

You Know, So I Know!

Endogenous Information Acquisition and Observability in a Threshold Public Goods Game*

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October 23, 2025

Abstract

We investigate how endogenous information acquisition and its observability affect threshold public goods provision under uncertainty. Our experiment shows that allowing players to acquire private signals about uncertain thresholds increases provision by 12 percentage points over baseline, benefiting exclusively from information acquirers. When acquisition choices become observable, provision rises another 11 percentage points, primarily when both players acquire information and coordinate efficiently. We find observable acquisition serves as an effective coordination device. Our results demonstrate

*We thank Moumita Deb, Carsten de Dreu, Marco Haan, Pim Heijnen, Mark van Oldeniel, Noemi Peter, Jason Shachat, Adriaan Soetevent, Gijsbert Zwart, and participants at the ESA European Meeting 2024, the ESA World Meeting 2025, the workshop “Experiments for the Environment” 2025, and at Micro/GrEELab meetings in Groningen for discussions and comments. The financial and practical support of the Groningen Experimental Economics Lab (GrEELab) is gratefully acknowledged (Grant no. GR23-06). This study has been preregistered at AsPredicted (#171270) and received approval from the Institutional Review Board of the University of Groningen (FEB-20240404-14784). We used stargazer (Hlavac, 2025) to export tables from R. All remaining errors are those of the authors.

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that transparency about information-gathering activities, not just information content, mitigates strategic uncertainty and enhances collective action.

Keywords: *threshold public goods game; endogenous information acquisition; private and public acquisition.*

JEL Classification: C71; C92; D82; D83; Q54.

1 Introduction

Threshold Public Goods Games (TPGGs)—where minimum contributions are necessary to achieve collective benefits—play a crucial role in various societal outcomes, including climate adaptation (Barrett, 2003), fundraising initiatives (Andreoni, 1998), infrastructure development (Carlsson et al., 2015), and voluntary effort provision (Turiansky, 2021).¹ Yet uncertainty about the provision threshold is endemic in real-world collective action problems and alters people’s strategic motives in theory (Barrett, 2013; McBride, 2006; Suleiman, 1997). To illustrate, consider two companies entering an emerging market with regulatory uncertainty. The regulatory environment determines the minimum investment required for successful market entry. High regulatory barriers establish a threshold that necessitates substantial investment from both companies combined, while low barriers set a threshold that can be met by either company’s investment alone. When companies anticipate high barriers, they must coordinate—both invest heavily or market entry fails. When they expect low barriers, each may try to free-ride, hoping the other bears more cost. When the regulatory environment is uncertain, companies face a strategic dilemma: should they risk overinvestment by coordinating when free-riding might be effective, or attempt free-riding by underinvesting when coordination might be essential?

This strategic dilemma pervades many real-world scenarios, including natural resource management, public health, and environmental conservation. For instance, pharmaceutical companies developing vaccines for emerging viruses face uncertainty about the virus’s strength. A resistant virus requires both companies to invest heavily in research and development (coordination motive), whereas a weak virus allows for individual investments, tempting each company to hope the other invests so they can benefit from shared knowledge while minimizing their own costs (free-riding incentive). Similarly, agricultural communities deciding on irrigation capacity for the upcoming season face drought uncertainty. Severe droughts necessitate coordinated investment in high-capacity systems, whereas mild droughts allow individual communities to meet their needs independently, creating tensions between coordination and free-riding incentives.

¹Early research on threshold public goods with complete information includes the works of Van De Kragt et al. (1983), T. R. Palfrey and Rosenthal (1984), Bagnoli and Lipman (1989), and Cadsby and Maynes (1999). A comprehensive review of this literature is provided by Croson and Marks (2000).

Threshold uncertainty thus creates competing strategic pressures that reshape decision dynamics in TPGGs. If the threshold turns out to be low, agents tend to free-ride, hoping that others will bear the full cost. If the threshold proves to be high, they prefer to coordinate their investments. Yet, threshold uncertainty traps them between the temptation to free ride and the necessity to coordinate. This tension distinguishes our setup from standard linear public good games, where contributing nothing remains dominant regardless of uncertainty. Such structural differences also yield different conclusions regarding how uncertainty affects contributions to the public goods. In Threshold Public Goods Games with uncertainty, there are frequent provision failures and wasteful overinvestment—inefficiencies documented by multiple studies (Barrett and Dannenberg, 2012; Barrett and Dannenberg, 2014; Dannenberg, 2015; McBride, 2010; Suleiman et al., 2001). In contrast, experimental studies on linear public goods with uncertainty show mixed results regarding contribution levels.²

We investigate how endogenous information acquisition—a powerful yet underexplored mechanism (Angeletos and Pavan, 2007; Morris and Shin, 2002)—can mitigate inefficiencies in threshold public goods provision. Similar to findings in strategic environments such as wars of attrition and bargaining, where information acquisition critically shapes equilibrium strategies and coordination outcomes (Chatterjee et al., 2025; Kim and Lee, 2014), we explore how this mechanism affects collective action under threshold uncertainty. Confronted with uncertainty, individuals in practice often actively seek information to guide their decisions (Stigler, 1961). Returning to our examples, companies may hire consultants to assess regulatory barriers before making an investment. Pharmaceutical companies may consult virologists about the resistance of viruses before developing vaccines. Agricultural communities might commission hydrologists to forecast drought severity before irrigation investments. This introduces a new strategic dimension, beyond the coordination-versus-free-riding tension we identified. Agents must decide not only how much to contribute, but also whether to acquire threshold information beforehand. Moreover, when agents can observe each other’s information acquisition decisions, they may interpret others’ decisions to seek or avoid information as revealing their strategic intentions and adjust their own investment strategies accordingly. We thus examine how both the *opportunity to acquire information* and the *observability* of such acquisition—whether information is gathered privately

²For instance, Dickinson (1998) and Levati et al. (2009) found negative effects of uncertainty on contributions, while Boulu-Reshef et al. (2017) and Théroude and Zylbersztein (2020) found no significant effects. Also, notice that in these experiments, uncertainty is typically modeled as mean-preserving spreads of returns.

or publicly—shape information-gathering incentives and subsequent contribution decisions in TPGGs.

We address these questions both theoretically and experimentally using a minimalist two-player TPGG with threshold uncertainty. Players can invest a high, medium, or zero amount to reach a threshold, which is equally likely to be low or high. We design the game parameters such that a low threshold can be achieved with high investment from a single player or medium investment from both players, while a high threshold necessitates high investment from both players. We then introduce endogenous information acquisition, allowing players to purchase an informative signal about the threshold under two conditions: when acquisition decisions remain private to each player, and when these decisions are publicly observable. Beyond resolving state uncertainty, information acquisition influences strategic dynamics by creating correlated signals (Myatt and Wallace, 2012). When both players acquire information, their highly correlated signals enable better coordination of their investment strategies, potentially allowing them to escape the inefficiencies that threshold uncertainty creates.

