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Who is Best at Mediating a Social Conflict? Comparing Robots, Screens and Humans

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Abstract

The impacts of various mediation platforms on negotiation outcomes and perceptions are compared in this article. The mediator platforms contrasted were a (teleoperated) Telenoid robot, a human, and a computer screen. All of these platforms used the same script for process diagnosis, analysis, and advice on how to resolve an impasse in a simulated high-tech company de-merger negotiation. A fourth experimental condition consisted of a no-mediation control. More agreements and more integrative agreements were attained by the robotic platform than by the other types of mediator platforms and the control. Mediation via the Telenoid robot also produced more non-structured agreements, which consisted of decisions made outside of the scenario options. Negotiators in this condition had more positive perceptions of the mediation experience, were more satisfied with the outcome, and thought that the mediator's advice was more useful. Indirect analyses showed that the outcomes mediated the effects of the conditions on perceived satisfaction. Implications of the findings are discussed in terms of responses to novelty, which include creative and divergent modes of thinking.

Keywords Divergent thinking · Electronic mediation · Integrative agreements · Novelty · Representative negotiations · Telenoid robots

This article is dedicated to the memory of Gregory Kersten, editor par excellence, frontier e negotiation scholar, teacher and mentor, and humanitarian.

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1 Introduction

Advances in the technologies of electronic communication have facilitated conversations and collaborations. Rapid developments over the past three decades have revolutionized the scope and rapidity of written, oral, and visual communication. The positive and negative effects of new technologies of telecommunication on human behavior and relationships are intensely discussed (Williams and Rice 2016). Whether telecommunication with physical stand-ins or proxies such as "communication robots" amplifies effects is a focal research task in the new area of human–robot interaction (HRI) (Seibt and Vestergaard 2018).

The mediation experiment reported in this article was motivated by the advent of new interactive technologies and suggestive findings from early research on their impacts. [See the review of these technologies by Druckman and Koszegi (2017) and Damholdt et al. (2019).] Taking advantage of recent advances in technologies, we discerned an opportunity to let the research lines on e-mediation (Druckman et al. 2014) and human–robot interaction (see Goodrich and Schultz 2007) cross in new ways. Focusing on mediation effectiveness, we compare three electronic mediation (e-mediation) platforms for their impacts on agreements, types of agreements (integrative or distributive), and perceptions of the mediator. The study was designed in the context of literatures on third-party interventions in conflict and electronic mediation discussed below. We begin by reviewing studies on mediation effectiveness. Findings from these studies provide benchmarks for evaluating the effects obtained in our experiment. We then present the contributions made by the e-mediation studies before introducing the communication set-up with human–robot interaction. These reviews correspond to the conditions compared in the experiment: human, electronic, and robotic mediators.

2 Benchmarking Mediator Effectiveness

Attempts to evaluate impacts of interventions are aided by previous studies that establish benchmark effects. This works well for educational interventions as shown by Hill et al. (2007). Investigators in those fields have established rules of thumb or methods norms that facilitate comparison across studies, aiding in the cumulation of policy-relevant knowledge. This methodological culture has not been established in the field of mediation. Studies have been performed in a variety of different domains, there is a lack of control group (no mediation conditions) comparisons, and little agreement on metrics for assessing impacts (see Wall and Dunne 2012). Although this has impeded cumulation, there are three avenues available for empirical benchmarking. One avenue is the literature on international mediation. Another includes two published meta-analyses conducted in different arenas. A third is the stream of studies on electronic mediation.

Findings from analyses by Bercovitch and his colleagues (e.g., Bercovitch and Gartner 2006; De Rouen et al. 2011) provide a basis for evaluating effectiveness of mediation in both interstate and intrastate conflicts. These can be summarized:

Over half (55%) of all mediation efforts in interstate disputes are unsuccessful. Only six percent produce full settlements, twenty-seven percent result in partial settlements and eight percent result in ceasefires. A similar pattern occurs for intrastate conflicts with thirty-eight percent being unsuccessful and thirty-one percent producing either partial or full settlements (see Grieg et al. 2019). Thus, roughly one-third of mediated inter and intra-national conflicts produce a full or partial agreement. This can be interpreted as a modest effect size. Interestingly, mediation has also been shown to be somewhat effective in reducing tensions in long-term contentious conflicts (Beardsley et al. 2019).

Shaw's (2010) meta-analysis of divorce mediation supports the international mediation findings. She compared mediation and litigation outcomes obtained in five studies, reporting an average effect size (grand *d* statistic) of .36 ($SD = 13.5$) across the studies that made this comparison possible. This study is interesting for two reasons. One is that it is one of only two quantitative meta-analyses of mediation effectiveness. Another is that the focus on marital divorce mediation is similar to the company de-merger scenario used in this study. Both deal with issues concerning the terms of separation.

The other meta-analysis was performed by Nugent, Williams, and Umbresit (2004) on victim-offender mediation (VOM). They included 15 studies (9307 juveniles at 19 service sites) in their sample. All of these studies compared the effects of a VOM program with a control group (no VOM program) on re-offense or recidivism. The odds of VOM participants were only about .70 as great as the odds of nonparticipants reoffending, which converts to an effect size of .39. This is comparable to the average ES reported by Shaw. A field study by Ashford and Faith (2004) compared participants randomly assigned to a mediation ($n = 124$) with a pretrial conference ($n = 76$) condition. They reported a significant difference between the conditions on degree of settlement: An *F* ratio of 7.91 which, when expressed as an ES is .20. A third study by Wall (1979) compared two mediation techniques, rewarding negotiator concessions, and suggesting concessions on agreements, total and initial concessions, and joint payoffs (integrative agreements). The ES for rewards (vs. no rewards) were .22 (total concessions), .26 (agreements), and .31 (joint payoffs). The ES for suggestions (vs no suggestions) was .30 on initial concessions. The average ES across these comparisons is .27.

A third empirical benchmark comes from our research on e-mediation. The current study extends that research by adding a condition using a communication robot. Control group comparisons were made in Druckman et al. (2004) and Druckman et al. (2014). In the earlier Druckman et al. (2004) study, a comparison between a screen mediator and reflection control on agreements yielded an effect size (*r*) of .32. Other pairwise comparisons on agreements included a screen mediator and mediation advice ($r = .23$) and a screen vs. a human mediator (.24). The average effect size across these comparisons is .26. The proportion of agreements that were integrative were also analyzed. Three comparisons yielded an average effect size of .32 (the screen-human comparison yielded an effect size of .48, favoring the human mediator). In the more recent Druckman et al. (2014) study, mediation advice provided by a screen did not produce more agreements or more compromise agreements than the

controls but did produce agreements where the conflicting parties made larger concessions ($r = .20$) and reciprocated more of their opponent's concessions ($r = .22$).

Overall, across the three domains, mediation, including e-mediation, is effective in about one-third of the cases and produces an average effect size of about .33. This background serves as a benchmark for evaluating the impact of the mediation platforms used in this study. We now turn to a discussion of e-mediation support, first by describing the support functions and then reviewing the earlier results.

The review of mediation studies leads to the first pair of hypotheses:

H1 Mediation produces more agreements than no mediation. The expected effect size for this comparison will be around .30.

H1a Mediation produces more integrative agreements than no mediation. The expected effect size for this comparison will be around .30.

3 Mediator Support Functions

The study reported in this article focuses on the impacts of alternative platforms for delivering mediation. We compare mediation delivered by a human, by a computer screen, and by a communication robot.[1] All of the mediation conditions in the study were based on a model of mediator functions developed by Druckman et al. (2002), implemented in a software system, and referred to initially as Negotiator Assistant and later as Negotiator Support System (NSS). The support provided by the computer system captures three functions of process mediation, referred to as diagnosis, analysis, and advice.[2] These functions spring into operation at the moment of a negotiation impasse. Diagnoses are based on answers to suites of questions, created by the authors, about the negotiating parties, their delegations, the issues, situation and process. Depending on the answers, an algorithm calculates the extent of flexibility shown by the negotiators. Flexibility "scores" are displayed on a grid with forecasts of likely outcomes such as no agreement, capitulation by one party to the other, compromise or fair agreement. Analyses are based on the imputed sources of disagreements or impasses, including issue complexity, value differences, lack of a plausible solution, and intra-delegation disputes. These sources are then linked to

[1] The heuristic background for adding a robotic platform was an exploratory study on conflict facilitation performed in 2016 with the Telenoid communication robot, reported in Seibt/Vestergaard 2018. We describe below the communication set-up and the design features of the robot.

