Pandemic Panic: The Effect of Disaster-Related Stress on Negotiation Outcomes

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ABSTRACT

Prior research often finds increased altruism following natural disasters. One explanation is the social heuristic hypothesis: humans are prosocial by nature but become self-interested when they have the opportunity to deliberate. As the stress of a disaster lowers people's ability to engage in effortful deliberation, their heuristic prosocial tendencies emerge. However, this link has often been explored with very simple tasks like the dictator game. Here we study the impact of COVID-related stress on outcomes in multiissue negotiations with a computational virtual agent. These tasks are interesting because they share some of the characteristics of dictator games (some pot of resources must be divided) but they also involve presumably effortful perspective taking (that can grow the size of the pot). Furthermore, the interaction of humans with virtual agents allows us to explore the extent to which humans apply the CASA (computers as social actors) paradigm to negotiation when under considerable stress. In two experiments with a virtual negotiation partner, we provide evidence for two distinct pathways for how COVID-19 stress shapes prosocial behavior. Consistent with the social heuristic hypothesis, COVID-stress increases giving, mediated by heuristic thinking. But COVID-stress also seems to enhance information-exchange and perspective taking, which allowed participants to grow more value which they could give away. Our results give new insights into the relationship between stress, cognition, and prosocial behavior.

KEYWORDS

Negotiation; Human-Computer Interaction; IAGO Platform; Stress; COVID-19; Dual-Process Cognition; Empirical Study; Mediation Analysis

ACM Reference format:

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IVA '21, September 14–17, 2021, Virtual Event, Japan © 2021 Copyright is held by the owner/author(s). Publication rights licensed to ACM. ACM ISBN 978-1-4503-8619-7/21/09...\$15.00 https://doi.org/10.1145/3472306.3478353

1 Motivation

As the world adapts to the massive changes, societal and otherwise, wrought by the COVID-19 pandemic, the effects on human behavior remain the subject of intense research. While the impact of worldshaking events such as COVID are myriad, there has already been specific scrutiny on the psychological effects of COVID stress (e.g., see [22]).

However, there are almost certainly secondary effects to which the behavioral pressures of COVID contribute. We examine the performance of humans in negotiation, which is a highly complex and social task [23]. It stands to reason that such tasks are particularly prone to the behavioral modifications that may be brought on by COVID-related stress, and we examine this research question through a set of two human studies in which participants interact with a virtual agent that exhibits human-like qualities.

By using standard measures of self-reported stress, and combining this with a data-rich platform for examining humanagent negotiation, we provide a cognitive path by which negotiation outcomes can be understood to be affected. The data show that COVID-related stress significantly predicts the outcome for the negotiation opponent, and that this relationship is mediated via deliberative versus heuristic thinking, as well as negotiation-specific intermediators. We use virtual agents to elucidate these effects, providing further evidence to the CASA (computers as social actors) paradigm [14], in which humans exhibit these same pathways to prosocial behavior in the virtual scenarios.

2 Background

2.1 Negotiation, Computing, & Cognitive Science

Studies using negotiation as a social task for understanding human behavior are myriad (e.g., [5]). In recent years, negotiation with artificial agent partners and opponents has garnered interest, with two broad directions (e.g., [24]). For agent developers, negotiation serves as a challenge problem for numerous cutting-edge problems in AI—developing adequately sophisticated agents that can negotiate is a goal of computing [11]. Within psychology, business, and cognitive sciences, artificial agents serve as nigh-perfect confederates due to their consistency and adaptability, and these agents can participate in negotiations as well as gather a plethora of behavioral data [6]. Agents provide the ability to create truly interactive and dynamic experiences for humans (thus improving validity), but retain the control desired from confederates in behavioral studies (e.g., paid actors).

Due to this interest in negotiation, several platforms have been developed to create virtual negotiating chatbots [19] as well as multi-channel negotiating agents [12]. To facilitate this study, we use the latter platform, IAGO, to conduct our investigation of COVID-related stress. IAGO allows negotiation to be realized in the form of the multi-issue bargaining problem [8], in which a diverse set of items with hidden values are traded and divided. Multi-issue bargaining represents a direct extension of previous, more limited interactions such as the Ultimatum Game.