Our theoretical analysis reveals that both private and public information acquisition environments support a favorable equilibrium characterized by substantial yet efficient coordination. In this equilibrium, players acquire information and adopt investment strategies contingent on their acquired signals: when signals suggest a low threshold, both players invest at a medium level; when signals suggest a high threshold, both invest at a high level. This allows the public good to be provided at a high rate while maintaining allocation efficiency, and both players also achieve the maximum expected payoffs. Crucially, the observability of acquisition decisions creates fundamental structural advantages, facilitating coordination on this favorable equilibrium as mutual acquirers leverage signal correlation for efficient provision. Our equilibrium comparison reveals that while players always acquire information when acquisition is private, they lack coordination mechanisms for reliable equilibrium selection—explaining why correlated signals remain underutilized under private acquisition. These theoretical findings inform our main hypotheses: information acquisition should occur more frequently when private, while the success and efficiency of public goods provision should be higher when acquisition decisions are publicly observable.

We test these theoretical predictions through a controlled laboratory experiment. Our design features three main treatments: *Baseline*, Private Endogenous (*PrivateEndo*), and Public Endogenous (*PublicEndo*). In the *Baseline* treatment, par-

participants make allocations simultaneously to a TPGG with a common prior that the thresholds are equally likely to be low or high. In the *PrivateEndo* and *PublicEndo* treatments, participants, in addition, can acquire a private signal with a 90% accuracy about the threshold before making allocation decisions. The crucial difference between *PrivateEndo* and *PublicEndo* lies in the observability of signal acquisition. It remains private in *PrivateEndo* but becomes publicly observable in *PublicEndo*, allowing participants to further condition their allocation strategies on each other's information choices.

Our experimental design isolates two mechanisms central to mitigating the strategic trap we identified: how endogenously-formed signal correlations help resolve threshold uncertainty, and how observability affects strategic coordination. Comparing *Baseline* against *PrivateEndo* treatments reveals the benefits of correlated signals from endogenous information acquisition, while comparing *PrivateEndo* versus *PublicEndo* assesses whether mutual knowledge of acquisition (or non-acquisition) decisions enables players to better leverage signal correlations for implicit coordination.

We find that public good provision significantly improves with both endogenous information acquisition and its observability, consistent with theoretical predictions. First, private information acquisition raises provision success rates by 12 percentage points over *Baseline* (from 27% to 39%), but exclusively through the actions of information acquirers. They demonstrate a significant increase in their contributions, while non-acquirers show negligible behavioral change. Second, public observability of acquisition decisions yields an additional 11 percentage point gain (to 50%) by enabling equilibrium selection among mutual acquirers. When both players observe each other acquiring information, they achieve a remarkable 69% success rate, compared to 54% in *PrivateEndo*. Contrary to theoretical predictions, we observe no significant difference in acquisition rates between *PrivateEndo* (63%) and *PublicEndo* (71%) treatments. Instead, the benefits of observability stem from mutual acquirers strategically conditioning their contributions on visible acquisition decisions: they tend to increase allocations when paired with fellow acquirers but reduce them when paired with non-acquirers. Consequently, observability transforms information acquisition decisions into coordination devices that resolve strategic uncertainty through coordinated equilibrium selection, rather than merely threshold uncertainty resolution. Efficiency gains follow closely with success rates (12pp and 7pp improvements), confirming welfare benefits.

Our study extends the analysis of information acquisition to the domain of public good provision under uncertainty.³ Previous experimental work on public goods with information has focused on linear environments with exogenous information provision. Agents are randomly assigned signals about uncertain returns or Marginal Per Capita Returns (MPCRs) before contributing to the public goods (Aksoy and Krasteva, 2020; Cox and Stoddard, 2021).⁴ In these linear settings, contributing zero is a dominant strategy regardless of whether the return is high or low, limiting agents' strategic tension solely to free-riding incentives. In our setting, the environment shifts to a threshold public good with uncertain thresholds, creating a fundamentally different strategic tension between free-riding temptations at low thresholds versus coordination necessities at high thresholds.

Crucially, we endogenize information acquisition itself: agents decide whether to acquire a signal about the threshold.⁵ This transforms information into a strategic instrument, creating new channels through which others' information choices influence one's investment strategies to the public good. The key mechanism—signals are highly correlated when both players acquire—generates a coordination pathway that operates even when signals always remain private. This pathway delivers substantial efficiency gains through its endogenously formulated information structure, rather than its information content alone. As a result, information acquisition serves as a central lever for overcoming coordination frictions in threshold environments, beyond merely reducing state uncertainty.

We also contribute to the information design literature (Bergemann and Morris, 2019) by providing a systematic investigation of observability in games with endogenous information acquisition. Foundational theoretical work (Colombo et al., 2014; Hellwig and Veldkamp, 2009; Myatt and Wallace, 2012) examines simultaneous acquisition within Gaussian-quadratic frameworks but overlooks how acqui-

³There is a broader experimental literature on information acquisition across domains (e.g., auctions (Gretschko and Rajko, 2015), voting (Bhattacharya et al., 2017), asset markets (Page and Siemroth, 2017), and school choice (Chen and He, 2021).) that motivates the general relevance of information-seeking behavior in strategic settings.

⁴Aksoy and Krasteva (2020) study a linear public good with uncertain MPCR where participants are exogenously informed or uninformed about its realization. They find that information increases contributions in less generous groups but decreases them in more generous ones. Cox and Stoddard (2021) similarly examines a linear public good with uncertainty where participants receive exogenous private signals and can engage in cheap talk. They find that communication often improves efficiency despite incentives to exaggerate.

⁵Deb et al. (2024) similarly study endogenous information acquisition about uncertain thresholds on a range, but within a catastrophe avoidance framework (Milinski et al., 2008; Waichman et al., 2021) where heterogeneous groups of four face potential losses if contributions are insufficient. They mainly focus on how inadequate information updating and group heterogeneity in risk lead to negative effects of information acquisition on public good provision.

sition observability affects coordination. In our study, while acquired information always remains private, we manipulate whether the acquisition decision itself is observable to others before contribution choices are made. Building on evidence that common knowledge about fundamentals often fosters coordination (Deuchman et al., 2022)⁶, we show that observable information-seeking or avoidance can serve as an alternative when agreement on the state is infeasible.

The comparison between *PublicEndo* and *PrivateEndo* highlights how observability amplifies the benefits of information acquisition with an enhanced common knowledge about the intentions to coordinate. The mechanism operates through observability, serving as a coordination device. Participants strategically condition their investments on others' observable acquisition decisions, effectively utilizing others' information-acquiring (but not non-acquiring) behaviors as signals for coordinating on a high amount. This represents a novel mechanism distinct from traditional complementarity or substitutability frameworks in information acquisition theory, where information acquisition creates focal points for equilibrium selection. When acquisition decisions are publicly observable, players can further coordinate on which Bayesian game to play together, transforming the strategic environment from one with dual uncertainty (state and strategic) to one where strategic uncertainty is mitigated through observable information choices. Our findings reveal a straightforward and actionable policy insight: even when the content of acquired information cannot or should not be shared (as in climate assessments or financial stress tests), making the acquisition activity publicly observable can significantly improve coordination outcomes.

The rest of the paper is structured as follows: Section 2 develops our theoretical framework for Threshold Public Goods Games with uncertainty and analyzes equilibria across different information acquisition regimes. Section 3 details our experimental design and procedures. Section 4 presents our empirical findings and analysis. Section 5 concludes.

