

# Online Appendix for “Learning Theory and Heterogeneous Play in a Signaling-Game Experiment”

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## Online Appendix A: Bandit Problems with Perfect Correlation

### Experimental Design

In the bandit treatments with perfect correlation, there is a computer that is programmed to select  $a_2 \in A_2 = \{\square, \triangle\}$  independent of player 1’s type. This means that there is a perfect correlation between what the computer does if player 1’s type is Red and what it does if player 1’s type is Blue. Specifically, in each period the computer selects  $\square$ , with probability  $\sigma_2^{PC}$  and participants are not informed of this probability. Participants are informed, however, that the probability is fixed throughout the session. Participants know their payoffs and that nature selects player 1’s type randomly, but are not informed of the likelihood of each type, in line with the Game treatments.

We implement two treatments with perfect correlation: one in which with equal probability a type  $\theta_1 \in \Theta_1 = \{\text{Red}, \text{Blue}\}$  is randomly assigned to player 1 in each of the 120 periods ( $\text{BR}_{PC}$ ), and another in which player 1’s type is selected at the beginning of the session once and fixed for the rest of the session ( $\text{BF}_{PC}$ ). Notice that the problem of a player 1 Red in the fixed version is trivial as selecting *In* strictly dominates *Out* regardless of the computer’s choice. In order to focus on the interesting situation, essentially all participants in  $\text{BF}_{PC}$  are assigned to be player 1 Blue.<sup>47</sup>

In the sessions, we fix  $\sigma_2^{PC}$  to 95 percent to approximate the aggregate frequency with which player 2s select  $\square$  in the last twenty periods of the Game treatments.

### Analysis

In both treatments it is a dominant strategy for Player 1 Red to select *In*. Let  $\hat{\sigma}_{2,t=0}^{PC}$  be Player 1’s prior on  $\sigma_2^{PC}$ . If Player 1 Red uses the information he collects, his belief in the long run ( $\hat{\sigma}_{2,t \rightarrow \infty}^{PC}$ ) can be a precise estimate of  $\sigma_2^{PC}$ . In both treatments, player 1 Blue’s choice depends on  $u_1$ . If  $\hat{\sigma}_{2,t \rightarrow \infty}^{PC} u_1(18) + (1 - \hat{\sigma}_{2,t \rightarrow \infty}^{PC}) u_1(5) > u_1(15)$ , then player 1 will select *In* when Blue. A temporary Blue could optimally select selecting *Out* even knowing the ‘*In* lottery’ chances if it is sufficiently risk averse. In the treatment with types fixed ( $\text{BF}_{PC}$ ), a permanent Blue’s choice can depend on the

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<sup>47</sup>See instructions in Online Appendix D, where we explain how we introduced this to participants in order to keep comparability in terms of the instructions that participants read across treatments.

prior. A participant whose prior of  $\sigma_{2,t=0}^{PC}$  is sufficiently pessimistic will never select *In*, which happens if  $\hat{\sigma}_{2,t=0}^{PC}u_1(18) + (1 - \hat{\sigma}_{2,t=0}^{PC})u_1(5) < u_1(15)$ .<sup>48</sup> With fixed types it is thus possible that a participant who would have selected *In* had she collected enough information, ends up selecting *Out*.

## Discussion

The bandit treatments with perfect correlation allow for a comparison between a fixed-type and a random-type environment just as in the game treatments, except that the behavior of player 2 is fixed throughout the session. This will be useful for exploring why some participants select *Out* when Blue in GR. To see how, notice first that because the behavior of player 2 is fixed the observations that player 1s collect at the beginning of the session are a good predictor of the behavior of player 2 later on.<sup>49</sup> That is, for a fixed number of observations, a participant in BR<sub>PC</sub> is in a better position to predict the behavior of player 2 later on than a participant in GR.<sup>50</sup> When we compare the proportion of temporary Blues who select *Out* in BR<sub>PC</sub> to that in GR, three cases are possible:

Case 1: Fewer temporary Blues select *Out* in BR<sub>PC</sub> than in GR, which would be consistent with imperfect learning. In this scenario, if temporary Blues who selected *Out* in GR had had better information to predict the behavior of player 2, they would have been less likely to select *Out*.

Case 2: No difference between the fraction of temporary Blues selecting *Out* in GR and in BR<sub>PC</sub>. This is consistent with risk aversion given  $\sigma_2^{PC} = 0.95 < 1$ . Thus, if Case 2 were verified, it would suggest that participants in GR *did* collect enough information on player 2 behavior, and that risk preferences can rationalize their choices.

Case 3: More temporary Blues select *Out* in BR<sub>PC</sub> than in GR. If this were the case, this would also indicate that temporary Blues selecting *Out* in GR can be rationalized as being risk averse. However, this would also suggest that some participants who were not willing to take the risky prospect in the bandit treatment do select *In* when Blue in GR.

Briefly anticipating our results, we will document patterns that are consistent with Case 3. A crucial difference between BR<sub>PC</sub> and GR is that while in the former the behavior of player 2s is fixed at a level lower than one, in the latter the behavior of player 2s is moving towards one

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<sup>48</sup>Player 1 Blue selecting *Out* in BR<sub>PC</sub> can also result if the participant is not patient enough even if her initial belief is not very pessimistic. Since our data gives us limited information as to whether selecting *Out* early on is driven by priors or lack of patience, we do not distinguish between these possible explanations.

<sup>49</sup>Our experimental design uses a bandit problem and not simply an instrument to elicit risk. The reason is that the participant's perception of risk with and without experimentation may not be the same. We want to control for imperfect learning by having an environment in which observations earlier in the session are informative on player 2s choices later on, but that still requires experimentation.

<sup>50</sup>We will document that, in fact, by the period when participants lock in their choices ( $t^{SL}$ ), those who select *Out* when Blue in BR<sub>PC</sub> collect about the same number of observations as participants who select *Out* when Blue in GR.

as the session evolves. Per *Result 3*, most player 1s in GR do collect information indicative of the increase in player 2s' selection of  $\square$ . Our findings suggest that experiencing a change in the behavior of player 2s that moves towards 1 may be enough for some participants to select *In* in GR.

## Experimental sessions

We have 67 and 63 participants in  $BR_{PC}$  and  $BF_{PC}$ , respectively.<sup>51</sup> We tell participants that they will be informed if the selected deck is the Red or the Blue deck, but that they will not know how many of the cards have a square shape and how many have a triangle shape. Participants are told that the composition of the decks (the number of square- and triangle-shaped cards) is fixed throughout the session. Participants are also told that the composition of both decks is the same. While we stress that the composition of both decks is the same, it is possible that some participants think of the two decks as different objects. This approach can affect behavior in  $BR_{PC}$ , where participants are assigned both decks throughout the session. As a control, we also conducted two sessions of the  $BR_{PC}$  treatment (44 participants) in which we tell participants that there is only *one* deck of cards of fixed composition, but that in each period the deck will be randomly painted either Red or Blue. We refer to this control treatment as  $BR_{PC}^{1D}$ , where the superscript 1D refers to the fact that instructions use only one deck.

In bandit treatments, information regarding payoffs was directly presented on the instructions. All sessions consist of 120 periods that are divided into two parts just as in the Game treatments. In total 174 participants participated. Sessions took about 75 minutes, and the average payment per participant was \$17.1.

## Behavior in the last 20 periods

In  $BF_{PC}$  and  $BR_{PC}$  all participants selected *In* if their assigned type was Red, and all participants but one also selected *In* when Red in  $BR_{PC}^{1D}$ . The behavior towards the end of the session for the cases when the type was Blue is summarized in Table 4, which also includes the game-treatments frequencies as a reference. Of all participants, the vast majority (93.7 percent out of 174 participants) are classified as not changing their choices from some period onwards (*S* participants).

We focus first on the comparison of player 1 Blue behavior between  $BF_{PC}$  and  $BR_{PC}$ . Approximately half of *S* participants in either  $BF_{PC}$  or  $BR_{PC}$  select *Out* when Blue. More broadly, the treatment effect in the behavior of player 1 Blue is not statistically significant (see Column (2) of Table 5).<sup>52</sup>

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<sup>51</sup>Collecting more observations in these treatments relative to the Game treatments will help when comparing results to the experiment presented in Online Appendix B.

<sup>52</sup>For brevity we only show regression results for *S* (stable) participants in the main text, but Tables 11 and 12

		GR	GR <sub>HYP</sub>	GF	BR <sub>PC</sub> <sup>1D</sup>	BR <sub>PC</sub>	BF <sub>PC</sub>
Last 20 Periods	<i>In (%)</i>	62.3	57.9	40.0	34.1	41.8	49.2
	<i>Out (%)</i>	33.3	26.3	48.9	59.1	41.8	49.2
	<i>Mix (%)</i>	4.4	15.8	11.1	6.8	16.4	1.6
	<i>Participants (#)</i>	45	19	45	44	67	63
<i>S</i> participants	<i>In (%)</i>	65.9	66.7	48.8	38.1	50.9	50.8
	<i>Out (%)</i>	34.1	33.3	51.2	61.9	49.2	49.2
	<i>Participants (#)</i>	44	18	43	42	59	63
<i>S<sub>L</sub></i> participants	<i>In (%)</i>	65.0	63.6	45.0	35.3	49.1	49.2
	<i>Out (%)</i>	35.0	36.4	55.0	64.7	50.9	50.8
	<i>Participants (#)</i>	40	11	40	34	53	61

Table 4: Summary of choices for participants in the role of player 1 Blue

Notes: In ‘Last 20 periods’ columns percentages are computed using all participants. Percentages in ‘*S* participants’ computes the choices of participants classified as not changing their choices starting at  $t^S \leq 111$ . ‘*S<sub>L</sub>* participants’ columns compute results using only participants who at some point selected to lock their choices in for all remaining periods. The actual number of participants in each case is reported in the corresponding # *Subj.* row. *In* indicates that the participant selected *In* in all corresponding periods (last twenty), that an *S* participant selected *In* from some period onwards, or that an *S<sub>L</sub>* participant who decided to program her choices selected to program the computer to select *In*. Similar categories apply to *Out* and to the options of Player 2. *Mix* indicates the proportion of player 1s (player 2s) who selected *In* and *Out* ( $\square$  and  $\triangle$ ) in some periods. By definition *S* and *S<sub>L</sub>* participants do not *Mix*. GR, GR<sub>HYP</sub>, GF, BR<sub>PC</sub><sup>1D</sup>, BR<sub>PC</sub> and BF<sub>PC</sub> indicate the treatments: game with random types, game with random types and hypothetical payoffs, game with fixed types, one-deck random-types bandit with perfect correlation, random-types bandit with perfect correlation and fixed-type bandit with perfect correlation.

	(1)	(2)	(3)	(4)
$D_{0=BR_{PC}}^{1=BR_{PC}}$	0.128 (0.079)			
$D_{0=BR_{PC}}^{1=BF_{PC}}$		0.052 (0.081)		
$D_{0=BF_{PC}}^{1=GF}$			-0.020 (0.083)	
$D_{0=BR_{PC}}^{1=GR}$				0.206*** (0.066)
Constant	0.381*** (0.074)	0.455*** (0.043)	0.508*** (0.068)	0.455*** (0.043)
Observations	101	164	106	163

Table 5: Player 1 Blue: Bandit Treatments with Perfect Correlation ( $S$  participants)

Notes: All estimations are linear regressions in which the dependent variable takes value 1 if the  $S$  participant eventually selected  $In$  when Blue and 0 otherwise. All estimations include one observation per  $S$  participant.  $S$  participants do not change their choice from  $t^S \leq 111$  onwards. Column (1) compares results using data for  $BR_{PC}$  (dummy equals 1) and  $BR_{PC}^{1D}$  (dummy equals 0). Column (2) compares results using data for  $BF_{PC}$  (dummy equals 1), and  $BR_{PC}$  &  $BR_{PC}^{1D}$  (dummy equals 0). That is, Column (2) pools participants of  $BR_{PC}$  &  $BR_{PC}^{1D}$ . Column (3) compares results between  $GF$  (dummy equals 1) and  $BF_{PC}$  (dummy equals 0). Column (4) compares results using data for  $GR$  &  $GR_{HYP}$  (dummy equals 1), and  $BR_{PC}$  &  $BR_{PC}^{1D}$  (dummy equals 0). Standard errors between parentheses.  $GR$ ,  $GR_{HYP}$ ,  $GF$ ,  $BR_{PC}^{1D}$ ,  $BR_{PC}$  and  $BF_{PC}$  indicate the treatments: game with random types, game with random types and hypothetical payoffs, game with fixed types, one-deck random-types bandit with perfect correlation, random-types bandit with perfect correlation and fixed-type bandit with perfect correlation. Significant at 10% (\*), 5% (\*\*), 1% (\*\*\*). Standard errors clustered by session.