In multi-issue bargaining, the "value claiming" activity of the Ultimatum Game is extended to allow for "value generation". This ability to "grow the pie" leads to more complex potential paths that affect prosocial behavior [2]. In the Ultimatum Game, participants have a binary choice—to accept or reject a given offer. By contrast, multi-issue bargaining allows repeated opportunities to interact with a partner. Participants are able to exchange information about their preferences over a basket of goods/issues, and then make complex offers back and forth (rather than only from one participant to another). In situations where the preferences over the goods/issues are not completely identical, this also means that there exists as solution that allows for the aforementioned value generation. Therefore, outcomes such as "joint points" (the sum of both players' points) become areas of interest and benefit to analyze, as well as the points that one side alone earns.

Platforms like IAGO facilitate a high degree of experimental control when exploring cognitive effects with agents. They allow the customization of agent physical characteristics (e.g., their appearance and clothing) as well as cognitive behaviors and negotiation strategies (e.g., desire for fairness, honesty, rationalization). Beyond this, they allow the collection of useful data about the participants in the negotiation. Of relevance to the topics of this paper are the negotiation-relevant concepts of information exchange, joint points (the ability to "grow the pie" of earnings), and individual point outcomes.

2.2 Stress and Dual-Process Cognition

Disasters are traumatic. They can produce profound psychological stress, strong emotions, repeated disturbing thoughts, and difficulty concentrating. Yet symptoms can vary considerably across impacted populations depending on their material circumstances and psychological resilience. Within disaster research, it is common to measure this individual variability with standard measures of psychological trauma, such as the Physician's Check List (PCL-C), a self-reported measure of post-traumatic stress disorder (e.g., [4], [13]). We follow this practice in the present studies, a scale to query

people specifically about their psychological reactions to COVID-19. The scale was specifically adapted to ask participants about their stress as a result of COVID-19.¹ This scale first appeared in work by de Melo et al. [7], and has been used in a similar fashion in this work.

Research on disasters has shown that the resulting stress can increase cooperative or prosocial behavior. For example, Cassar and colleagues [3] found an increase in prosocial decisions in economic games, such as the Trust Game, following the 2014 Tsunami in Thailand. One proposed explanation for these effects are "dual-process" models of cognition, in which people either engage in a rapid, emotional, heuristic mode of thought or a slow, rational, and deliberative style of thinking (see [16], [21]). The stress of disasters presumably shifts thinking towards the heuristic mode, which in turn, promotes prosocial actions. This is consistent with Rand's [18] *social heuristic hypothesis*, which argues that heuristic thinkers tend towards altruism, whereas deliberate thinkers tend towards self-interest.

If Rand's social heuristic hypothesis truly explains prosocial behavior during disasters, we would expect the effect to be mediated by a shift towards heuristic thinking. This shift can be measured by the Cognitive Reflection Task (CRT), first introduced by [10]. CRT asks a series of short questions with apparently obvious (but incorrect) answers, subjects' propensity for heuristic thinking at that moment can be accurately measured. A greater number of correct answers indicates the respondent avoided the trap through careful deliberation. If the social heuristic hypothesis explains disasterrelated altruism, then the impact of COVID on prosocial behavior should vanish if we control for CRT.

This link between stress and heuristic thinking has begun to be explored in earnest. Recent work such as that by de Melo and colleagues has found that stress is correlated with an increase in heuristic thinking, but that this difference applies unequally to human versus machine partners [7]. However, one limitation of existing disaster research such as de Melo et al.'s is it has tended to focus on simple "easy" forms of prosocial behavior like donating to charity or splitting money with another in a dictator game. But some forms of prosocial behavior are effortful. For example, some forms of empathy require effortful perspective taking or theory of mind [25]. Negotiation is a more complex social task which requires individuals to deeply understand the other side's perspective to discover win-win solutions. To succeed at negotiation therefore requires more sophisticated theory of mind to determine what the opponent might be planning or desiring ("hard" social behavior) vs. merely evaluating what impact a single transaction might have ("easy" social behavior). Thus, we wanted to revisit the link between disaster-stress and prosocial behavior using a more complex task that afforded both "easy" and "hard" forms of prosocial behavior.

¹ Our scale was adapted to ask how much participants "experienced problems in the last month **resulting from the pandemic**" (emphasis added). This allowed us to directly measure self-reported COVID-related stress, rather than general stress.