⁶They study TPGGs with a certain threshold but manipulate the extent to which the threshold is commonly known within groups. Unlike our study, where thresholds are genuinely uncertain and signals are noisy, they focus solely on how common knowledge reduces strategic uncertainty. Our mechanism complements theirs by showing that observability of information seeking can achieve similar coordination benefits even when the state remains uncertain.

2 Theoretical Framework

2.1 Game Setup

We consider a two-person Threshold Public Goods Game (TPGG) without a rebate. Two players, $i \in \{1, 2\}$, each start with an endowment of 10 Experimental Currency Units (ECUs) and simultaneously contribute $a^i \in A^i$ to a public good that requires reaching a contribution threshold, denoted by $\theta \in \Theta$. If the combined contributions meet or exceed the threshold, the public good is provided, generating a bonus of 30 ECUs evenly split between the two players. If the threshold is not met, the contributions are forfeited, incurring a loss of the contributed amount. We simplify the game and restrict each player's contribution to 0, 5, or 10 ECUs, reflecting a low, medium, or high investment in public good provision (i.e., $A^i = \{0, 5, 10\}$).

We establish two thresholds to highlight the different dynamics of *free-riding* versus *coordination* motives in the TPGG. The *LGame* (left panel of Table 1) features a low threshold of $\theta = 10$, which can be met either through a single player's high investment (10) or by equal medium investments (5) from both players. This game has three pure-strategy Nash equilibria—(5, 5), (10, 0), and (0, 10)—all of which are socially efficient. The asymmetric equilibria highlight the free-riding temptation, as each player prefers the other to bear the full cost. Nevertheless, the public good can also be provided through inefficient over-contributions, such as when one player contributes 5 and the other 10, or both contribute 10.

In contrast, the *HGame* (middle panel of Table 1) features a high threshold of $\theta = 20$, requiring both players to contribute their entire endowment for successful provision and making coordination motives critical. Here, players want to coordinate effectively; players must either both fully invest, thus achieving the unique socially efficient equilibrium, or jointly opt not to invest at all, thus preventing a futile expenditure on an unattainable public good.⁷ Any investment miscoordination leads to a failure of public good provision and a socially inefficient outcome.

While our model is simple with two discrete thresholds and three investment levels, the core strategic motives generalize to continuous settings with $\theta \in [0, 20]$ (or $a \in [0, 10]$). The strategic tension between free-riding and coordination emerges precisely when the threshold transitions from being "individually achievable" ($\theta \leq$

⁷Note that the full investment equilibrium is payoff dominant, and the no investment equilibrium is risk dominant, as outlined by Harsanyi and Selten (1988).

Table 1: Payoff matrices for the LGame, the HGame and the UGame

LGame ($\theta = \{10\}$)				HGame ($\theta = \{20\}$)				UGame ($\theta = \{10, 20\}$)			
P2				P2				P2			
	0	5	10		0	5	10		0	5	10
0	10, 10	10, 5	25, 15	0	<u>10, 10</u>	10, 5	10, 0	0	<u>10, 10</u>	10, 5	17.5, 7.5
P1 5	5, 10	20, 20	20, 15	P1 5	5, 10	5, 5	5, 0	P1 5	5, 10	<u>12.5, 12.5</u>	12.5, 7.5
10	15, 25	15, 20	15, 15	10	0, 10	0, 5	15, 15	10	7.5, 17.5	7.5, 12.5	15, 15

Note: Payoff matrices for the public good game, featuring a low threshold of 10, a high threshold of 20, and an uncertain threshold where two players share a common prior with high and low thresholds being equally likely. In the *LGame* and the *HGame*, the pure strategy Nash equilibrium outcomes are underlined. The sets of successful public good provisions are highlighted in red, while the efficient outcomes are indicated in bold. The underlined outcomes in the *UGame* are the pure strategy Bayesian Nash equilibrium outcomes.

individual endowment) to “collectively mandatory” ($\theta \geq$ individual endowment). Our parameterization deliberately isolates these fundamental incentives. $\theta = 10$ captures games where free-riding is dominating, representing the motives for any threshold $\theta \leq 10$. For $10 < \theta < 20$, both free-riding (underprovision risk) and coordination (overprovision inefficiency) motives coexist. At $\theta = 20$, coordination becomes strictly necessary and free-riding is less relevant, isolating the coordination problem. We fix $\theta = 20$ in the high-threshold case to cleanly capture coordination motives prevalent in demanding public goods.

If players are uncertain about the threshold, as the *UGame* in the right panel of Table 1 ($\theta \in \{L, H\}$), they must navigate both the state uncertainty regarding the threshold and the strategic uncertainty about their opponents’ potential contributions. These uncertainty concerns compel players to formulate strategies based not only on their own beliefs about the true state, but also on their expectations of how others will perceive and respond to the same uncertainties. These strengthen the free-riding versus coordination tension and represent fundamental strategic challenges in public goods provision that information acquisition may help resolve.

We extend the basic framework of Threshold Public Goods Game by introducing endogenous information acquisition in two variants: PublicTPGG and PrivateTPGG. In both variants, players begin with a common prior that the two thresholds (L and H) are equally likely. Players must independently decide whether to acquire an informative signal s before making their contribution decisions, with acquisition denoted as $z^i \in \{0, 1\}$. When acquired, the signal $s^i \in \{l, h\}$ indicates the corresponding state L or H with 90% accuracy.⁸ Both variants ultimately require players to make contribution decisions for the public good, with information-

⁸We set signal precision at 90% to balance realism and experimental control. This choice aligns with real-world ‘high-confidence’ signals, such as IPCC confidence intervals (85–95% range), while avoiding unrealistic certainty. Lower values critically erode informational quality and the induced correlation: for example, at an accuracy of 70%, the correlation between signals drops to 58% (versus 82% at our benchmark), undermining shared coordination incentives.

acquirers formulating contingent contribution plans $(a_l, a_h) \in (A_l, A_h)$ based on their signals, while non-acquirers select non-contingent contribution levels $a_\phi \in A_\phi$ based on their initial prior.

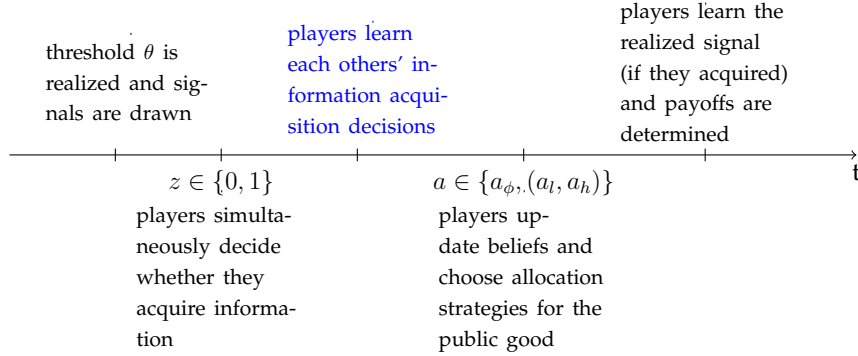


Figure 1: Timeline of the TPGG with endogenous information acquisition.

Notes: The upper portion shows the sequence of exogenous events: threshold realization, signal generation, and payoff determination. The lower portion displays players' decisions, including information acquisition choices and contribution strategies. The disclosure phase (highlighted in blue) exists only in the PublicTPGG, but not in the PrivateTPGG.