[2] We distinguish between process and substantive mediation. By process mediation, we refer to aspects of the negotiation that move it in the direction of agreement or impasse. For example, regarding the talks as a strategic game or problem-solving process, offering or retracting concessions, focusing on gains and losses or relationships. This is the type of mediation modeled by the system used in this study. By substantive mediation, we refer to preferences on issues. Substantive mediators help negotiators find solutions that benefit both or all of them. They are encouraged to trade on different preferences for optimal outcomes (Raiffa 1982) or to create multiple equivalent simultaneous outcomes (Leonardelli et al. 2019).

various types of advice. Further details about these functions with examples are provided in the section on VienNA.

4 Evaluating the Negotiator Support System

The NSS support system was used initially in a case resembling the conflicts that preceded the 2003 war in Iraq (Druckman et al. 2004). Seven issues were presented to role-playing negotiating delegates representing the fictitious nations of Anice or Izeria. The case was sufficiently complex to produce an impasse after the first round of negotiating. At this point, negotiators availed themselves of the NSS before proceeding to another round. Three experiments were conducted. The first experiment compared the NSS system with a comparable period of reflection. Significantly more agreements (both across and within the issues) and fewer impasses were obtained for the NSS negotiators. These negotiators also had more favorable perceptions of the outcome, but not the negotiating process. They did not find the NSS to be more helpful or essential for resolving the issues than the period of reflection; significantly more favorable perceptions were obtained for the reflecting activity. A second experiment compared the NSS system with a paper (rather than screen) advice only condition. More agreements were obtained on most issues for the NSS condition. However, negotiators in a condition of paper advice had more favorable perceptions of the outcome and process.

The third experiment compared two screen conditions, referred to as separate and joint use of the system, with a scripted human mediator. In one screen condition, negotiators used the support system separately on different computers; in the other condition, they used the system together in the same room on the same computer. The separate NSS condition produced as many agreements across the issues as human mediation; significantly more agreements were produced by the joint NSS condition than those obtained in the separate NSS or human mediation conditions. Moreover, significantly fewer integrative agreements occurred for separate NSS negotiators than for those in the joint NSS or human mediation conditions. Similar to the results obtained in the first experiment, negotiators with human mediators had more favorable perceptions of mediator helpfulness than those in both NSS conditions.

Further developments in NSS technology enabled negotiators to access mediation at any time, in any location. Referred to as asynchronous or non-face-to-face negotiation, this NSS configuration could be considered as a forerunner to many of the current social media platforms. It resembles the way many professional negotiators conduct their business these days. Technical details, including the use of a modular platform known as Negoisst (Schoop et al. 2003), are described in Druckman et al. (2014). The mediation system is known as VienNA and was developed in collaboration with TU Wien (Druckman et al. 2014). VienNA revises the analysis, diagnosis, and advice functions of the original system so that they can be executed separately for the involved negotiation parties. This enables negotiators in different time zones or locations to use this form of mediation

support. It also provides decision and documentation support from other asynchronous NSS like Negoisst (Schoop et al. 2003).

A next experiment was designed to evaluate VienNA and, in so doing, test a number of hypotheses (Druckman et al. 2014). This was a control-group comparison of conditions where negotiators had access to or no access to VienNA. Hypotheses were developed for impacts on outcomes, processes, timing of mediation, types of advice, mediation approaches and perceptions. These results reinforce and extend the earlier findings in several directions. The earlier study by Druckman et al. (2004) showed NSS advantages in producing agreements while the second study by Druckman et al. (2014) showed effects primarily on the size of concessions. Both studies showed that the NSS produced more favorable outcome perceptions of satisfaction than process perceptions. The more recent study showed that only fairness advice produced more agreements and more reciprocated concessions. Together these findings raise questions about mediation, the substance of mediation, and the platform for delivering mediation services. Mediation per se may matter more than the substantive advice provided by mediators. Electronic platforms for delivering mediation may not have an advantage over human mediators except when delivered in the joint presence of the negotiating parties. These platforms are regarded by the experimental participants as being less helpful than humans even though they produced more willingness to compromise.

The findings obtained in this set of experiments suggest the following hypotheses (we abbreviate hereafter 'screen-based mediation' as 'screen mediators'):

H2 Screen mediators produce as many agreements as humans.

H2a Screen mediators do not produce more integrative agreements than humans.

H3 Negotiators are more satisfied with screen mediators than with no mediation.

H3a Negotiators are more satisfied with human than with screen mediators.

5 Introducing Human–Robot Interactions

Human–robot Interaction (HRI) is a burgeoning multidisciplinary field exploring benefits and drawbacks of robotics applications in the health care and education sectors, but also in areas of therapy and counseling, including conflict detection and resolution. As a number of HRI studies show, human–robot interactions differ from human–human interactions and human–computer (screen) interactions in numerous ways. During the past 15 years of HRI research, it has become apparent that, depending on interaction contexts, robots can be as or more effective than humans in engaging human interaction partners and getting them to follow directions (Utami et al. 2017; Bainbridge et al. 2008), increasing prosocial behavior (Krátký et al.

2016), showing a willingness to disclose private information (Yamazaki et al. 2012), providing some cognitive learning gains (Lyzberg et al. 2012), eliciting empathy (Seo et al. 2015; Connolly et al. 2020) and rapport building (Seo et al. 2018), and effectively mediating conflict between pairs of children as they attempted to resolve their conflict (Shen et al. 2018).

Of particular importance is the finding that we experience robots as physical agents in three-dimensional space. As shown by Krátký et al. (2016), the dimensionality of the visual information apparently plays an important role: more prosocial behavior occurred when experimental subjects interacted with a 3D rather than a 2D picture of the same robotic agent.

Whether the distinctive differences between human–human interaction, human–robot interaction, and human–computer interaction, can be attributed to differences in the way in which we cognitively process socially relevant information (implicit social cognition), is currently an open research interest (Wykowska et al. 2016; Cross et al. 2019). Computers and robots lack distinctive perceptual cues for gender, age, ethnicity, or status. As a result, they may be perceived as acting more fairly, leading to attributions of neutrality. This hypothesis underlies the idea of "Fair Proxy Communication" (FPC), a communication format where two people interact with each other via a teleoperated robot without perceptual cues for gender, age, ethnicity, race, or status.[3] Since the robot does not afford perceptual biases based on visual appearance, it may enable the person who is interacting with the robot to act 'more fairly' or in a less biased way. Seibt and Vestergaard (2018) suggest applications of this communication format in conflict facilitation, counseling, and assessment communication (job interviews). The latter is currently explored in experimental and real-life settings (Nørskov and Nørskov 2020), while a variation of the former, the application of the communication format FPC in the context of conflict facilitation, constituted the 'robotic platform' of the current study.

A central goal of mediators is to deliver fair outcomes that satisfy all sides of a dispute. That robots can support the goals of mediation was shown in the Shen et al. (2018) study of children reacting to a robot mediator. The key intervention in that study was the mediator's role in flagging the conflict onset. This may be regarded as an early diagnosis of the conflict.

The issue of mediator neutrality is complex. Izumi's (2010) detailed treatment of these issues makes it clear that neutrality is illusory. There is simply no way of preventing implicit biases or expunging mediators of their own incentives for favoring certain agreements (or parties) over others or of the reputational stakes involved in their

[3] The specific physical (i.e.humanoid but with neutral appearance) and functional design features required by FPC are currently best realized by the telecommunication robot Telenoid R1 produced by the ATR/Hiroshi Ishiguro Robotics Lab in Japan (Osaka, Kyoto). The Telenoid robot enables teleoperated communication as follows: A person (interlocutor) interacts with the robot in the normal physical setting of direct communication among two people in the same room. The robot is teleoperated by a person, who sits in a remote location at a computer with a webcam and microphone; a software package transmits the operator's verbal input, his or her voice (modified or unmodified), facial expressions (limited to lip movements), and head movements to the robot. In the standard format of FPC, the interlocutor is aware of the fact that the robot is teleoperated by a person; this condition was modified in the present study, see Sect. 7.6 below.

performance or outcome. Indeed, a case can be made for some advantages of bias when the biased mediator delivers the preferred party (Savun 2008). Computers and associated NSS software, including robotic delivery systems, are presumed to eliminate the perceptual human cues and demographic characteristics of mediators. However, robots may not fully succeed in doing so (our robot resembles a small Caucasian person) and may introduce their own characteristic demeanor (voice and expressions) and stereotype. One question is whether these systems are perceived as unbiased. Another is whether the perceptions influence the effectiveness of mediation. These questions are central to the idea of Fair Proxy Communication.

