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An anger premium: An experiment on the role of counterpart emotions in coordination

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ABSTRACT

Using an online experiment, we induce happy and angry emotions among MTurk participants and examine how information of their counterparts' emotions affects their aggressive versus accommodating choices and coordination outcomes in the Battle-of-the-Sexes games. We find that participants are significantly more likely to choose the accommodating (aggressive) option if their counterparts are angry (happy), regardless of their induced emotions. Moreover, coordination rates are significantly improved when participants make decisions given counterparts' emotions. Among the successfully coordinated pairs, angry participants are more likely to choose the aggressive option and thus gain a larger share of the payout, or an anger "premium". A potential mechanism could be that information of counterparts' emotions modulates individual beliefs of counterparts' decisions and thus, influences coordination outcomes.

1. Introduction

In this paper, we study how information of counterparts' induced emotions influences individual decisions and in turn, coordination outcomes in a Battle of the Sexes (BoS) experiment with multiple equilibria. The BoS game (Rapoport 1966) lies at the core of certain theoretical models in industrial organization literature (see for example Farrell 1987; Dixit and Shapiro 1986). The Nash Equilibria (NE) occur when both players coordinate – that is, one player chooses the aggressive option that favors oneself with a larger payoff and the other chooses the accommodating option that favors the counterpart with a smaller payoff; otherwise, they fail to coordinate and receive nothing. Therefore, while both players agree that coordination is desirable in the BoS game, as players receive unequal payoffs at different NE, players disagree as to which equilibrium they should coordinate on. In this study, we induce the emotions of happiness and anger among players and have them make decisions in the basic BoS game as well as the modified BoS game where they are asked to consider the emotional status of their randomly-matched counterparts.

Despite the fact that existing experimental literature suggests communication is crucial for achieving coordination in the BoS games (e.g., Agranov & Schotter, 2002; Cooper et al., 1989), what we argue in this paper is that even without any communication, information of counterparts' emotions could potentially serve as an effective device to modulate participants' beliefs of counterparts' strategies and facilitate coordination and promote efficiency. Some literature such as Schelling (1960) points out that absent of communication, a salient decision label can help participants to coordinate with others who receive equal payoffs at NE. However, Crawford et al. (2008) show that small amounts of unequal equilibrium payoffs (e.g., $ 5.1 versus $5) dramatically decrease the coordination rates in the BoS experiments even with salient decision labels. Chmura et al. (2005) support such finding and further demonstrate that the greater the difference in individual payoffs, the less likely a successful coordination could be achieved. Thus, in experimental literature that has explored ways to enhance coordination in the BoS games with *unequal* payments at the NE, researchers suggest that successful coordination relies largely on whether communication is allowed. For instance, Cooper et al. (1989) find that pre-play communication promotes coordination in the BoS games with unequal equilibrium payoffs while Agranov and Schotter (2002) confirm the importance of communication in coordination by introducing a benevolent announcer in their experiments. Whereas in the novel experimental setting like ours, we do not offer participants the opportunity to communicate but only ask them to make decisions based on their matched counterparts' emotional status in the modified BoS game with unequal equilibrium payoffs (i.e., $3 versus $1). We are able to show that without any direct communication, information regarding counterparts' emotions could facilitate coordination and consequently,

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coordination rates and efficiency are significantly improved.

There is abundant experimental literature that has investigated the impact of individuals' induced emotions on their own decisions in behavioral games. Previous work shows that individuals' positive emotions such as happiness are often found to be positively correlated with generous behaviors in dictator games (Capra, 2004; Ibanez, Moureau and Roussel 2016), cooperation in public goods games (Drouvelis & Grosskopf, 2016), and increased trusting behaviors (Dunn & Schweitzer, 2005)[1]. On the other hand, negative emotions such as irritation, contempt, anger and envy are shown to increase the rejection rate of unfair offers in the ultimatum game (Forgas & Tan, 2013; Harlé & Sanfey, 2007), link to destruction in the power-to-take game (Ben--Shakhara et al., 2007; Bosman & van Winden, 2002; Bosman et al., 2005; Galeotti, 2015; Reuben & van Winden, 2010), and have a negative effect on feelings of trust (Dunn & Schweitzer, 2005).[2] Following these studies, we focus on two specific emotions – happiness and anger as the existing literature suggests happiness and anger are two of the six "primary or universal" emotions[3] (e.g., Damasio, 1999; Drouvelis & Grosskopf, 2016). Compared to previous studies that examine the roles of individuals' emotions in their own behaviors, our study aims to investigate how the information of others' happy or angry emotions modulates individual beliefs of others' accommodating versus aggressive strategies and thus, helps explain individual choices and coordination outcomes in an experimental BoS game setting.

Similar to our experimental finding which suggests participants' beliefs regarding others' strategies associated with others' emotions may serve as an important device enabling coordination, a few experimental studies also show the importance of players' beliefs of counterparts' possible strategies to successful coordination. Using a modified stag hunt experiment, Bosworth (2017) finds players prefer to invest when they believe that others are "optimistic". McCannon (2011) studies the interaction between a fictitious player and a sophisticated player in 2 × 2 coordination games. He finds that even if the fictitious player puts relatively little weight on the superior equilibrium, the sophisticated player could form accurate belief of the fictitious player's future choice and thus, switch play to the superior outcome to achieve coordination. Crawford (1995) also points out that players' beliefs are coordinated when play begins and their beliefs interact with the learning process. Indeed, as soon as the game starts, players adjust strategies in response not only to their beliefs of counterparts' possible decisions, but also to their beliefs of others' personality traits and emotions. For instance, Drouvelis and Georgantzis (2019) show experimentally that revealing personality data for disagreeable individuals has detrimental effects on their pro-social behavior in a one-shot modified dictator game and a public goods game. Fehr and Gächter (2002) conduct a public goods experiment where participants can learn about the investments of other members in the same groups and then choose whether to punish other members at a cost. They find that, even in a one-shot context, free riders contribute because they expect free-riding behavior may anger others, thus triggering others' costly punishment. In another paper, van Leeuwen et al. (2017) show that after viewing photos of their counterparts exhibiting angry facial expressions, subjects in an ultimatum game can correctly predict the counterparts' rejection decisions. Moreover, Van Kleef et al. (2004) show that, in buyer and seller negotiations, individuals motivated to consider their opponent's emotions are more likely to concede to an angry opponent than to a happy one. Therefore, our paper adds to this strand of experimental literature concerning the role of players' beliefs, especially beliefs regarding counterparts' strategies associated with their induced emotions in individual decisions and coordination outcomes.

Furthermore, our paper also contributes to the coordination literature. Experimental economists have explored ways to foster coordination mainly utilizing the minimum effort games (*aka*, the weak-link games). For example, Dugar (2010) finds expression of disapproval enforces efficient behavior and facilitates coordination in the minimum effort games while some others focus on the role of intergroup competition in promoting coordination (e.g., Bornstein et al., 2002; Riechmann & Weimann, 2008). Although a vast amount of experimental literature has studied coordination, the role of players' beliefs regarding counterparts' emotions and their associated strategies in the coordination games, in particular the BoS game has received little attention. Therefore, we believe our work adds unique value to this area of inquiry and advances our understanding of how beliefs of others' induced emotions and their associated strategies impact individual choices and coordination in an experimental BoS game setting.

Our study intends to investigate the following questions and provide empirical evidence. First, how do players' induced emotions of happiness and anger influence their decisions in the BoS game experiment? Second, are players more or less willing to accommodate if they are asked to make decisions given the emotional status of their counterparts? Third, without direct communication, does allowing players to make decisions given their counterparts' emotions promote efficiency by facilitating coordination? Fourth, among the successfully coordinated players in the BoS game, are happy or angry individuals more likely to receive higher payoffs?

To answer these questions, we design an online experiment combined with a series of well-established surveys and recruit 466 participants from Amazon Mechanical Turk (MTurk) to take part in our study. The recruited MTurk participants are randomly assigned to either the emotion-induction treatment or the no-emotion-induction treatment. Only those in the emotion-induction treatment are required to complete the Autobiographic Emotional Memory Task (AEMT) prior to the decision tasks. Participants in both treatments are asked to make decisions in the basic BoS game as well as the modified BoS game where they make decisions given their randomly-matched counterparts' emotional status. Participants in both treatments answer a post-task questionnaire and provide information on individual characteristics relevant to their choices in the BoS games (e.g., age, gender, ethnicity, and education).[4]

Overall, our main experimental results show that when individuals are asked to make decisions given their counterparts' emotions, they are more likely to choose the accommodating (aggressive) option when their counterparts are angry (happy), regardless of their own induced emotions[5].We further find a significant improvement in the coordination rate and game efficiency regardless of the emotions held by participants in a pair (e.g., both are happy, both are angry, or one is happy and the other is angry), although the effect is most evident when one individual is happy and the other is angry. Moreover, since angry participants among the successfully coordinated pairs are more likely to

[1] Although this result is found in most experimental literature, the reduced or even opposite effects of positive emotions on individual choices and behaviors are also observed. For example, Capra (2004) does not find any significant differences among individuals who possess positive versus negative emotions in exhibited trusting behaviors. In another study, Tan and Forgas (2010) find that happiness is associated with greater selfish behavior.

[2] Both Capra (2004) and Kirchsteiger, Rigotti, and Rustichini (2006) show that negative rather than positive emotions promote trustworthiness. They induce sadness rather than anger emotion. Existing literature shows that people interpret sadness and anger differently (e.g., Tiedens 2001).

[3] The other four "primary or universal" emotions are sadness, fear, surprise, and disgust (see Drouvelis & Grosskopf 2016).

[4] To ensure that subjects receive basic participation fee after finishing the decision tasks, we ask them to complete a survey questionnaire. Although from the survey, we have collected data on other variables, they are not related to the theme of this paper. Thus, they are not reported here.

[5] Interestingly, we do not find that participants' induced emotions play significant roles in their own decisions. Although participants' induced emotions are not shown to have significant effects, we think this question is still worth exploring and thus, we report relevant findings in Section 3.