As discussed earlier, we describe the  $BR_{PC}$  treatment using two decks (a Blue and a Red deck), where in each period one of the two decks is randomly selected but participants are informed that the composition of the decks (number of  $\square$  and  $\triangle$ ) is the same. It is possible that this explanation obscures the fact that there is a perfect correlation in the composition of the two decks, which may lead to some temporary Blues treating the decks separately and subsequently selecting  $Out$ . We make the correlation more transparent in our  $BR_{PC}^{1D}$  treatment, which uses one deck (that can be painted Red or Blue in each period) to describe the environment.

Comparing  $S$  or  $S_L$  participants between  $BR_{PC}^{1D}$  and  $BR_{PC}$  we find that, if anything, there are slightly more temporary Blues selecting  $Out$  in  $BR_{PC}^{1D}$ . The effect, however, is not statistically significant for  $S$  participants (see Column (1) of Table 5).<sup>53</sup> This suggests that the lack of treatment effect between  $BF_{PC}$  and  $BR_{PC}$  cannot be attributed to participants in  $BR_{PC}$  not understanding that the information they collect when the type is Red is also useful when the type is Blue. The behavior of participants who are using the information they collect when the type is Red and eventually select  $Out$  when Blue in  $BR_{PC}$  is consistent with risk aversion playing a role. The following result summarizes our findings with respect to the behavior of player 1 Blue.

of Online Appendix C present the estimation results if constrained to  $S_L$  (stable and locked in) participants or to all choices in the last twenty periods, respectively.

<sup>53</sup>In the case of  $S_L$  participants or when the sample is constrained to the last twenty periods (See Column (1) of Tables 11 and 12 of Online Appendix C) the effect is significant at the 10 percent level.

***Result OA-1: There is no significant treatment effect in the behavior of Player 1 Blue when comparing between  $BF_{PC}$  and  $BR_{PC}$ .***

While there is a treatment effect in the behavior of player 1 Blue for the game treatments (*Result I*), the treatment effect is missing in the comparison of bandit problems with perfect correlation (*Result OA-1*). Table 4 also shows that the main difference between games and bandit problems is in the treatments with random types. In the case of fixed types, in the game (GF) and the bandit with perfect correlation ( $BF_{PC}$ ) approximately half of  $S$  or  $S_L$  permanent Blues select *Out* and the small difference is not statistically significant (see Column (3) of Table 5). Meanwhile, about two-thirds of  $S$  or  $S_L$  temporary Blues in GR select *In* when Blue, a frequency that drops to about fifty percent in  $BR_{PC}$ . The difference, as reported in column (4) of Table 5 is statistically significant (p-value < 0.01). We summarize these findings next.

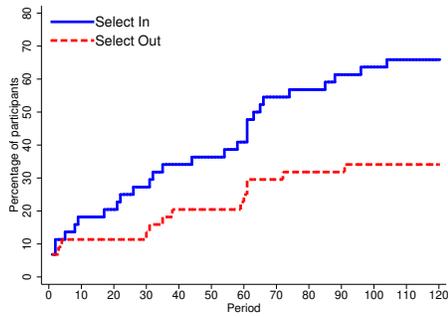
***Result OA-2: Comparing the behavior of player 1 Blue between Games and Bandit Problems with Perfect Correlation: There is no difference between GF and  $BF_{PC}$ , but more participants select *In* in GR than in  $BR_{PC}$ .***

According to *Result OA-2*, player 1 Blue behavior is similar in GF and  $BF_{PC}$  even though the behavior of player 2s is changing as the session evolves in GF and fixed in  $BF_{PC}$ . In particular, the rate at which player 2s select  $\square$  at the beginning of the session in GF is lower than the fixed rate for  $BF_{PC}$ . However, as shown in Table 3, player 1 Blue in GF who settle for *Out* collect basically no observations, and Table 6 replicates the same finding for  $BR_{PC}$ . Essentially, this suggests that regardless of whether the environment is the game or the bandit problem approximately half of player 1 Blue participants when types are fixed decided not to experiment and collect no information on player 2s. The other half of player 1 Blues in treatments with fixed types experiments and settles for *In*.

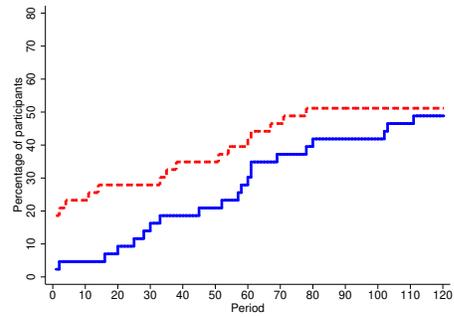
Meanwhile, in treatments with random types we find that temporary Blues' behavior *does* differ between GR and  $BR_{PC}$ . Behavior is, in fact, consistent with Case 3 outlined in the discussion to the experimental design. The fact that more player 1 Blue participants are selecting *Out* in  $BR_{PC}$  (when the frequency is fixed) relative to GR suggests that many player 1 participants in GR are observing and responding to the increase of the frequency of  $\square$  choices, which is consistent with the SCE. To take a closer look, in the next section we examine the data as the session evolves.

## **The time path over the course of the sessions**

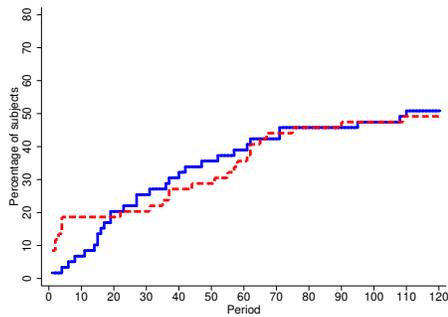
Figures 6c and 6d present the evolution of choices of  $S$  participants in Bandit treatments with perfect correlation when the type is Blue. Each figure shows the proportion of  $S$  participants who select *In* and the proportion who select *Out* from period  $t$  onwards. As a reference, Figures 6a and 6b reproduce the behavior for the Game treatments (previously presented in Figure 4).



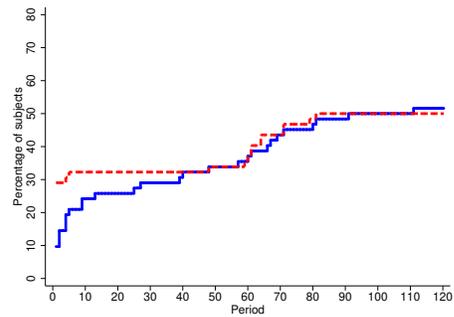
(a) GR



(b) GF



(c) BR<sub>PC</sub>



(d) BF<sub>PC</sub>

Figure 6: Player 1 Blue  $S$  participants

Note: For each period  $t$ , a ‘Select In’ (‘Select Out’) line captures the % of participants who select ‘In’ (‘Out’) in all periods from  $t$  onwards in which the assigned type was Blue. GR, GF, BR<sub>PC</sub><sup>1D</sup>, BR<sub>PC</sub> and BF<sub>PC</sub> indicate the treatments: game with random types (including the game with random types and hypothetical payoffs treatment), game with fixed types, one-deck random-types bandit with perfect correlation, random-types bandit with perfect correlation and fixed-type bandit with perfect correlation.  $S$  participants do not change their choice from  $t^S \leq 111$  onwards.

		<i>In</i> when Blue		<i>Out</i> when Blue	
		BR <sub>PC</sub>	BF <sub>PC</sub>	BR <sub>PC</sub>	BF <sub>PC</sub>
$t^S$	Mean	30	32.9	35.9	24.1
	Median	29	19	37	1
$t^{SL}$	Mean	71	72	64	63.5
	Median	61	71	61	61
# Observed at $t^{SL}$	Mean	62.7	58	37.9	9.7
	Median	58.5	61	34	0
# Observed $\Delta$ at $t^{SL}$	Mean	2.8	2.4	2	0.8
	Median	3	3	2	0

Table 6: Collected Observations by Bandit Treatment with Perfect Correlation

Notes:  $t^S$  indicates the first period after which there was No Change in choices.  $t^{SL}$  indicates the first period in which choices were locked in. # Observed  $t^{SL}$  indicates the number of times the participant selected *In* prior to  $t^{SL}$ . # Observed  $\Delta$  at  $t^{SL}$  indicates the number of times the participant selected *In* and observed a  $\Delta$  prior to period  $t^{SL}$ . BR<sub>PC</sub> and BF<sub>PC</sub> indicate the treatments: random-types bandit with perfect correlation and fixed-type bandit with perfect correlation.

The figures highlight that the main difference is in the comparison between treatments with random types.<sup>54</sup> There is a surge in the frequency that selects *In* in GR (Figure 6a) that is missing in BR<sub>PC</sub> (Figure 6c). The surge, in fact, is consistent with the increase in selection of  $\square$  by player 2s in the game treatments.<sup>55</sup>

The evidence also suggests that choices of temporary *Blues* in GR who select *Out* may be driven by risk preferences. Table 6 reproduces the information participants collected up until the period when participants lock their choices in for bandit treatments with perfect correlation, the counterpart to Table 3 in Game treatments. Overall, the patterns in Bandit and Game treatments are similar. In particular, the number of average observations collected by temporary Blues who select *Out* in BR<sub>PC</sub> (37.9) are quite close to the figure for GR (40.6). Since the frequency of  $\square$  is fixed in BR<sub>PC</sub>, this suggests that some participants choose not to go in based on risk preferences, consistent with the situation described in Case 3 of the discussion to the experimental design.

<sup>54</sup>There is also a (relatively minor) difference between Game and Bandit treatments with perfect correlation in the case of fixed types. In both treatments approximately half of the sample selects *In* and half selects *Out* when the type is Blue. However, in GF the proportion of *S* participants selecting *In* from  $t$  onwards is below the proportion selecting *Out* up until the end of the session, when both lines almost coincide (Figure 6b). In BF<sub>PC</sub>, the proportion of *S* participants selecting *In* from  $t$  onwards overlaps with the proportion selecting *Out* almost throughout the full session. This is also consistent with the fact that in GF the frequency of  $\square$  choices by player 2s is increasing and that it may take longer for some participants to assess that it is worthwhile to select *In*.

<sup>55</sup>In BR<sub>PC</sub> we also reproduce the exercise reported for GR in section 3.7, that computes the observed choices of  $\Delta$  of player 2 (the computer) for the first 20 observations collected (*initial* measure) and the last twenty observed prior to locking choices in (*final* measure). While in GR we documented a significant difference between the *initial* and the *final* measure, there is no difference in BR<sub>PC</sub>.

## Discussion

The third of temporary Blues who lock on *Out* in GR constitute the main quantitative deviation relative to predictions in Game treatments. If we had found even more temporary Blues locking on *Out* in  $BR_{PC}$ , behavior in the Game treatment could have been attributed to imperfect learning (outlined as Case 1 in the discussion to the experimental design). However, the proportion of temporary Blues selecting *Out* is actually higher in  $BR_{PC}$ . Per Case 3, this is consistent with risk aversion playing a role for some participants who select *Out* in GR.<sup>56</sup> But, in addition, it is also consistent with participants in GR who are responding to the observed behavior of player 2s.

Overall, the evidence indicates that indeed the main difference in behavior between GR and GF is driven by the extra information that participants receive when the type is Red in GR. The lack of a treatment effect between  $BR_{PC}$  and  $BF_{PC}$  in player 1 Blue behavior suggests that experimenting an increasing frequency of  $\square$  choices is also important for the treatment effect between GF and GR.