The crucial difference between the variants lies in the observability of information acquisition decisions, as highlighted in Figure 1. In the PublicTPGG, players' information acquisition decisions are publicly announced before contribution choices are made, creating a two-stage game: first information acquisition, then contribution. This public revelation allows players to update beliefs based not only on their own signals (if acquired) but also on knowledge of opponents' information states. In contrast, the PrivateTPGG maintains secrecy around acquisition decisions—players never learn whether opponents acquired signals. This fundamental difference transforms the PrivateTPGG into a static Bayesian game with an expanded action space, while the PublicTPGG remains a dynamic game where strategic reasoning must account for the public knowledge of who is informed. These structural differences significantly impact strategic incentives for information acquisition and subsequent contribution behavior in the presence of threshold uncertainty.

2.2 Key Theoretical Results

For our theoretical analysis, we characterize equilibria of TPGGs across different information regimes and evaluate their performance using three key metrics: success rate (the probability of successful public good provision across possible threshold realizations), efficiency rate (the likelihood of exactly meeting the threshold without wasteful over-investments), and expected payoff per player.

Solving equilibria for TPGGs with uncertainty We first explore how threshold uncertainty affects behaviors in TPGGs. Players share a common prior about the low threshold, denoted by p_0 , and simultaneously choose their investments. In Appendix A.1, we analyze how the Bayesian Nash Equilibria (BNEs) of the game vary with different values of the common prior.

Proposition 1 (Benchmark without Information). *Under a common prior of one-half and no information acquisition, the pure-strategy BNEs are $(0, 0)$ and $(5, 5)$. The public good is provided if and only if the true threshold is low and both players contribute 5. This yields a success rate of 50%, an efficiency rate of 50%, and an expected payoff per player of 12.5 ECUs.*

Proof. See Appendix A.1. □

This result demonstrates how threshold uncertainty leads to a lower rate of public good provision and less efficient outcomes. The *UGame* in Table 1 provides the expected payoffs for each player with a common prior of one-half. Compared to the equilibrium outcomes in the *LGame* and the *HGame*, high contributions become strictly dominated, and therefore, the public good is never provided when the threshold is high. The common prior captures the extent to which the two players agree about the underlying threshold. As the common prior changes, the set of BNEs also changes systematically. When the prior probability of a low threshold exceeds two-thirds, both players believe that a low threshold is highly likely, the equilibria resemble those of the *LGame*, reflecting primarily free-riding concerns. When the prior probability falls below one-third, the equilibria resemble those of the *HGame*, emphasizing coordination motives. In the intermediate range, players encounter a sizable uncertainty about the true threshold and possible strategies of each other, creating the most severe tension between free-riding temptations and coordination necessities.

Solving equilibria for the PublicTPGG The PublicTPGG represents a two-stage sequential game. A complete strategy profile for player i specifies both the information acquisition decision z^i and a contribution plan contingent on the observed information acquisition profile (z^i, z^j) and, if applicable, the received signal s^i . We solve the game using backward induction. We first provide an overview of equilibria of each subgame (denoted as $G(z^i, z^j)$) and then analyze the full equi-

libria with information acquisition.⁹ This approach enables us to evaluate how endogenous information acquisition affects equilibrium selection across different subgames and, ultimately, influences public good provision under threshold uncertainty.

Table 2 presents the equilibrium comparisons for the four subgames following players' information acquisition decisions. Each subgame is a Bayesian game in which players formulate beliefs about the state and further infer the other's signal. We apply the concept of Bayesian Nash Equilibria (BNEs), and the derivative details can be found in Appendix A.2.

Table 2: Equilibrium comparisons for subgames $G(z^i, z^j)$ in the PublicTPGG

Subgame	Strategy	Equilibria	Success	Efficiency	Expected Payoffs
G(1,1)	$((a_l^i, a_h^i), (a_l^j, a_h^j))$	$((5, 0), (5, 0))$	0.405	0.405	(13.575, 13.575)
		$((5, 10), (5, 10))$	0.905	0.81	(16.075, 16.075)
G(1,0)	$((a_l^i, a_h^i), a_\phi^j)$	$((10, 0), 0)$	0.45	0.45	(11.75, 13.75)
G(0,1)	$(a_\phi^i, (a_l^j, a_h^j))$	$(0, (10, 0))$	0.45	0.45	(13.75, 11.75)
G(0,0)	(a_ϕ^i, a_ϕ^j)	$(0, 0)$	0.00	0.00	(10, 10)
		$(5, 5)$	0.50	0.50	(12.5, 12.5)

Different subgames create varying degrees of correlation between players' signals, which fundamentally affects their coordination potential. For instance, when player i receives a signal h , they update to a 90% posterior probability that the threshold is high, partially resolving the state uncertainty. In subgame $G(1, 1)$, when they observe their opponents also acquired a signal, this posterior further allows them to infer that the other player j has an 82% chance of receiving the same signal.¹⁰ This creates alignment in both their beliefs about the state and their strategies. This dual resolution of uncertainty enhances coordination potential. Players can effectively coordinate on intermediate investments when signals indicate a low threshold and higher investments when signals suggest a high threshold.¹¹ Such coordination significantly increases the chance of reaching high thresh-

⁹Our theoretical analysis assumes free information acquisition, while our experimental design implements a small cost for obtaining signals. This small cost is carefully chosen to preserve all theoretical results.

¹⁰This correlation emerges from Bayes' rule: $P(s^j = h \mid s^i = h) = P(s^j = h \mid \theta = H)P(\theta = H \mid s^i = h) + P(s^j = h \mid \theta = L)P(\theta = L \mid s^i = h) = 0.9 \times 0.9 + 0.1 \times 0.1 = 0.82$.

¹¹In additional theoretical analyses, we found that this equilibrium collapses when precision falls below $1 - \sqrt{3}/6$ (≈ 0.789). Therefore, our precision choice of 90% ensures the viability of efficiency-enhancing outcomes and sustains our core design objective: promoting contributions even under pessimistic signals.

olds that would remain unattainable without information. Although players do not directly observe each other's acquired signals, their signal correlation creates sufficient agreement about the state and each other's likely strategies to facilitate coordination.

This correlation-enhanced coordination vanishes when only one (or no) player acquires information. In subgame $G(1, 0)$, player i 's signal helps resolve state uncertainty but provides no insight into their opponent's strategy. For example, receiving a signal l updates player i 's belief to a 90% chance of a low threshold. Knowing their opponent has not acquired a signal, however, this updated belief cannot provide further inference regarding their opponent's strategy. Similarly, in subgames $G(0, 1)$ and $G(0, 0)$, player i maintains prior beliefs about the state, preventing any inference about the other player's signal or investment strategies.

However, signal correlation does not automatically guarantee optimal coordination. Both subgames $G(1, 1)$ and $G(0, 0)$ contain a favorable and an unfavorable equilibrium. The most striking contrast appears within subgame $G(1, 1)$. In the favorable equilibrium, players coordinate on intermediate investments (5) after receiving low signals and high investments (10) after high signals. In the unfavorable equilibrium, players contribute intermediate amounts after low signals but nothing after high signals. The performance difference is substantial: the favorable equilibrium achieves a 90.5% success rate and 81% efficiency rate, while the unfavorable equilibrium manages only 40.5% on both metrics.¹² The key distinction between these equilibria hinges on whether players coordinate on high investments after signals suggest a high threshold.