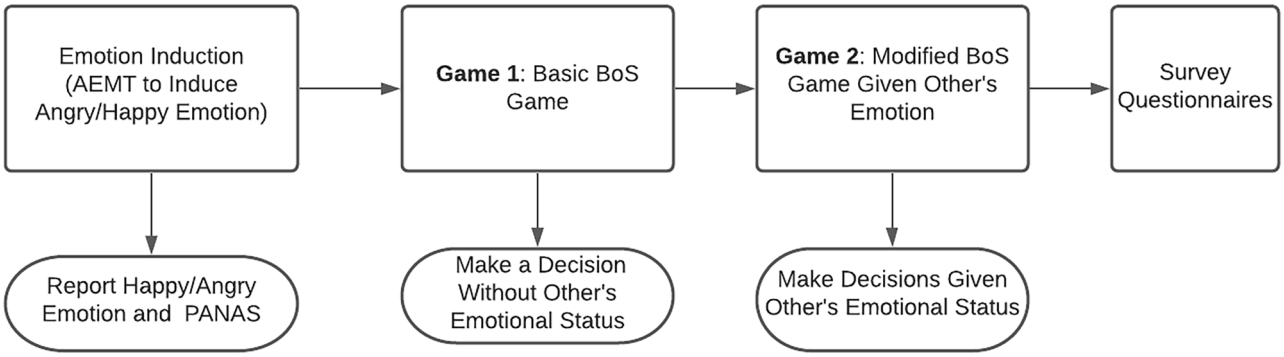

Fig. 1. Flowchart for the emotion-induction treatment.

choose the aggressive option while their counterparts are more likely to respond to this anger with an accommodating choice, we find that angry participants tend to receive a larger share of the total amount. By contrast, when individuals are not asked to consider their counterparts' emotional status, there is no difference between angry and happy participants in either their decisions or the share they receive.

The rest of the paper is organized as follows. In the following section, we describe our experimental design and procedures. Section 3 presents and explains our empirical findings. Finally, Section 4 concludes and discusses the implications and contributions of our study.

2. Experimental design and procedures

2.1. Description of the study

We conduct our study online via Qualtrics with 466 subjects (294 males and 172 females) recruited via Amazon Mechanical Turk (MTurk) [6]. All subjects reside in the United States, with an age range of 19 to 70 years and an average age of 35.6. Regarding participants' characteristics, 71.1% of the recruited subjects indicate they are white and 74.7% indicate they have completed at least some college or other level of higher education. 333 subjects participate in the emotion-induction treatment and 133 subjects participate in the no-emotion-induction treatment[7]. In the emotion-induction treatment, the emotion of happiness or anger is induced through an Autobiographic Emotional Memory Task (AEMT), which we describe in the next paragraph. To test the robustness of our experimental results from the emotion-induction treatment, we conduct the no-emotion-induction treatment and report the findings in Section 3.5.

2.2. Emotion induction treatment

We ask subjects in the emotion-induction treatment to complete an Autobiographic Emotional Memory Task (AEMT) – a widely used method to experimentally induce emotions, which involves recalling and writing about intense emotional experiences. In our experiment, subjects assigned to the emotion-induction treatment are required to describe in detail one situation that has made them the most angry or happy in their life in such a way that a person reading the description would become angry or happy just from hearing about the situation. They are requested to provide their responses in a minimum of 100 characters. Immediately after subjects complete the AEMT, they are asked to report which of the emotions, happiness or anger, is closer to how they feel as well as the extent to which they feel this emotion (from "not at all (1)" to "extremely (5)"). For more information on the AEMT, please see Mills and D'mello (2014) who conduct a meta-analysis of experiments using this task to induce emotions among subjects. Morris (1989) suggests that the AEMT is able to evoke direct individual experience of emotions. Among economists, Capra (2004) and Capra et al. (2010) also use the memory elicitation tasks to induce emotions. Thus, we consider this task as an appropriate method for inducing individual emotion in our experimental setting. In addition, subjects in both the emotion-induction and no-emotion-induction treatments are given a PANAS (The Positive and Negative Affect Schedule, Watson et al., 1988) questionnaire to report emotions[8] other than happiness and anger prior to the decision tasks, which we explain in the next paragraph. It is the most widely and frequently used scale to assess positive and negative emotions (Díaz-García et al., 2020). In the PANAS questionnaire, subjects report a self-assessment score from 1 to 5 on each of the 20 different emotions which may describe how they feel at that moment and could be categorized as either positive (i.e., interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, and active) or negative (i.e., distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid), while a score of 1 stands for "very slightly or not at all" and a score of 5 stands for "extremely". The PANAS scales are shown to be highly internally consistent, largely uncorrelated, and stable at appropriate levels (Watson et al., 1988). The flowchart in Fig. 1 outlines the procedures of the emotion-induction treatment.

2.3. Decision tasks

Under both treatments, subjects give online consent to participate in the study. The decision tasks involve making simultaneous decisions in both the basic and modified BoS games. Prior to the decision tasks, all subjects are informed how many stages there are in the experiment and that only one randomly-selected stage will count for calculating their

[6] MTurk is an Internet marketplace that provides access to thousands of worldwide survey takers (i.e., workers) who can perform requested tasks. Individuals who are interested in signing up and completing the requested tasks on MTurk could earn money during their spare time and in any locations convenient to them. Therefore, we are able to obtain our research participants very quickly at relatively lower costs than if conducting the experiment with traditional undergraduate students in the laboratory.

[7] We check the demographic characteristics of the subjects who participate in the emotion-induction treatment versus the no-emotion-induction treatment, and we do not find any significant differences in their demographics across two treatments.

[8] We acknowledge that direct measures such as certain software that can read emotions from faces would provide us with more accurate measures of subjects' emotions. However, given the current experimental design with MTurk subjects who access and complete the online survey and decision tasks via Qualtrics from anywhere in the United States, it would not be possible to have such direct measures of their emotions. Therefore, we use self-reported or self-assessed emotions. As far as we are aware, a vast amount of literature in behavioral and experimental economics has also relied on self-reported emotions to examine their effects on decisions (see for example, Capra 2004; Capra et al. 2010; Ben-Shakhar et al. 2007; Drouvelis & Grosskopf 2016; Ibanez, Moureau & Roussel 2017).

Table 1
Battle of the Sexes (BoS).

		Person B Option 1	Option 2
Person A	**Option 1**	$3, $1	$0, $0
	Option 2	$0, $0	$1, $3

Table 2
Comparison of sample demographics.

Variable	(1) Mturk Sample (Emotion Treatment)	(2) Mturk (No-emotion Treatment)	(3) Our MTurk Sample (Overall)	(3) U.S. Adult Population
Age	35.89	34.47	35.64	47
Men	0.601	0.677	0.63	0.487
Married	0.502	0.414	0.479	0.482
Have children	0.535	0.489	0.524	N/A
Graduate	0.174	0.083	0.149	0.126
College Associate	0.583	0.624	0.598	0.286
High school	0.240	0.211	0.233	0.269
Less than High School	0.003	0.000	0.002	0.117
White	0.706	0.714	0.711	0.722
Black	0.150	0.135	0.146	0.127
Hispanic	0.057	0.075	0.062	0.183
U.S. Born	0.961	0.970	0.968	1.0
Observations	N=333	N=133	N=466	N=499,8000

Note: Sources for U.S. adult population data are from American Community Survey 2018, one-year estimates, from Barton and Pan (2021).

final payment. They are also aware that they are matched with different MTurk workers in each games, their decisions are kept anonymous to other participants during the experiment, and they will not learn any game outcomes until all subjects have completed the study. Upon completing the decision tasks, subjects are asked to answer a post-task questionnaire and provide information on their demographics as well as questions related to their beliefs about their counterparts.

2.4. Game 1: the basic Battle of the Sexes (BoS) game

In Game 1 (the basic BoS game), subjects are first randomly paired within treatments and then asked to make simultaneous decisions regarding which option they would prefer in the game. There are two roles in Game 1: Person A and Person B. Subjects are randomly assigned to one of these roles and then asked to choose between Option 1 and Option 2 for their game strategy (see Table 1). If each member of a pair selects the same option, each receives either $1 or $3; otherwise, neither receives anything. Therefore, there are two pure Nash Equilibria (NE) in the basic BoS game: NE1= (Option 1, Option 1) that Person A prefers and NE2= (Option 2, Option 2) that Person B prefers, considering which player receives a relatively higher payoff in the preferred NE. We follow Charness et al. (2007) and define the aggressive option as the decision that is made to favor oneself (i.e., Person A chooses Option 1 or Person B chooses Option 2). We define the accommodating option as the decision that is made to favor a participant's counterpart (i.e., Person A chooses Option 2 or Person B chooses Option 1). We ensure that subjects understand the options by asking them to answer a few practice questions before presenting the decision tasks to them.

2.5. Game 2: modified BoS game based on matched counterparts' emotions

After completing Game 1 but before knowing the outcomes, subjects in all treatments participate in a modified BoS game. They are reminded that each game is independent and either Game 1 or Game 2 will be randomly selected to determine their earnings. The details of both treatments are described below.

Emotion-induction treatment: 333 subjects participate in the emotion-induction treatment. In this treatment, we ask subjects in our randomly-assigned pairs to make simultaneous decisions based on the strategy method assuming their matched counterparts are either "happy" or "angry". Subjects are also informed that their payoffs will be determined using their counterparts' actual emotional status and decisions. Thus, it is safe to assume that subjects' decisions in the emotion-induction treatment could be influenced by their induced emotions as well as the emotions of their counterparts.

No-emotion-induction treatment: To test the robustness of the results in the emotion-induction treatment, we conduct the no-emotion-induction treatment and 133 subjects participate in it. Subjects in this treatment do not experience induced emotion through the AEMT prior to the decision tasks and the Game 1 procedure is the same as that in Game 1 of the emotion-induction treatment. In Game 2, they are told that their randomly-matched counterparts have already reported their emotional status and made their decisions (i.e., in the basic BoS game or Game 1). Therefore, given their matched counterparts' emotion being "happy" or "angry", all the subjects in the no-emotion-induction treatment are then asked to decide what option they would like to choose under each scenario (please see the specific language that we use to describe this procedure to the subjects in Appendix II: Stage 2 Instructions). In this treatment, subjects are informed that their earnings in Game 2 will be based on their counterparts' actual reported emotions and decisions. While it might be possible that subjects' decisions could be influenced by some unobservable variables such as their own emotions prior to entering the decision tasks in the no-emotion-induction treatment, such influences would also exist in the emotion-induction treatment. Thus, compared to the emotion-induction treatment, our results in the no-emotion-induction treatment present baseline findings without the emotion-induction procedure.