In Online Appendix B we take a different perspective to study to what extent the treatment effect is driven by the information that participants receive in GR when the type is Red. We bring 130 more participants to the laboratory and conduct another set of bandit experiments in which observing the behavior of player 2 if the type is Red is not informative on the behavior of player 2 when the type is Blue. The results suggest that absent the cross-type information in observations when the type is Red we would have observed an even higher proportion of temporary Blues locking on *Out* in GR.

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<sup>56</sup>As pointed out in footnote 44, if the participant has CRRA preferences and  $\hat{\sigma}_{2,t \rightarrow \infty}^{PC} = .95$ , then the CRRA parameter such that the participant is indifferent between *In* and *Out* equals 0.82. There are 17 percent of participants in Holt and Laury (2002) who make choices consistent with this value or higher, but we observe close to 50 percent in our environment in which the probability is not common knowledge but something participants can learn about. We leave it for future research to evaluate if there is a systematic difference in lottery choices depending on whether probabilities are known or objects participants can learn about.

# Online Appendix B: Bandit Treatments with Independent Beliefs

## Experimental Design

In the bandit treatments with independent beliefs the information collected when the type is Red is no longer useful when the type is Blue. Specifically, in these treatments beliefs across types are independent because the frequency of the computer's choices for one type is not informative with respect to computer's choices for the other type. We implement treatments with independent beliefs in the following manner. The computer that replaces player 2 can be of two types. Type 1 selects  $\square$  with probability 80% and Type 2 selects  $\square$  with probability 95%. At the beginning of the session with probability 50% one of the two computer types is selected for the case in which player 1's type is Red. At the same time, and independently, one of the two types is with equal probability selected for the case in which player 1's type is Blue. Participants are told that there is a 50-50 chance that the computer is of either type; they also know the probabilities with which each computer type selects  $\square$ , and that the computer's type for the case in which player 1 is Red is selected independently from the computer's type for the case in which player 1 is Blue. Participants are not told which computer type is actually selected for each player 1 type.

Notice that the bandit treatments with independent beliefs also allow us to study how participants respond to different fixed frequencies of computer's choices. *Result 2* states that in the Game treatments the frequency of  $\square$  choices by player 2s increases as the session evolves. The frequency increases from roughly 80 percent in the first twenty periods to 95 percent in the last twenty. We can eventually compare the behavior of player 1 Blues depending on the probability assigned. That is, to what extent are participants responsive to an increase in  $\Pr(\square|\theta_1 = \text{Blue})$  from 80 to 95 percent?

We implement two bandit treatments with independent beliefs. In  $BR_{IB}$  player 1's type is randomly selected in every period and in  $BF_{IB}$ , types are fixed throughout the session.<sup>57</sup>

## Analysis

Regardless of the treatment, it is a dominant strategy for player 1 Red to select  $In$ . In contrast to  $BR_{PC}$ , in  $BR_{IB}$  the information collected when the type is Red is not useful when the Blue type is assigned. Player 1 Blue's choice may eventually converge to  $In$  or  $Out$  depending on preferences, her prior belief on the computer's type and the realization of payoffs in case he explores. The same applies to the treatment with fixed types  $BF_{IB}$ , except that in this case participants assigned the player 1 Blue type cannot be influenced by the Red type's payoffs.

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<sup>57</sup>As described for  $BF_{PC}$  (see footnote 47), all participants are assigned to the player 1 Blue role in  $BF_{IB}$ .

		BR <sub>IB</sub> <sup>80</sup>	BF <sub>IB</sub> <sup>80</sup>	BR <sub>IB</sub> <sup>95</sup>	BF <sub>IB</sub> <sup>95</sup>
Last 20 Periods	‘In’	22.9	35.1	53.3	39.3
	‘Out’	74.3	62.2	46.7	57.1
	Mix	2.8	2.7	0.0	3.6
	<i># Participants</i>	35	37	30	28
<i>S</i> participants	‘In’	22.9	36.1	53.3	40.7
	‘Out’	77.1	63.9	46.7	59.3
	<i># Participants</i>	35	36	30	27
<i>S<sub>L</sub></i> participants	‘In’	23.5	36.1	51.7	36.0
	‘Out’	76.5	63.9	48.3	64.0
	<i># Participants</i>	34	36	29	25

Table 7: Bandit Treatment with Independent Beliefs: Behavior of Player 1 Blue

Notes: ‘Last 20 periods’ percentages computed using all participants. The actual number of participants in each case is reported in the corresponding *# Subj.* row. *In* indicates that the participant selected *In* in all corresponding periods (last twenty or all periods), that an *S* participant selected *In* from some period onwards, or that an *S<sub>L</sub>* participant selected to program the computer to select *In*. Similar categories apply to *Out*. Mix indicates the proportion of participants who selected *In* and *Out* in some periods. By definition *S* and *S<sub>L</sub>* participants do not Mix. Let  $\Pr(\square|\theta_1 = \text{Blue}) = X \in \{80\%, 95\%\}$ . The condition BR<sub>IB</sub><sup>*X*</sup> indicates participants who were assigned to BR<sub>IB</sub> (independent-beliefs bandit with random types treatment) with the probability at *X*. The condition BF<sub>IB</sub><sup>*X*</sup> indicates participants who were assigned to BF<sub>IB</sub> (independent-beliefs bandit with fixed types treatment) with the probability at *X*.

## Experimental Sessions

In each treatment 65 participants participated. We opted to collect more information on player 1 participants for Bandit treatments with independent beliefs (relative to Game treatments) in order to allow for a comparison within independent-beliefs treatments depending on whether player 1 Blue participants were assigned the 80 or the 95 percent probability that the computer selects  $\square$ .

To describe how the decks of cards are selected we tell participants that each deck of cards can be of one of two versions. In version 1 of the deck, 80 of the 100 cards are  $\square$ , and in version 2 of the deck the proportion is 95%. We then explain that one of the two versions is independently selected for each deck. Once a version is selected for each deck, we tell them that decks are fixed throughout the session.

## Results within bandit treatments with independent beliefs

This section presents results that compare behavior between BR<sub>IB</sub> and BF<sub>IB</sub>. In the Discussion subsection we will compare bandit treatments with independent beliefs to treatments presented earlier and further discuss our findings.

The first finding is in line with results for the Bandit treatments with perfect correlation and the Game treatments: all player 1 participants that were assigned the Red type in Bandit treatments with independent beliefs select  $In$  in every choice of the last twenty periods. This happens regardless of whether  $\Pr(\square|\theta_1 = \text{Red}) = 80\%$  or  $\Pr(\square|\theta_1 = \text{Red}) = 95\%$  was assigned. We thus focus on the behavior in case the type is Blue, which is summarized in Table 7. The table distinguishes within treatment depending on whether the participant was assigned to an 80 or 95 percent value for  $\Pr(\square|\theta_1 = \text{Blue})$ . For example,  $\text{BR}_{\text{IB}}^{80}$  indicates that the participant participated in  $\text{BR}_{\text{IB}}$  and that the probability she faced when the type was Blue was 80 percent.

*Result OB-1* summarizes what happens towards the end of the session when we fix  $\Pr(\square|\theta_1 = \text{Blue})$  and compare between fixed and random types. We find that for all categories (Last 20 periods,  $S$  or  $S_L$  participants) more permanent Blues select  $In$  in  $\text{BF}_{\text{IB}}^{80}$  relative to temporary Blues in  $\text{BR}_{\text{IB}}^{80}$ , but in all of these comparisons the treatment effect is not significant.<sup>58</sup> Meanwhile, more temporary Blues select  $In$  in  $\text{BR}_{\text{IB}}^{95}$  relative to permanent Blues in  $\text{BF}_{\text{IB}}^{95}$ , but again the differences are not statistically significant for any category.

***Result OB-1: No significant difference in choices towards the end of the session between  $\text{BR}_{\text{IB}}^X$  and  $\text{BF}_{\text{IB}}^X$  for both  $X \in \{80, 95\}$ .***

A second comparison fixes the type assignment and contrasts behavior when  $\Pr(\square|\theta_1 = \text{Blue})$  changes from 80 to 95 percent. In this case, comparing  $\text{BR}_{\text{IB}}^{95}$  to  $\text{BR}_{\text{IB}}^{80}$  across all categories we note a thirty-percentage-point difference that is statistically significant: more temporary Blues select  $In$  when the probability is at 95 percent. For the comparison with fixed types the difference is positive in the case of the last twenty periods or  $S$  participants, but very small and not significant. There is virtually no difference for  $S_L$  participants. We summarize these findings next.

***Result OB-2: Significantly more participants select  $In$  when  $\Pr(\square|\theta_1 = \text{Blue})$  is at 95 percent relative to 80 percent when types are randomly assigned. No significant difference if types are fixed.***

Overall, the main difference across treatments is that participants are more responsive to the change in  $\Pr(\square|\theta_1 = \text{Blue})$  when types are randomly assigned than when types are fixed. This result towards the end of the session could be the consequence of differences in collected information as the session evolves. However, we do not find substantive evidence in this direction.

Table 8 summarizes the information that  $S_L$  participants gathered in bandit treatments with independent beliefs. Notice first that the median  $S_L$  participant locks choices in at period 61 across all treatments. At that moment, participants who select  $In$  in  $\text{BF}_{\text{IB}}$  have collected on average approximately double as many observations than participants in  $\text{BR}_{\text{IB}}$ . This is reasonable, as in

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<sup>58</sup>Tables 13, 14 and 15 in Online Appendix C provide statistical support for conclusions reported in *Results OB-1* and *OB-2*.

		<i>In</i> when Blue				<i>Out</i> when Blue			
		BR <sub>IB</sub> <sup>80</sup>	BF <sub>IB</sub> <sup>80</sup>	BR <sub>IB</sub> <sup>95</sup>	BF <sub>IB</sub> <sup>95</sup>	BR <sub>IB</sub> <sup>80</sup>	BF <sub>IB</sub> <sup>80</sup>	BR <sub>IB</sub> <sup>95</sup>	BF <sub>IB</sub> <sup>95</sup>
$t^S$	Mean	39	39.9	24.6	16.7	30.4	29.5	11.9	13.4
	Median	45	56	8	1	21	7	2	1
$t^{SL}$	Mean	66	64.8	64.3	64.3	63.3	64.5	61.7	62.5
	Median	61	61	61	61	61	61	61	61
# Observed at $t^{SL}$	Mean	25.8	49.2	28.6	59.6	8.2	9.8	2.2	7.2
	Median	27.5	56	29	61	4.5	4	0	0
# Observed $\Delta$ at $t^{SL}$	Mean	3.8	10.1	1.3	2.4	1.8	2.3	0.1	0.4
	Median	4.5	11	1	2	1	1	0	0

Table 8: Collected Observations by Bandit Treatment with Independent Beliefs

Notes:  $t^S$  indicates the first period after which there was no change in choices.  $t^{SL}$  indicates the first period in which the subject locked in her choices. # Observed  $t^{SL}$  indicates the number of times the participant selected *In* prior to  $t^{SL}$ . # Observed  $\Delta$  at  $t^{SL}$  indicates the number of times the participant selected *In* and observed a  $\Delta$  prior to period  $t^{SL}$ . Let  $\Pr(\square|\theta_1 = \text{Blue}) = X \in \{80\%, 95\%\}$ . The condition BR<sub>IB</sub><sup>X</sup> indicates participants who were assigned to BR<sub>IB</sub> (independent-beliefs bandit with random types treatment) with the probability at  $X$ . The condition BF<sub>IB</sub><sup>X</sup> indicates participants who were assigned to BF<sub>IB</sub> (independent-beliefs bandit with fixed types treatment) with the probability at  $X$ .

about half of the periods in BR<sub>IB</sub> participants are assigned the Red type. Likewise, participants who select *In* in BF<sub>IB</sub> have experienced approximately double as many  $\Delta$  than such participants in BR<sub>IB</sub>.

However, when comparing temporary Blues (in BF<sub>IB</sub>) who select *Out* to permanent Blues (in BR<sub>IB</sub>) who select *Out* the amount of collected information no longer doubles. If the probability is at 95 percent, participants who select *Out* essentially collect little to no information. In fact, in both treatments the median participant collected no information at  $t^{SL}$ . In conjunction with *Result OB-1*, this suggests that between 50 and 60 percent of our participants (those who select *Out*) start with a prior and preferences such that they do not find collecting information valuable when the type is Blue. When the probability is at 80 percent, participants who select *Out* collect on average about the same amount of observations in both treatments. That is, there is no evidence that the amount of collected information conditional on selecting *Out* depends on whether types are randomly assigned or fixed.