Figure 1: IAGO Online Agent Negotiation Platform

3 Design and Method

During disasters, we expect an increase in stress levels. And, there is work [3] that indicates that this should results in increased cooperation and prosocial behavior. However, the effects of stress deliberative thinking are not entirely clear, and the work of Rand [18] might suggest that changes to deliberative thinking might also affect cooperation. We examine these two potential effects on actual negotiation outcomes, and pose the following research questions:

- Does COVID-related stress reduce deliberative thinking?
- Does deliberative thinking affect joint points or agent points?
- Is information exchange a key antecedent to outcomes?

The last question is predicated on the assumption of negotiation "best practices", in which users are prone to "fixed-pie biases" [9]. Since information exchange can break down these biases and often leads to increased joint points, we consider it a key metric to track in this set of studies; it is the metric by which cooperation may affect actual outcomes.

To analyze the effects of COVID-related stress on negotiation outcomes and cognitive processes, we conducted a set of two studies using the IAGO negotiation platform. Both studies involved a negotiation with a virtual agent partner, and the deliberation over a set of 4 issues. The issues contained values such that it was possible to "grow the pie", as both parties preferred certain issues to others. However, all items had some value to both the human subject and the agent partner, so it was desirable to gain as many items as possible to maximize gains. A standard IAGO agent was used; the agent's behavior was dynamic and contingent on the actions of the human subject, but was fundamentally deterministic (i.e., the same set of actions by the humans would always lead to the same result). Furthermore, the available responses and actions the humans could take were bounded to a select set of pre-determined utterances (several dozen) that covered many aspects of the negotiation (e.g., meta-discussion: "I think we should try to split things evenly"). IAGO's agents therefore have bounded responses to this finite set of potential utterances.

Per best practices, participants were paid a base compensation for their participation in the study, and were incentivized to engage by rewarding higher performance with lottery tickets to an additional cash prize. All studies were approved by an appropriate institutional review board. The studies were conducted online, using Amazon's Mechanical Turk service for recruitment. 199 subjects were recruited for Study 1, and 198 subjects were recruited for Study 2. All participants were exposed to attention check questions during the study. Subjects that did not pass these checks, or who timed out of the negotiation entirely were removed, leaving 134 for Study 1 and 120 for Study 2.

The studies themselves were comprised of a multi-celled between-subjects factorial design, however none of the factors of had any impact on these results and are not discussed here. Study 1 varied the gender of the agent and also varied the presence of a surgical mask on the face of the agent's character. Study 2 again varied the presence of the surgical mask, and also varied the framing of the task—some participants were told they were negotiating with an agent (as in Study 1, an "agent" frame) while other were told they were negotiating with a human (an "avatar" frame). None of these factors impacted the pathways discussed in the remainder of Section 4, and there were no significant differences between them. We note that this lack of differentiation between agent and avatar frames lends support to the idea that the agents were being treated similarly to humans, in line with CASA.

Following consent, subjects were shown a questionnaire wherein they filled out the COVID-related stress scale and CRT to ascertain COVID-related stress and deliberative thinking, respectively. They then were introduced to the IAGO platform (Figure 1) and received brief training in its use. Following this, the subjects negotiated with the dynamic virtual agent, and then finally completed a short postsurvey and debrief. Beyond the results of the COVID-related stress and CRT data, data on the agent points, user points, joint points, and information exchange rate (as measured by the amount of relevant questions and answers that were exchanged) were collected.

Additional behavior variables were collected, totaling 158 distinct variables. These variables included measures such as quantity of questions asked by the participant, number of emojis used, lies told by the participant, etc.²

4 Results and Analysis

4.1 Analytical Approach

In order to establish the psychological mechanism(s) by which stress-specifically around COVID-affects the ultimate outcome of a negotiation, we tested for every possible combination and order of mediators. Specifically, we used a series of regressions and Sobel tests to determine whether a variable carries (or "mediates") the effect of an independent variable to the dependent variable (or outcome). A significant Sobel test, in combination with appropriate pattern of results in a series of regressions (explained below), provides evidence that an independent variable has an "indirect effect" (or an effect that is mediated through another variable) on the dependent variable. This is done by testing the hypothesis that there is no statistical difference between the total effect (i.e., the effect of a specified independent variable on the dependent variable) and the direct effect (i.e., the effect of that same independent variable on the dependent variable) after taking into account the influence of a potential mediator.