Solving the full equilibria of the PublicTPGG, we find that endogenous information acquisition with observability indeed selects the favorable equilibrium outcomes over the unfavorable ones.

Proposition 2 (Observable Information Acquisition). *In the PublicTPGG, two symmetric equilibria emerge¹³:*

¹²The signals have 90% accuracy, meaning there is a 10% chance they indicate the wrong threshold. In our favorable equilibrium analysis, public good provision succeeds with 90.5% probability: always when the threshold is low (occurring in 50% of cases), and when both players receive high signals when the threshold is high ($50\% \times 81\% = 40.5\%$ of cases). The efficiency rate, where contributions exactly meet the threshold, occurs in two scenarios: both players receive low signals with a low threshold, or both receive high signals with a high threshold. Each scenario occurs with 40.5% probability ($50\% \times 81\%$), resulting in a total efficiency rate of 81%.

¹³We skip the discussions for the other two non-symmetric equilibria, in which one player acquires a signal while the other does not. See Appendix A.2 for details.

- (i) *an information-acquiring equilibrium where both players acquire information and choose an allocation plan (5, 10) upon observing that the opponent has acquired a signal, and (10, 0) when facing a non-acquirer. The equilibrium outcome is the same as the favorable one in $G(1, 1)$, yielding a success rate of 90.5%, an efficiency rate of 81%, and an expected payoff of 16.075 ECUs per player; and*
- (ii) *a non-acquiring equilibrium where players forgo information and allocate 0 after observing an acquirer and 5 after a non-acquirer. The equilibrium outcome is the same as the favorable one in $G(0, 0)$, yielding a success rate of 50%, an efficiency rate of 50%, and an expected payoff of 12.5 ECUs per player.*

Proof. See Appendix A.2. □

These two symmetric equilibria demonstrate how public information acquisition and non-acquisition facilitate selection between multiple equilibria of the subgames. The public observability of acquisition decisions is crucial—it allows players to coordinate their expectations about each other’s investment strategies before receiving signals. By mutually choosing and observing to acquire a signal, players are able to coordinate according to the favorable equilibrium in $G(1, 1)$ and achieve substantially higher success rates and payoffs than otherwise possible. Conversely, when both players mutually observe each other choosing not to acquire information, they coordinate on the favorable equilibrium in $G(0, 0)$, effectively agreeing to ensure public good provision when the threshold is low.

Solving equilibria for the PrivateTPGG We analogously examine how a private information acquisition environment affects equilibrium selection and public good provision efficiency. The PrivateTPGG differs fundamentally from the PublicTPGG in that information acquisition decisions remain unobservable to opponents. This key distinction transforms the game structure: whereas the PublicTPGG is a multi-stage game where observable acquisition decisions create distinct subgames to be played, the PrivateTPGG is effectively a single-stage Bayesian game where information acquisition choices and investment strategies are integrated. Non-acquirers must specify a fixed allocation, while acquirers select a signal-contingent allocation plan. They share different strategy spaces. The PrivateTPGG thus functions as a unified Bayesian game with an extended strategy space $A_\phi \cup (A_l, A_h)$, comprising non-contingent allocation $a_\phi \in A_\phi$ for non-acquirers and the contingent plan $(a_l, a_h) \in (A_l, A_h)$ for acquirers. We solve the PrivateTPGG using the BNE concept.

Proposition 3 (Unobservable Information Acquisition). *In the PrivateTPGG, two symmetric equilibria (BNEs) emerge:*

- (i) *a favorable information-acquiring equilibrium where both players acquire information and choose an allocation plan (5, 10). The equilibrium outcome is the same as the favorable one in $G(1, 1)$, yielding a success rate of 90.5%, an efficiency rate of 81%, and an expected payoff of 16.075 ECUs per player; and*
- (ii) *an unfavorable information-acquiring equilibrium where both players acquire information and choose an allocation plan (5, 0). The equilibrium outcome is the same as the unfavorable one in $G(1, 1)$, yielding a success rate of 40.5%, an efficiency rate of 40.5%, and an expected payoff of 13.575 ECUs per player.*

Proof. See Appendix A.3. □

Comparing these two equilibria reveals a critical limitation of private information acquisition: while it universally promotes information gathering, it fails to facilitate selection between favorable and unfavorable coordination outcomes. Despite identical information acquisition decisions in both equilibria, players' responses to high threshold signals diverge. They coordinate on high investment (10 ECUs) in the favorable equilibrium but on low investment (0 ECUs) in the unfavorable one. This coordination challenge arises precisely because information acquisition decisions remain unobservable, making it impossible to signal each other's contribution intentions. Without observability, players have no way to establish which contribution norm will prevail when high signals are received, leaving both optimistic and pessimistic equilibria equally viable.

In the PrivateTPGG, information acquisition strictly dominates non-acquisition, eliminating the symmetric non-acquiring equilibrium observed in the public setting. This result follows directly from the free-disposal principle of information: players with private information can always strategically mimic uninformed behavior if desired, while uninformed players cannot replicate the contingent strategies available to the informed. For instance, an information acquirer can implement any non-contingent strategy by simply setting identical allocations across signal realizations ($a_l = a_h$), effectively discarding the informational advantage when suboptimal. This asymmetric flexibility contrasts sharply with the PublicTPGG, where observable acquisition decisions serve as coordination devices that enable players to condition their strategies on their opponent's information

status. This observability transforms information acquisition from a private decision tool into a public coordination mechanism, enabling equilibrium selection capabilities that are impossible in the private environment.

2.3 Equilibrium Comparison and Hypotheses

Our theoretical analysis reveals systematic differences in equilibrium behaviors and outcomes across information regimes, which form the basis for our experimental hypotheses. To test these theoretical predictions, we implement three treatments: (1) a *Baseline* treatment with no information acquisition, (2) a Private Endogenous treatment (*PrivateEndo*) where acquisition decisions remain unobservable, and (3) a Public Endogenous treatment (*PublicEndo*) where acquisition decisions are publicly observed.

Hypothesis 1. *Participants in PrivateEndo choose to acquire information (draw a signal) more often than those in PublicEndo.*¹⁴

Hypothesis 1 directly follows from the equilibrium comparison between public and private information acquisition environments. In the PrivateTPGG, acquiring information emerges as a strictly dominant strategy, precluding any equilibrium where players do not acquire information. Conversely, the PublicTPGG yields both acquiring and non-acquiring equilibria. Not acquiring information in the public environment carries strategic value, as it enables players to achieve efficient coordination through mutual non-acquisition decisions—an equilibrium outcome theoretically impossible in the private setting.

Hypothesis 2. *The rates of public good provisions in the Public Good games will follow $PublicEndo \geq PrivateEndo \geq Baseline$.*

Hypothesis 3. *The rates of reaching efficient outcomes in the Threshold Public Good games will follow $PublicEndo \geq PrivateEndo \geq Baseline$.*

Hypotheses 2 and 3 stem from comparing theoretical success and efficiency rates across treatments. The *Baseline* treatment, characterized by the $G(0, 0)$ subgame, serves as a natural benchmark since participants in information acquisition treatments can replicate baseline behavior by choosing not to acquire signals.