## Discussion

In GF and BF<sub>PC</sub> approximately half of permanent Blues select *Out* towards the end of the session (Table 4). The proportion is slightly higher in BF<sub>IB</sub> (Table 7), but the difference is not statistically significant when comparing the fixed-types treatment with independent beliefs to either previous

treatment with fixed types.<sup>59</sup> The finding that there is a small and not significant difference between participants assigned  $\Pr(\square|\theta_1 = \text{Blue})$  at 80 or 95 percent in  $\text{BF}_{\text{IB}}$  (*Result OB-2*) is consistent with having found no difference between GF and  $\text{BF}_{\text{PC}}$  (*Result OA-2*) even though the frequency of  $\square$  choices in GF starts at a lower level (about 80 percent) than that of  $\text{BF}_{\text{PC}}$  (which is fixed at 95 percent). In a few words, the data indicates that in treatments with fixed types participants' responsiveness to an increase in  $\Pr(\square|\theta_1 = \text{Blue})$  from 80 to 95 percent is relatively small. Meanwhile, in  $\text{BR}_{\text{IB}}$  we do find that there is a significant effect when increasing  $\Pr(\square|\theta_1 = \text{Blue})$  from 80 to 95 percent (*Result OB-2*). We leave for future research the study of why there is a differential response to a change in the primitive depending on whether types are randomly assigned or fixed.

The treatments with independent beliefs allow us to shed some light on the influence of the information channel in the difference between player 1 Blue behavior GR and GF. According to *Result 1*, more permanent Blues (in GF) select *Out* relative to temporary Blues (in GR), and recall that towards the beginning of the sessions in GR most participants experience a frequency of  $\square$  at about 80 percent. *Result OB-2* suggests that absent the information channel, we would have observed more temporary Blues eventually selecting *Out*. Indeed, the evidence once again confirms that most participants in GR are closely following and are responding to the free information that they collect when the type is Red.

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<sup>59</sup>For statistical support, see Table 16 in Online Appendix C.

## Online Appendix C: Extra Figures and Tables

In this Online Appendix we present extra Figures and Tables that were not reported in the main text.

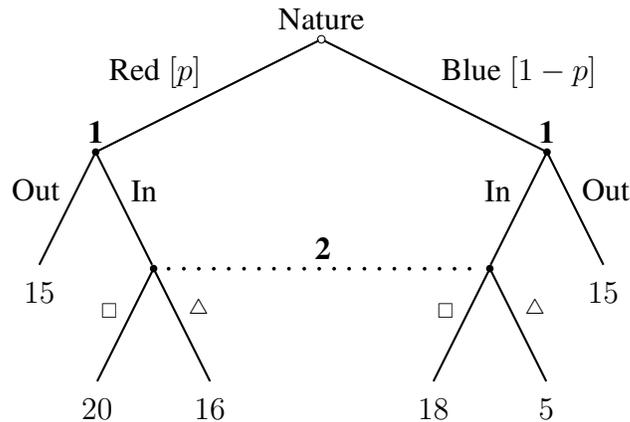


Figure 7: Game from the perspective of player 1 (only his own payoffs are represented)

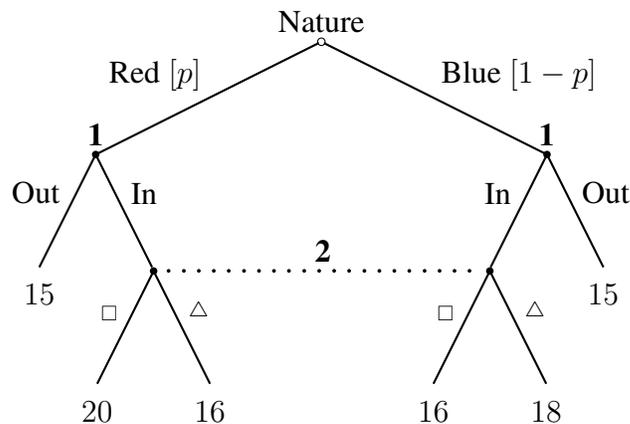


Figure 8: Game from the perspective of player 2 (only her own payoffs are represented)

For each  $S_L$  participant we can compute the frequency of  $\square$  at the period when they decide to lock their choices in ( $t^{SL}$ ). We can then compute the distribution of observed frequencies depending on whether the participant selected to lock on *In* or *Out* when Blue. Figure 10 presents the cumulative distribution for each of the two cases (*In* and *Out* when Blue) in each treatment.

Figure 10a presents the case of GR, where the cumulative distribution of *In* is below and to the right of the cumulative distribution of *Out*. This indicates that higher values of the observed frequency of  $\square$  are more likely when the participant selects *In* when Blue.

In GF the findings are qualitatively similar. Figure 10a presents the cumulative distribution of the frequency depending on whether the participant selects *In* or *Out* when Blue and again we observe that higher values of the frequency are associated with selecting *In*.

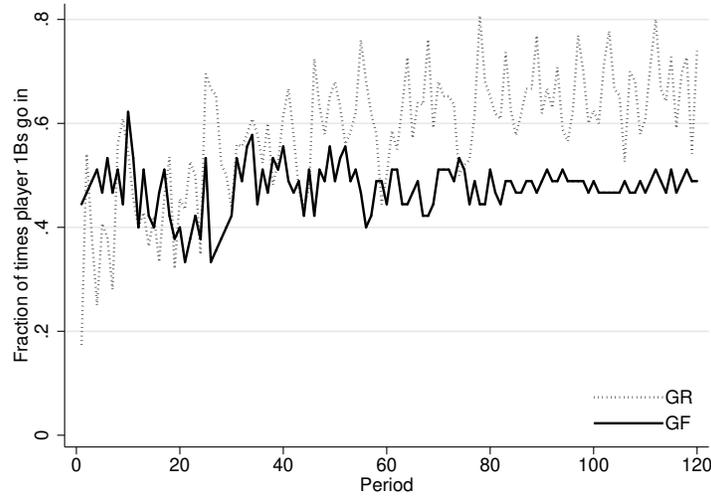


Figure 9: Player 1 Blue (Without averaging over bins of five periods in GR)

Notes: GR, and GF indicate the treatments: random types, and fixed types, respectively. GR also includes participants who participated in GR<sub>HYP</sub>, the random-type treatment with hypothetical payoffs. As indicated in footnote 32, there is more volatility in the choices of player 1 in GR because types are randomly assigned across periods. This figure is identical to Figure 3, except that it does not group player 1 choices in GR in bins of five periods. The GR line provides the average by period. Taking averages over five periods removes some of the volatility in aggregate choices in GR.

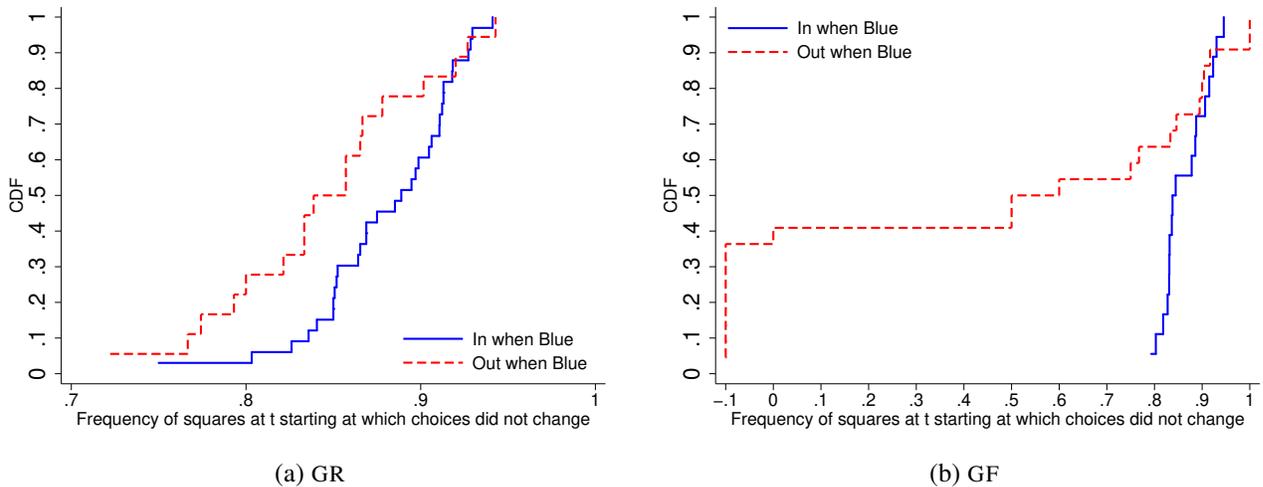


Figure 10:  $S_L$  participants: Distribution of the frequency of  $\square$  at  $t^{S_L}$

Notes: GR, and GF indicate the treatments: random types, and fixed types, respectively. GR also includes participants who participated in GR<sub>HYP</sub>, the random-type treatment with hypothetical payoffs. Notice that the scale in the horizontal axis changes depending on the treatment. In GF we coded participants who collected no information as -0.1.

	(1) $t \leq 20$	(2) $20 < t \leq 40$	(3) $40 < t \leq 60$	(4) $60 < t \leq 80$	(5) $80 < t \leq 100$	(6) $t > 100$
$D_{0=GR \text{ or } GR_{HYP}}^{1=GF}$	0.040 (0.073)	-0.073 (0.075)	-0.092 (0.078)	-0.184*** (0.065)	-0.193*** (0.065)	-0.178*** (0.066)
Constant	0.430*** (0.031)	0.528*** (0.043)	0.575*** (0.046)	0.662*** (0.053)	0.676*** (0.047)	0.660*** (0.049)
Observations	1544	1541	1553	1545	1522	1515

Table 9: Game: Treatment Effect for Player 1 Blue as the Session Evolves

Notes: All estimations are random effects regressions in which the dependent variable takes value 1 if in period  $t$  the type assigned is Blue and the participant selected *In*, and 0 if the type assigned is Blue and the participant selected *Out*. The right-hand side dummy variable takes value 1 if the observation is from GF and value 0 if it belongs to GR or GR<sub>HYP</sub>. Each column only includes data from the indicated periods. For example, the regression column (1) only includes periods 20 or lower. GR, GR<sub>HYP</sub>, and GF indicate the treatments: game with random types, game with random types and hypothetical payoffs, and game with fixed types. Standard errors between parentheses. Significant at 10% (\*), 5% (\*\*), 1% (\*\*\*). Standard errors clustered by session.

	(1)	(2)	(3)	(4)	(5)
$D_{0 \text{ if } t \leq 20}^{1 \text{ if } t > 100}$	0.150*** (0.011)				
$D_{0 \text{ if } 20 < t \leq 40}^{1 \text{ if } t > 100}$		0.093*** (0.015)			
$D_{0 \text{ if } 40 < t \leq 60}^{1 \text{ if } t > 100}$			0.078*** (0.012)		
$D_{0 \text{ if } 60 < t \leq 80}^{1 \text{ if } t > 100}$				0.019*** (0.007)	
$D_{0 \text{ if } 80 < t \leq 100}^{1 \text{ if } t > 100}$					0.012** (0.006)
Constant	0.810*** (0.008)	0.866*** (0.011)	0.881*** (0.007)	0.940*** (0.011)	0.948*** (0.009)
Observations	6000	6000	6000	6000	6000

Table 10: Game Treatments: Player 2 Choices as the Session Evolves

Notes: All estimations are random effects regressions in which the dependent variable takes value 1 if in period  $t$  the player selected  $\square$ . For each regression the data pools player 2 choices from GF, GR and GR<sub>HYP</sub>. Notation for the right-hand side dummy variables ( $D_B^A$ ) is as follows. Superscript  $A$  (Subscript  $B$ ) captures the condition under which the dummy equals 1 (0). For example  $D_{0 \text{ if } t \leq 20}^{1 \text{ if } t > 100}$  indicates that the dummy variable takes value 1 if the observation is from a period higher than 100 and 0 if it is from period 20 or earlier. GR, GR<sub>HYP</sub>, and GF indicate the treatments: game with random types, game with random types and hypothetical payoffs, and game with fixed types. Standard errors between parentheses. Significant at 10% (\*), 5% (\*\*), 1% (\*\*\*). Standard errors clustered by session.