However, according to Preacher & Hayes [17], before a Sobel test should be run, certain relationships need to be established using a series of regressions. For mediation to occur, (1) the IV must significantly affect the mediator, (2) the IV must significantly affect the DV (as the sole predictor—in the absence of the mediator), (3) the mediator must have a significant unique effect on the DV, and (4) when both the IV and the mediator are entered as predictors into the regression, the effect of the IV on the DV must be reduced and the effect of the mediator must remain (or be the same strength as when the mediator is entered as the sole predictor of the DV). Accordingly, for each possible path or relationship in the analysis, we conducted four regression analyses: (1) IV predicting the mediator, (2) IV predicting the DV, (3) the mediator predicting the DV, and (4) the IV and mediator predicting the DV simultaneously in the same regression. Fitting within the assumptions of the Sobel test, our independent variable, dependent variable, and all of our possible mediators are continuous measures.

Our results (as detailed in the subsequent subsections) indicate that significant mediative relationships do exist, and these relationships are summarized in Figure 2 and Figure 3. We analyze the studies separately, but emphasize the shared pattern of results in our final discussion.

4.2 Study 1

As displayed in Table 1, we conducted correlations between our predictors (COVID-related stress and deliberative thinking) and our negotiation measures. As predicted, users who experienced more COVID-related stress gave away more points to the agent in the

negotiation, resulting in a positive significant correlation between stress and agent points. In contrast, user points were unrelated to COVID-related stress, such that those with greater stress did not end up with significantly more points for themselves. Information exchange during the negotiation and resulting integrative value found by "growing the pie" such that there are more points for both the agent and user (i.e., joint points) were both related to the predictor (COVID-related stress) as well as the outcome (agent points); likewise, deliberative thinking was associated with both lower COVID-related stress and lower agent points. Therefore, all three variables-information exchange, joint points, and deliberative thinking-have the potential to mediate the observed relationship between COVID-related stress and agent points. To unpack this potential mediation, we used path modeling to explore the nature of the psychological mechanisms operating between the antecedent stress and resultant effect of transferred points to the opponent.

To establish mediation, the predictor (COVID-related stress) would need to predict the mediator, and, when entered simultaneously, the mediator should significantly predict the outcome (agent points) while this effect of COVID-related stress on agent points is significantly reduced (from $\beta = 0.17$, t(133) = 2.02, p < .05, [1]). This required pattern to establish mediation holds for all three of the potential mediators (see Figure 2). First, COVID-related stress significantly predicted reduced deliberative thinking, $\beta = -0.42$, t(133) = -5.27, p < .001, deliberative thinking significantly predicted fewer agent points, $\beta = -0.33$, t(133) = -4.07, p < .001, and, when entered simultaneously to predict agent points, this effect of deliberative thinking remained, $\beta = -0.32$, t(133) = -3.50, p = .001, whereas the effect of COVID-related stress was reduced to non-significant, $\beta = 0.04$, t(133) = 0.45, p = .65. A Sobel [20] test confirmed that full mediation was significant, Z = 2.92, p = .004.

However, we also explored information exchange and joint points as potential alternative pathways between COVID-related stress and agent points. Again, information exchange was a full mediator: COVID-related stress significantly predicted information exchange, $\beta = 0.31$, t(133) = 3.68, p < .001, information exchange significantly predicted agent points, $\beta = 0.24$, t(133) = 2.84, p = .005, and, when entered simultaneously to predict agent points, this effect of information exchange remained, $\beta = 0.21$, t(133) = 2.33, p = .02, whereas the effect of COVID-related stress was reduced to nonsignificance, $\beta = 0.11$, t(133) = 1.24, p = .22; Sobel test Z = 1.97, p < .05). Likewise, joint points was also a full mediator: COVIDrelated stress significantly predicted joint points, $\beta = 0.28$, t(133) = 3.37, p = .001, joint points significantly predicted agent points, $\beta =$ 0.60, t(133) = 8.69, p < .001, and, when entered simultaneously to predict agent points, this effect of joint points remained, $\beta = 0.60$, t(133) = 8.30, p < .001, whereas the effect of COVID-related stress was reduced to non-significance, $\beta = 0.01$, t(133) = 0.05, p = .96; Sobel test Z = 3.12, p = .002.

