one may wonder what prompted the improvement. One possibility is that describers in the Multiple Partners condition were more likely to encounter difficulties, such that description strategies that they had used beforehand successfully,

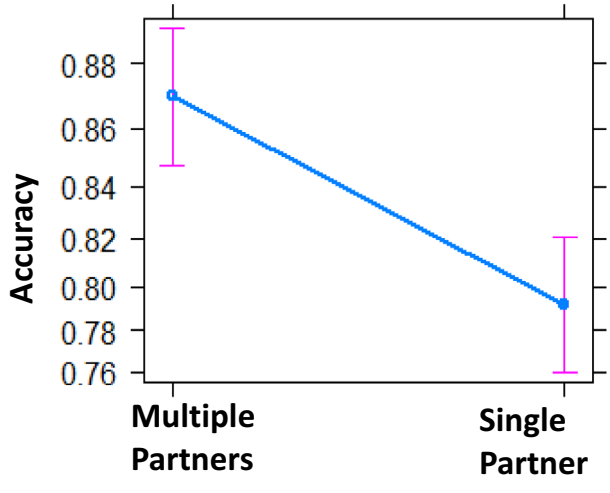

Fig. 3. Participants' accuracy as dependent on describer's condition. Bars represent the standard error.

were no longer being understood with the change of partner. Such difficulties could prompt them to modify their manner of description as well as increase their tendency to take their listener's perspective in order to do so successfully. To examine whether this is the case, we quantified how likely describers were to experience a drop in performance across consecutive rounds. If participants experienced a drop of at least 0.333 points across consecutive rounds during training (i.e., the first three rounds in the Descriptions Collection Phase), we coded the drop as 1. Otherwise, we coded it as 0. Fifty-four percent of participants in the Multiple Partners condition experienced such a drop compared with only 21% of participants in the Single Partner condition. This difference was significant ($t(46) = 2.49$, $p < .02$). That said, when instead of calculating the drop in a binary manner, we code the raw magnitude of the largest drop (calculating the smallest increase with a negative sign if there was no drop), this difference becomes only marginal (0.42 vs. 0.05; $t(46) = 1.99$, $p < .06$). Additionally, these analyses were not preplanned, so these results should be treated as only suggestive, and offering potential directions for future research.

2.2.4. Discussion

The results of Experiment 1 show that interacting with multiple others promotes better communication even when the amount of interaction is held constant and the input that addressees provide is minimal. This raises the question of why interacting with multiple others benefits communication. As mentioned earlier, one possibility is that interacting with multiple others increases the tendency to take others' perspective. The difference between the speaker's and the addressee's perspective is that whereas the speaker focuses each time on a specific figure to describe, the addressee sees the set as a whole as they try to identify the relevant figure in it. Describers should be better if they took the addressee's perspective, that is, examined the set as a whole in order to select what and how to describe the figure. Indeed, as the examples of better versus poorer describers in Table 1 show, poorer describers focus on the figure and describe it in its entirety, distinctive and nondistinctive features alike. Better describers seem to focus more on distinctive features and describe them in a systematic manner. We hypothesize that participants in the Multiple Partners condition provided better descriptions because they took the addressee's perspective and viewed the set as a whole, as the addressee did, enabling them to provide more useful descriptions.

This focus on the set as a whole also goes hand in hand with the shift to global processing that interaction with unfamiliar others should encourage (Förster et al., 2009; Woltin et al., 2012). Experiment 2 tests whether addressing multiple and varied addressees across trials encourages processing the stimuli globally, in line with the addressees' perspective. Furthermore, in Experiment 1, we controlled the input from the addressees by instructing them not to provide descriptions of the images but only to signal understanding. While this input is minimal and could not have provided participants with strategies regarding how to best describe the images, it is possible that it was the addressees' comprehension or lack thereof that allowed participants to learn which of their description strategies was best comprehended. In Experiment 2, we eliminated that

option, testing whether merely anticipating that the listener would be the same or different suffices for triggering a shift in perspective.

3. Experiment 2

Experiment 2 tested whether directing communication toward one or several dissimilar others leads to a shift in perspective. As in Experiment 1, participants described sets of tangram images to addressees. This time, however, no addressee was present and participants were merely given information about who their addressee would be. Participants were either informed that the addressee of all their descriptions would be the same or that each description would be provided to a different addressee. Participants were further given details about the occupation of each addressee, and addressees in the Multiple addressees condition were portrayed to be dissimilar from each other (e.g., an MSc Physics student vs. a hairdresser). Following the communication task, participants performed a surprise memory test in which they distinguished between the sets of figures they had described as a set and mixed sets containing figures from different sets. If those who interact with multiple partners are more likely to take the addressees' perspective and if taking addressees' perspective leads to a tendency to process the set of figures as a whole, then participants who described the figures for multiple addressees should be better in judging whether or not they had encountered a set before, compared to participants describing the figures for a single addressee.