Based on the few previous studies on the use of robots in mediation or facilitation, we propose an additional five hypotheses as contributions to this nascient literature (we abbreviate 'mediation by Telenoid robot' as 'Telenoid mediators').

Together with the study reported by Seibt and Vestergaard (2018), three studies suggest that robots can be effective mediators—in direct employment as interlocutors in conflicts among children (Shen et al. 2018), and more indirectly as promotors of prosocial motivation in Krátký et al. (2016) and Connolly et al. (2020).

H4 Mediation by a Telenoid robot is more effective than mediating a social conflict via a screen – Telenoid mediators produce more agreements than screen mediators

H4a Mediation by a Telenoid robot produces more integrative agreements than screens.

The Krátký et al. (2016) findings on the effects of dimensionality on prosocial behavior also suggest that physical robots are similar to humans concerning animation and voice. This suggests another pair of hypotheses:

H5 Mediation by a Telenoid robots does not produce more agreement outcomes than those produced by a human mediator.

H5a Mediation by a Telenoid robot does not produce more integrative agreements than those produced by a human mediator.

A next hypothesis derives from the arguments about biased communication made by Skewes et al. (2019):

H6 Agreements obtained by Telenoid mediators and screen mediators are perceived as more fair than those obtained by human mediators.

A final hypothesis is on the role of gender perceptions. In the case of the Telenoid robot visual gender cues are removed but acoustic cues are present. Thus, the voice of the Telenoid could have an influence on gender attributions to the Telenoid. If negotiators were to attribute a gender to the Telenoid on the basis of voice, the biased assessments of mediators should apply to both human mediators (visual and acoustic cues) and Telenoids–females should prefer female mediators and Telenoids with a female voice.

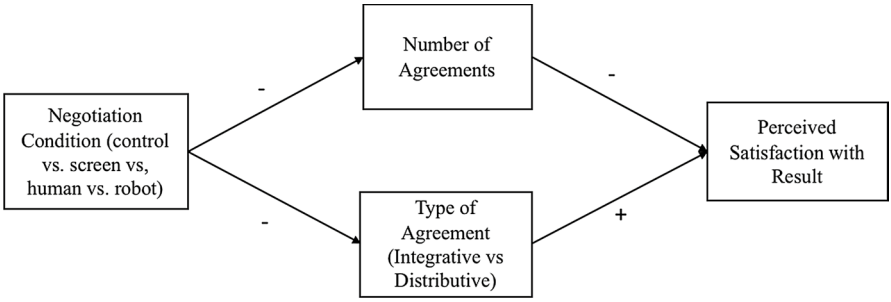


Fig. 1 Indirect Effects Model

H7 Negotiators have more favorable perceptions of mediators of the same gender.

6 Mediation Platforms, Outcomes, and Satisfaction: A Model

The hypotheses presented above posit direct effects, a relationship between the experimental conditions and an outcome or perceptions. We can also evaluate indirect effects, where one or more variables mediate the relationship between an IV (experimental conditions) and a DV (perceptions). These effects connect the hypothesized effect of the conditions on agreements and types of agreements with perceptions of satisfaction. The model is shown in Fig. 1. Referred to as parallel mediation, the model evaluates two paths, one through agreements to satisfaction with the results in the negotiation and another through types of agreements to satisfaction. The analysis procedure consists of contrasts between each pair of conditions.

7 Methods

This section is divided into several parts. First, the case scenario is described. Second, the participants are described. Third, we present the experimental design. Next, the procedures are discussed including how each of the experimental conditions was run. Additional sections include technical details on the computer system known as VienNA and the Telenoid robot.

7.1 Case Description

The case was designed to create a multi-issue, distributive negotiation problem with the potential for an integrative solution if subjects engaged in integrative problem-solving behaviors. The subjects were assigned the roles of representatives of Sarah and Peter who jointly owned a high-tech company, but had different plans with it for the future: Peter preferred focusing on cures for Alzheimer's while Sarah was more interested in Diabetes. The case created a scenario in which a demerger of the company, including the distribution of its assets (patent, employees, laboratory

equipment, building) and liabilities, was the only option to resolve the conflict between the owners.

The negotiators were provided with a case description including public information about the company (known to both subjects) as well as private information about the individual plans of Sarah and Peter. A utility scoring table was constructed for each party, indicating the relative importance of the issues and the preferences for the different settlement options on the five issues to be negotiated. These utility scores were transformed into a graphical representation of the preferences of the parties represented in the negotiation role play. Individual preferences were private information and, therefore, known only to the respective representatives. A graphical preference representation has been shown to be advantageous in previous studies (see Filzmoser and Gettinger 2019).

The most important issue of the case, the patent for a nano-technology, was indivisible and had to be assigned either to Sarah or Peter, creating a strong conflict between the parties. The private information for Sarah's and Peter's representatives, however, also included an integrative option to resolve the problem: They could sell the patent to a large investor who was interested in Sarah's and Peter's plans. Different representatives of the investor had talked to both parties without consulting with each other. Since this information was private and only known to either Peter or Sarah and one of the investors, problem-solving and information sharing was required to identify this integrative solution.

Since we hypothesized (see H6) that the approximately gender-neutral visual appearance of the Telenoid would contribute to the perceived fairness of the mediation delivered by this specific platform, we assigned different genders to the negotiating parties to charge the case with a gender perspective.

7.2 Experimental Design

The design consisted of four experimental conditions: a screen-based mediator, a human mediator, a Telenoid robot mediator, and a no-mediation control group. The mediators in each of the three mediation conditions were scripted in the same way. They were trained, in the robot and human conditions, to deploy the three functions developed for the VienNA system. The key addition for this experiment was the VienNA scripting of operators for the Telenoid robot. A male and female operator was assigned randomly to the robot sessions, with half the sessions being run with the male and the other half with the female operator. Male and female mediators were trained to run the human mediator condition; these mediators were also randomly assigned to sessions in this condition, again ensuring that half of the sessions were run by male and half by female mediators. The same scripting was used for the screen condition, which was essentially the same as that run in the Druckman et al. (2014) study. The control condition substituted a between-rounds period of reflection for mediation similar to that designed for the first experiment reported by Druckman et al. (2004). Implementation details for each condition are discussed below in the section on procedures.

7.3 Participants

The participants (gender-balanced male–female dyads) were recruited from a university-based research participant pool arranged for experiments conducted at the *Cognition and Behavioural lab* at Aarhus University, Denmark. Inclusion criteria were: (a) 18 years or older at the time of enrollment, (b) good proficiency in written and spoken English. The participants were compensated for their time with the amount of 100–250 DKK (approx. 13–33 EUR) depending on how much time was spent in the lab. None of the participants knew the size of their compensation until after the experiment. A total of 286 participants were recruited.

7.4 Procedures

Approval was obtained from the research labs ethics committee and the study was conducted in accordance with the Helsinki Declaration (ethical principles for research mainly focused on medical studies but applicable to all research with human subjects). All participants were greeted individually and received written and verbal information about the study before informed consent was obtained. They were informed that the purpose of the project was to evaluate technological aids to help resolve conflict and that they would have to negotiate a case of a business demerger with another person. They were also told that the experiment consisted of several conditions and that they would be assigned randomly to one of the conditions. Then the participant received an envelope containing the negotiation case corresponding to their gender (females were given the case representing Sarah while males were given the case representing Peter). They were given 20 min to read and prepare the case and instructed to ring a bell if they were finished beforehand. Then they were assigned ID numbers and asked to fill in the baseline questionnaires on tablets. All Questionnaires were delivered via Qualtrics Software© (2013; Qualtrics, Provo, UT, USA).