2.6. Payment

The experiment takes subjects approximately 15 minutes to complete. All subjects are told that they will receive a $2 participation fee for completing the experiment and that, depending on chance and their choices, they will also receive a $1 or $3 bonus in one of the randomly-selected decision tasks. Immediately after we review and approve their work, they receive the payment via MTurk. To ensure that MTurk workers have a good reputation and that they complete our experiments with care, we recruit workers whose qualification scores or approval ratings are greater than 90%.[9]

3. Results

3.1. Summary statistics

In Table 2, we present the summary statistics for our experimental subjects. From Table 2, we see that our subject pool consists of slightly more men compared to the general U.S. population (American Community Survey 2018). We further see that our subjects are younger and more educated, with a higher percentage of individuals who have obtained an associate degree or greater than the general U.S. adult population. Finally, the racial composition of our sample is similar to that of the U.S. population, with the greatest number of participants identifying as White, followed by Black and Hispanic.

3.2. Emotion induction

We next present the results from our experiment, beginning with the

[9] Both Arechar et al. (2018) and Peer et al. (2014) discuss the importance of recruiting reputable MTurk workers with relatively high approval rates.

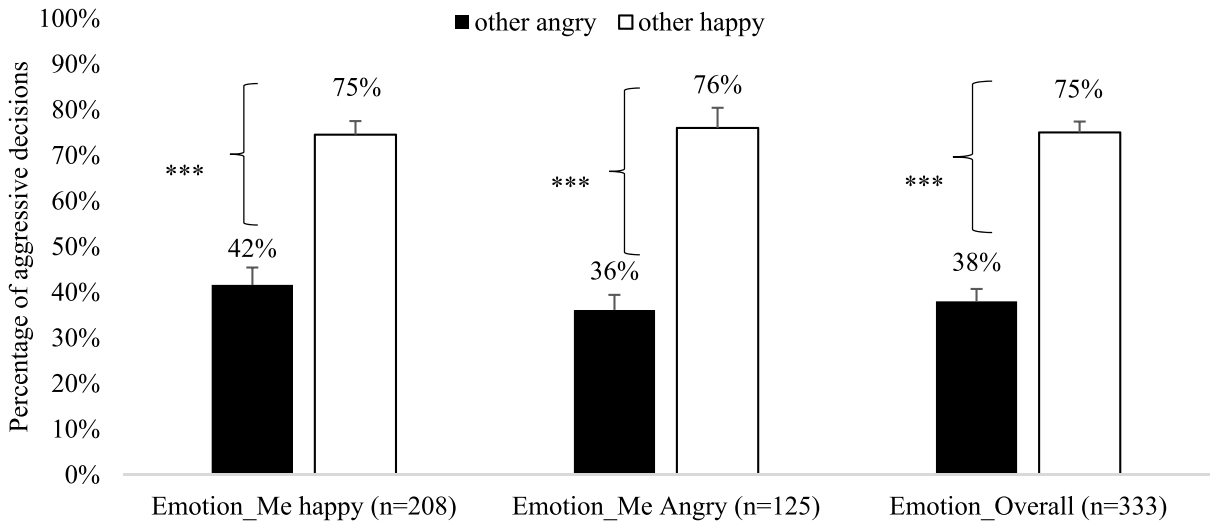

Fig. 2. Percentages of Aggressive Decisions in Game 2 Given Others' Emotional Status.
Note: The solid (non-solid) bars show the percentages of aggressive choices when the counterparts are angry (happy). The bars from left to right are based on one's induced emotional status: happy, angry, and overall including both emotions. *$p < 0.05$, **$p < 0.01$, *** $p < 0.001$. Note that our results still hold if we use the PANAS-positive and negative affect instead of the happy/angry emotions. For more details, please see Fig. A.5 and the notes below it in the Appendix.

results for our emotion-induction treatment.

RESULT 1. : *Subjects in the angry/happy emotion induction treatment are significantly more likely to report they are angry/happy than otherwise. Similarly, they are significantly more likely to experience negative/positive emotions than otherwise.*

Of the 333 subjects in the emotion-induction treatment, 161 (or 48.3%) are randomly assigned to the "angry" emotion induction treatment or "angry condition" and 172 (or 51.7%) are assigned to the "happy" emotion induction treatment or "happy condition." From the results in Table A.1 of the Appendix, we see that those in the "angry condition" are significantly more likely to report they are angry than those in the "happy condition" (74.5% versus 2.9%, adjusted $p < 0.001$, two-sided Mann-Whitney test)[10], while those randomly assigned to the "happy condition" are significantly more likely to report they are happy than those in the "angry condition" (97.1% versus 25.5%, adjusted $p < 0.001$).

In addition to the self-reported anger and happiness, we also measure subjects' immediate feelings prior to the decision tasks using a PANAS-scale (Watson et al., 1988). The PANAS-scale includes a list of 20 specific emotions (i.e., excited, upset, scared, guilty, hostile, and enthusiastic, etc.) which may describe how they feel at that moment and could be categorized as either positive affect or negative affect defined in Watson et al. (1988)[11]. Our PANAS results show that those assigned to the "angry condition" are significantly more likely to report negative emotions than those assigned to the "happy condition" (24.2% versus 6.4%, adjusted $p < 0.001$), and that those assigned to the "happy condition" are more likely to report positive emotions than those assigned to the "angry condition" (91.9% versus 67.7%, adjusted $p < 0.001$).[12] For a more robust check on our emotion elicitation method, we have also examined whether subjects who are assigned to the happy emotion treatment or the angry emotion treatment are more likely to report overall more positive or negative affect based on the PANAS-scale. Indeed, we find a confirmed answer: the induced happy emotion is consistent with the reported PANAS-positive affect, while the induced angry emotion is consistent with the reported PANAS-negative affect (please see more details in the Appendix, Fig. A.1). From these results, we conclude that our emotion induction procedure effectively elicits the respective emotions. Please see detailed instructions for the emotion-induction treatment in Appendix I.

3.3. The effects of induced emotion on individual decisions in the BoS games

Recall that subjects in the basic BoS game or Game 1 make decisions without considering the emotional status of their randomly-matched counterparts, whereas in the modified BoS game or Game 2, they make their decisions based on the emotional status of their counterparts. In this section, we describe our experimental findings related to the effects of induced emotions on individual decisions in Game 1 and Game 2.

RESULT 2. *: Overall, participants' induced emotions do not play significant roles in their own decisions in both the BoS games.*

In Game 1, we find that those who self-report they are angry do not choose the aggressive option differently from those who self-report they are happy (Fig. A.2 in the Appendix: n = 125 versus 208: 71% versus

[10] We use Benjamini-Hochberg (BH) method (see Benjamini & Hochberg 1995) to correct for multiple comparisons and report adjusted p-value hereafter. In addition, all remaining adjusted p-values are based on two-sided Mann-Whitney tests unless indicated otherwise.

[11] The PANAS-scale includes a list of specific emotions that could be categorized as either positive affect (i.e., interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, and active) or negative affect (i.e., distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid). We calculate each subjects' total scores on the PANAS-positive affect as well as those on the PANAS-negative affect. Then we identify subjects who report a higher total score on positive (negative) emotions than negative (positive) ones as those whose emotions are dominated by positive (negative) affect; thus, they are put into the PANAS-Positive (PANAS-Negative) group. However, if the two scores are identical for an individual, s/he is not included in the PANAS-Positive or PANAS-Negative group. Of the 466 subjects, only 16 (3.4%) in our experiment have identical positive-negative PANAS scores.

[12] We find that the Autobiographic Emotional Memory Task (AEMT) is more effective in inducing happy or positive emotions than angry or negative emotions in our test subjects. Comparing the percentage of those whose self-reported emotion is consistent with their randomly-assigned emotion, we find those assigned to the "happy condition" are significantly more likely to report emotions classified as happy/positive than those assigned to "angry condition" who report angry/negative emotions (97.1% versus 74.5% and 91.9% versus 24.22%, respectively, adjusted $p < 0.001$).

Table 3
Comparison of coordination outcomes in Game 1 and Game 2.

	All Pairs (N=167 pairs)		Happy-Angry Pairs (N= 79 pairs)		Happy-Happy Pairs (N= 65 pairs)		Angry-Angry (N = 23 pairs)	
	Game 1	Game 2	Game 1	Game 2	Game 1	Game 2	Game 1	Game 2
Coord. rate	40.1%	53.3%	36.7%	54.4%	43.1%	50.8%	43.4%	56.5%
Std. Error	(0.038)	(0.039)	(0.055)	(0.056)	(0.062)	(0.062)	(0.106)	(0.106)

Table 4
Percentages of aggressive choices among the successfully coordinated pairs.

	All Subjects		Subjects in Happy-Angry Pairs	
	Game 1 (N=134 subjects)	Game 2 (N=178 subjects)	Game 1 (N= 58 subjects)	Game 2 (N=86 subjects)
Happy subjects	50.6%	34.9%	51.7%	11.6%
Std. Error	(0.055)	(0.046)	(0.094)	(0.049)
Angry subjects	49.0%	73.9%	48.3%	88.4%
Std. Error	(0.072)	(0.053)	(0.094)	(0.049)

Note: "Happy-angry" pairs include all subjects who possess different emotions prior to entering the decision tasks. If both subjects in a pair hold the same emotions (angry-angry or happy-happy), we are not able to compare the percentages of aggressive choices within each pair made by the happy subjects versus the angry subjects. Therefore, we do not include those pairs in our comparison. Nevertheless, for overall comparisons of aggressive decisions, we take into account all pairs which are summarized in columns 1 and 2 of Table 4.

74%, p = 0.64). Using the PANAS-scale to measure subjects' positive/negative affect rather than the self-reported angry or happy emotion, we discover a similar pattern, but with a slightly larger proportion of those who report a positive affect choosing the aggressive option and yet, it is not significant at the 5% level (n = 50 versus 267: 64% versus 75%, adjusted p = 0.431)[13]. We further examine the effect of PANAS affect on participants' choices in Game 1 through regression analysis and the results are presented in Table A.2 in the Appendix. We also do not find that PANAS affect is significantly correlated with subjects' decisions.