3.1. Methods

3.1.1. Participants

In all, 105 native English speakers were recruited via Prolific. We aimed for a sample size similar to the one in Experiment 1, while allowing for the need to exclude participants who did not follow the instructions. In total, 13 participants provided nonsensical or too minimal descriptions that did not attempt to describe each figure individually. All analyses were therefore conducted on the remaining 92 participants.

3.1.2. Stimuli

Five sets of four tangrams each served as stimuli during the communication phase. The test phase included these five sets and five distractor sets. Each distractor set included two figures that had appeared in the same set and two figures from other sets, such that each figure appeared twice, once in its original set, and once in a distractor set. Five addressee identities were constructed: a hairdresser, someone training to be a kindergarten teacher, a journalism student, a BA student in literature, and an MSc student in Physics. The identities were constructed to be dissimilar in level of education and interests, as we expected heterogeneity to increase the tendency to take perspective. In the Multiple condition, each set was matched with a different addressee. There were five

different versions of the Multiple condition, such that, across participants, each set was matched with each of the addressees. In the One condition, all sets were matched with the same addressee. There were five versions for the One condition, each with a different addressee.

3.1.3. Procedure

Participants were told that they were being tested on their communication skills. They were told that their task was to describe sets of figures to future pre-selected participants. The experiment had a between-participant design with participants randomly allocated to either the Multiple Partners or the Single Partner condition. Before describing the first set, participants were either told that each of their descriptions would be shown to a different addressee, and that they would be told who the addressee is each time, or that all their descriptions would be shown to the same future participant. In both conditions, the identity of the addressee was shown during the presentation of each set (see Fig. 4). In the Multiple Partners conditions, all potential addressees were presented and their order of presentation was random. In the Single Partner condition, one of the five potential addressees was chosen at random for each participant and all trials referred to that addressee. To control the amount of exposure to each set, each set was shown for five timed periods. In each period, the set was shown for 20 s and then replaced with a text box. Participants then described the set for as long as they wanted by typing into the text box. Once they completed their description, they pressed ENTER and were presented with the set for another 20 s, so they could gather more details they could describe afterwards. Participants could not see or edit the description that they had already provided in previous periods. Participants were informed of this procedure before starting the task. After participants had described all five sets, they performed a surprise memory test. Sets were shown one at a time in a random order. Participants indicated whether the set was the original one or a mixed one by selecting the "old set" or the "new set" option.

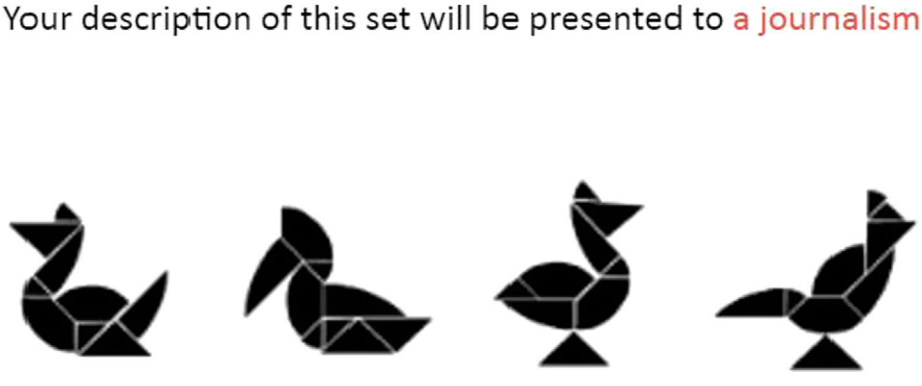

Fig. 4. An illustration of a communication trial in Experiment 2.

3.2. Results and discussion

To test whether participants in the Multiple condition had better memory for the set, we ran a logistic mixed effects regression with the lme4 package (Bates et al., 2015) in R (R Core Team, 2016). The model included Condition (One, Multiple) as a main effect, and Participant and Item as random effects. The model did not include a slope because its inclusion led to failure of convergence. Results showed the predicted effect of Condition ($\beta = -0.39$, $SE = 0.16$, $z = -2.41$, $p < .02$). Participants who wrote descriptions for multiple future addressees were better at distinguishing the sets they had seen from the rearranged ones, suggesting that the expectation of multiple dissimilar addressees increased participants' tendency to take their addressees' perspective and shifted them to a more global manner of processing.