¹⁴We initially pre-registered this hypothesis in the opposite direction, i.e., we expected participants in *PublicEndo* to acquire more signals than participants in *PrivateEndo*. However, in line with our theoretical model, we revised this hypothesis in the paper.

Both public and private treatments theoretically enable superior equilibria with 90.5% success and 81% efficiency rates. The critical difference lies in equilibrium selection: the PrivateTPGG features multiple equilibria within the $G(1, 1)$ subgame without mechanisms to coordinate on favorable outcomes, while the PublicTPGG facilitates coordination on favorable outcomes through observable acquisition decisions. When players mutually observe each other acquiring signals, they better capitalize on the 82% probability of receiving identical signals, creating aligned beliefs about both the state and each other’s likely responses. This alignment facilitates coordination on efficient contribution strategies—intermediate investments after low signals and critically, high investments after high signals when the threshold is likely high.

The PrivateTPGG lacks this coordination mechanism despite universal information acquisition. Without observability, players face persistent uncertainty about their opponent’s information status, making them potentially cautious about high investments even after receiving high signals. A player who receives a high signal might reasonably worry their opponent is uninformed (for whom high investment is never optimal) or informed but received a contradictory signal. This uncertainty undermines the coordination benefits of correlated signals, potentially trapping players in the unfavorable equilibrium where high signals fail to trigger the necessary high contributions. These structural differences in equilibrium selection capabilities drive our hypothesized performance ranking across treatments.

3 Experimental Design

Treatments In the main part of our experiment, participants engage in twelve rounds of Threshold Public Goods Games (TPGGs) with an uncertain threshold. Three rounds are randomly selected for payment. At the start of each round, participants are endowed with 10 Experimental Currency Units (ECUs) and randomly paired with another participant to play a new TPGG, referred to as a funding game. In this game, participants decide how much to keep in their private account and how much to contribute to a joint project account. If the total contributions in the project account meets a minimum funding threshold, both participants will earn a profit of 15 ECUs; otherwise, their contributions will be forfeited. Following the framework outlined in Section 2, participants can choose to allocate either 0, 5, or 10 ECUs. Two states of the world are equally likely: a low threshold of 10, which can be met if one participant contributes their entire endowment or both contribute

half of it, and a high threshold of 20, which requires both players to contribute their full endowments.

We design three main treatments to assess how information acquisition affects contributions to the public good under uncertainty: *Baseline*, *PrivateEndo*, and *PublicEndo* treatments. They vary in terms of the availability of information and the nature of acquisition decisions—either public or private. In the *Baseline* treatment, participants start with a common prior that the low and high thresholds are equally likely and make their allocation decisions simultaneously without any additional information. The *PrivateEndo* and *PublicEndo* treatments allow participants to acquire private signals about the threshold prior to making their allocation decision.¹⁵ In the *PublicEndo* treatment, these signal acquisition decisions are disclosed, enabling players to know whether their opponents have obtained a signal before deciding on their contributions to the public good. Conversely, in the *PrivateEndo* treatment, players remain unaware of their opponents' signal acquisition throughout the game. Table 3 provides a comparative overview of all treatment conditions.

Table 3: Experiment design: treatment comparisons

Treatment	Information acquisition	Acquisition Decision	Signal Realization	N
NoInfo	No	N/A	N/A	42
PrivateEndo	Endogenous	Private	Private	100
PublicEndo	Endogenous	Public	Private	127

Note: We excluded six subjects because they made random, illogical choices in the introductory part.

Fearing the different information acquisition dynamics may potentially drive the differences between *PrivateEndo* and *PublicEndo*,¹⁶ we also implement two exogenous treatments: *PrivateExo* and *PublicExo*. We exogenously assign participants to receive a signal in these two treatments, according to the empirical distributions observed in *PrivateEndo* and *PublicEndo*, respectively, thereby replicating the frequencies of informed and uninformed pairs across the corresponding treatments. Prior to making allocation decisions, participants are informed of whether they have been assigned a signal. All other parameters, including signal precision, contribution rules, and (in *PublicExo*) observability of whether their opponents are signal receivers, mirror the main treatments. In addition, acquisition costs are waived.

¹⁵Information acquisition is costly. Participants must pay 10 euro cents for each round they choose to acquire a signal, regardless of whether that round is selected for payment. We chose this small cost to ensure that all equilibrium outcomes remained unchanged.

¹⁶However, our experimental results show that participants in the *PublicEndo* and the *PrivateEndo* treatments exhibited similar propensity and dynamics in acquisition choices.

Main Tasks Figure 2 illustrates the decision page for participants who acquire information in the *PublicEndo* treatment. Threshold uncertainty is visualized using two boxes representing the possible thresholds (10 ECUs and 20 ECUs). Participants are informed that, at the beginning of each round, the computer randomly selects one box to determine the threshold for that round. The selected box will be the same for both participants in a pair and will only be revealed at the end of the round. In the *Baseline* treatment, both boxes are empty, while in the *PublicEndo* and *PrivateEndo* treatments, each box contains ten balls, predominantly red (9:1) in the low threshold box and predominantly blue (9:1) in the high threshold box. If participants choose to acquire a signal, a ball is randomly drawn from the selected box (with replacement), and its color, as a signal realization, is revealed. We employ the strategy method, asking participants to specify their allocation choices for each possible signal realization if they choose to acquire information. Conversely, if participants decide to be non-acquirers, they make a single, non-contingent allocation decision. At the end of each round, the computer implements allocations based on each pair's acquisition decisions and the actual color of their draws (if they chose to acquire). The *PrivateEndo* treatment interface is similar, but without displaying opponents' acquisition decisions.

Round
1 of 12 Your will see this decision page if you choose to DRAW a ball

If this funding game is selected for payment, your earnings = ECUs in your Individual Account + ECUs from the project.
 • If the total ECUs in the Project Account are at least the minimum fund, you will earn 15 ECUs from the project.
 • If the total ECUs in the Project Account are less than the minimum fund, you will earn 0 ECUs from the project.

A reminder about the rule of the funding game

The following tables provide your ECU earnings (highlighted in green) for each possible minimum fund and allocations by you and the participant matched to you in this round.

If the minimum fund is 10 ECU

		ECUs allocated to the Project Account by the other participant		
		0	5	10
ECUs allocated to the Project Account by you	0	0	10	5
	5	10	10	20
	10	25	20	15

BOX: minimum 10 ECU

BOX: minimum 20 ECU

If the minimum fund is 20 ECU

		ECUs allocated to the Project Account by the other participant		
		0	5	10
ECUs allocated to the Project Account by you	0	0	10	5
	5	10	10	20
	10	25	20	15

Check your possible ECU earnings in these tables

In this funding game, the minimum fund required for the project is either 10 or 20 ECUs.
 You will only learn the color of the ball at the end of this round.
 The other participant has **chosen not to draw a ball** from the box selected by the computer.
 You and the other participant both have 10 ECUs.