We next examine our results for the modified BoS game or Game 2. In this game, the decisions subjects make under their counterparts' actual self-reported emotions prior to the decision tasks count toward their payments in Game 2. Thus, Game 2 allows us to examine how an individual's own induced emotion as well as her matched counterpart's emotion influences her game strategy.

From Fig. 2, we see that there is no significant difference in aggressive choices for those who are happy versus angry when subjects are told their counterparts are angry ("Me Happy" versus "Me Angry": 42% versus 36%, p = 0.31), as well as when subjects are told their counterparts are happy ("Me happy" versus "Me angry": 75% versus 76%, p = 0.76), consistent with our results for Game 1.

[13] In the Autobiographic Emotional Memory Task (AEMT) where we ask the reflective question to elicit the happy or angry emotion among all the subjects, we also explicitly state that "the reflective questions may differ across participants in that some participants are asked to describe a situation that has made them the most angry while others are asked to describe a situation that has made them the most happy." Even though the emotion information of their counterparts is not provided to the subjects, it is possible that they may still hold beliefs of the counterparts' emotions in the basic BoS game or Game 1 experiment (e.g., based on the one particular emotion induced in their own AEMT). Similarly, when subjects make decisions in Game 2 where they are asked to consider the emotional state of their counterparts, they could also hold certain beliefs of their counterparts' emotions. Thus, instead of focusing on the effects of induced emotions on decisions, we mainly compare how coordination outcomes differ when the information of counterparts' emotional states is given in Game 2 versus not given in Game 1, as discussed in Section 3.4.

RESULT 3. *: Individuals are significantly more likely to choose the aggressive option when their randomly-matched counterparts are happy than when their counterparts are angry. On the contrary, individuals are significantly more likely to choose the accommodating option when their counterparts are angry than when their counterparts are happy.*

Result 3 indicates that subjects are significantly more likely to choose the aggressive option when their counterparts are happy versus angry in the *emotion-induction* treatment (Fig. 2, overall: 75% versus 38%, adjusted p < 0.001), regardless of their own induced emotions. Overall, subjects are much less likely to choose the aggressive option when their randomly-matched counterparts are angry versus happy (me being happy: respective percentages of aggressive decisions of 42% versus 75%; me being angry: respective percentages of aggressive decisions of 36% versus 76%, adjusted p < 0.001), suggesting that subjects adapt their strategies based on their counterparts' emotional status especially when their counterparts are angry.

3.4. Coordination in the emotion-induction treatment

3.4.1. Information on emotion and coordination rate

RESULT 4. : *The coordination rate in the BoS game is significantly higher when subjects are given the opportunity to make decisions based on the emotional status of their counterparts than otherwise and this improvement is largely driven by pairs who hold different emotions (i.e., happy-angry pairs).*

Among the 333 subjects who participate in the emotion-induction treatment, we find that 53.3% of the 167 pairs successfully coordinate in Game 2, which is significantly higher than the 40.1% coordination rate in Game 1 (see Table 3 column 1 versus column 2, adjusted p < 0.05).

Furthermore, for randomly matched happy-angry pairs, the coordination rate is significantly higher when subjects make decisions given their counterparts' emotions than otherwise (36.7% versus 54.4%, n = 79, adjusted p < 0.05). Interestingly, for randomly matched happy-happy (angry-angry) pairs, there exists the same pattern. However, the coordination rate is not significantly different between Game 1 and Game 2 (happy-happy pairs: 43.1% versus 50.8%, n = 67, p = 0.38; angry-angry pairs: 43.4% versus 56.5%, n = 23, adjusted p = 0.38). This result suggests that information of others' emotions is most effective in improving game coordination and efficiency when the paired subjects hold different emotions.

3.4.2. Payout share distribution in the basic and modified BoS games

RESULT 5. : *In the basic BoS game, regardless of their own induced emotional status, on average, subjects receive an equal share of the payout. By contrast, in the modified BoS game given counterparts' emotional status, angry subjects receive a significantly larger share of the payout compared to happy subjects.*

To better understand how a counterpart's emotional status impacts the game coordination rate, we examine subject decisions and game outcomes for angry versus happy subjects. In the basic BoS game (Game 1), we find that the percentage of aggressive decisions made by happy subjects is not significantly different from the percentage made by angry subjects (see Table 4 49% versus 50.6%, n = 49 and n = 85, p = 0.86). This indicates that, on average, subjects earn similarly regardless of their own induced emotional status. However, when subjects make decisions

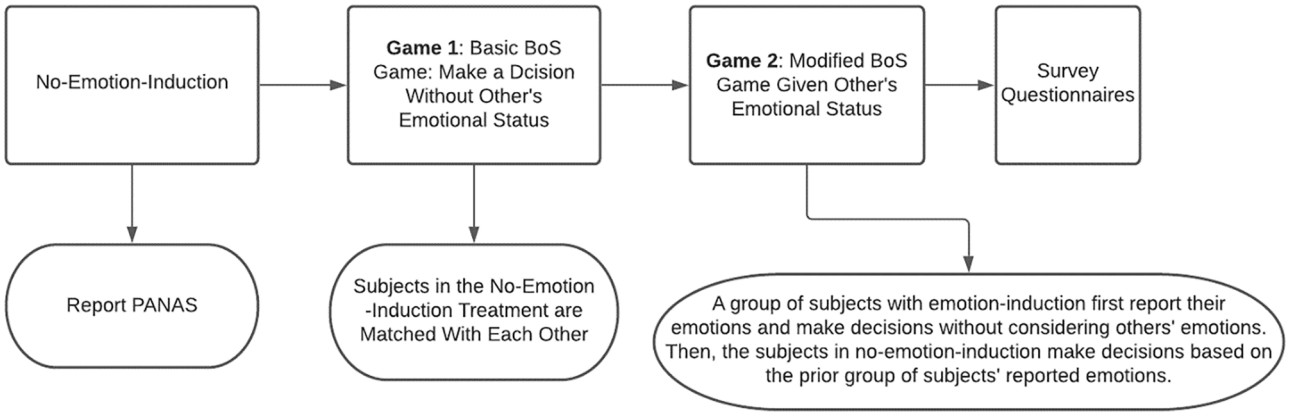

Fig. 3. Flowchart for the no-emotion-induction treatment.

given their counterparts' emotional status in the modified BoS game (Game 2), we find that angry subjects are significantly more likely to choose the aggressive option compared to happy subjects (73.9% versus 34.9%, $n = 109$ and $n = 69$, adjusted $p < 0.001$), leading to a greater share of the payout for angry subjects.

Interestingly, we find that successfully coordinated happy subjects are significantly less likely to choose the aggressive option given their counterparts' emotional status (34.9% versus 50.6%, adjusted $p < 0.05$; 11.6% versus 51.7%, adjusted $p < 0.001$), while angry subjects are more likely to choose the aggressive option given their counterparts' emotions (73.9% versus 49%, adjusted $p < 0.01$; 88.4% versus 48.3%, adjusted $p < 0.001$), both compared to their decisions in Game 1. Thus, whether subjects make decisions based on the emotional status of their randomly matched counterparts may help to explain our findings of a significantly higher overall coordination rate in Game 2 than in Game 1, as well as why angry subjects earn a greater share of the payout in Game 2.

In summary, our findings show that information on counterparts' emotions facilitates coordination in a BoS game. Moreover, for those who make decisions based on their counterparts' emotions, we find that angry subjects are significantly more likely to choose the aggressive option and thus obtain a larger share of the payout than are happy subjects. By contrast, subjects who do not consider their counterparts' emotions in the basic BoS game receive similar payouts regardless of their own induced emotions.

In Game 2 of our experiment, the strategy method (i.e., asking subjects to make decisions in the BoS game when the counterparts are happy versus angry) is designed to mainly capture how a coordination outcome is influenced by the players' decisions given their counterparts' induced emotions. Some readers may question whether such experimental procedure might potentially create an experimenter demand effect (EDE). EDE might be possible in our study in that asking subjects to make choices based on the counterparts' happy versus angry emotions might be suggestive that the subjects' choices are expected to be different and contingent on the counterparts' emotions in a certain direction. However, our emphasis is not on the effects of induced emotions on decisions. Rather, what we intend to show is that, considering counterparts' emotions serves as an important signal device enabling coordination: the emotional information of their counterparts modulates subjects' beliefs such that most of them naturally associate a certain strategy with a certain emotion. Our results show that in Game 2 of both the emotion-induction and no-emotion-induction treatments, subjects think that an angry counterpart is more likely to play an aggressive strategy (72.7% in emotion-induction treatment and 70.7% in no-emotion-induction treatment) and a happy counterpart is more likely to accommodate (62.2% in emotion-induction treatment and 69.9% in no-emotion induction treatment) – see Table A.3 in the Appendix. Therefore, irrespective of whether subjects experience the emotion induction, most of them naturally associate an aggressive strategy with an angry counterpart and an accommodating strategy with a happy counterpart, and such beliefs also align with their decisions that they choose to accommodate an angry counterpart and yet, play aggressively toward a happy counterpart. Our results further confirm that a successful coordination is reached when subjects make decisions consistent with such beliefs while those who fail to coordinate make decisions opposite to these beliefs in Game 2. Since we find a significant improvement in the coordination rate and game efficiency when asking subjects to consider the emotional status of their counterparts in Game 2 compared to Game 1 when such procedure is absent, it shows that our solicitation method contingent on the counterparts' emotions is effective in promoting coordination without direct communication, whereas existing experimental literature suggests direct communication is crucial for achieving coordination in the BoS games (e.g., Agranov & Schotter, 2002; Cooper et al., 1989).

3.5. *Robustness check: no-emotion-induction treatment*

It is possible that subjects make decisions not only based on the counterparts' emotions, but also their own induced emotions. To address the potential concern that our findings may reflect the effect of a confounding variable – subjects' own induced emotions, we conduct a no-emotion-induction treatment where subjects do not complete the AEMT prior to entering the decision tasks. The purpose of running this treatment is to reduce the influence of subjects' own induced emotions as well as the influence of subjects' perceptions of their counterparts' decisions on their choices.