	(1)	(2)	(3)	(4)
$D_{0=BR_{PC}^{ID}}^{1=BR_{PC}}$	0.138* (0.059)			
$D_{0=BR_{PC}}^{1=BF_{PC}}$		0.055 (0.074)		
$D_{0=BF_{PC}}^{1=GF}$			-0.042 (0.082)	
$D_{0=BR_{PC}}^{1=GR}$				0.210** (0.075)
Constant	0.353*** (0.032)	0.437*** (0.043)	0.492*** (0.060)	0.437*** (0.042)
Observations	87	148	101	138

Table 11: Player 1 Blue: Bandit Treatments with Perfect Correlation ( $S_L$  participants)

Notes: All estimations are linear regressions in which the dependent variable takes value 1 if the  $S_L$  participant eventually locked in to  $In$  when Blue and 0 otherwise. All estimations include only  $S_L$  participants. Column (1) compares results using data for  $BR_{PC}$  (dummy equals 1) and  $BR_{PC}^{ID}$  (dummy equals 0). Column (2) compares results using data for  $BF_{PC}$  (dummy equals 1), and  $BR_{PC}$  &  $BR_{PC}^{ID}$  (dummy equals 0). That is, Column (2) pools participants of  $BR_{PC}$  &  $BR_{PC}^{ID}$ . Column (3) compares results between  $GF$  (dummy equals 1) and  $BF_{PC}$  (dummy equals 0). Column (4) compares results using data for  $GR$  &  $GR_{HYP}$  (dummy equals 1), and  $BR_{PC}$  &  $BR_{PC}^{ID}$  (dummy equals 0).  $GR$ ,  $GR_{HYP}$ ,  $GF$ ,  $BR_{PC}^{ID}$ ,  $BR_{PC}$  and  $BF_{PC}$  indicate the treatments: game with random types, game with random types and hypothetical payoffs, game with fixed types, one-deck random-types bandit with perfect correlation, random-types bandit with perfect correlation and fixed-type bandit with perfect correlation. Standard errors between parentheses. Significant at 10% (\*), 5% (\*\*), 1% (\*\*\*). Standard errors clustered by session.

	(1)	(2)	(3)	(4)
$D_{0=BR_{PC}^{ID}}^{1=BR_{PC}}$	0.136* (0.076)			
$D_{0=BR_{PC}}^{1=BF_{PC}}$		-0.014 (0.076)		
$D_{0=BF_{PC}}^{1=GF}$			-0.025 (0.081)	
$D_{0=BR_{PC}}^{1=GR}$				0.193*** (0.065)
Constant	0.385*** (0.069)	0.521*** (0.032)	0.506*** (0.067)	0.467*** (0.042)
Observations	1115	1898	2160	1730

Table 12: Player 1 Blue: Bandit Treatments with Perfect Correlation (Last 20 Periods)

Notes: All estimations are random effects regressions in which the dependent variable takes value 1 if in period  $t > 100$  the type assigned is Blue and the participant selected  $In$  and 0 if the type assigned is Blue and the participant selected  $Out$ . Column (1) compares results using data for  $BR_{PC}$  (dummy equals 1) and  $BR_{PC}^{ID}$  (dummy equals 0). Column (2) compares results using data for  $BF_{PC}$  (dummy equals 1), and  $BR_{PC}$  &  $BR_{PC}^{ID}$  (dummy equals 0). That is, Column (2) pools participants of  $BR_{PC}$  &  $BR_{PC}^{ID}$ . Column (3) compares results between  $GF$  (dummy equals 1) and  $BF_{PC}$  (dummy equals 0). Column (4) compares results using data for  $GR$  &  $GR_{HYP}$  (dummy equals 1), and  $BR_{PC}$  &  $BR_{PC}^{ID}$  (dummy equals 0).  $GR$ ,  $GR_{HYP}$ ,  $GF$ ,  $BR_{PC}^{ID}$ ,  $BR_{PC}$  and  $BF_{PC}$  indicate the treatments: game with random types, game with random types and hypothetical payoffs, game with fixed types, one-deck random-types bandit with perfect correlation, random-types bandit with perfect correlation and fixed-type bandit with perfect correlation. Standard errors between parentheses. Significant at 10% (\*), 5% (\*\*), 1% (\*\*\*). Standard errors clustered by session.

	(1)	(2)	(3)	(4)
$D_{0=BR_{IB}^{80}}^{1=BF_{IB}^{80}}$	0.133 (0.111)			
$D_{0=BR_{IB}^{95}}^{1=BF_{IB}^{95}}$		-0.132 (0.156)		
$D_{0=BR_{IB}^{80}}^{1=BR_{IB}^{95}}$			0.295*** (0.106)	
$D_{0=BF_{IB}^{80}}^{1=BF_{IB}^{95}}$				0.030 (0.189)
Constant	0.238*** (0.063)	0.533*** (0.090)	0.238*** (0.069)	0.372*** (0.098)
Observations	1084	862	646	1300

Table 13: Player 1 Blue: Bandit Treatments with Independent Beliefs (Last 20 Periods)

Notes: All estimations are random effects regressions in which the dependent variable takes value 1 if in period  $t > 100$  the type assigned is Blue and the participant selected *In* and 0 if the type assigned is Blue and the participant selected *Out*. Notation for the right-hand side dummy variables ( $D_B^A$ ) is as follows. Superscript  $A$  (Subscript  $B$ ) captures the condition under which the dummy equals 1 (0). Let  $\Pr(\square|\theta_1 = \text{Blue}) = X \in \{80\%, 95\\}$ . The condition  $BR_{IB}^X$  indicates participants who were assigned to  $BR_{IB}$  (independent-beliefs bandit with random types treatment) with the probability at  $X$ . The condition  $BF_{IB}^X$  indicates participants who were assigned to  $BF_{IB}$  (independent-beliefs bandit with fixed types treatment) with the probability at  $X$ . Standard errors between parentheses. Significant at 10% (\*), 5% (\*\*), 1% (\*\*\*). Standard errors clustered by session.

	(1)	(2)	(3)	(4)
$D_{0=BR_{IB}^{80}}^{1=BF_{IB}^{80}}$	0.133 (0.103)			
$D_{0=BR_{IB}^{95}}^{1=BF_{IB}^{95}}$		-0.126 (0.162)		
$D_{0=BR_{IB}^{80}}^{1=BR_{IB}^{95}}$			0.305* (0.097)	
$D_{0=BF_{IB}^{80}}^{1=BF_{IB}^{95}}$				0.046 (0.191)
Constant	0.229*** (0.059)	0.533*** (0.091)	0.229** (0.064)	0.361** (0.092)
Observations	71	57	65	63

Table 14: Player 1 Blue: Bandit Treatments with Independent Beliefs ( $S$  participants)

Notes: All estimations are linear regressions in which the dependent variable takes value 1 if the  $S$  participant eventually selected *In* when Blue and 0 otherwise. All estimations include only  $S$  participants.  $S$  participants do not change their choice from  $t^S \leq 111$  onwards. Notation for the right-hand side dummy variables ( $D_B^A$ ) is as follows. Superscript  $A$  (Subscript  $B$ ) captures the condition under which the dummy equals 1 (0). Let  $\Pr(\square|\theta_1 = \text{Blue}) = X \in \{80\%, 95\\}$ . The condition  $BR_{IB}^X$  indicates participants who were assigned to  $BR_{IB}$  (independent-beliefs bandit with random types treatment) with the probability at  $X$ . The condition  $BF_{IB}^X$  indicates participants who were assigned to  $BF_{IB}$  (independent-beliefs bandit with fixed types treatment) with the probability at  $X$ . Standard errors between parentheses. Significant at 10% (\*), 5% (\*\*), 1% (\*\*\*). Standard errors clustered by session.

	(1)	(2)	(3)	(4)
$D_{0=BR_{IB}^{80}}^{1=BR_{IB}^{80}}$	0.126 (0.102)			
$D_{0=BR_{IB}^{95}}^{1=BR_{IB}^{95}}$		-0.157 (0.150)		
$D_{0=BR_{IB}^{80}}^{1=BR_{IB}^{95}}$			0.282** (0.088)	
$D_{0=BF_{IB}^{80}}^{1=BF_{IB}^{95}}$				-0.001 (0.185)
Constant	0.235*** (0.057)	0.517*** (0.086)	0.235** (0.061)	0.361** (0.092)
Observations	70	54	63	61

Table 15: Player 1 Blue: Bandit Treatments with Independent Beliefs ( $S_L$  participants)

Notes: All estimations are linear regressions in which the dependent variable takes value 1 if the  $S_L$  participant eventually locked in to  $In$  when Blue and 0 otherwise. All estimations include only  $S_L$  participants. Notation for the right-hand side dummy variables ( $D_B^A$ ) is as follows. Superscript  $A$  (Subscript  $B$ ) captures the condition under which the dummy equals 1 (0). Let  $\Pr(\square|\theta_1 = \text{Blue}) = X \in \{80\%, 95\%$ . The condition  $BR_{IB}^X$  indicates participants who were assigned to  $BR_{IB}$  (independent-beliefs bandit with random types treatment) with the probability at  $X$ . The condition  $BF_{IB}^X$  indicates participants who were assigned to  $BF_{IB}$  (independent-beliefs bandit with fixed types treatment) with the probability at  $X$ . Standard errors between parentheses. Significant at 10% (\*), 5% (\*\*), 1% (\*\*\*). Standard errors clustered by session.

	(1)	(2)	(3)	(4)	(5)	(6)
$D_{0=BF_{IB}}^{1=GF}$	0.089 (0.080)					
$D_{0=BF_{IB}^{80}}^{1=GF}$		0.089 (0.100)				
$D_{0=BF_{IB}^{95}}^{1=GF}$			0.090 (0.132)			
$D_{0=BF_{IB}}^{1=BF_{PC}}$				0.131 (0.085)		
$D_{0=BF_{IB}^{80}}^{1=BF_{PC}}$					0.257** (0.084)	
$D_{0=BF_{IB}^{95}}^{1=BF_{PC}}$						-0.025 (0.105)
Constant	0.361*** (0.057)	0.361*** (0.083)	0.360** (0.120)	0.361*** (0.058)	0.235*** (0.056)	0.517*** (0.085)
Observations	101	76	65	122	95	90

Table 16: Player 1 Blue - Fixed Types: Comparing Bandit Treatments with Independent Beliefs to Game and Bandit Treatments with Perfect Correlation ( $S_L$  participants)

Notes: All estimations are linear regressions in which the dependent variable takes value 1 if the  $S_L$  participant eventually locked in to  $In$  when Blue and 0 otherwise. All estimations include only  $S_L$  participants. Notation for the right-hand side dummy variables ( $D_B^A$ ) is as follows. Superscript  $A$  (Subscript  $B$ ) captures the condition under which the dummy equals 1 (0). Let  $\Pr(\square|\theta_1 = \text{Blue}) = X \in \{80\%, 95\%$ . The condition  $BR_{IB}^X$  indicates participants who were assigned to  $BR_{IB}$  (independent-beliefs bandit with random types treatment) with the probability at  $X$ . The condition  $BF_{IB}^X$  indicates participants who were assigned to  $BF_{IB}$  (independent-beliefs bandit with fixed types treatment) with the probability at  $X$ . Standard errors between parentheses. Significant at 10% (\*), 5% (\*\*), 1% (\*\*\*). Standard errors clustered by session.