4. General discussion

In this study, we investigated whether describing information to multiple (real or imagined) partners improves communication skills in terms of learning how to convey information such that it is better understood by unfamiliar others. Our findings show that interacting with multiple partners is useful even when the partners do not provide any input other than feedback on comprehension or are merely anticipated. Therefore, this study opens a line of research on how the properties of our social environment, such as the number of interaction partners we have, can influence our trajectory of learning by changing the way we behave during interaction. We propose that the number of partners can influence the tendency to take their perspective and induce a shift towards global processing, and thus improve the clarity of our messages.

The results of Experiment 2 indicate that participants who designed their descriptions for a different addressee in each trial were better at discriminating between sets that they had described and re-arranged sets. This advantage could be due to several different mechanisms. We hypothesized that interacting with multiple partners could increase the likelihood of taking the addressee's perspective and thereby lead to more global processing. However, participants' performance could reflect the effect of both perspective taking and global processing or only one of them. Both tendencies have been argued to become more pronounced in novel and unfamiliar situations, as when communicating to multiple unfamiliar and diverse partners (O'Brien & Ellsworth, 2012; Todd et al., 2011; Woltin et al., 2012). At the same time, it could be that one of these behaviors is more sensitive to the number of interaction partners or contributes more to the development of communication skills. Performance on the memory test in Experiment 2 benefits similarly from both processes, making it difficult to assess their relative role in our experiment. Future research should disentangle the two to better understand how interaction shapes our behavior and, consequently, learning. Additionally, while participants' performance was in line with our predictions and proposed mechanisms, it could also be in line with alternative mechanisms, such as increased attention triggered by interacting with multiple

partners. In other words, while the results of Experiment 2 are in line with our predictions, they are not a direct test of our proposed mechanism. Future research should explore in more detail such alternative possibilities and try to disentangle our proposed mechanism from other non–mutually exclusive alternatives.

One prior study (Rogers, Fay, & Meybery, 2013) examined whether interacting with a larger audience influences audience design, a phenomenon tightly related to perspective taking. That study did not find a difference in message length between tailoring a message to 1, 4, or 9 unknown addressees. These messages were also later equally understood by naïve addressees. While this previous study seems to conflict with the conclusions we have drawn from our study, the previous study differs from ours in both manipulation and measures. One important difference between the studies is that our experiments required participants to switch perspective on each trial, whereas the previous study manipulated the presumed size of the audience, but the audience and its size remained fixed throughout the experiment, thus encouraging maintaining the same perspective throughout the experiment. It is likely that frequent switches in addressees would be more effective in increasing the tendency to take perspective. Second, the perspective-taking measures in the previous study were quite different. The main measure used in Rogers et al. (2013) was message length. This is quite different from our measure, and we would not expect message length to necessarily reflect perspective taking in our task. Perhaps more surprisingly, Rogers et al. (2013) examined whether messages targeted at larger audiences were better understood by naïve addresses, and we did not find an effect. At a first blush, this might seem to conflict with our findings from Experiment 1. However, in addition to the different audience size manipulation which could influence the size and likelihood of finding an effect, note that our account proposes that interacting with multiple others improves communication skills by influencing communicators' behavior during their interaction in a manner that promotes improvement. In other words, we predict that after interacting with multiple others, communicators would become better. Correspondingly, in our study, we measured the clarity of communicators' description after they had completed three training rounds. In contrast, in Rogers et al. (2013), participants did not have the opportunity to learn and improve. Instead, the tested messages were all the messages that they had constructed. Therefore, despite the superficial similarity of the studies, it is difficult to directly compare the results, and it is not clear that our account would even predict an effect of audience design in that study.

We demonstrated improvement in communication skill by focusing on one dimension of communication, comprehensibility by naïve listeners. Communication skill, however, is a multifaceted skill that includes other dimensions such as ability to rephrase when misunderstood, optimal use of contextual cues, and adjustment to changes in context, addressee, or discovered knowledge. We hypothesize that interaction with multiple partners would lead to improvement in at least some of these dimensions as well, since interaction with multiple partners increases attention to context, and therefore might lead to better utilization of it and greater sensitivity to changes in it. These are open questions though and further research is required to explore these possibilities.