At this point, the participants were escorted to another room and introduced to each other as the representatives of Sarah or Peter. They were instructed that they would have 15 min to negotiate during a first round and that they were not expected to come to an agreement within this time. For the three mediation conditions (see below) they were told that they would be offered mediation after this first round. All negotiations were audio-recorded. Following the initial negotiation, the participants were assigned to one of the following four conditions.

Unmediated negotiation (control condition): The participants were given a five-minute break in separate rooms after the initial negotiation and were then instructed to continue negotiating the case for 30 min and fill out an agreement sheet. This phase ended after 30 min regardless of whether an agreement had been reached.[4] If

[4] The decision to use a 30-min period for negotiation was based on previous negotiation research conducted by several of the authors including our previous e-mediation experiments (e.g., Druckman et al. 2014). We have found that this is sufficient time to discuss and decide on possible settlements for five issues. The total amount of negotiating time (Rounds 1 and 2) was 45 min.

the participants reached an agreement before the deadline, they were instructed to ring a bell.

Screen-based negotiation with VienNA: The participants were led to two different locations. One participant, selected randomly, was instructed to stay in a waiting room while the other was introduced to the VienNA system. Following a 25-min mediation session, the other participant was offered a mediation session. After both parties had used the VienNA system they returned to the negotiating room and continued their talks about the case for 30 min.

Human facilitated negotiation based on the VienNA system (50% with male mediator): The participants were led to different locations. One randomly selected participant was instructed to remain in a waiting room while the other was introduced to the human mediator. The human mediator guided the participants through a human-facilitated VienNA mediation. The mediation content and procedures were the same as the screen condition; the flexibility grid was presented on the computer. The human mediator gave the advice. Following the 50 min mediation session (25 min for each participant), they returned to the same room to continue negotiating the case for a maximum of 30 min.

Telenoid facilitated negotiation based on the VienNA system (50% male operator): The participants were led to different locations. One, randomly selected, participant was instructed to remain in a waiting room while the other was introduced to the Telenoid mediator. The waiting period instructions were the same as those used in the screen and human conditions. The mediation content and procedures were also the same as the screen and human conditions; the flexibility grid was presented on the computer. The Telenoid mediator gave the advice. Following the 50 min mediation session (25 min for each participant), they returned to the same room to continue negotiating the case for a maximum of 30 min.

During the waiting period, while the other party was receiving mediation in the screen, human, and robot conditions, the participants were instructed to refrain from using telephones or computers and remain on the premises. The waiting period during mediation was roughly the same for each of the mediation conditions, screen, human, or Telenoid mediation. The order was randomly determined. Thus, differences found among the mediation conditions could not be attributed to waiting time.[5] A negotiation outcome agreement sheet was left on the table (see the Appendix). The negotiators were told to sign the contract if an agreement was reached. Those that completed the negotiation before the allowed 30 min were told to ring a bell. When an agreement was signed the participants were asked to explain the content of the agreement. If 30 min had passed without an agreement it was registered as a case of non-agreement.

[5] The waiting time was shorter for the control condition. Several reasons prompted this decision. One is that we were interested in evaluating the effects of no mediation. A long waiting period between rounds would be difficult to justify to the negotiators. Another is that the impact of waiting time on outcomes is not clear. There are no studies to inform us about this. A third is that a longer period may have led negotiators to wander away from the task at hand. That said, it would be of interest to evaluate the impact of between-round breaks on processes and outcomes.

For all four conditions, the participants were taken to separate waiting areas and asked to complete post-negotiation questionnaires. Finally, they were debriefed and instructed not to disclose anything about the study to others until the data collection had been completed.

The number of negotiating dyads per conditions are as follows: Female Telenoid (42); Male Telenoid (42); female human (42); male human (42); screen (44), and control (42). Male and female participants were randomly assigned to one of the four conditions. Thirty-two dyads reached an agreement during the first round, before the mediation took place. They were excluded from the analyses. The distribution of age and education across the conditions is shown in Table 1. None of the differences is statistically significant.

7.5 VienNA

VienNA is an algorithmic-based electronic mediation system based on the three functions of mediation discussed above, diagnosis, analysis, and advice (Druckman et al. 2004). The diagnosis function is based on answers to suites of self-report survey questions about the issues and negotiation process. Issue questions are shown in Fig. 2.

The questions correspond to variables explored in experiments on flexibility in negotiation (Druckman 1993). They are grouped into two categories referred to as process (concessions made by your party) and issues (complexity, type as reflecting values or interests). Answers to each question were coded as indicating more (willingness to move from opening positions) or less (unwillingness to move) flexibility. The questions were weighted in terms of their relative influence on negotiating flexibility, based largely on effect sizes obtained in an earlier meta-analysis of the corresponding variables (Druckman 1994). The weighted sums for each section are converted by algorithms into locations on the flexibility grid shown in Fig. 3. The calculations are discussed in detail in Druckman et al. (2002) and Druckman et al. (2004). The grid displays nine possible outcomes, including no agreement, asymmetrical agreement, and fair agreement.

The analysis function of the software identifies survey answers that indicate difficulties for the negotiators or suggests the sources of their problems. Examples of difficult answers include the following: differences on the issue are large, issue complexity is high, no available compromise or salient solution to the conflict, large differences exist within the negotiating delegation, values are at stake, and reluctance to problem-solve.

These sources of conflict are linked to the third function, advice to overcome the difficulties faced by negotiators. Nine advice windows are available: information exchange, integrative agreements, fractionation, fairness norms, conceptual framework, differences, log-rolling, flexibility options, and overall approach. The type of advice connects to the analyzed source of the problem as shown in Fig. 4: For example, when issue complexity is high, negotiators are directed to advice on fractionation and information exchange; when there is no available compromise, negotiators

Table 1 Demographic characteristics of the participants

	Agreement before mediation (excluded) (n = 32)	Control (n = 44)	Screen (n = 44)	Human (n = 84)	Telenoid (n = 84)	F or χ^2 value
	Mean (SD) n (%)	Mean (SD) n (%)	Mean (SD) n (%)	Mean (SD) n (%)	Mean (SD) n (%)	
Demographic						
Age, years	23 (3.8)	25.2 (5.2)	24.3 (4.7)	23.1 (3.1)	23.9 (4.4)	$F(4, 278) = 2.25$, $p = .064$
Education						
Currently enrolled as student	26 (81%)	32 (78%)	40 (90%)	70 (83%)	69 (81%)	χ^2 (4, 286) = 2.92, $p = .57$
Highest level of education completed						
Less than high school	0	1 (2.4%)	0	0	0	
High school graduate	9 (28.1%)	8 (19.5%)	13 (29.5%)	26 (31%)	25 (29.4%)	
Some college	6 (18.8%)	10 (24.4%)	7 (15.9%)	19 (22.6%)	10 (11.8%)	
Bachelor's degree	12 (37.5%)	15 (36.6%)	22 (50%)	31 (36.9%)	37 (43.5%)	
Master's degree	5 (15.6%)	6 (14.6%)	2 (4.5%)	8 (9.5%)	13 (15.3%)	
PhD or similar	0	1 (2.4%)	0	0	0	χ^2 (20,286) = 22.67, $p = .31$