	(1)	(2)	(3)	(4)	(5)	(6)
$D_{0=BR_{IB}}^{1=GR}$	0.282*** (0.084)					
$D_{0=BR_{IB}^{80}}^{1=GR}$		0.412*** (0.084)				
$D_{0=BR_{IB}^{95}}^{1=GR}$			0.130 (0.105)			
$D_{0=BR_{IB}}^{1=BR_{PC}}$				0.125 (0.074)		
$D_{0=BR_{IB}^{80}}^{1=BR_{PC}}$					0.255** (0.074)	
$D_{0=BR_{IB}^{95}}^{1=BR_{PC}}$						-0.027 (0.098)
Constant	0.365*** (0.056)	0.235*** (0.055)	0.517*** (0.084)	0.365*** (0.057)	0.235*** (0.056)	0.517*** (0.085)
Observations	114	85	80	116	87	82

Table 17: Player 1 Blue - Random Types: Comparing Bandit Treatments with Independent Beliefs to Game and Bandit Treatments with Perfect Correlation ( $S_L$  participants)

Notes: All estimations are linear regressions in which the dependent variable takes value 1 if the  $S_L$  participant eventually locked in to  $In$  when Blue and 0 otherwise. All estimations include only  $S_L$  participants. Notation for the right-hand side dummy variables ( $D_B^A$ ) is as follows. Superscript  $A$  (Subscript  $B$ ) captures the condition under which the dummy equals 1 (0). Let  $\Pr(\square|\theta_1 = \text{Blue}) = X \in \{80\%, 95\%\}$ . The condition  $BR_{IB}^X$  indicates participants who were assigned to  $BR_{IB}$  (independent-beliefs bandit with random types treatment) with the probability at  $X$ . The condition  $BF_{IB}^X$  indicates participants who were assigned to  $BF_{IB}$  (independent-beliefs bandit with fixed types treatment) with the probability at  $X$ . Standard errors between parentheses. Significant at 10% (\*), 5% (\*\*), 1% (\*\*\*). Standard errors clustered by session.

# Online Appendix D: Instructions

## Game Treatments

Between brackets we report on protocol regarding the instruction period. In italics we highlight areas where there are differences between GR and GF. In the case of the GR<sub>HYP</sub> treatment, instructions coincide with the instructions for GR except for the portion indicated between { }.

[Once participants seated in each terminal have signed consent forms, the welcome message and general instructions pages are distributed to all participants and read aloud.]

### Welcome

You are about to participate in a session on decision-making, and you will be paid for your participation with cash, privately at the end of the session. What you earn depends partly on your decisions and partly on chance.

The entire session will take place through computer terminals and there will be no interaction with participants seated at other terminals. Please do not communicate with other participants during the session. Please turn off cell phones now.

Please remember that the experiment will last 75 minutes. We will start with a brief instruction period. Please pay attention. When I finish reading the instructions, you will be asked questions regarding these instructions. If you have any questions, please wait until we finish reading the instructions.

### General Instructions

There are two roles in this experiment: The ‘Color’ role and the ‘Shape’ role.

- Now, please flip over the piece of paper taped to your desk. If you see the word ‘Color,’ your role for the session is the ‘Color’ role. If you see the word ‘Shape,’ your role for the session is the ‘Shape’ role. You will remain in the same role throughout the session.

There are two decks of cards in this experiment.

- The ‘red deck’ contains 100 red cards. The ‘blue deck’ contains 100 blue cards.

*[In GF only:]*

- *At the beginning of the session the interface will randomly select a deck of cards for each participant in the ‘Color’ role: either the ‘red deck,’ or the ‘blue deck.’ This means that some participants in the ‘Color’ role can be assigned the ‘red deck’ and others can be assigned the ‘blue deck.’ If you are a participant in the ‘Color’ role, you will use the same deck throughout the session.*

[GR and GF:]

The experiment consists of 120 rounds.

Each round

- One participant in the ‘Color’ role will be matched with one participant in the ‘Shape’ role.

*[In GR only:]*

- *The interface will randomly select a deck of cards: either the ‘red deck,’ or the ‘blue deck.’*
- *The participant in the ‘Color’ role will be informed which deck of cards was selected (red or blue). The participant in the ‘Shape’ role will not be informed which deck of cards was selected.*

[GR and GF:]

- The participant in the ‘Shape’ role will not be informed which deck of cards was selected for the participant in the ‘Color’ role that they are interacting with.
- Both participants will make a decision at the same time, which means that each participant will not know what the other chose when making their own decision.
- The participant in the ‘Shape’ role decides if either all cards have a square shape, or if all cards have a triangle shape.
- The participant in the ‘Color’ role will have to make a choice between the following two options:
  - Get a card;
  - Do not get a card.
- If the participant in the ‘Color’ role decides not to get a card, the round is over.
- If the participant in the ‘Color’ role decides to get a card, the interface will pick one card from the deck.
- We will now describe how your payoff is determined. If your role is ‘Color,’ you will know your own payoffs, but you will not know the payoffs of the participant in the Shape role. If your role is ‘Shape,’ you will know your own payoffs, but you will not know the payoffs of the participant in the Color role.

- I will now distribute a sheet of paper with the information on payoffs. All participants in the ‘Shape’ role receive the same sheet of paper, but participants in the ‘Color’ role will not receive this information. All participants in the ‘Color’ role receive the same sheet of paper, but participants in the ‘Shape’ role will not receive this information.
- The sheet of paper explains how your payoff is determined. Please read it carefully. After you finish reading it I will instruct you to answer on your screen a few questions related to payoffs.

[The next sheet is distributed only to participants in the Color role. Participants in the Color role are seated in the first two rows of the laboratory. Participants in the Shape role are seated in the last two rows of the laboratory. There is no row of computer terminals in which participants in the Color and Shape roles are seated next to each other.]

Color Role

- Payoffs:
  - If you decide not to get the card, your payoff for the round is 15.
  - If you decide to get the card, the payoff depends on the color of the deck of cards and on the choice of the participant in the shape role as indicated in the following table:

Shape	Red Deck	Blue Deck
Squares	20	18
Triangles	16	5

That is, if the deck consists of:

- Red Squares, your payoff is 20;
- Red Triangles, your payoff is 16;
- Blue Squares, your payoff is 18;
- Blue Triangles, your payoff is 5.

[Sheet distributed only to participants in the Color role]

Shape role

- Payoffs:
  - If the participant in the ‘Color’ role decides not to get the card, your payoff for the round is 15.

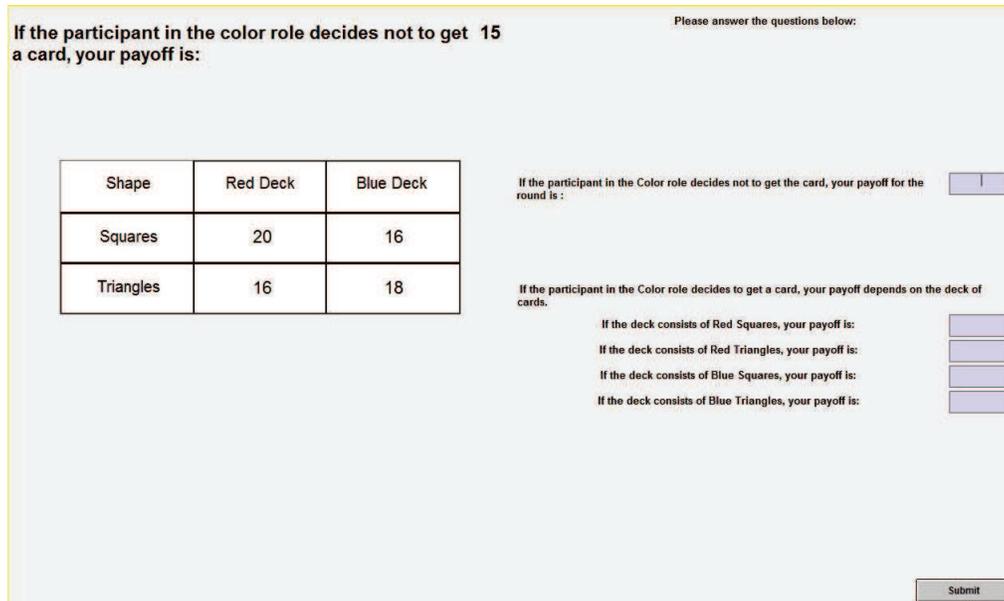


Figure 11: Example of screenshot with questions on the instructions for player 2

- If the participant in the ‘Color’ role decides to get the card, the payoff depends on the color of the deck and on your choice of shape as indicated in the following table:

Shape	Red Deck	Blue Deck
Squares	20	16
Triangles	16	18

That is, if the deck consists of:

- Red Squares, your payoff is 20;
- Red Triangles, your payoff is 16;
- Blue Squares, your payoff is 16;
- Blue Triangles, your payoff is 18.

[The interface is started and participants are asked to answer a few questions related to the payoff sheet on their screens. Figure 11 presents a screenshot of the questions that participants in the role of player 2 answered. The interface would move on only all of submitted answers are correct. Otherwise, a pop-up box appears indicating that at least one of the entries is not correct. Once all participants answer all questions correctly, the sheet entitled ‘Payoffs for the session and other information’ is distributed to all participants and read aloud.]

Payoffs for the session and other information

- To determine your payoff for the session the interface will randomly select one round. Your payoff for the session is equal to the payoff you obtained in the selected round.
- Throughout the session on the right side of the screen you will have information on choices for previous rounds that were needed to determine payoffs.
- When a new round begins you will be randomly matched with a participant in the other role. This means that in different rounds you can be interacting with different participants.
- Part 1 of the experiment consists of 60 rounds. Part 2 of the experiment consists of 60 rounds. Part 2 of the experiment is identical to Part 1 except that in Part 2 the interface will provide an additional way for you to submit your choices.

[Start the interface and read the following script: “I will now start the interface, but please do not click anywhere until I describe how you will make your choices. At the top left of your screen you are reminded of the round number. The current round number is 1 since this is the first round of the session. Below the round information you are reminded of how your payoff is determined. The information provided to you reproduces the information in the sheet of paper distributed earlier. Below you can identify a box with two buttons. If you are in the Color role the buttons read: ‘Get a card’ and ‘Do not get a card.’ If you are in the Shape role, the buttons read: ‘Squares’ and ‘Triangles.’ Please do not click anywhere yet, but I will describe how you will make a choice. To make a choice you simply have to click on the button of your preferred alternative. You will see that the selected alternative is highlighted in grey and that a submit button appears at the bottom. You can change your choice as long as you haven’t clicked on the submit button. Once you click on the submit button, your decision is final. You can now take your time and make your choices for round 1.” Once all participants have made choices for round 1, the interface presents on the screen the payoff outcome for the round. Before they make their round 2 choices, read the following script: “You just finished with round 1 with the experiment. Please do not click anywhere until I ask you to. At the top left of your screens you can now see that you are starting round 2. Since there is now information on past choices –the choices of round 1– the right side of your screen presents this information. At the top right of your screens there is a table and in this table one row will be added for each round. For each round you are reminded of your choice and the choice of the person in the other role, whenever these choices were necessary to determine payoffs. You are also reminded of the payoff for that round. Below this table you are also provided with a summary of the information on past choices and outcomes. If you are in the color role, you can see the average payoff that you received in cases when: [GR: i) you selected to get a card and the deck was red, ii) you selected to get a card and the deck was blue, iii) you selected not to get a card.] [GF: i) you selected to get a card, and ii) you selected not to get a card.] You are also provided summary

information on the choices of the participants in the other role that you observed: the number of times you observed a participant in the shape role select squares and the number of times they selected triangles. If you are in the shape role, you can see the average payoff that you received in cases when you selected squares (and your choice was relevant to determine your payoff), and the average payoff that you received in cases when you selected triangles (and your choice was relevant to determine your payoff). You are also provided summary information of the choices of the participants in the other role. The number of times you observed participants in the color role select to get a card when the deck was red, the number of times you observed participants in the color role select to get a card when the deck was blue, and the number of times a participant in the color chose not to get a card. You can now make your choices for round 2.”]

{GR<sub>HYP</sub>: Follow the previous script until all participants have made choices for round 1, and the interface presents on the screen the payoff outcome for the round. Before they make their round 2 choices read the following script. “You just finished with round 1 with the experiment. Please do not click anywhere until I ask you to. At the top left of your screen you can now see that you are starting round 2. Since there is now information on past choices –the choices of round 1– the right side of your screen presents this information. At the top right of your screen there is a table and in this table one row will be added for each past round. For each round you are reminded of your choice. You are also reminded of the person in the other role, whenever this choice mattered for your payoff. You are also reminded of the payoff for that round. Below this table you are provided with a summary of the information on past choices and outcomes.