Please decide how many ECUs you want to allocate to the Project Account if a **red** ball was drawn: ☐ 0 ☐ 5 ☐ 10

Please decide how many ECUs you want to allocate to the Project Account if a **blue** ball was drawn: ☐ 0 ☐ 5 ☐ 10

learn whether the opponent has drawn a signal or not

Decide your allocation to the Project for each possible color you might draw

OK

Figure 2: Experimental interface for a decision round in the *PublicEndo* treatment of an information acquirer.

In each round, learning the color of a ball drawn from the selected box is highly informative about the likely threshold; a red ball indicates a posterior probability of 90% for a low threshold, while a blue ball implies the same posterior for a

high threshold. This applies to both the public and private treatments. However, beyond state resolution, the observability of information acquisition affects participants' inferences about each other's strategies. Since all balls are drawn from the same box, their colors are highly correlated. Information acquirers expect that their acquiring opponent will draw a ball of the same color with an 82% chance, facilitating implicit coordination on strategies. In the private treatment, however, information acquirers may encounter either an acquiring or a non-acquiring opponent, leading to a perceived lower correlation of signals and a reduction in strategic coordination. Our design of private and public treatments effectively compares these implicit coordination mechanisms due to observability. After each round, participants receive feedback on the randomly selected threshold, their allocation choices, and their earnings, but not on the color of their drawn balls.

Introductory TPGG Tasks and Post-Experimental Questionnaire Prior to the main experiment, participants complete four introductory TPGGs to familiarize themselves with the game mechanics. These games use the same parameters as the main experiment but with explicit thresholds, and participants play with fixed partners throughout this phase. The first two games involve unconditional allocation decisions, one for each threshold level (10 and 20 ECUs), presented in random order. The subsequent two games employ the strategy method (Fischbacher et al., 2001), where participants specify allocations conditional on all possible opponent contributions (0–10 ECUs), again one for each threshold level in random order. Unlike the main experiment, participants can contribute any integer amount from 0–10 ECUs. At the end of this phase, one of the four games is randomly selected for payment.

We select these introductory tasks for three main purposes. First, we aim to familiarize participants with the decision-making tasks for the main part of the experiment. By gaining experience with certain low and high thresholds, participants are less likely to feel overwhelmed by the uncertain thresholds encountered later, ensuring their choices reflect strategic considerations of threshold uncertainty rather than task confusion. Second, we seek to enhance participants' understanding of equilibrium and efficiency concepts within the TPGG setup. Through both unconditional and conditional allocation decisions, participants gain a practical understanding of how low thresholds create free-riding incentives while high thresholds present coordination challenges. Third, these tasks also allow us to categorize each participant's contribution types for TPGGs. We can identify whether a participant is an *Efficient* contributor, someone who consistently allocates the nec-

essary amount to meet the threshold. We can also identify *Conditionally Efficient* contributors, who are willing to contribute only if their opponent also contributes an acceptable level. Additionally, we are able to recognize confused participants, whose choices are largely driven by mistakes and noise rather than strategic considerations.¹⁷ We identify six such participants and exclude them from our data analyses.

Following the main experiment, participants complete a structured questionnaire designed to elicit their acquisition motivation, strategic reasoning, and normative beliefs. In *PrivateEndo* and *PublicEndo*, we first classify participants based on whether their acquisition frequency is above or below their session's average, ensuring balanced samples for acquisition-related questions. Participants report their motivations for information decisions through both multiple-choice options and open-ended responses. They also choose allocation strategies and report expectations about opponents' strategies across various hypothetical scenarios. The questionnaire concludes with three incentivized questions. Two elicit social norms regarding information acquisition and non-acquisition using the coordination methodology of Krupka and Weber (2013). The third assesses understanding of signal correlation by asking participants to estimate the probability that two players will acquire the same signal.

Procedures We collected data from April to November 2024 in the Groningen Experimental Economics Lab (GrEELab). The experiment was coded using z-Tree (Fischbacher, 2007). Sessions lasted approximately one hour for the baseline treatment and one hour and twenty minutes for the other treatments. A total of 330 students participated, with average earnings of 15.62 €.

We would like to admit that a few of our sessions were affected by a programming error, which caused allocation to be implemented as if the signal had a 100% accuracy rate instead of the intended 90%. This issue impacted 6.3% of our observations in the affected sessions, 7.2% for *PublicEndo* and 5.2% for *PrivateEndo*, respectively. Importantly, this error only affected the behind-the-scenes implemen-

¹⁷Our analysis reveals that the majority of participants understand the strategic tensions in TPGG games with commonly known low or high thresholds. Consistent with Nash equilibrium predictions for the *HGame* and the *LGame*, participants recognize free-riding incentives when the threshold is low and attempt to achieve coordination when the threshold is high. In the TPGG with a low threshold, 60% of participants are classified as Efficient contributors while 31% are Conditionally Efficient contributors. In the TPGG with a high threshold, a striking 88% of participants are classified as Efficient contributors. Figures B.2.1a and B.2.1b in the Appendix provide an overview of different contribution types.

tation of contingent allocations and not the information environment participants experienced.¹⁸ To address this issue, we undertook several remedial steps. First, we recalculated all affected payoffs in our analysis to reflect the correct 90% implementation, ensuring accurate performance metrics in our results. Second, we conducted additional bug-free sessions to verify that participants' behavior was not systematically affected by the error. A comprehensive comparison revealed no strong behavioral differences between the original and bug-free sessions, confirming that the error did not meaningfully impact participants' decision-making strategies.¹⁹ Consequently, we pool data from all sessions in our analysis.

4 Results

We measure public good provision with three core metrics: (1) *Pair Allocation*, which measures the total contributions to public goods within pairs; (2) *Success Rate*, indicating the proportion of pairs meeting or exceeding the actual threshold; and (3) *Efficiency Rate*, capturing exact threshold attainment without inefficient overprovision. This triad comprehensively captures the magnitude (allocations), robustness (success), and optimality (efficiency) of collective action—critical dimensions in threshold public goods games (Croson and Marks, 2000).

4.1 Threshold Uncertainty

We first evaluate how threshold uncertainty influences performance metrics. In the initial phase across all treatments, participants made unconditional contributions to public goods with known thresholds of 10 (low) or 20 (high) ECUs. We denote these choices as made under the condition of *Certainty*. The *Baseline* treatment introduced threshold uncertainty, where participants made unconditional contributions without knowing whether the threshold was 10 or 20 ECUs. By comparing

¹⁸Participants always received signals with the correct 90% accuracy rate, and understood this accuracy level correctly. When such an error occurs, participants see the correct color on their feedback page, but the allocations implemented do not match the correct choices. If the affected participants remembered their allocations for different colors from the previous pages, they should have been able to identify the inconsistency. However, none of our participants reported this issue or mentioned it in their comments. We also investigated participants' answers to the open-ended questions and found no indication that they noticed the deviation in the implemented allocation.

¹⁹In Appendix B.1, we evaluated the consequences of the bug on information acquisition decisions and allocation strategies using session-fixed effects and individual-level fixed effects regressions. The results confirm that the programming error did not significantly affect participants' decisions.

choices across these conditions, we are able to identify the impact of threshold uncertainty on collective action. Importantly, participants in the *Baseline* treatment received feedback about realized thresholds and peer contributions before subsequent rounds, potentially enabling learning effects. We distinguish between an *Uncertainty* condition, referring to choices in the first period, and an *Uncertainty + Feedback* condition, capturing choices in subsequent periods of the treatment *Baseline*.