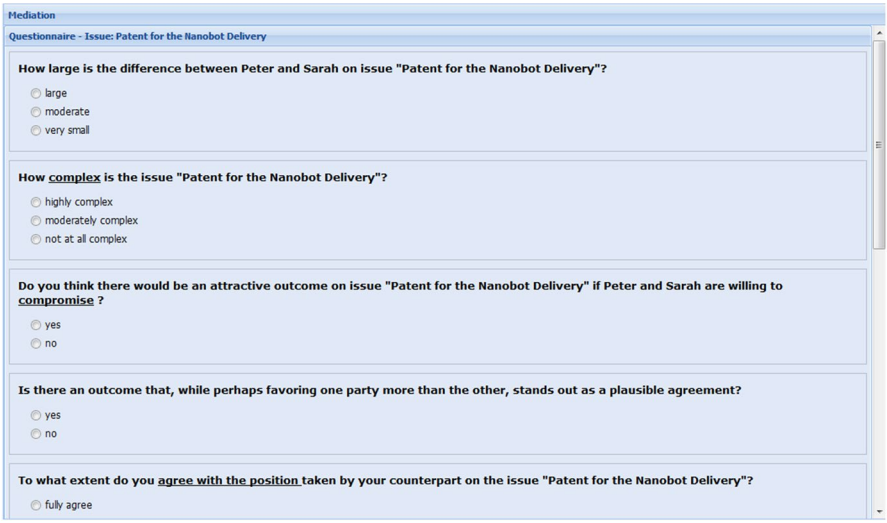


Fig. 2 VienNA survey questions for issues

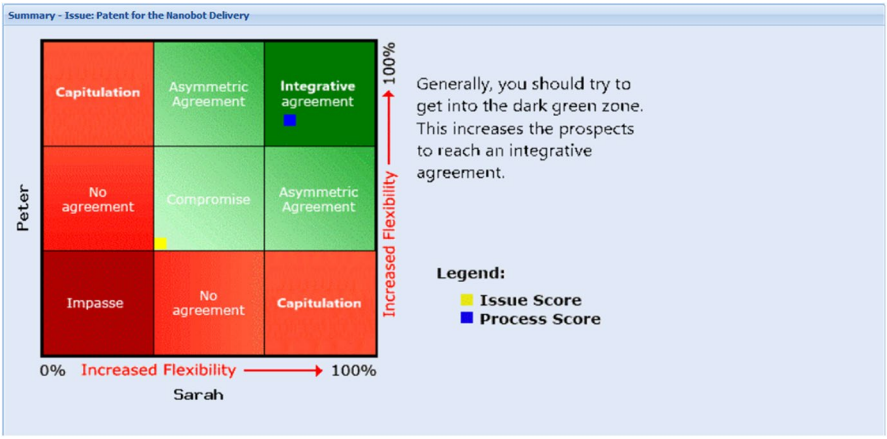


Fig. 3 VienNA flexibility grid

are directed to advice on issue linking and log rolling. An example of advice is: divide large complex issues into component parts and address them separately. The system was originally designed as a screen mediator (Druckman et al. 2002; see also Druckman et al. 2014). It was adapted for use with humans by Druckman et al. (2004) and Telenoid robot mediators in this experiment.[6]

[6] Neither the knowledge nor the technical aspects of the software were described to the negotiators. They were encouraged to focus attention on the grid, the analysis, and the relevant advice given by the screen, human, or robot.

Fig. 4 VienNA advice window

7.6 The Telenoid Robot

Participants in the robot mediation condition interacted with the tele-operated robot *Telenoid*. The Telenoid is an android robot developed by Hiroshi Ishiguro from Osaka University and the Advanced Telecommunication Research Institute International. The Telenoid is: "developed to appear and behave as a minimal design of human features… A minimal human conveys the impression of human existence at first glance, but it doesn't suggest anything about personal features such as being male or female, old or young" (Ogawa et al. 2011). The tele-operation of the Telenoid entails that the limited body movements of the robot mirror the operators. The operator controlling the movements of the Telenoid is placed in a separate, adjacent room and receives video and audio-input from the Telenoid (see Fig. 5).

8 Assessment Procedures

This section is divided into three parts, coding the negotiation outcomes, assessing perceptions, and evaluating indirect effects.

8.1 Coding the Outcomes

Two decisions were made about each outcome. The first decision was whether the outcome was an agreement. Two types of agreements occurred. Negotiation representatives either solved all issues using the range of choices given in the scenario or they solved all issues by inventing alternative solutions.

Fig. 5 The operating system of the Telenoid

Both types of agreements could be either integrative or distributive. Both were guided by the same defining criteria. The key difference was between joint and individual benefits. Joint benefits (integrative agreements) were indicated by a mutual willingness to enter into a new relationship that would benefit both, not favoring one or the other party. This type of agreement reflects an attempt to expand the pie. Individual benefits (distributive agreements) consisted of either asymmetrical agreements where one party was favored or symmetrical agreements where each party assumed the same losses as in a compromise. This type of agreement reflects a fixed-pie bias.

The examples below show agreements that were coded as distributive or integrative for negotiators that adhered to the structured scenario and for those that invented agreements outside that structure. The former consisted of decisions made on each of the five issues. Sixty-eight percent (about two thirds) of the agreements took this form. The latter consisted of decisions made outside of the options given for the issues. These may be considered as inventive or creative agreements. Thirty-two percent (about one third) of the agreements took this form and are referred to as non-structured agreements (NSAs).

A typical distributive agreement from the structured scenario takes the following form:

Agreement on the five issues as follows: 1. Sarah owns the patent, Peter is licensed to use the technology; 2. Sarah gets 60 employees, Peter gets 120 employees; 3. Peter

stays in the building; 4. Peter keeps the equipment for a compensation; 5. Sarah takes over the responsibilities. This asymmetrical agreement favors Peter.

$$\text{Utility Sarah}: 10 + 0 + 2 + 2 + 0 = 14$$
$$\text{Utility Peter}: 5 + 5.2 + 15 + 10 + 5 = 40.2$$

An example of an integrative agreement from the structured scenario is the following:

Agreement on the five issues as follows: 1. The patent is sold to a third party, Myotosis; 2. Sarah gets 95 employees, Peter gets 85; 3. Peter keeps the building; 4. Sarah keeps the building for compensation; 5. Peters takes the responsibility.

The utility values are about the same for Sarah and Peter. They resolved the key issue of patent ownership and split the other four issues with two favoring Sarah and two favoring Peter

$$\text{Utility Sarah}: 0 + 2.25 + 2 + 5 + 10 = 19.25$$
$$\text{Utility Peter}: 0 + 2.4 + 15 + 4 + 0 = 21.4$$

Examples of the NSA distributive agreements are the following:

Peter takes a commitment to develop the Alzheimer's nanobot first. The revenue gained will then be used to develop the diabetes project. He will then sell the new patent to Sarah.

They agree not to de-merge, but rather to stay together and pursue research on Alzheimer's. Profits from the research will then be spent on the diabetes project.

Examples of the NSA integrative agreements are the following:

The four parts of the agreement include: 1. The patent will continue to be shared. 2. Both parties will stay in the building 3. The lab equipment is shared. 4. Both Sarah and Peter will have a first responsibility to MED Inc, then to their respective departments. In general: A joint effort– trying to find new funding.

Everything is shared, and they work on Peter's project for the first 5 years since it is the most time-sensitive, then Sarah's project for the next 5 years. The goal is to find a cure within 5 years and if found before the 5 years, the other project will begin. Participants argued that this solution also would be most valuable for the shareholders.

8.2 Assessing Perceptions

Twenty-six self-report questions were asked following the negotiations.[7] Each was arranged on a seven-point Likert-scale with higher scores indicating more positive perceptions about the mediator or mediation process. The questions were divided into three clusters, including various types of satisfaction (5 questions), perceptions of the mediator (12 questions), and of the VienNA mediating system (9 questions). The satisfaction questions represent each of the three factors (outcome, relationship,

[7] Questions about hostility, attitudes towards robots, gender perception, and tendency to anthropomorphize were also asked but fall outside the scope of this study.

process) obtained from a factor analysis conducted by Druckman et al. (2014). The mediator and system perceptions came from the three experiments conducted in the earlier e-mediation study by Druckman et al. (2004). Examples of questions about the mediator, not asked in the control condition, include reducing the intensity of the conflict, helping to resolve disagreements and breaking impasses, improving fairness and trust, addressing problems in the negotiation, and improving problem-solving. The questions on the VienNA system focused on the usefulness of the flexibility grid and the advice function as well as helping increase their awareness of aspects of the negotiation process.

8.3 Evaluating Indirect Effects

To test the significance of the indirect effects (see Fig. 1), we followed Hayes and Preacher's (2014) use of multivariate contrast codes with robot, control, screen, and human as conditions. We derived path estimates to examine the predicted indirect effects between each condition on perceived satisfaction with performance through negotiation agreement and type of agreement. Mediation analyses were conducted with 5000 95% bootstrapped confidence intervals.

9 Results

As described in the sections above, the dependent variables consisted of outcomes—agreement frequency, type of agreement as integrative or distributive, type of agreement as structured or non-structured (NSA)—and the post-negotiation perceptual questions. No statistically significant differences in agreement outcomes were found between the male and female human mediators or between the male and female Telenoid operators. This led to a decision to combine the genders in these conditions for the outcome analyses. This decision has the advantage of increasing the power of the statistical tests.