[Distribute a sheet of paper with the image below to participants in the color role

Summary information	
Number of times the Shape role selected "Squares"	= #Squares
Number of times the Shape role selected "Triangles"	= #Triangles
Expected Payoff of "Get a Card when the Deck is Red"	$= 20 \times \left( \frac{\#Squares}{\#Squares + \#Triangles} \right) + 16 \times \left( \frac{\#Triangles}{\#Squares + \#Triangles} \right)$
Expected Payoff of "Get a Card when the Deck is Blue"	$= 18 \times \left( \frac{\#Squares}{\#Squares + \#Triangles} \right) + 5 \times \left( \frac{\#Triangles}{\#Squares + \#Triangles} \right)$
Expected Payoff of "Do not Get a Card"	= 15

]

If you are in the color role, you are provided with summary information on the choices of the participants in the other role that you observed. I will use the sheet of paper I just distributed to explain the summarized information you will see.

The first line will show the number of times you observed participants in the shape role selecting squares (indicated as #Squares in the sheet of paper). The second line shows the number of times that Shape selected triangles (indicated as #Triangles).

You can also see the expected payoff for three cases.

First, for the case where you choose to get a card and the deck is red. The expected payoff is computed as shown in the sheet of paper next to the ‘Expected Payoff of “Get a Card when the Deck is Red”’ line. The expected payoff equals the payoff you get if the participant in the shape role selects squares times the proportion of times that you observed participants in the shape role selecting squares, plus the payoff that you get if the participant in the shape role selects triangles times the proportion of times that you observed participants in the shape role selecting triangles.

Second, for the case where you choose to get a card and the deck is blue. The expected payoff is computed as shown in the sheet of paper next to the ‘Expected Payoff of “Get a Card when the Deck is Blue”’ line. The expected payoff equals the payoff you get if the participant in the shape role selects squares times the proportion of times that you observed participants in the shape role selecting squares, plus the payoff that you get if the participant in the shape role selects triangles times the proportion of times that you observed participants in the shape role selecting triangles.

Third, you can also see the payoff of selecting not to get a card.

If you are in the shape role, you can see the average payoff that you received in cases when you selected squares (and your choice was relevant to determine your payoff), and the average payoff that you received in cases when you selected triangles (and your choice was relevant to determine your payoff). You are also provided summary information of the choices of the participants in the other role. The number of times you observed participants in the color role select to get a card when the deck was red, the number of times you observed participants in the color role select to get a card when the deck was blue and the number of times a participant in the color role chose not to get a card.

You can now make your choices for round 2.}

[Both treatments: Once participants finish with round 60 the interface pauses. Distribute the instructions for part 2 and read these instructions aloud.]

### Instructions for Part 2

If you are the participant in the ‘Color’ role you can from now on every 10 rounds:

- Either continue to make choices round by round as in Part 1,

*[In GR only:]*

- *Or indicate to the interface what you want to do for the current and future rounds:*
  - *You can select what to do for each possible color of the deck of cards. That is, you would indicate what you want the interface to do for you if the deck of cards is red and what to do if the deck of cards is blue.*
  - *In all future rounds once the color of the deck is determined, the interface will implement your choice for the selected deck of cards.*

*[In GF only:]*

- *Or indicate to the interface what you want to do for the current and future rounds:*
  - *You can select: get a card or do not get a card.*
  - *In the current and all future rounds, the interface will implement the choice that you indicated.*

[GR and GF:]

If you are the participant in the ‘Shape’ role you can from now on every 10 rounds:

- Continue to make choices round by round as in Part 1.
- Indicate to the interface what you want to do for the current and future rounds:
  - You can select: all squares or all triangle cards.
  - In the current and all future rounds, the interface will implement the choice that you indicated.

For all participants:

- Once you indicate what you want to do for future rounds you cannot change your choices.
- If you choose to make your choices round by round as in Part 1 in round 61, you will not have an option to specify what to do in future rounds until round 71. That is, you will have to make your choices round by round until round 71 when you can decide again whether to indicate what to do in future rounds or to still make your choices round by round.
- The alternative to indicate what to do in future rounds will be presented to you every 10 rounds as long as you are making your choices round by round.

[After having read the instructions, read the following script. “Please locate the grey button at the bottom right of your screens and click on it. There’s a pop-up that will appear, please click on yes and do not click anywhere else after that. I will explain how you can make your choices in Part 2. This is the beginning of round 61, as you can read at the top left and it is the first time that the interface allows you to select whether you want to indicate choices for the current and all future rounds. On your screen you can see two buttons. The button the right side reads ‘Make choices round by round.’ Don’t click anywhere yet, but if you were to click on that button, you would move on and make a choice for round 61 in the same manner that you made choices for the first 60 rounds. The button on the left reads ‘Implement choices for current and future rounds.’ Don’t click anywhere, but if you were to click on that button, the interface would present you with a

screen that looks similar to the screen where you indicate what choice to make each round. [GR. If your role is color, you will have to indicate what you want the interface to select for you when the deck is red (get a card or do not get a card) and what to select for you when the deck is blue (get a card or do not get a card).] [GF. If your role is color, you will have to indicate whether you want the interface to get a card or not get a card in the current and future rounds.] If your role is shape, you will have to indicate what you want the interface to select for you in the current and future rounds, either squares or triangles. If you ever click on the ‘Implement choices for current and future rounds’ button but change your mind and would rather make choices round by round, you can indeed go back to making choices round by round as long as you haven’t made a selection. There is a button at the bottom of the screen where you specify your choices that reads: ‘go back to making choices round by round.’ That button is available as long as you have not made a selection on what you would want the computer to select for you. Once you make such selection, you cannot go back to making choices round by round. If you decide to indicate what choices you would want the computer to make for you, you will still have to remain in the laboratory until the 120 rounds have passed. In other words, indicating what choices you would want the computer to make for you will not lead to the experiment ending sooner. If you decide to make choices round by round, you will be presented with this screen again in round 71, and from then on every 10 rounds as long as you keep on making choices round by round. You can now make your choices for round 61.”]

## **Bandit Treatments with Perfect Correlation**

Between brackets we report on protocol regarding the instruction period. In italics we highlight areas where there are differences between  $BR_{PC}$ ,  $BF_{PC}$  and  $BR_{PC}^{1D}$ .

[Once participants seated in each terminal have signed consent forms, the welcome message and general instructions pages are distributed to all participants and read aloud.]

### Welcome

You are about to participate in a session on decision-making, and you will be paid for your participation with cash, privately at the end of the session. What you earn depends partly on your decisions and partly on chance.

The entire session will take place through computer terminals and there will be no interaction with participants seated at other terminals. Please do not communicate with other participants during the session. Please turn off cell phones now.

Please remember that the experiment will last 75 minutes. We will start with a brief instruction period. Please pay attention. When I finish reading the instructions, you will be asked questions regarding these instructions. If you have any questions, please wait until we finish reading the instructions.

## General Instructions

*[BF<sub>PC</sub> and BR<sub>PC</sub> only]*

There are two decks of cards in this experiment.

- The “red deck” contains 100 red cards. The “blue deck” contains 100 blue cards.
- Cards can have one of two shapes: square or triangle.
- The composition of both decks is the same. That is, the red deck has the same number of square cards as the blue deck, and the red deck has the same number of triangle cards as the blue deck.
- You do not know how many of the 100 cards in a deck have a square shape and how many have a triangle shape.
- The composition of the decks will not change throughout the experiment. This means that the number of square- and triangle-shaped cards will not change.

*[in BF<sub>PC</sub> only]*

- *At the beginning of the session the interface will randomly select a deck of cards for each participant: either the “red deck,” or the “blue deck.” This means that some of you can be assigned the “red deck” and others can be assigned the “blue deck.” You will know the color of the deck assigned to you and you will use the same deck throughout the session.*

*[in BR<sub>PC</sub><sup>1D</sup> only]*

*There is one decks of cards in this experiment.*

- *The deck consists of 100 cards.*
- *Cards can have one of two shapes: square or triangle.*
- *You do not know how many of the 100 cards have a square shape and how many have a triangle shape.*
- *The composition of the deck will not change throughout the experiment. This means that the number of square- and triangle-shaped cards will not change.*

[All treatments]

The experiment consists of 120 rounds.

Each round

*[in BR<sub>PC</sub> only:]*

- *The interface will randomly select a deck of cards: either the ‘red deck,’ or the ‘blue deck.’*
- *You will be informed which deck of cards was selected (red or blue).*

*[in BR<sub>PC</sub> and BF<sub>PC</sub> only:]*

- *The interface will then randomly pick one card from the selected deck. All 100 cards are equally likely of being selected. You will not be informed the shape of the selected card.*

*[in BR<sub>PC</sub><sup>1D</sup> only]*

- *The interface will randomly paint the deck. Either all 100 cards are painted red or all 100 cards are painted blue.*
- *You will be informed of the color that was randomly selected to paint the cards.*
- *The interface will then randomly pick one card from the deck. All 100 cards are equally likely to be selected. You will not be informed the shape of the selected card.*

[All treatments]

- You will have to make a choice between the following two options:
  - Get the card
  - Do not get the card
- Payoffs:
  - If you decide not to get the card, your payoff for the round is 15.
  - If you decide to get the card, the payoff depends on the color and on the shape of the selected card as indicated in the following table:

Shape	Red Deck	Blue Deck
Squares	20	18
Triangles	16	5

- That is, if the selected card is a:
  - \* Red Square, your payoff is 20;
  - \* Red Triangle, your payoff is 16;
  - \* Blue Square, your payoff is 18;
  - \* Blue Triangle, your payoff is 5.

### Payoffs for the session and other information

- To determine your payoff for the session the interface will randomly select one round. Your payoff for the session is equal to the payoff you obtained in the selected round.
- Throughout the session on the right side of the screen you will have information on choices for previous rounds that were needed to determine payoffs.
- Part 1 of the experiment consists of 60 rounds. Part 2 of the experiment consists of 60 rounds. Part 2 of the experiment is identical to Part 1 except that in Part 2 the interface will provide an additional way for you to submit your choices.

[Start the interface and read the following script: “I will now start the interface, but please do not click anywhere until I describe how you will make your choices. At the top left of your screen you are reminded of the round number. The current round number is 1 since this is the first round of the session. Below the round information you are reminded of how your payoff is determined. The information provided to you reproduces the information in the instructions. Below you can identify a box with two buttons that read: ‘Get a card’ and ‘Do not get a card.’ Please do not click anywhere yet, but I will describe how you will make a choice. To make a choice you simply have to click on the button of your preferred alternative. You will see that the selected alternative is highlighted in grey and that a submit button appears at the bottom. You can change your choice as long as you haven’t clicked on the submit button. Once you click on the submit button, your decision is final. You can now take your time and make your choices for round 1.” Once all participants have made choices for round 1, the interface presents on the screen the payoff outcome for the round. Before they make their round 2 choices, read the following script: “You just finished with round 1 with the experiment. Please do not click anywhere until I ask you to. At the top left of your screens you can now see that you are starting round 2. Since there is now information on past choices –the choices of round 1– the right side of your screen presents this information. At the top right of your screens there is a table and in this table one row will be added for each round. For each round you are reminded of your choice and the selected card, whenever this information was necessary to determine payoffs. You are also reminded of the payoff for that round. Below this table you are also provided with a summary of the information on past choices and outcomes. If you are in the color role, you can see the average payoff that you received in cases when:

*[BR<sub>PC</sub> and BR<sub>PC</sub><sup>1D</sup>: i) you selected to get a card and the deck was red, ii) you selected to get a card and the deck was blue, iii) you selected not to get a card.]*

*[BF<sub>PC</sub>: i) you selected to get a card, and ii) you selected not to get a card.]*

You are also provided summary information on the cards that you observed: the number of times you observed the square-shaped cards and the number of times you have observed triangle-shaped cards. You can now make your choices for round 2.”]