This paper demonstrated how interacting with multiple partners can improve communication skills even when the interaction partners provide only minimal input. In the real world, however, when addressees provide input, the benefit of interacting with multiple partners is likely to be even larger, as the input that multiple partners provide could have its own beneficial consequences. First, multiple partners are likely to provide more variable input, more ways to describe the stimuli, as well as questions that highlight areas of potential confusion. Second, in the real world, the variability in the input and needs of multiple partners could trigger variability in our behavior which could also promote learning. During communication, interaction partners adjust their pitch, speech rate, use of dialectical variants, lexical choices, grammatical choices, and even nonlinguistic gestures to become more similar to their interaction partner (Barr & Keysar, 2002; Branigan, Pickering, & Cleland, 2000; Chartrand & Bargh, 1999; Coupland, 1980; Coupland, Coupland, & Giles, 1991; Gregory & Webster, 1996; Street, 1982). Additionally, speakers accommodate to the needs of their interaction partners, such as slowing down their speech when talking to non-native speakers or increasing their pitch amplitude when talking to infants (e.g., Burnham, Kitamura, & Vollmer-Conna, 2002; Uther, Knoll, & Burnham, 2007). Consequently, interacting with multiple partners should increase the variability in one's communicative behavior as a consequence of aligning with the speech of the interaction partner or of adjusting to their needs. Research in motor learning suggests that variation in one's own behavior during practice improves learning (e.g., Douvis, 2005; Krakauer, 2006; Schilling, Vidal, Ployhart, & Marangoni, 2003; Wulf & Schmidt, 1997). This literature thus suggests that, in the real world, interaction with multiple partners might further benefit the development of communication skill by increasing variability in one's communicative behavior.

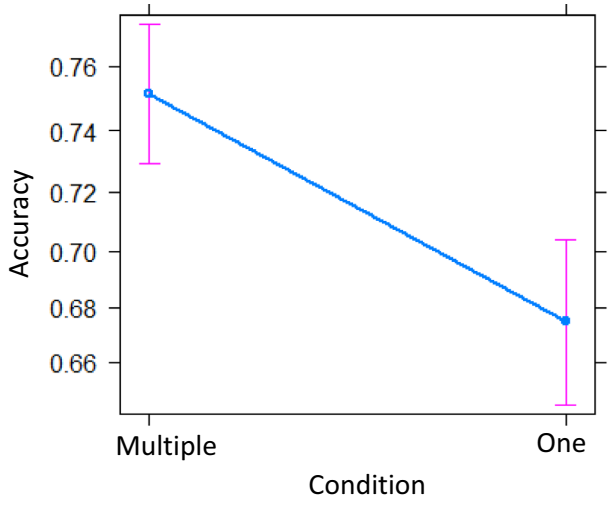

Fig. 5. Accuracy in the memory test of Experiment 2 as dependent on number of anticipated future addressees during the communication task.

Interacting with multiple others might also improve communication skills by increasing our understanding of what we explain. Indeed, research in education shows that teaching improves learning (e.g., Bargh & Schul, 1980; Cohen, Kulik, & Kulik, 1982; Fiorella & Mayer, 2013), and argumentation with others has similarly been argued to improve comprehension (Mercier & Sperber, 2011). Thus, interacting with multiple others might improve our understanding, and better understanding might lead to better explanation. Future research should evaluate the relative role of the different mechanisms and their interaction in order to better understand the development of communication skills and design better programs to improve it.

Additionally, it will be interesting to investigate in future studies how the benefit of increasing the number of interaction partners changes depending on the magnitude of the increase and the number of interaction partners one already has. In the present studies, participants interacted with either one individual or three different individuals in Experiment 1, and they tailored their description to either one or five different interlocutors in Experiment 2. One may wonder whether a larger increase in the number of interaction partners would lead to further improvement as well as whether there is a threshold above which further increases in the number of interaction partners is no longer beneficial. Similarly, in Experiment 1, we relied on natural variation across addressees, while in Experiment 2 we set an expectation for addressees that are dissimilar from one another. It would be informative to systematically manipulate the similarity of the addressees both to the speaker and to each other to examine whether such dissimilarity promotes the development of communication skills.

To conclude, the present paper shows that having more communication partners improves communication skills in terms of comprehensibility of descriptions. Increasing the number of communication partners is a practise that can be applied in the real world and could be easily integrated into programs training communication or teaching skills, especially in occupations in which failure of communication can have grave consequences.

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