9.1 Agreements

Agreements reached by the dyads in each experimental condition are shown in Table 2. A logistic regression analysis showed that the differences among the four

Table 2 Distribution of agreements across conditions

	Agreement Count (proportion)	No agreement Count (proportion)
Condition		
Telenoid	38 (.91)	4 (0.9)
Human	32 (.76)	10 (.24)
Screen	18 (.82)	4 (.18)
Control	12 (.59)	8 (.41)

conditions are significant ($\beta = .502$, $p = .016$). An omnibus total model coefficient calculation was also significant ($\chi^2 = 5.96$, $p = .015$).[8] Differences between each pair of conditions in the proportion of the outcomes that resulted in agreements were also calculated with a z test statistic which was converted into effect sizes (ES)[9]. Comparisons between each mediation condition and the controls resulted in the following effect sizes: $r = .41$ (Telenoid vs. control), $r = .30$ (screen vs. control), and $r = .17$ (human vs. control). The average effect size for these control comparisons is $r = .29$. This result provides support for H1, which posits a mediator effect with an average ES of about .30. The strongest effect was obtained for the Telenoid-control comparison.

In addition, the human-screen comparison was not significant, supporting H2. The Telenoid negotiators did not produce more agreements than screen mediators ($z = 1.05$, *NS*, $r = .14$). This result does not support H4. Significantly more agreements were obtained by the Telenoid negotiators than by those with human mediators ($z = 1.9$, $p = .032$, r = .23). This result does not support H5. Thus, the Telenoid mediator produced more agreements than human mediators but not screens.

9.2 Type of Agreement

Types of agreements by the dyads in each experimental condition are displayed in Table 3. A logistic regression showed significant differences among the conditions including a very strong regression coefficient ($\beta = -.752$, $p < .0001$). An omnibus total model coefficient calculation was also significance ($\chi^2 = 8.28$, $p = .004$).[10] Differences between each pair of conditions in the proportion of the outcomes that resulted in integrative agreements were also calculated with a z test statistic and corresponding effect sizes. Telenoid condition negotiators had significantly more integrative agreements than humans ($z = 1.9$, $p = .054$, r = .41), screen negotiators ($z = 2.2$, $p = .014$, r = .53) and the controls ($z = 2.9$, $p <= .002$, $r = .73$). The average ES across the three comparisons is .56. None of the other pair comparisons was significant. These results support a Telenoid rather than a mediator effect. Thus, they do not support H1a. However, they do support H2a, showing no difference between humans and screens and H4a, showing that the Telenoid mediator produces more integrative agreements than screens. They do not support H5a, which posited that there would be no difference between Telenoid and human mediators. More insights about these results come from internal analyses of the non-structured agreements reported next.

[8] Similar results were obtained with a Chi square evaluation of condition differences ($\chi^2 = 8.09$, $p < .044$).

[9] The effect size (r) is calculated as the z score divided by the square root of the sum of the two sample sizes.

[10] Similar results were obtained with a Chi square evaluation of condition differences ($\chi^2 = 8.04$, $p < .045$).

Table 3 Distribution of agreement types across conditions

	Distributive Count (proportion)	Integrative Count (proportion)
Condition		
Telenoid	23 (.61)	15 (.39)
Human	25 (.78)	7 (.21)
Screen	16 (.89)	2 (.11)
Control	11 (.92)	1 (.08)

9.3 Non-Structured Agreements (NSAs)

As discussed in the coding section above 32% of the cases produced non-structured agreements. These are considered as inventions or creative ideas. They are distributed unevenly across the conditions with 50% occurring in the Telenoid condition (vs. 29% [human], 15% [screen] and 5% [control; $\chi^2 = 11.04$, $p < .012$]. The Telenoid condition differs significantly from the each of the other three conditions: z (Telenoid vs human) = 2.46, $p < .007$, $r = .49$; z (Telenoid vs. screen) = 2.93, $p < .003$, $r = .64$; z (Telenoid vs. control) = 3.89, $p < .0001$, $r = .92$. The average ES across the three comparisons is .68. They were also divided into distributive and integrative agreements (see examples above). Twenty-nine percent of the NSA agreements were integrative. Roughly two thirds of these occurred in the Telenoid condition. About the same number of integrative agreements occurred in the structured (13) and NSA (12) cases. The integrative NSAs were also divided unevenly across the four conditions. Virtually all of these agreements were in the Telenoid condition (83%). Thus, the findings show a Telenoid effect for the number of NSAs and the number of integrative NSAs.

In summary, nine z tests for the difference in proportions were calculated as pairwise comparisons on agreements, types of agreements, and NSAs. The average ES is .42 but reduces to .36 if we consider the highest score (.92) as an outlier. These averages suggest overall effects. With regard to computed comparisons with the control group, the average ES is .47, which can be regarded as a mediation effect. The average ES across all comparisons with the Telenoid is .41, which can be regarded as a Telenoid effect.

9.4 Perceptions

Three clusters of post-negotiation perceptual questions are the focus of our individual-level ANOVA analyses. One cluster consists of five questions on satisfaction. Telenoid condition negotiators were more satisfied with their results ($M = 5.11$) than those in the human (4.55), screen (4.82), and control (3.92) conditions ($F = 8.64$, $p < .0001$). These findings are regarded as a Telenoid effect. Screen condition negotiators were more satisfied with their results than the controls ($p < .006$), supporting H3. However, they were not more satisfied than those with human mediators, not supporting H3a. Further analyses of these effects are presented in the section below on Indirect Effects.

Negotiators in the three mediation conditions were more satisfied with their performance ($F=3.76$, $p<.01$), with their results when considering initial objectives ($F=6.13$, $p<.0001$), and when compared with expectations ($F=4.05$, $p<.004$) than the controls. This is regarded as a mediation effect. Telenoid and screen condition negotiators were more satisfied with the results because they were more favorable to themselves than to those in the human and control conditions ($F=2.67$, $p<.05$). Negotiators in both the Telenoid and screen conditions were more satisfied with the results favoring themselves than those in the human and control conditions. This finding may help to explain the lack of difference in number of agreements obtained by the Telenoid and screen condition negotiators.

A second cluster consists of twelve questions on perceptions of the mediator. The ANOVA comparisons were among the three mediation conditions. Six of the 12 questions produced significant or near-significant differences. The Telenoid condition negotiators (compared to the human and screen conditions) were viewed as providing more help in reducing the intensity of the conflict ($F=2.78$, $p<.07$), in helping to break impasses ($F=3.69$, $p<.03$), in helping to resolve the disagreement ($F=6.59$, $p<.002$), and in improving the problem-solving process ($F=5.30$, $p<.006$). These findings can be construed as a Telenoid effect. The Telenoid and human condition negotiators (compared to the screen condition) thought that the mediator increased trust in the other party ($F=2.72$, $p<.07$) and helped them to address problems in the negotiation ($F=3.93$, $p<.02$). These findings can be construed as a social interaction partner (SIP) effect. However, no significant differences among the conditions were obtained on leading to a fair agreement, disconfirming H6.

A third cluster consists of nine questions about the VienNA system used in each of the mediation conditions. The ANOVA results showed that five of the nine produced significant differences among the three conditions. Telenoid and human mediators as compared to screen mediators agreed that the VienNA questions helped them become more aware of aspects of the negotiation they had not thought about ($F=5.14$, $p<.007$) and of reflecting on the negotiation process ($F=4.58$, $p<.012$). This may be considered to be a SIP effect. No significant differences were obtained for the three flexibility grid questions. All negotiators thought that the grid was helpful. As reported above, the conditions differed on the value of the advice offered by the system: the Telenoid mediator (compared to the human and screen) helped them address problems, resolve disagreements, and break impasses. This is a Telenoid effect.