Accordingly, we next explored if pathways occurred between the mediators. The effect of information exchange on agent points was fully mediated by joint points: information exchange predicted joint points, $\beta = 0.26$, t(133) = 3.14, p = .002, and, when entered simultaneously to predict agent points, this effect of joint points remained, $\beta = 0.58$, t(133) = 8.08, p < .001, whereas the effect of

² A full list of variables recorded is available from the IAGO documentation and can be provided by request at <u>https://myiago.com</u>.

predict joint points, the effects of both information exchange, $\beta =$ 0.20, t(133) = 2.27, p = .03, and of COVID-related stress, $\beta = 0.22$, t(133) = 2.56, p = .01, remained significant, although the latter was substantially reduced (from $\beta = 0.28$, t(133) = 3.37, p = .001); while this only qualifies as partial mediation, a Sobel test revealed it was borderline significant (Z = 1.93, p = .05), thus an additional direct pathway between COVID stress and joint points remained. Similarly, the effect of COVID-related stress on information exchange was also only partially mediated by deliberative thinking: when entered simultaneously to predict information exchange, the effects of both deliberative thinking, $\beta = -0.21$, t(133) = -2.39, p = .02, and of COVID-related stress, $\beta = 0.22$, t(133) = 2.41, p = .02, remained significant, although the latter was substantially reduced (from $\beta = 0.31$, t(133) = 3.68, p < .001); mediation was significant (Z = 2.18, p = .03), but partial, thus an additional direct pathway between COVID stress and information exchange remained. In contrast, deliberative thinking did not mediate the effect of COVIDrelated stress on joint points: when entered simultaneously, deliberative thinking did not significantly predict joint points, $\beta = -$ (0.15, t(133) = -1.68, p = .10), whereas COVID-related stress did, $\beta =$ 0.22, t(133) = 2.38, p = .02.

The effect of deliberative thinking on agent points was partially mediated by joint points: deliberative thinking significantly predicted fewer joint points, $\beta = -0.24$, t(133) = -2.90, p = .004, joint points significantly predict more agent points, $\beta = 0.60$, t(133) = 8.69, p < .001, and, when entered simultaneously, joint points continued to predict agent points, $\beta = 0.55$, t(133) = 7.96, p < .001, and while deliberative thinking did as well, $\beta = -0.20$, t(133) = -2.84, p = .005, it was substantially reduced (from $\beta = -0.33$, t(133) = -4.07, p < .001) such that a Sobel test for partial mediation was highly significant (Z = 2.72, p = .006). Moreover, that association between deliberative thinking and joint points was itself partially mediated by information exchange: deliberative thinking significantly predicted reduced information exchange, $\beta = -0.31$, t(133) = -3.66, p < .001, information exchange significantly predict more joint points, $\beta = 0.26$, t(133) = 3.14, p = .002, and, when entered simultaneously, information continued to predict joint points, $\beta =$ 0.21, t(133) = 2.40, p = .02, and while deliberative thinking also just reached significance, $\beta = -0.18$, t(133) = -2.08, p = .04, it was reduced (from $\beta = -0.24$, t(133) = -2.90, p = .004) such that a Sobel test also reached significance (Z = 2.01, p < .05). In contrast, deliberative thinking could not logically mediate the effects of information exchange or joint points because it was measured before the negotiation, as a more distal state predictor variable occurring during COVID.

4.3 Study 2

As displayed in Table 2, users who experienced more COVIDrelated stress again gave away more points to the agent in the negotiation. Unlike Study 1, those with greater COVID-related stress also took fewer points for themselves; but user points were unrelated to anything else (except joint points of course). As in Study 1, information exchange, joint points, and deliberative thinking were all related to COVID-related stress and agent points. We therefore again used path modeling to explore the meditational paths.

To establish mediation by these variables, we were again looking for this effect of COVID-related stress on agent points to be significantly reduced (from $\beta = 0.41$, t(119) = 4.90, p < .001; see Figure 3). First, COVID-related stress significantly predicted reduced deliberative thinking, $\beta = -0.49$, t(119) = -6.04, p < .001, deliberative thinking significantly predicted fewer agent points, $\beta =$ -0.43, t(119) = -5.16, p < .001, and, when entered simultaneously to predict agent points, this effect of deliberative thinking remained, β = -0.29, t(119) = -3.16, p = .002, as did the effect of COVID-related stress, $\beta = 0.27$, t(119) = 2.90, p = .004, although the latter was considerably reduced, resulting in highly significant partial mediation (Sobel test Z = 2.80, p = .005).