The setup of the no-emotion-induction treatment is almost the same as that in the emotion-induction treatment, but with subjects completing only the PANAS questionnaire not the AEMT. That is, subjects in the no-emotion-induction treatment do not have emotions induced nor do they report happy or angry emotion, but only self-assess how they feel on the 20 different PANAS affect prior to the decision tasks[14]. In Game 1, the instructions are the same for all the subjects who participate in the emotion-induction treatment or the no-emotion-induction treatment. Whereas in Game 2, unlike those in the emotion-induction treatment, subjects assigned to the no-emotion-induction treatment make decisions given the emotional status of their counterparts who have already made decisions beforehand. We do this through two steps. First, a different group of MTurk workers complete the AEMT, self-report being happy or angry, and then make decisions in Game 1 without conditional on others' emotions. Second, subjects in the no-emotion-induction

[14] Existing literature (e.g., van Leeuwen et al 2017; Van Kleef Dreu & Manstead 2004) shows that without inducing emotions among participants, if participants are informed of the others' emotional status (happiness or anger), they could still predict others' behaviors and respond accordingly.

Table 5
Coordination rates in Game 1 and Game 2 of the No-emotion-induction treatment.

	Game 1 (Total 67 Pairs)	Game 2 (Total 133 Pairs)	Game 2: Counterparts Report Happy (Total 85 Pairs)	Game 2: Counterparts Report Angry (Total 48 Pairs)
Coordination Rate	44.7%	46.6%	34.1%	68.8%
Std. Error	(0.061)	(0.043)	(0.052)	(0.068)

Table 6
Aggressive choices among successfully coordinated pairs in the no-emotion-induction treatment.

	Game 1 (Total 67 Pairs)	Game 2: Overall (Total 133 Pairs)	Game 2: Counterparts Report Happy (Total 85 Pairs)	Game 2: Counterparts Report Angry (Total 48 Pairs)
Coordinated Pairs	N=30 pairs	N=62 pairs	N=29 pairs	N=33 pairs
Me Aggressive **(Receive a larger share of the payout)**	50%	25.8%	44.8%	9.09%
Std. Error	(0.089)	(0.056)	(0.094)	(0.051)

treatment are randomly matched with the Mturk workers from step 1 and asked what option they would like to choose if their counterparts are happy and what option they would like to choose if their counterparts are angry. The flowchart in Fig. 3 outlines the procedures of the no-emotion-induction treatment and please also see Appendix II for detailed instructions.

By implementing the no-emotion-induction treatment, we attempt to eliminate the possibility that subjects may choose strategically based on how they think their counterparts would respond to their own induced emotions in Game 2. As a result, subjects' decisions made in Game 2 of the no-emotion-induction treatment reflect how they choose based on the emotional status of their counterparts, without considering how the counterparts might act on their emotions.

3.5.1. *No-emotion-induction treatment: Game 1*

In the basic BoS game (Game 1) of the no-emotion-induction treatment, subjects are randomly matched and asked to select Option 1 or Option 2 (see Table 1). Similar to our results for the emotion-induction treatment, we find no significant impact of individuals' induced emotional status, as measured by the PANAS-scale, on their choices of the aggressive versus accommodating option (n = 11 versus 122; 55% versus 68%, p = 0.36). Fig. A.3 in the Appendix visually depicts the distribution of aggressive choices in this game. Overall, we find that no-emotion-induction subjects are not influenced by their own induced emotions.

3.5.2. *No-emotion-induction treatment: Game 2*

In the modified BoS game or Game 2, subjects are asked to make respective decisions considering the self-reported emotions of their counterparts. These counterparts first report their emotions and make decisions without considering others' emotional status as in Game 1. Therefore, subjects in the no-emotion-induction treatment are aware that there is no secondary-level reasoning involved for their matched counterparts. As a result, these subjects' decisions reflect their perceptions of how to best respond to their counterparts given counterparts' emotions. We calculate payments for subjects in the no-emotion-induction treatment as follows. If Game 1 is randomly selected to count, we match all the subjects within the no-emotion-induction treatment and based on the matched pairs' decisions in Game 1, subjects' payments are calculated accordingly. If Game 2 is randomly selected to count, each subject in the no-emotion-induction treatment is matched with an emotion-induced counterpart who has already self-reported "happy" or "angry" and made a decision in Game 1; therefore, given the matched counterpart's self-reported emotional status and decision, each subject's payment in the no-emotion-induction treatment could be determined.

Note that in the no-emotion-induction treatment, we assess all the 133 subjects' pre-task emotional status using the PANAS questionnaire. Doing so, we find that 122 (11) out of 133 subjects indicate positive (negative) affect. Similar to Game 2 of the emotion-induction treatment, we find no significant impact of either affect on subjects' decisions (percentage of aggressive choices when counterparts are happy: 75% versus 64%, p = 0.43; when counterparts are angry: 32% versus 55%, p = 0.13)[15]. Fig. A.4 in the Appendix shows the pattern of aggressive choices among subjects in Game 2 of the no-emotion-induction treatment.

We also check the robustness of our finding regarding the effect of counterparts' emotions on subjects' choices and find that this effect still holds: overall, an individual is significantly more likely to choose the aggressive decision when the randomly-matched counterpart is happy than when the counterpart is angry (percentage of subjects who choose the aggressive option when their counterparts are happy versus angry: 74% versus 34%, adjusted p < 0.001, two-sided WSR test)[16]. In what follows, we check whether our coordination results also hold for our no-emotion-induction treatment.

3.5.3. *Coordination in the no-emotion-induction treatment*

In Game 2 of the no-emotion-induction treatment, we find that the overall coordination rate is slightly higher when subjects are asked to consider their matched counterparts' emotional status, but not significantly so at the 5% level (see Table 5: 44.7% versus 46.6%, p = 0.695, two-sided WSR test). Interestingly, when their counterparts are angry compared to when they are happy, the coordination rate doubles, which is significant at the 0.1% level (34.1% versus 68.8%, adjusted p < 0.001). This finding partially aligns with our finding of a higher coordination rate with perceived counterpart anger in the emotion-induction treatment. Together, these results suggest that subjects anticipate angry counterparts will choose the aggressive option; if so, then subjects choose the accommodating strategy, thus facilitating coordination and

[15] The insignificant differences in the no-emotion-induction treatment could be due to the fact that we do not have enough subjects (i.e., only 11 or 8.3% of total 133 subjects) in the "Me negative category" or the PANAS-Negative group. This means, without the emotion induction, most MTurk subjects do not naturally experience the negative affect compared to positive affect listed in the PANAS-scale. Result from our power analysis suggests that there needs to be at least 695 participants in the no-emotion-induction treatment (or 57 participants in the PANAS-Negative group) to reach a power of 0.8. However, given the current sample sizes for the emotion-induction and no-emotion-induction treatments, we find that regardless of whether participants experience the induced emotions or not, information of counterparts' emotions could potentially serve as an effective device to facilitate coordination and promote game efficiency. It suggests that it is not necessarily the induced emotions, but having participants consider the counterparts' emotions and they naturally associating a certain strategy with a certain emotion that lead to increased coordination and game efficiency. Thus, the current sample sizes are sufficient to provide significant empirical evidence that supports the main findings of this paper.

[16] We believe this result is driven mainly by the majority of the 133 subjects in the no-emotion-induction treatment indicating a positive effect (percentages of 122 subjects who make aggressive choices when their counterparts are happy versus angry: 75% versus 32%, adjusted p < 0.001, two-sided WSR test). By contrast, among the small proportion of 133 subjects who indicate a negative effect, despite a similar trend, we find no statistically significant impact of counterparts' emotions on subject choices (percentages of 11 subjects who make aggressive choices when their counterparts are happy versus angry: 64% versus 55%, adjusted p=0.655, two-sided WSR test).

receiving a $1 versus $0 payout. By contrast, subjects may have greater difficulty predicting which option a happy counterpart will choose. Therefore, allowing subjects to make decisions based on matched counterparts' emotions enhances coordination especially when counterparts are angry.

Next, we examine the payout received by subjects in Game 2 in the no-emotion-induction treatment. From the results in Table 6, we find that subjects are significantly more likely to choose the aggressive option in Game 1 and receive the larger payout, when they do not make decisions given their matched counterparts' emotional status, than in Game 2 (50% versus 25.8%, adjusted $p < 0.05$, two-sided WSR test). Yet, such increased percentage of choosing aggressive decisions is mostly driven by those matched with angry subjects (percentages of aggressive decisions if counterparts are happy versus angry: 44.8% vs. 9.09%, adjusted $p < 0.001$, two-sided WSR test).

3.6. The role of beliefs in decisions

To fully understand our results, we analyze the experimental data on subjects' beliefs in Game 2 of both the emotion- and no-emotion-induction treatments. To elicit subjects' first-order beliefs[17], we ask the following question[18]: "When your matched person is angry or happy, what choice would you expect him/her to make?" The results in Table A.3 of the Appendix show that subject choices are consistent with their responses to the question. That is, subjects who think they are matched with angry counterparts believe their counterparts are significantly more likely to choose the aggressive option than otherwise (emotion-induction treatment: 72.7% versus 24.9%, adjusted $p < 0.001$, no-emotion-induction treatment: 70.7% versus 28.6%, adjusted $p < 0.001$, two-sided WSR tests); similarly, subjects who think they are matched with happy counterparts believe their counterparts are significantly more likely to choose the accommodating option than otherwise (emotion-induction treatment: 62.2% versus 34.5%, adjusted $p < 0.001$; no-emotion-induction treatment: 69.9% versus 29.3%, adjusted $p < 0.001$, two-sided WSR tests).

Table A.4 in the Appendix summarizes the regression results that support this finding. The dependent variable is whether an individual chooses the aggressive or accommodating decision (zero-or-one dummy variable equals to one when an individual chooses the aggressive decision, and zero otherwise), conditional on the matched counterpart being angry (columns 1 and 2) or happy (columns 3 and 4). We find that when the randomly matched counterparts are angry (happy), those who believe their counterparts will choose the aggressive (accommodating) option are significantly less (more) likely to choose the aggressive option ($p < 0.01$).

In summary, we show that when subjects are not asked to make decisions based on the matched counterparts' emotions in Game 1, they make decisions without being affected by their induced emotions, and the occurrence of a successful coordination is random. When subjects make decisions given each other's emotional status in Game 2, a successful coordination is reached when they make decisions consistent with the general beliefs that angry subjects are more likely to choose the aggressive option and the happy subjects are more likely to choose the accommodating option; meanwhile, those who fail to coordinate make decisions opposite to these beliefs. Therefore, subjects who are given the opportunity to make decisions based on their counterparts' emotions, they take advantage of each other's emotions to achieve coordination in Game 2. As a result, allowing subjects to make decisions given each other's emotions serves as an effective coordination device and improves game efficiency.