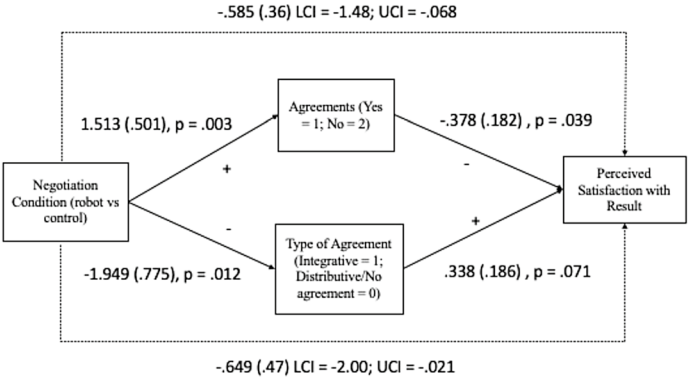
Further insights about the Telenoid effects come from additional analyses on the NSAs. Comparing the integrative ($n=18$) with the distributive ($n=13$) agreements, we found a number of significant effects by two-tailed independent means *t*-tests (29 *df*). The Telenoid mediation was perceived by negotiators who attained integrative (as compared to distributive) agreements as being more helpful in addressing problems ($t=2.67$, $p<.03$), in breaking impasses ($t=2.44$, $p<.04$), in leading to fairer agreements ($t=1.69$, $p<.10$), in producing more favorable agreements ($t=1.69$, $p<.10$), as being more trusting ($t=1.76$, $p<.09$), reducing the intensity of the conflict ($t=2.46$, $p<.02$), less confusing ($t=3.66$, $p<.001$), and less frustrating ($t=2.26$, $p<.04$). In addition, the integrative agreement NSAs said that the Telenoid

mediator helped them to become more aware of aspects of the negotiation they had not known about before. These findings provide additional support for a Telenoid effect: They attained more NSA integrative agreements and were generally more positive about the mediation and the negotiating results.

In summary, Telenoid effects occurred within each of the three question clusters. Negotiators in the Telenoid condition were generally more satisfied and more positive about the advice given by the mediator, especially those that attained non-structured integrative agreements. A few of the questions showed that the robot and human mediators (SIPs) were viewed more favorably than the screen.

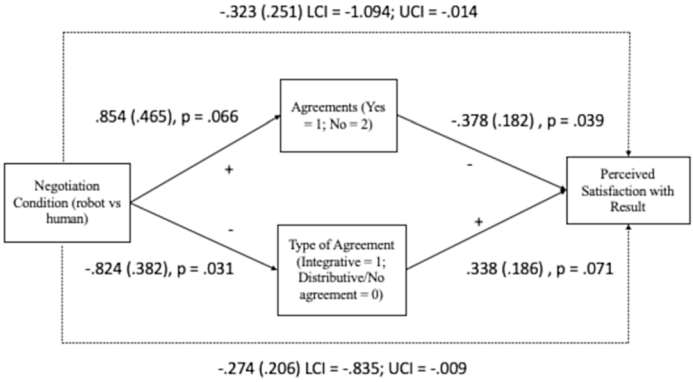
9.5 Indirect Effects

We first tested for the predicted indirect effects on perceived satisfaction with results through negotiation agreement. We began with the indirect effects for the robot condition. Results show that negotiation agreement significantly predicted perceived satisfaction ($\beta = -.378$, $SE = .182$, $p = .039$). As shown in Fig. 6, when contrasting robot vs. control, results indicate that the path from negotiation condition (robot vs. control) to negotiation agreement is significant ($\beta = 1.513$, $SE = .501$, $p = .003$), and importantly that the indirect effect of negotiation condition (robot vs. control) on perceived satisfaction through negotiation agreement was significant, as the 95% confidence interval did not include zero ($\beta = -.585$, $SE = .36$, 95% CI [−1.48, − .068]). As shown in Fig. 6, the results also indicate a significant path from negotiation condition (robot vs. human) to negotiation agreement ($\beta = 1.513$, $SE = .501$, $p = .003$), and a significant indirect effect for negotiation condition (robot vs. human) on perceived satisfaction through negotiation agreement ($\beta = -.323$, $SE = .251$, 95% CI [−1.094, − .014]). When contrasting robot vs. screen, results indicate that the



Note: IV is main contrast between Robot vs Control (1 = Control; 0 = Robot) using multivariate contrast coding procedure with Robot, Control, Screen, and Human as conditions. Beta Weights are unstandardized. Standard errors are in parentheses. *p < .05. **p < .01.

Fig. 6 Indirect effects for agreements



Note: IV is main contrast between Robot vs Human (1 = Human; 0 = Robot) using multivariate contrast coding procedure with Robot, Control, Screen, and Human as conditions. Beta Weights are unstandardized. Standard errors are in parentheses. *p < .05. **p < .01.

Fig. 7 Indirect effects for types of agreements

path from negotiation condition (robot vs. screen) to negotiation agreement is not significant ($\beta = .384$, $SE = .550$, $p = .485$), and the indirect effect of negotiation condition (robot vs. screen) on perceived satisfaction through negotiation agreement was also not significant, as the 95% confidence interval did include zero ($\beta = -.140$, $SE = .247$, 95% CI [−.885, .182]).[11]

We next tested the predicted indirect effects on perceived satisfaction with results through type of agreement. We began with the indirect effects for the robot condition. Results show that type of agreement marginally predicted perceived satisfaction ($\beta = .338$, $SE = .186$, $p = .071$). As shown in Fig. 7, when contrasting robot vs. control, results indicate that the path from negotiation condition (robot vs. control) to type of agreement is significant ($\beta = -1.949$, $SE = .775$, $p = .012$), and importantly that the indirect effect of negotiation condition (robot vs. control) on perceived satisfaction through negotiation agreement was significant, as the 95% confidence interval did not include zero ($\beta = -.646$, $SE = .47$, 95% CI [−2.00, − .021]). As shown in Fig. 7, results also indicate a significant path from negotiation condition (robot vs. human) to type of agreement ($\beta = -.824$, $SE = .382$, $p = .031$), and a significant indirect effect for negotiation condition (robot vs. human) on perceived satisfaction through type of agreement ($\beta = -.274$, $SE = .206$, 95% CI [−.835, −.009]). When contrasting robot vs. screen, results indicate a significant path from negotiation condition (robot vs. screen) to type of agreement ($\beta = -1.630$, $SE = .580$, $p = .005$), and a significant indirect effect of negotiation condition (robot vs. screen) on perceived satisfaction through type of agreement ($\beta = -.552$, $SE = .370$, 95% CI [−1.496, − .012]).

[11] Results on all the other contrasts for agreements and types of agreements are available from the senior author.

These results extend the direct tests presented above. They show that the Telenoid effects on outcomes lead to more satisfied negotiators than the other conditions. These effects are particularly strong on integrative agreements.

9.6 Gender

As reported above, there were no differences between the male and female negotiators on either agreements or types of agreements. However, differences did occur on several perceptual questions. Male negotiators thought that the male operator and male mediator (compared to female operators and mediators as well as screen mediators) helped them to resolve impasses ($F = 3.74$, $p < .007$). Female negotiators also viewed the male operator and mediator more favorably: The male Telenoid operator was more helpful in addressing problems ($F = 3.13$, $p < .02$), helped them to resolve the disagreement ($F = 4.19$, $p < .004$), and helped them to break impasses ($F = 3.84$, $p < .007$). Male Telenoid operators and male mediators were thought to lead to fairer agreements than the other conditions ($F = 2.65$, $p < .04$). The female mediator and screen mediator were viewed as producing less improvement in problem solving for females than the other conditions ($F = 4.74$, $p < .002$). Overall, the male operator voice and mediator evoked more positive perceptions, especially for female negotiators, than female voices or mediators and screens. These findings do not support H7.

10 Discussion

The experiment reported in this article is an evaluation of different mediation platforms, Telenoid, human, and screen mediators. The statistical analyses were guided by a set of hypotheses drawn from earlier studies on mediation, e-mediation, and human–robot interaction. Because only a limited number of studies have been reported to date, we regard the hypotheses in an exploratory mode. They are derived less from theoretical perspectives than from evaluations of alternative types of mediators. Thus, the results shed light on the relative performance of these platforms with implications for further research and practice. But there are also implications for theoretical directions based on possible explanations for the findings. Both types of implications are discussed in this section.