In this study, however, information exchange did not mediate the relationship between COVID-related stress and agent points, as when entered simultaneously, information exchange was not a significant predictor, $\beta = 0.14$, t(119) = 1.57, p = .12, but COVID-related stress was, $\beta = 0.38$, t(119) = 4.43, p < .001.

Because of the relationships with user points in this study, we explored it as a possible mediator: COVID-related stress significantly predicted reduced user points, $\beta = -0.27$, t(119) = -3.03, p = .003, reduced user points significantly predicted more agent points, $\beta = -0.53$, t(119) = -6.91, p < .001, and, when entered simultaneously to predict agent points, this effect of user points remained, $\beta = -0.46$, t(119) = -6.01, p < .001, as did the effect of COVID-related stress, $\beta = 0.29$, t(119) = 3.76, p < .001, although the latter was considerably reduced, resulting in highly significant partial mediation (Sobel test Z = 2.71, p = .006). Joint points also served a partial mediator: COVID-related stress significantly predicted joint points, $\beta = 0.19$, t(119) = 2.13, p = .04, joint points significantly predicted agent points, $\beta = 0.58$, t(119) = 7.82, p < .001, and, when entered simultaneously to predict agent points, this effect of joint points remained, $\beta = 0.52$, t(119) = 7.32, p < .001, as did the effect of COVID-related stress, $\beta = 0.31$, t(119) = 4.37, p < .001, although the latter was reduced enough to qualify as significant partial mediation (Sobel test Z = 2.05, p = .04).

Accordingly, we next explored if pathways occurred between the mediators. Unlike in Study 1, deliberative thinking did mediate the effect of COVID-related stress on joint points: COVID-related stress significantly predicted reduced deliberative thinking, $\beta = -0.49$, t(119) = -6.04, p < .001, deliberative thinking significantly predicted fewer joint points, $\beta = -0.32$, t(119) = -3.66, p < .001, and, when entered simultaneously, deliberative thinking continued to predict joint points, $\beta = -0.29$, t(119) = -2.84, p = .005, whereas stress was reduced to non-significance, $\beta = 0.05$, t(119) = 0.54, p = .59; Sobel test Z = 2.57, p = .01. In contrast, deliberative thinking did not mediate the effect of COVID-related stress on user points: when entered simultaneously, deliberative thinking did not significantly predict user points, $\beta = 0.04$, t(119) = 0.37, p = .71, whereas COVID-related stress did, $\beta = -0.25$, t(119) = -2.45, p = .02.

The effect of deliberative thinking on agent points was partially mediated by joint points: deliberative thinking significantly predicted fewer joint points, $\beta = -0.32$, t(119) = -3.66, p < .001, joint points significantly predict more agent points, $\beta = 0.58$, t(119) =7.82, p < .001, and, when entered simultaneously, joint points continued to predict agent points, $\beta = 0.50$, t(119) = 6.64, p < .001, and while deliberative thinking did as well, $\beta = -0.27$, t(119) = -3.60, p < .001, it was substantially reduced (from $\beta = -0.47$, t(119) = -5.16, p < .001) such that a Sobel test was highly significant (Z = 3.21, p = .001).

Although information exchange does not mediate the relationship(s) with the outcome (agent points) in this study, it does partially mediate the relationship between deliberative thinking and joint points: reduced deliberative thinking significantly predicted information exchange, $\beta = -0.24$, t(119) = -2.71, p = .008, information exchange significantly predicted joint points, $\beta = 0.32$, t(119) = 3.65, p < .001, and, when entered simultaneously to predict joint points, the effect of information exchange remained, $\beta = 0.26$, t(119) = 2.95, p = .004, as did the effect of deliberative thinking, β = -0.26, t(119) = -2.95, p = .004, although the latter was reduced enough to qualify as significant partial mediation (Sobel test Z =2.00, p < .05). Finally, deliberative thinking could not logically mediate the effects of user or joint points because it was measured before the negotiation, as a more distal state predictor variable occurring during COVID-19; and user and agent points are combined to create joint points so there is a direct relationship between these variables created by definition, rather than by psychological mechanism.