4. Conclusion and discussion

In this study, we examine the role of both a player's induced emotion and his/her belief toward a matched counterpart's emotion in decision-making in a BoS game. We recruit subjects from Amazon Mechanical Turk (MTurk) to participate in an online experiment combined with a series of well-established surveys. Subjects are randomly assigned to either the emotion-induction treatment where the emotions of happiness or anger are elicited through the Autobiographic Emotional Memory Task (AEMT) or the no-emotion-induction treatment without emotion elicitation. Subjects are asked to make decisions in the basic BoS game as well as in the modified BoS game given their randomly-matched counterparts' emotional status. Overall, we find that subjects' induced emotions do not play a significant role in their decisions; with matched counterparts' emotions, subjects make decisions in accordance with their beliefs of these emotions.

Our study sheds important light on how players' beliefs of counterparts' emotions might influence coordination, which differs from existing studies in the experimental literature that often explore what individuals would do as a result of their induced emotions (e.g., Capra, 2004; Drouvelis & Grosskopf, 2016). We show that allowing subjects to make decisions based on their counterpart's emotional status improves coordination. Furthermore, our findings also suggest that among the successfully coordinated pairs, most subjects make the choices consistent with the beliefs that angry (happy) counterparts are more likely to choose the aggressive (accommodating) decision and thus, they respond by accommodating the angry counterparts and playing aggressively toward the happy counterparts. As a result, angry subjects tend to receive higher payoffs once the coordination is achieved, i.e., an anger "premium", and those who are unable to conform to such beliefs and respond accordingly fail to reach coordination and end up paying for it in terms of final payoffs.

Why do most individuals associate an aggressive strategy with an angry counterpart and an accommodating strategy with a happy counterpart? It might be that most people think positive emotions such as happiness are positively correlated with prosociality including generosity, cooperation, and trust, whereas negative emotions such as irritation, contempt, and anger are linked to rejection, punishment, and destruction. Despite the fact that existing experimental economics literature provides empirical evidence supporting the idea that most individuals associate other people's positive emotions with prosociality and negative emotions with antisocial behaviors (see for example, Bosworth, 2017; Fehr & Gächter, 2002; van Leeuwen et al., 2017), little work has been done to examine why there exists such connections. Interestingly in some psychology literature, researchers study the interpersonal effects of emotions and find that positive emotions may lead others to continue their course of action while negative emotions may call for behavioral adjustment (Averill, 1982; Cacioppo & Gardner, 1999; Van Kleef, 2008; Van Kleef et al., 2004). Drawing on Emotions as Social Information (EASI) theory, Van Kleef (2009) shows that people can often infer information about the emotional states of their counterparts: when faced with happy counterparts, most individuals infer that things are going well and expectations are positive (Smith et al., 1993), which may encourage individuals to stay on the course; when faced with angry counterparts, most individuals infer that counterparts' goals are being frustrated and they would blame someone else for it (Smith et al., 1993) - this inference informs individuals of the need to adjust behaviors (e.g., apologizing and changing one's conduct). Although explaining why most individuals naturally associate an aggressive strategy with an angry counterpart and an accommodating

[17] While eliciting subjects' beliefs is not incentivized in our experiment, recent work by Charness, Gneezy and Rasocha (2021) suggests that non-incentivized elicitation of subjects' beliefs seems to work as well as complex incentivized methods. In addition, since we aim to simplify the procedure for our subjects so that they could focus better on making decisions in the BoS games, we do not incentivize their responses to the belief question.

[18] Besides the aggressive and accommodating options in the responses, we also provide additional choices including "Neither of the Two Options". Out of the 333 subjects in the emotion-induction treatment, 8 subjects select this option.

strategy with a happy counterpart is beyond the scope of our investigation, our paper contributes to the experimental literature and emphasizes that when two individuals make decisions given each other's emotions, their beliefs of counterparts' emotions can serve as an effective coordination device which leads to improved game efficiency.

Our study also helps answer the question of whether coordination can be achieved without direct communication. Specifically, our study suggests that simply allowing individuals to make decisions based on the emotional status of their matched counterparts without direct communication can improve coordination in a one-shot BoS game. Our study highlights the importance of players' beliefs regarding others' emotions and expands on a stream of research that examines the role of beliefs in decision-making and successful coordination. Our study further suggests when individuals do not directly observe counterparts' facial expressions or emotions, allowing them to make decisions considering counterparts' emotions can also facilitate coordination and promote efficiency. Therefore, an environment that allows individuals to respond to emotional status of others could potentially benefit individuals (e.g., team members, trade partners, or corporations) who seek to coordinate on their production, pricing, and marketing decisions.

Finally, our study provides insight into the question of how successful coordination could be achieved when payoffs are unequal at different Nash Equilibria. Agranov and Schotter (2002) argue that even a slight payoff asymmetry in equilibrium (e.g., $5 vs. $5.1) is sufficient to cause a departure from the equilibrium points. Our results contribute insight by showing that coordination could be improved under asymmetric payoffs (i.e., $1 vs. $3) at the Nash Equilibria if players make decisions based on their counterparts' emotional status. More specifically, we find that angry emotion is more effective than happy emotion in promoting coordination even when one of the matched pair does not have their emotion induced. Therefore, in certain situations where coordination is needed, allowing individuals to respond to each others' emotions in a safe and friendly environment may significantly facilitate coordination. While subjects in our study make decisions in the coordination game environment, future studies could also examine subjects' decisions in a variety of interpersonal environments beyond the BoS game by allowing them to take counterparts' emotions into consideration.

Data availability

Data will be made available on request.

Acknowledgements

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Appendices

In Fig. A.1 shown above, we present the intensities of reported positive and negative emotions among those who have been assigned to the happy and angry emotion treatments. We can see that participants report significantly higher levels of positive emotions in the "Assigned Happy" emotion treatment than in the "Assigned Angry" emotion treatment [for eight out of the 10 positive emotions, except for alert ($p=0.34$, two-sided Mann-Whitney test) and strong ($p=0.16$, two-sided Mann-Whitney test)]. In addition, we find that mean intensities of all reported negative emotions are significantly lower in the "Assigned Happy" emotion treatment than in the "Assigned Angry" emotion treatment. This shows the induced happy emotion is consistent with the reported PANAS-positive affect, while the induced angry emotion is consistent with the reported PANAS-negative affect.

As Fig. A.5 shows, regardless of which categorization we have used to identify subjects' emotional status (happiness vs. anger or positive vs. negative affect), we find that subjects are more likely to behave aggressively when they believe their counterparts are happy than angry (Me Positive: 76% vs. 39% $p < 0.001$; Me Negative: 74% vs. 32%, $p < 0.001$, two-sided Wilcoxon signed-rank test).

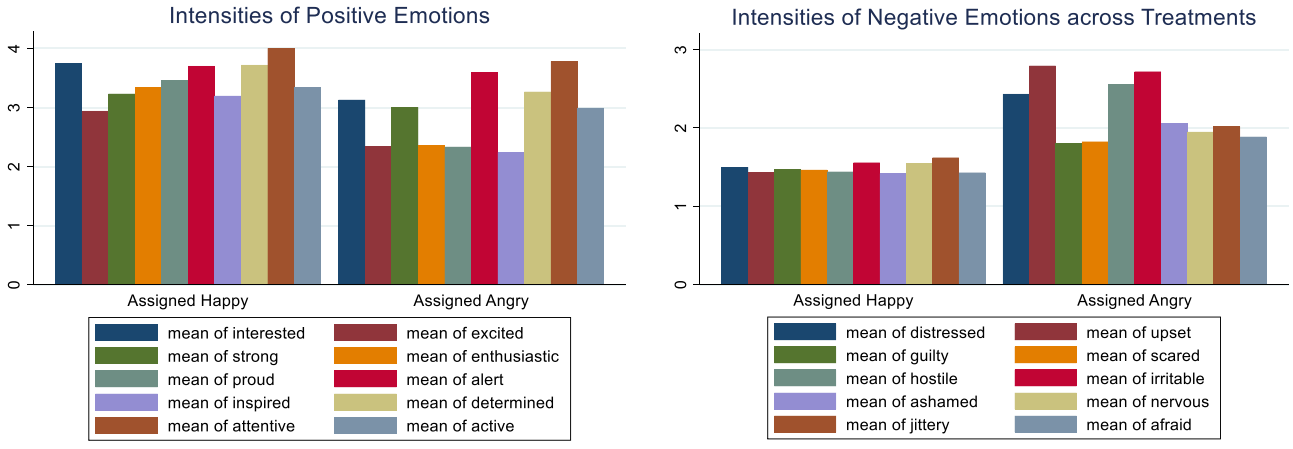

Fig. A.1. Intensities of positive and negative emotions.

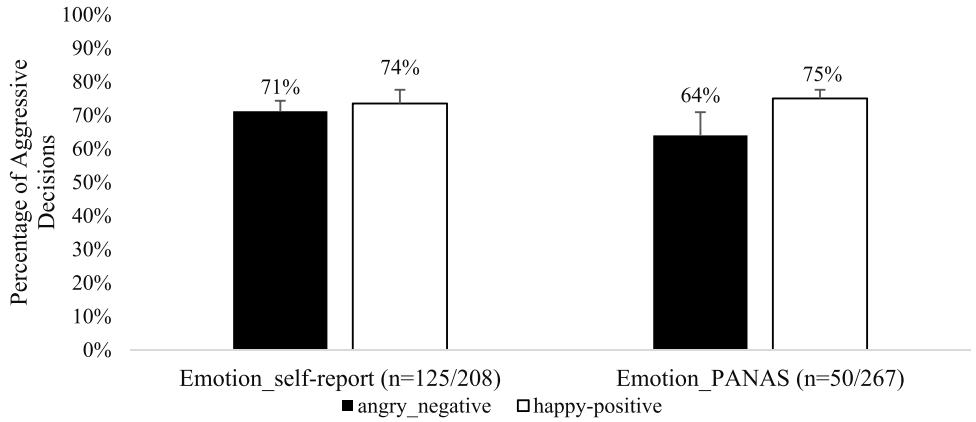

Fig. A.2. Percentages of Aggressive Choices in Game 1 of the Emotion-induction Treatment.
Note: The solid (non-solid) bars show the percentages of aggressive choices for participants who report they are angry (happy) and who indicate their overall emotion is negative (positive).