## Instructions for Part 2

You can from now on every 10 rounds:

- Either continue to make choices round by round as in Part 1,

*[in BR<sub>PC</sub> and BR<sub>PC</sub><sup>1D</sup>.]*

- *Or indicate to the interface what you want to do for the current and future rounds:*
  - *You can select what to do for each possible color of the deck of cards. That is, you would indicate what you want the interface to do for you if the deck of cards is red and what to do if the deck of cards is blue.*
  - *In all future rounds once the color of the deck is determined, the interface will implement your choice for the selected deck of cards.*

*[in BF<sub>PC</sub> only:]*

- *Or indicate to the interface what you want to do for the current and future rounds:*
  - *You can select: get a card or do not get a card.*
  - *In the current and all future rounds, the interface will implement the choice that you indicated.*

*[All treatments:]*

- Once you indicate what you want to do for future rounds you cannot change your choices.
- If you choose to make your choices round by round as in Part 1 in round 61, you will not have an option to specify what to do in future rounds until round 71. That is, you will have to make your choices round by round until round 71 when you can decide again whether to indicate what to do in future rounds or to still make your choices round by round.
- The alternative to indicate what to do in future rounds will be presented to you every 10 rounds as long as you are making your choices round by round.

[After having read the instructions, read the following script. “Please locate the grey button at the bottom right of your screens and click on it. There’s a pop-up that will appear, please click on yes and do not click anywhere else after that. I will explain how you can make your choices in Part 2. This is the beginning of round 61, as you can read at the top left and it is the first time that the interface allows you to select whether you want to indicate choices for the current and all future rounds. On your screen you can see two buttons. The button on the right side reads ‘Make choices

round by round.’ Don’t click anywhere yet, but if you were to click on that button, you would move on and make a choice for round 61 in the same manner that you made choices for the first 60 rounds. The button on the left reads ‘Implement choices for current and future rounds.’ Don’t click anywhere, but if you were to click on that button, the interface would present you with a screen that looks similar to the screen where you indicate what choice to make each round.

*[BR<sub>PC</sub> and BR<sub>PC</sub><sup>1D</sup>. You will have to indicate what you want the interface to select for you when the deck is red (get a card or do not get a card) and what to select for you when the deck is blue (get a card or do not get a card).]*

*[BF<sub>PC</sub>. You will have to indicate whether you want the interface to get a card or not get a card in the current and future rounds.]*

If you ever click on the ‘Implement choices for current and future rounds’ button but change your mind and would rather make choices round by round, you can indeed go back to making choices round by round as long as you haven’t made a selection. There is a button at the bottom of the screen where you specify your choices that reads: ‘go back to making choices round by round.’ That button is available as long as you have not made a selection on what you would want the computer to select for you. Once you make such selection, you cannot go back to making choices round by round. If you decide to indicate what choices you would want the computer to make for you, you will still have to remain in the laboratory until the 120 rounds have passed. In other words, indicating what choices you would want the computer to make for you will not lead to the experiment ending sooner. If you decide to make choices round by round, you will be presented with this screen again in round 71, and from then on every 10 rounds as long as you keep on making choices round by round. You can now make your choices for round 61.”]

## **Bandit Treatments with Independent Beliefs**

Between brackets we report on protocol regarding the instruction period. In italics we highlight areas where there are differences between BR<sub>IB</sub>, and BF<sub>IB</sub>.

[Once participants seated in each terminal have signed consent forms, the welcome message and general instructions pages are distributed to all participants and read aloud.]

### Welcome

You are about to participate in a session on decision-making, and you will be paid for your participation with cash, privately at the end of the session. What you earn depends partly on your decisions and partly on chance.

The entire session will take place through computer terminals and there will be no interaction with participants seated at other terminals. Please do not communicate with other participants during the session. Please turn off cell phones now.

Please remember that the experiment will last 75 minutes. We will start with a brief instruction period. Please pay attention. When I finish reading the instructions, you will be asked questions regarding these instructions. If you have any questions, please wait until we finish reading the instructions.

### General Instructions

There are two decks of cards in this experiment.

- The “red deck” contains 100 red cards. The “blue deck” contains 100 blue cards.
- Cards can have one of two shapes: square or triangle.
- There are two versions of each deck of cards. In Version 1, 95 cards are square cards and the remaining 5 cards are triangle cards. In Version 2, 80 cards are square cards and the remaining 20 cards are triangle cards.
- The computer tosses a fair coin to determine which version is used for the red deck. If heads comes up, the red deck will be of Version 1. If tails comes up, the red deck will be of Version 2.
- The computer tosses another fair coin to determine which version is used for the blue deck. If heads comes up, the blue deck will be of Version 1. If tails comes up, the blue deck will be of Version 2.
- You will not know which version of the red deck is selected. You will not know either which version of the blue deck is selected.
- The decks will not change throughout the experiment. This means that the number of square- and triangle-shaped cards in the “red deck” will not change. The number of square- and triangle-shaped cards in the “blue deck” will not change either.

*[in BF<sub>1B</sub> only]*

- *At the beginning of the session the interface will randomly select a deck of cards for each participant: either the “red deck,” or the “blue deck.” This means that some of you can be assigned the “red deck” and others can be assigned the “blue deck.” You will know the color of the deck assigned to you and you will use the same deck throughout the session.*

[All treatments]

The experiment consists of 120 rounds.

### Each round

*[in BR<sub>1B</sub> only:]*

- *The interface will randomly select a deck of cards: either the ‘red deck,’ or the ‘blue deck.’*
- *You will be informed which deck of cards was selected (red or blue).*

[All treatments:]

- The interface will then randomly pick one card from the selected deck. All 100 cards are equally likely of being selected. You will not be informed the shape of the selected card.
- You will have to make a choice between the following two options:
  - Get the card
  - Do not get the card
- Payoffs:
  - If you decide not to get the card, your payoff for the round is 15.
  - If you decide to get the card, the payoff depends on the color and on the shape of the selected card as indicated in the following table:

Shape	Red Deck	Blue Deck
Squares	20	18
Triangles	16	5

- That is, if the selected card is a:
  - \* Red Square, your payoff is 20;
  - \* Red Triangle, your payoff is 16;
  - \* Blue Square, your payoff is 18;
  - \* Blue Triangle, your payoff is 5.

#### Payoffs for the session and other information

- To determine your payoff for the session the interface will randomly select one round. Your payoff for the session is equal to the payoff you obtained in the selected round.
- Throughout the session on the right side of the screen you will have information on choices for previous rounds that were needed to determine payoffs.
- Part 1 of the experiment consists of 60 rounds. Part 2 of the experiment consists of 60 rounds. Part 2 of the experiment is identical to Part 1 except that in Part 2 the interface will provide an additional way for you to submit your choices.

Please answer the questions below:

If Version 1 of the deck is selected:  
 The number of Square cards in the deck is:   
 The number of Triangle cards in the deck is:

If Version 2 of the deck is selected:  
 The number of Square cards in the deck is:   
 The number of Triangle cards in the deck is:

Version 1 and Version 2 of the deck are equally likely of being selected. You will not know which version is selected for each deck, but once a version of the blue deck is selected and a version of the red deck is selected:

the selected version is used in all rounds of the experiment.  
 the selected version is not used in all rounds of the experiment

Figure 12: Example of screenshot with questions in bandit treatments with independent beliefs

[The interface is started and participants are asked to answer a few questions. Figure 12 presents a screenshot of the questions. The interface would move on only when upon clicking on the submit button their answer is correct. If the answer is incorrect, a pop-up box appears indicating that at least one of the entries is not correct. Once all participants answer all questions correctly, the sheet entitled ‘Payoffs for the session and other information’ is distributed to all participants and read aloud.]

[Read the following script: “I will now start the interface, but please do not click anywhere until I describe how you will make your choices. At the top left of your screen you are reminded of the round number. The current round number is 1 since this is the first round of the session. Below the round information you are reminded of how your payoff is determined. The information provided to you reproduces the information in the instructions. Below you can identify a box with two buttons that read: ‘Get a card’ and ‘Do not get a card.’ Please do not click anywhere yet, but I will describe how you will make a choice. To make a choice you simply have to click on the button of your preferred alternative. You will see that the selected alternative is highlighted in grey and that a submit button appears at the bottom. You can change your choice as long as you haven’t clicked on the submit button. Once you click on the submit button, your decision is final. You can now take your time and make your choices for round 1.” Once all participants have made choices for round 1, the interface presents on the screen the payoff outcome for the round. Before they make their round 2 choices, read the following script: “You just finished with round 1 with the experiment. Please do not click anywhere until I ask you to. At the top left of your screens you can now see that you are starting round 2. Since there is now information on past choices –the choices of round

1– the right side of your screen presents this information. At the top right of your screens there is a table and in this table one row will be added for each round. For each round you are reminded of your choice and the selected card, whenever this information was necessary to determine payoffs. You are also reminded of the payoff for that round. Below this table you are also provided with a summary of the information on past choices and outcomes. If you are in the color role, you can see the average payoff that you received in cases when: [BR<sub>IB</sub>: i) you selected to get a card and the deck was red, ii) you selected to get a card and the deck was blue, iii) you selected not to get a card. You are also provided summary information on the cards that you observed: the number of times you observed the square-shaped cards and the number of times you have observed triangle-shaped cards when the deck was blue, and the number of times you observed the square-shaped cards and the number of times you have observed triangle-shaped cards when the deck was red] [BF<sub>IB</sub>: i) you selected to get a card, and ii) you selected not to get a card. You are also provided summary information on the cards that you observed: the number of times you observed the square-shaped cards and the number of times you have observed triangle-shaped cards.] You can now make your choices for round 2.”]

#### Instructions for Part 2

You can from now on every 10 rounds:

- Either continue to make choices round by round as in Part 1,

[in BR<sub>IB</sub>:]

- *Or indicate to the interface what you want to do for the current and future rounds:*
  - *You can select what to do for each possible color of the deck of cards. That is, you would indicate what you want the interface to do for you if the deck of cards is red and what to do if the deck of cards is blue.*
  - *In all future rounds once the color of the deck is determined, the interface will implement your choice for the selected deck of cards.*

[in BF<sub>IB</sub>:]

- *Or indicate to the interface what you want to do for the current and future rounds:*
  - *You can select: get a card or do not get a card.*
  - *In the current and all future rounds, the interface will implement the choice that you indicated.*

[All treatments:]

- Once you indicate what you want to do for future rounds you cannot change your choices.
- If you choose to make your choices round by round as in Part 1 in round 61, you will not have an option to specify what to do in future rounds until round 71. That is, you will have to make your choices round by round until round 71 when you can decide again whether to indicate what to do in future rounds or to still make your choices round by round.
- The alternative to indicate what to do in future rounds will be presented to you every 10 rounds as long as you are making your choices round by round.

[After having read the instructions, read the following script. “Please locate the grey button at the bottom right of your screens and click on it. There’s a pop-up that will appear, please click on yes and do not click anywhere else after that. I will explain how you can make your choices in Part 2. This is the beginning of round 61, as you can read at the top left and it is the first time that the interface allows you to select whether you want to indicate choices for the current and all future rounds. On your screen you can see two buttons. The button on the right side reads ‘Make choices round by round.’ Don’t click anywhere yet, but if you were to click on that button, you would move on and make a choice for round 61 in the same manner that you made choices for the first 60 rounds. The button on the left reads ‘Implement choices for current and future rounds.’ Don’t click anywhere, but if you were to click on that button, the interface would present you with a screen that looks similar to the screen where you indicate what choice to make each round.

*[BR<sub>1B</sub>. You will have to indicate what you want the interface to select for you when the deck is red (get a card or do not get a card) and what to select for you when the deck is blue (get a card or do not get a card).]*

*[BF<sub>1B</sub>. You will have to indicate whether you want the interface to get a card or not get a card in the current and future rounds.]*

If you ever click on the ‘Implement choices for current and future rounds’ button but change your mind and would rather make choices round by round, you can indeed go back to making choices round by round as long as you haven’t made a selection. There is a button at the bottom of the screen where you specify your choices that reads: ‘go back to making choices round by round.’ That button is available as long as you have not made a selection on what you would want the computer to select for you. Once you make such selection, you cannot go back to making choices round by round. If you decide to indicate what choices you would want the computer to make for you, you will still have to remain in the laboratory until the 120 rounds have passed. In other words, indicating what choices you would want the computer to make for you will not lead to the experiment ending sooner. If you decide to make choices round by round, you will be presented with this screen again in round 71, and from then on every 10 rounds as long as you keep on making choices round by round. You can now make your choices for round 61.”]