The results show mediation effects and particularly strong Telenoid robot effects. Control group comparisons indicate that all types of mediators produced more agreements. Confirming H1, the mediation average effect size corresponded to the average ES obtained in the earlier benchmarked studies spanning an array of mediation contexts. This is an important finding. It supports the generality of mediation effects. The strongest effect was obtained by the Telenoid mediator, with effect sizes of .41 (agreements) and .73 (integrative agreements). The Telenoid mediator was significantly more effective than each of the other platforms, except for the screen mediator on agreements. Further support for these effects comes from the indirect analyses: Negotiation outcomes statistically mediated the relationship between type of mediation and satisfaction with the results; negotiators were most satisfied with

their results when the mediator was a Telenoid robot. These Telenoid effects are discussed in this section with an eye toward theory building.[12]

Although there were no significant differences among the conditions on fairness perceptions (H6), a number of other types of perceptual questions did show differences. We get a mix of mediation, Telenoid, and social engagement (human and Telenoid) effects. For example, compared to the controls, mediators of all three types were more satisfied with the outcome compared to their expectations. The Telenoid mediators were viewed as more helpful with problem-solving and with breaking impasses while the two animated mediators led to increased trust and helped them to address problems. Thus, negotiators appreciated mediation and social engagement but, perhaps most of all, valued the Telenoid's contribution to the advice given by the screen (VienNA) system.

The question of interest is what accounts for the strong Telenoid effects? Why does the Telenoid produce more and better outcomes than the other mediation platforms? Some clues are provided from the analyses of the perceptions and NSA outcomes. A very strong difference occurred among the conditions on the question concerning improvement in the problem-solving process: The Telenoid mediators were viewed as improving this process more than human or screen mediators. This finding suggests that these negotiators engaged in problem solving with the help of the Telenoid mediator. Their outcomes, showing significantly more integrative agreements, attest to a problem-solving orientation toward the negotiated case. Ten of the 15 integrative agreements obtained in the Telenoid condition were NSAs. These negotiators may have made a stronger effort to create new solutions to the impasse. They may have regarded these agreements as creative responses. They also perceived the Telenoid mediator more positively (than those who attained distributive agreements in this condition) across a set of post-negotiation questions, suggesting a halo effect stemming from their outcomes. For these negotiators, the positive Telenoid experience may have encouraged a problem-solving process leading to the integrative outcomes.

The Telenoid effects suggest two processes at play. On the one hand, the frequency of NSAs may reflect divergent thinking, defined as the ability to produce multiple original responses (NSAs) to a specific stimulus (Telenoid mediator) (Guilford 1956; Runco 2013). On the other hand, the number of integrative agreements obtained are creative solutions, defined as generating something new (an integrative agreement). Of interest is the question of whether these are responses to novelty as suggested by Gillebaart et al. (2013) and Smedegaard (2019), which in turn may positively influence human creativity. Two aspects of novelty are reflected in exposure to the Telenoid robot. One is that the negotiators have never experienced this kind of robot, which has been referred to as epistemological novelty (Witt 2009). Another is that social robots combine living and non-living features, which has been referred to as ontological novelty (Kahn 2016). Both of these conditions may be considered to amount to a form of cognitive stimulation that has been found in other studies to enhance creativity (Fink et al. 2010).

[12] As noted in the Results section, there were no differences between screens and humans on agreements (H2) or types of agreements (H2a).

The "creativity-boosting" idea is suggested as well by Beaty and Kenett (2020). They report that creative thinking can be boosted over the course of a single experiment. They claim that "(t)aking a break from a problem to let your mind wander has been shown to improve subsequence performance on creative tasks" (2020: 224). Interacting with the Telenoid may have encouraged mind-wandering which in turn stimulated creativity. However, we await the insights that may emerge from systematic analyses of the conversations that unfolded during the second, post-mediation, round of negotiation.

More broadly, Miller (2020) calls attention to technological innovations on the role of AI neural networks in redefining the relationship between art and science. These innovations demonstrate improvements in the ways that machines and humans collaborate. Of particular relevance is the progress being made toward enhanced creativity, defined as going beyond the information or databases that we possess. While focusing primarily on a new age in machine architecture and function, it is apparent that new frontiers are on the horizon for human–machine interaction processes. Less attention is given to impacts of the technological revolution on human creativity.

The results obtained from this experiment extend the findings obtained from the earlier e-mediation experiments. Similar to the earlier experiments, screens produced more agreements and more integrative agreements than controls. They produced roughly the same number of agreements and types of agreements but received less positive perceptions than the human mediators. Both human and Telenoid mediators produced more positive perceptions than screens, supporting a social interaction partner effect. Animation in the form of moving figures was suggested by Druckman et al. (2004) as a way of increasing the effectiveness of electronic mediators. The Telenoid mediator provides such animation in 3D physical space. Indeed, the Telenoid was more effective in producing better outcomes and more positive perceptions than the other mediators and control. This third-generation study of e-mediation platforms has extended our appreciation for the possibilities of e-mediation.

Looking forward with the benefit of these results, we suggest a fourth generation of e-mediation experiments. One direction for a next experiment would build on the idea of Telenoid novelty. If the key to understanding responses to novel situations resides in divergent and creative thinking, then similar results should occur when these processes are stimulated by human or screen mediators. For example, negotiators can be primed or encouraged by human mediators to take divergent paths in search for solutions to negotiation impasses. If these negotiators produce more and better agreements than comparable negotiators not primed or primed differently (mediators who think convergently), then the Telenoid effect can be understood in terms of these concepts.

Another direction would involve using a robot that differs in terms of appearance, voice, and animation. These alterations would address the question of whether the effects are due to robots more generally or to the particular Telenoid robot design used for this experiment; Are novel experiences general or design-specific reactions to robots? A third direction would focus on gender questions. These results showed no negotiator gender differences on outcomes but did show differences in perceptions of male or females operator voices or human mediators. Females in particular preferred male mediators in both the Telenoid and human conditions, suggesting a

bias. This finding runs counter to H7, although male negotiators show some preference for male mediators with regard to breaking impasses. These results suggest a redoubling of our efforts to develop the tools that would be effective in assuring the perception of Telenoid neutrality.

These findings suggest a number of practical contributions. We have shown that mediation via communication robots can be particularly effective, but when and where would it be useful? This project is guided by "principles of responsible robotics" which, among other aspects, prohibit the practical exploration of applications where humans are replaced by robots (Seibt et al. 2020). However, the use of a robotic delivery platform for mediation 'keeps the human in the loop', and thus one may speculate about concrete practical scenarios for the use of "Fair Proxy Communication" in general, and the specific version of the platform explored here.

Several areas are suggested. One is when mediators are needed in dangerous situations such as hostage negotiations. Another is when mediators are asked to intervene in intense, intractable conflicts—especially ethnic or racial conflicts. A third is when disputants are reluctant to involve third parties. In each of these difficult situations a robot may be regarded as less threatening, may be easier to discard, and seen as being more neutral. These situations may be helped as well by robot-human mediation teams. The team can implement such tactics as the "good cop (the robot)-bad cop (human)" duo. As a team member, the "friendly" appearance of the communication robot may offset the perceived biases that emanate from human mediators. Robotic platforms can also add a novel or creative element to the intervention, and, following the results of this experiment, encourage divergent thinking about ways to resolve the conflict. The practice of mediation and related third-party roles is about to enter a brave new world of technological innovations that are likely to improve the craft.

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Appendix

ID No: Sarah rep: /Peter rep:

NEGOTIATION OUTCOMES

1. We have reached the following agreement (please fill in the form):

Who gets the patent for Nano-Boat technology?

Sarah exclusively owns the patent	o
Sarah owns the patent Peter is licensed to use the technology	o
Peter owns the patent Sarah is licensed to use the technology	o
Peter exclusively owns the patent	o
Patent is sold to a third party	o

Who gets how many employees?

Sarah	_____
Peter	_____

Who stays in the building?

Sarah stays in the building	o
Peter stays in the building	o
Neither Sarah nor Peter stay in the building	o

Who gets the laboratory equipment?

Sarah keeps the equipment for a compensation	o
Peter keeps the equipment for a compensation	o
Equipment is sold	o

Who is responsible for future legal and financial issues of MED-Tech?

Peter takes over the responsibilities	o
Sarah takes over the responsibilities	o

2. Any other Agreement:

_____
_____
_____
_____
_____

3. We have NOT reached an agreement: o

Signatures:

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