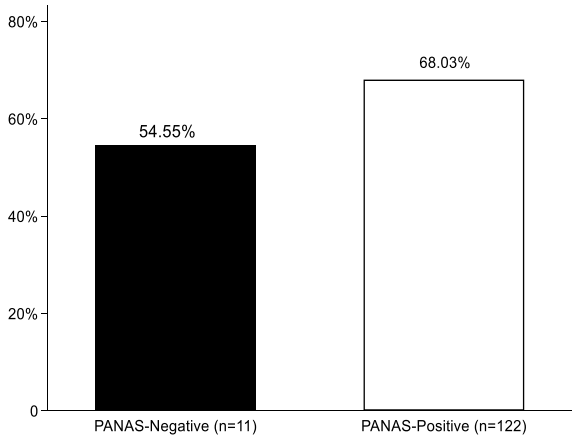

Fig. A.3. Percentages of Aggressive Choices in Game 1 of the No-emotion-induction Treatment.
Note: The solid bar shows the percentages of aggressive choices among those whose overall emotions are dominated by "negative" affect based on the PANAS-scale. The empty bar represents the percentage of aggressive choices among those whose overall emotions are dominated by "positive" affect based on the PANAS-scale. The number of observations in each category is reported in parenthesis.

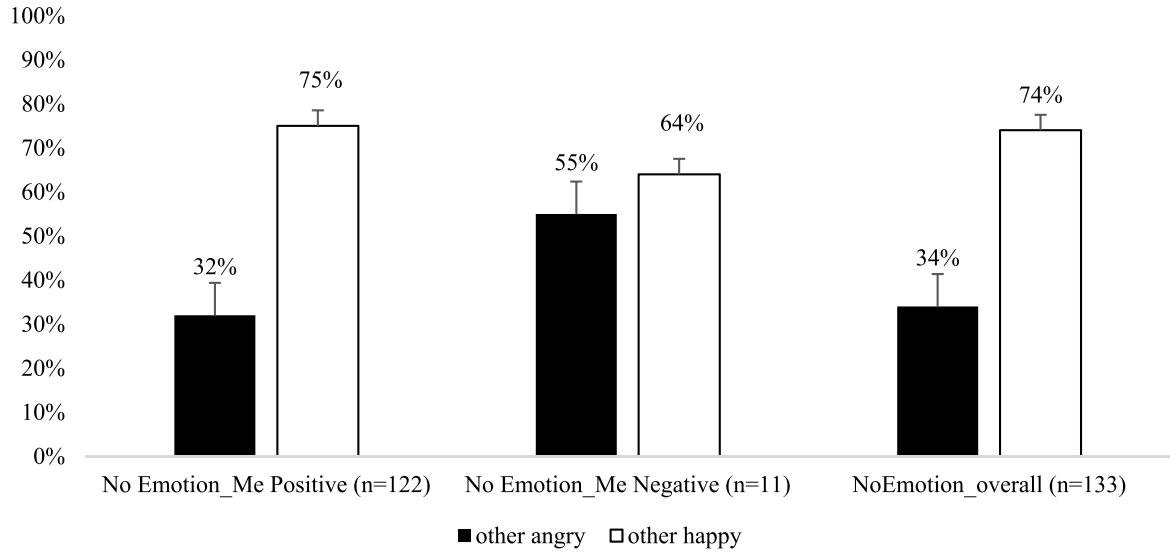

Fig. A.4. Percentages of Aggressive Choices in Game 2 of the No-emotion-induction Treatment.
Note: The dark solid bars show the percentages of aggressive decisions when the matched counterparts are angry and the light empty bars show the percentages of aggressive decisions when the matched counterparts are happy. The data are categorized into three sets, from left to right, when the subjects in the no-emotion induction treatment experience positive affect, negative affect, and the overall that takes into account both groups.

Table A.1
Emotion induction results.

Induced Emotion	Report Angry	Report Happy
Angry Condition (n=161)	74.5%	25.5%
Happy Condition (n=172)	2.9%	97.1%
Adjusted P-value	P< 0.001	P< 0.001

Note: All P-values have been adjusted using the Benjamini-Hochberg (BH) correction method for multiple comparisons.

Table A.2
Regression results in Game 1, based on the PANAS affect.

Variables	All_Emotion
Interested	-0.030
	(0.034)
Distressed	-0.040
	(0.036)
Excited	-0.022
	(0.031)
upset	-0.016
	(0.039)
strong	-0.018
	(0.030)
guilty	-0.066
	(0.045)
scared	0.027
	(0.050)
hostile	0.009
	(0.038)
enthusiastic	0.021
	(0.031)
proud	0.012
	(0.028)
irritable	0.017
	(0.035)
alert	0.054
	(0.028)
ashamed	-0.027
	(0.041)
inspired	-0.003
	(0.032)
nervous	-0.022
	(0.045)
determined	0.031
	(0.027)
attentive	-0.051
	(0.032)
jittery	0.027
	(0.037)
active	-0.007
	(0.028)
afraid	0.029
	(0.046)
Constant	0.881***
	(0.118)
Observations	333
R-squared	0.067

Note: These affects are assessed based on the "1 to 5 scale" ("not at all" to "extremely").
* p<0.05, ** p<0.01, *** p<0.001. Standard errors in parentheses.

Table A.3
Beliefs based on matched counterparts' emotional status.

	Emotion-induction Treatment			No-emotion-induction Treatment		
Game 2	Believe counterparts choose aggressive	Believe counterparts choose accommodating	Adjusted P-value	Believe counterparts choose aggressive	Believe counterparts choose accommodating	Adjusted P-value
Counterparts Angry	72.7%	24.9%	P<0.001	70.7%	28.6%	P<0.001
	(0.024)	(0.024)		(0.040)	(0.039)	
Counterparts Happy	34.5%	62.2%	P<0.001	29.3%	69.9%	P<0.001
	(0.026)	(0.027)		(0.040)	(0.040)	
	P< 0.001	P < 0.001		P < 0.001	P < 0.001	

Note: All P-values have been adjusted using the Benjamini-Hochberg (BH) correction method for multiple comparisons.

Table A.4
Correlation between beliefs and aggressive choices.

VARIABLES	Other Angry (1)	(2)	Other Happy (5)	(6)
Believe other aggressive	-0.428***		-0.403***	
	(0.054)		(0.049)	
Believe other accommodating		0.423***		0.378***
		(0.054)		(0.046)
Constant	0.692***	0.276***	0.890***	0.516***
	(0.048)	(0.028)	(0.020)	(0.042)
Observations	333	333	333	333
R-squared	0.154	0.142	0.196	0.179

Note: Robust standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001

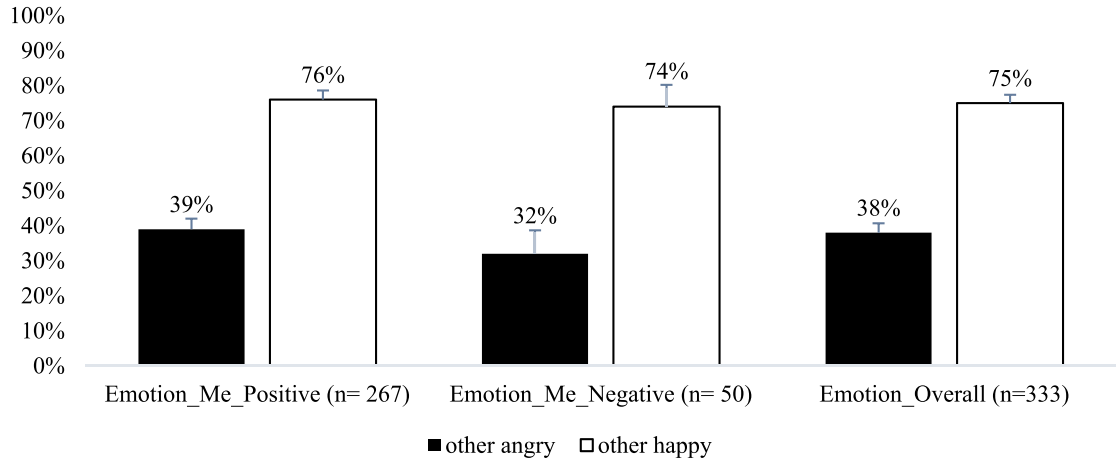

Fig. A.5. Percentages of Aggressive Decisions in Game 2 of the Emotion-induction Treatment.
Note: Subjects' decisions are categorized by the positive and negative affects rather than the self-reported happy and angry emotions. Emotion_Overall also includes 16 subjects who are identified as PANAS-neutral.

Experimental instructions

We include the instructions for the emotion-induction treatment in Appendix I and the no-emotion-induction treatment in Appendix II. The words in [parentheses] provide additional notes which are not presented to the participants.

Appendix I

Instructions for the Emotion-induction Treatment

Thank you for your participation!

General Information

There are two parts in today's study: (1) decision tasks and (2) a survey. For completing all questions truthfully in this study, you will be paid $2. Depending on your choices and on chance, you could earn additional bonus up to $3 in making decisions in part (1) decision tasks. At any time of this survey, your responses will be kept anonymous to the other participants.

You will receive payments only if you complete all questions. Immediately after we review and approve your answers, payments will be transferred to your Amazon account.

Reflective Question:

Before we start the decision tasks, please first describe in detail the one situation that has made you the most ***Angry*** you have been in your life, and describe it such that a person reading the description would become ***Angry*** just from hearing about the situation (minimum 100 characters).

All MTurk participants are required to answer the reflective question prior to starting this study. Note that the reflective questions may differ across participants in that some participants are asked to describe a situation that has made them the most angry while others are asked to describe a situation that has made them the most happy.

Your answer: _____

[Not for participants: The reflective question above is to elicit angry emotion. The question for eliciting happy emotion is the same except that the word "Angry" is changed to "Happy". Then we asked subjects to indicate their emotional status and the intensity of their self-reported emotion. Then they report the PANAS emotion status.]

Please give a score (1 to 5) on each of the 20 feelings/emotions displayed below which may describe how you feel right now.