5 Discussion

The results clearly indicate that there are strong correlations between COVID-related stress and negotiation outcomes such that stressed individuals give up value to their opponent. In both studies, we see a clear mediation through deliberative thinking, in which less deliberative processing correlates with points being given away to the opponent. Thinking more heuristically, because of stress due to COVID, people give more points to the agent. This mediational effect of reduced deliberative thinking itself was partially mediated in both studies by information exchange and then joint points. It seems that, at least partly, thinking more heuristically led people to ask questions and share information with the agent, which resulted in a "bigger pie" (joint points) from which to give away more points to the agent. This last point is in line with work that suggests that disasters may lead to more cooperation: this increased cooperation led to increased joint value, however that value was inequitably shared between partners.

Perhaps reliance on quicker heuristic thinking leaves participants missing key pieces of information about their opponents. They rectify this by gaining more information, which expectedly increases joint points-as they are now less likely to be subject to the fixed-pie bias that normally prevents joint points. However, this increased set of points is not distributed fairly: they give more of the points away to the agent. So even when more points are discovered through increased information exchange, those benefits are still over-allocated to the opponent. While it is possible that this is due to conflict avoidance, it could be due to altruism, as more stressed users seem to be promoting the agent's welfare, even at a cost to themselves (increasing the size of the pie but giving the additional points away). We posit that this mediating path may be due to a lack of realization that joint value has been created, which thereby allows a self-interested opponent to claim it. Finally, there are other mediating pathways, but they fail to replicate between studies, so we do not discuss them here.

Generally, we feel that these results contribute strongly in two ways to the body of existing literatures. First, they show that there does exist a mediating pathway between COVID-related stress and pro-social behavior for more advanced interactions like negotiation. This is an advancement over prior work, which has focused on simpler games such as the Dictator Game. Secondly, we show that these effects extend to situations with an embodied virtual agent such as those provided by IAGO. This lends credence to the use of virtual agents to study socio-behavioral effects, including complex pathways that involve mediating variables. We note that the framing of the agent as an agent or an avatar did not have a significant change on these results, indicating that these agents are "sufficiently human-like" to evoke the CASA paradigm.

We do concede that work that attempts to link COVID-related stress via self-report of participants does have some limitations. In particular, the COVID-related stress scale used in this study relates stress to particular *events* rather than a generally elevated stress level. Further, it may not be possible for participants to accurately report their level of COVID-specific stress and fully disentangle that from their stress from other sources. Still, use of this modified scale has appeared in the literature [7], and we believe the benefits of such research should be weighed positively against the limits of this approach.

In sum, we believe these results clearly indicate the secondary effects of COVID-related stress as they relate to complex cognitive and social tasks such as negotiation. Specifically, while stress may have the unintended side effect of causing more information to be exchanged, it also leads to unequal outcomes, as more value is claimed by opponents. While we stop short of making normative sociological claims regarding this result, we do believe it underscores the importance of understanding stress at it relates to human cognitive and behavioral patterns—and indeed, stresses the need for studies which specifically examine these secondary repercussions of stress. Pandemic Panic: The Effect of Disaster-Related Stress on Negotiation Outcomes

Table 1: Pearson Zero-order Correlations Among COVID-19-related Stress and Outcome Variables in Study 1

		1	2	3	4	5	6
1) COVID-19-related stress	-						
2) Deliberative thinking	42***	-					
3) Information exchange	.31***	30***	-				
4) Joint Points	.28***	24**		26**	-		
5) User Points	.11	.12		01	.39***	-	
6) Agent Points	.17*	33***		24**	.60***	50***	-
*p <= .05; **p <= .01; ***p <= .001							

Table 2: Pearson Zero-order Correlations Among COVID-19-related Stress and Outcome Variables in Study 2

		1	2	3	4	5	6
1) COVID-19-related stress	-						
2) Deliberative thinking	49***	-					
3) Information exchange	.23**	24**		-			
4) Joint Points	.19*	32***		.32***	-		
5) User Points	27**	.16		.07	.38***	-	
6) Agent Points	.41***	43***		.23**	.58***	54***	-
*p <= .05; **p <= .01; ***p <= .001							





Figure 3: Study 2 Mediative Pathways

ACKNOWLEDGMENTS

Research was sponsored by the Army Research Office and was accomplished under Cooperative Agreement Number W911NF-20-2-0053. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the Army Research Office or the U.S. Government. The U.S. Government is authorized to reproduce and distribute reprints for Government purposes notwithstanding any copyright notation herein.

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