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

#	Score	Feelings/emotions
1		Interested
2		Distressed
3		Excited
4		Upset
5		Strong
6		Guilty
7		Scared
8		Hostile
9		Enthusiastic
10		Proud
11		Irritable
12		Alert
13		Ashamed
14		Inspired
15		Nervous
16		Determined
17		Attentive
18		Jittery
19		Active
20		Afraid

[Not for participants: the five-scale rating on how participants feel from "very slightly or not at all" to "extremely" for twenty different affects are based on PANAS (Watson et al., 1988).]

Now Part (1) Begins:

There are three stages[19] in this part. One of the three stages will be randomly chosen to determine whether you would receive additional bonus payment up to $3. You will not be informed of the outcome from each stages until after all participants have completed this study. After you finish this part, you will proceed to the survey part where you are asked to answer a set of demographic and attitudinal questions.

Stage 1 Instructions

[Not for participants: Subjects are randomly assigned to either roles: Person A or Person B. Instructions for both stages 1 and 2 shown below are for Person A. Instructions for Person B are symmetric to that for Person A, but from Person B's perspective.]

You are Person A. You will remain in the same role for the entire session.

You will be paired with someone who is also a MTurk worker and randomly assigned the role of Person B. In this stage, you will be asked to make a decision. The decision that you make and the decision made by your matched person B will determine your earnings.

You are going to choose between Option 1 and Option 2.

- If **both** Person A and Person B choose **Option 1, Person A** receives **$3** and **Person B** receives **$1**.
- If **both** Person A and Person B choose **Option 2, Person A** receives **$1** and **Person B** receives **$3**.
- If **Person A and Person B** choose **different** options, **both** of you receive **$0.**

Your matched Person B is also asked to make the decision. **Then, we will match yours with Person B's.**

Note that neither you nor your matched person would be informed of the outcome from this stage until after all MTurk participants have completed this study. If you receive bonus payment from this stage, we will transfer it to your Amazon account, in addition to the $2 participation fee.

[*Note that two practice questions are given before the actual decision task to ensure that participants fully understand the decision task in this stage.*]

Stage 1 Decision Task

If this stage is randomly selected to count, then your choice and your matched Person B's choice will jointly determine your payment from this stage.

- If **Person A and B** both choose **Option 1, Person A** receives **$3,** and **Person B** receives **$1.**
- If **Person A and B** both choose **Option 2, Person A r**eceives **$1**, and **Person B** receives **$3**.
- If **Person A and Person B** choose **different** options, **both** of you receive **$0**.

You are person A. Please make your decision (Option 1 or 2): _____

Stage 2 Instructions

You are still Person A. You will be matched with **a different Mturk worker Person B from the one in Stage 1**. Below you see the same options as in Stage 1. You are going to choose between Option 1 and Option 2. Remember that neither you nor your paired Person B knows the outcome from Stage 1. For all Mturk workers in the decision tasks, one of the three stages will be randomly selected to count.

- If **both** Person A and Person B choose **Option 1, Person A** receives **$3** and **Person B** receives **$1.**
- If **both** Person A and Person B choose **Option 2, Person A** receives **$1** and **Person B** receives **$3**.

[19] Our experiment includes three stages. Subjects are aware of it and know these stages are independent from each other. This paper is based on the results only from the first two stages.

- If **Person A and Person B** choose **different** options, **both** of you receive **$0.**

In addition to choosing between Option 1 and 2, this time, we ask you to make the decision **based on your matched person's emotion status from answering the reflective question prior to the decision tasks.** Note that all MTurk participants are required to answer the reflective question and describe one situation that has made you the most **Angry/Happy** you have been in life. The emotion (angry/happy) from the situation that has been recalled may or may not be the same across different MTurk participants.

Stage 2 Decision Task

You will be matched with **a different Mturk worker Person B from the one in Stage 1:**

- If **both** Person A and Person B choose **Option 1, Person A** receives **$3** and **Person B** receives **$1.**
- If **both** Person A and Person B choose **Option 2, Person A** receives **$1** and **Person B** receives **$3**.
- If **Person A and Person B** choose ***different*** options, **both** of you receive **$0.**

Below, please enter your decisions assuming your matched Person B has reported "happy" or "angry" prior to the decision tasks. After we obtain data for all MTurk workers today, if this stage is randomly selected to count, we will match your responses with B's **actual reported** emotion status. ***Your choice under B's actual reported emotion status and B's choice under your actual reported emotion will jointly determine your payment for this stage.*** **Hence, depending on your paired person's actual emotion status, only one of the two following decisions you make will be used.**

Please make your choices below:

(1) If your paired Person B self-reported "Angry" prior to the decision tasks: what choice (Option 1 or 2) would you make: _____
(2) If your paired Person B self-reported "Happy" prior to the decision tasks: what choice (Option 1 or 2) would you make: _____

[*Note that participants are also asked to make predictions about what decisions they expect their matched counterparts to choose based on their counterparts' emotional status. At the end of the decision tasks, participants complete a post-task questionnaire and provide information on individual characteristics relevant to their choices in the BoS games including demographics (e.g., age, gender, ethnicity, and education), personality traits, and cognitive abilities.*]

Appendix II

Instruction for the No-emotion-induction Treatment

Thank you for your participation!

General Information

There are two parts in today's study: (1) decision tasks and (2) a survey. For completing all questions truthfully in this study, you will be paid $2. Depending on your choices and on chance, you could earn additional bonus up to $3 in making decisions in part (1) decision tasks. At any time of this survey, your responses will be kept anonymous to the other participants.

You will receive payments only if you complete all questions. Immediately after we review and approve your answers, payments will be transferred to your Amazon account.

Prior to entering Part (1), please tell us how you feel right now. You may give a score (1 to 5) on each of the 20 feelings/emotions displayed below to describe how you feel right now.

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

#	Score	Feelings/emotions
1		Interested
2		Distressed
3		Excited
4		Upset
5		Strong
6		Guilty
7		Scared
8		Hostile
9		Enthusiastic
10		Proud
11		Irritable
12		Alert
13		Ashamed
14		Inspired
15		Nervous
16		Determined
17		Attentive
18		Jittery
19		Active
20		Afraid

Now Part (1) begins:

There are two stages in this part. One of the two stages will be randomly chosen to determine whether you would receive additional bonus payment up to $3. You will not be informed of the outcome from each stages until after all participants have completed this study. After you finish this part, you will proceed to the survey part where you are asked to answer a set of demographic and attitudinal questions.

[Not for participants: subjects are randomly assigned to either roles: Person A or Person B. Instructions for both stages 1 and 2 shown below are for Person A. Instructions for Person B are symmetric to that for Person A, but from Person B's perspective.]

Stage 1 Instructions

You are Person A. You will remain in the same role for the entire session.

You will be paired with someone who is also a MTurk worker and randomly assigned the role of Person B. In this stage, you will be asked to make a decision. The decision that you make and the decision made by your matched person B will determine your earnings.

You are going to choose between Option 1 and Option 2.

- If **both** Person A and Person B choose **Option 1, Person A** receives **$3** and **Person B** receives **$1**.
- If **both** Person A and Person B choose **Option 2, Person A** receives **$1** and **Person B** receives **$3**.
- If **Person A and Person B** choose **different** options, **both** of you receive **$0.**

Your matched Person B is also asked to make the decision. **Then, we will match yours with Person B's.** Note that neither you nor your matched person would be informed of the outcome from this stage until after all MTurk participants have completed this study. If you receive bonus payment from this stage, we will transfer it to your Amazon account, in addition to the $2 participation fee.

[*Note that two practice questions are given before the actual decision task to ensure that participants fully understand the decision task in this stage.*]

Stage 1 Decision Task

Now the real task begins. If this stage is randomly selected to count, then your choice and your matched Person B's choice will jointly determine your payment from this stage.

- If **Person A and B** both choose **Option 1, Person A** receives **$3,** and **Person B** receives **$1.**
- If **Person A and B** both choose **Option 2, Person A r**eceives **$1**, and **Person B** receives **$3**.
- If **Person A and Person B** choose **different** options, **both** of you receive **$0**.

You are person A. Please make your decision (Option 1 or 2): _____

Stage 2 Instructions

You are still in the role of Person A. You will be matched with a different Mturk worker, Person B. Below you see the same options as in Stage 1. You are going to choose between Option 1 and Option 2. Remember that neither you nor your paired Person B knows the outcome from Stage 1. For all Mturk workers, either Stage 1 or Stage 2 will be randomly selected to count towards your earnings in this part.

- If **both** Person A and Person B choose **Option 1, Person A** receives **$3** and **Person B** receives **$1.**
- If **both** Person A and Person B choose **Option 2, Person A** receives **$1** and **Person B** receives **$3**.
- If **Person A and Person B** choose **different** options, **both** of you receive **$0.**

Some people make the decisions when they are **happy** and some people make the decisions when they are **angry**. A group of MTurk workers who are randomly assigned the role of Person B reported to us that they were either Happy or Angry right before they were asked to make their decisions in this task. Therefore in this stage, we ask you to make the decision **based on your matched person's emotion status**.

For example, if Person B reported "Happy", then your decision under the condition that Person B is happy as well as Person B's decision will be used to calculate your earnings in this stage. If Person B reported "Angry", then your decision under the condition that Person B is angry as well as Person B's decision will be used to calculate your earnings in this stage.

Below, please enter your decisions assuming your matched Person B's has reported emotion as "happy" or as "angry". After we obtain data for all MTurk workers today, if this stage is randomly selected to count, we will match your responses with the paired person's **actual reported** emotion status. **Your choice under B's actually reported emotion status and B's choice will together determine your payment for this stage. Hence, depending on your paired person's actual emotion status, only one of the decisions you make below will be used.**

Please make your choices below:

(1) If your paired Person B self-reported "Angry" prior to the decision tasks: what choice (Option 1 or Option 2) would you make: _____

(2) If your paired Person B self-reported "Happy" prior to the decision tasks: what choice (Option 1 or Option 2) would you make: _____

[*Note that participants are also asked to make predictions about what decisions they expect their matched counterparts to choose based on their counterparts' emotional status. At the end of the decision tasks, participants complete a post-task questionnaire and provide information on individual characteristics relevant to their choices in the BoS games including demographics (e.g., age, gender, ethnicity, and education), personality traits, and cognitive abilities.*]

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