Table 4 compares the public good performances across these three conditions. We find that threshold uncertainty significantly reduces all performance metrics. The average pair allocation decreases from 11.7 when participants faced known thresholds to 8.8 when they faced uncertain thresholds, and further declines to 6.1 with the addition of feedback. The declines are statistically significant at the 5% and the 0.1% level. Similarly, success rates drop from 65% to 43% and then to 26%, while efficiency rates fall from 41% to 19% and stabilize around 17%. These decay patterns align with observations in public goods games involving uncertain thresholds.²⁰

Table 4: Public good provision under different uncertainty conditions

Condition	Pair Allocation	Success Rate	Efficiency Rate
<i>Certainty</i>	11.70	0.65	0.41
<i>Low Threshold</i>	10.75	0.94	0.45
<i>High Threshold</i>	12.56	0.37	0.37
<i>Uncertainty</i>	8.81*	0.43*	0.19*
<i>Uncertainty + Feedback</i>	6.13***	0.26***	0.17***

Notes: Pair Allocations in ECU. Significance levels are determined by comparing to the *Certainty* condition. Statistical tests employed are two-sided Mann-Whitney U tests: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Finding 1 (Threshold Uncertainty Effects). *Uncertain thresholds significantly reduce the pair allocation, success rate, and efficiency rate compared to conditions of threshold certainty.*

Analysis of individual allocation choices reveals the behavioral mechanisms behind threshold uncertainty's negative impact on public good provision. As shown

²⁰In Barrett (2013) and Barrett and Dannenberg (2012), the average contribution also decreases by approximately 50% when comparing the treatment with a certain threshold to those with uncertain thresholds. Notice that their experimental design differs from ours. They employed a catastrophe avoidance framework with 10 players who must collectively contribute enough to avoid surpassing a threshold that would result in a loss for each player. They manipulated threshold uncertainty using mean-preserving uniform distributions, ranging from a certain value to an uncertain range of values. Additionally, they permitted non-binding communication prior to contributions to the public good.

in Figure B.3.1 in Appendix B.3, threshold uncertainty fundamentally disrupts coordination by shifting participants toward risk-dominant strategies. With known thresholds, participants' choices closely track NE strategies in the *HGame* and the *LGame*. However, when uncertainty is introduced, we observe a dramatic shift toward zero allocation—consistent with the risk-dominant BNE strategy. While approximately 30% of participants still chose the payoff-dominant BNE strategy (allocating 5 ECUs), the overall behavioral pattern demonstrates that uncertainty does not merely provide inferior information about the state, but fundamentally changes how people approach strategic coordination. Notably, the presence of feedback and repetition, rather than enabling learning, appears to amplify uncertainty's negative effects by pushing even more participants toward the risk-dominant zero allocation strategy.

4.2 Endogenous Information Acquisition and Observability

Building on the detrimental effects of threshold uncertainty, we now analyze how endogenous information acquisition (*PrivateEndo*) and its observability (*PublicEndo*) impact the performance of public good provisions. We define the information effect as the performance improvement in public good provision (measured by pair allocation, success rate, or efficiency rate) when comparing *PrivateEndo* to *Baseline* treatments. The observability effect represents similar performance gains when comparing *PublicEndo* to *PrivateEndo* treatments.

Table 5 provides an overview comparing treatments across the three key metrics. We observe systematic improvements in public good performance as information availability and observability increase. The average pair allocation progressively increases from 6.4 in *Baseline* to 8.4 in *PrivateEndo*, and further to 9.9 in *PublicEndo*. Success rates follow a similar pattern, increasing from a low 27% in *Baseline* (with uncertain thresholds) to 39% when information acquisition becomes possible (*PrivateEndo*), and reaching 50% when acquisition decisions are observable (*PublicEndo*). Efficiency rates, which exclude overinvestment in public good provision, follow a comparable trend: increasing from 18% in *Baseline* to 30% in *PrivateEndo*, and 37% in *PublicEndo*.²¹ All these increases are statistically significant

²¹In the sessions impacted by the coding error, no significant difference was observed between the efficiency rates in *PrivateEndo* and *PublicEndo*. Consequently, the treatment effects reported here with observations pooled together represent a conservative estimate of the potential impact.

Table 5: Treatment comparisons for public good provision performances

Treatment	Pair Allocation	Success Rate	Efficiency Rate
<i>Baseline</i>	6.35	0.27	0.18
<i>PrivateEndo</i>	8.42***	0.39***	0.30***
Non-acquirer/Non-acquirer (12.8%)	7.27	0.24	0.17
Acquirer/Non-acquirer (47.6%)	8.07***	0.30	0.22
Acquirer/Acquirer (39.6%)	9.21***	0.54***	0.43***
<i>PublicEndo</i>	9.93***	0.50***	0.37**
Non-acquirer/Non-acquirer (11.8%)	6.31	0.19	0.09
Acquirer/Non-acquirer (33.7%)	7.41	0.29	0.17
Acquirer/Acquirer (54.4%)	12.30***	0.69***	0.55**
<i>Certainty</i>	11.70***	0.65***	0.41

Notes: Pair Allocations in ECU. Significance levels for *PrivateEndo* treatments are determined by comparing with the *Baseline* treatments. For *PublicEndo* treatments, significance levels reflect comparisons with *PrivateEndo* treatments having the same information status pairs. The significance indicated for the *Certainty* condition represents comparison with the Acquired/Acquired pairs in the *PublicEndo* treatment. Percentages in parentheses show the frequency of each information acquisition configuration within their respective treatment conditions. Statistical tests employed are two-sided Mann-Whitney U tests: *p<0.05; **p<0.01; ***p<0.001

at the 1% level.²² The observed orderings are in line with our hypotheses 2 and 3 about the strategic role of information acquisition and observability in Threshold Public Goods Games.

Finding 2 (Information Effects). *Endogenous information acquisition significantly increases the pair allocation, success rate, and efficiency rate for the treatment PrivateEndo, enhancing public good outcomes compared to the Baseline.*

Finding 3 (Observability Effects). *Observability amplifies the positive effects of endogenous information acquisition, significantly improving the pair allocation, success rate, and efficiency rate for the treatment PublicEndo compared to those for PrivateEndo.*

We also examine how information and observability effects vary with different threshold realizations and illustrate the estimation results for success and efficiency rates in Figure 3.²³ The opportunity of information acquisition (left panel) shows stronger benefits under low thresholds, boosting success rates by 19.8% and efficiency rates by 17.6%, compared to more modest 10.3% improvements for both metrics under high thresholds. Conversely, making the information acquisition observable (right panel) demonstrates a greater balance across contexts—while adding only 7.3% to success rates and minimal efficiency gains under low thresh-

²²These treatment comparisons remain robust in linear regression analyses controlling for period and threshold realization. See Table B.4.1 in Appendix B for details.

²³Detailed estimates appear in columns (2), (5), and (8) of Table B.4.1

olds, it contributes 9.6% improvements to both metrics under high thresholds.²⁴ These patterns underscore the distinct roles of information and observability in public good provision. Information acquisition primarily enhances outcomes under attainable low thresholds, whereas observability becomes critical for facilitating coordination under more demanding high thresholds.

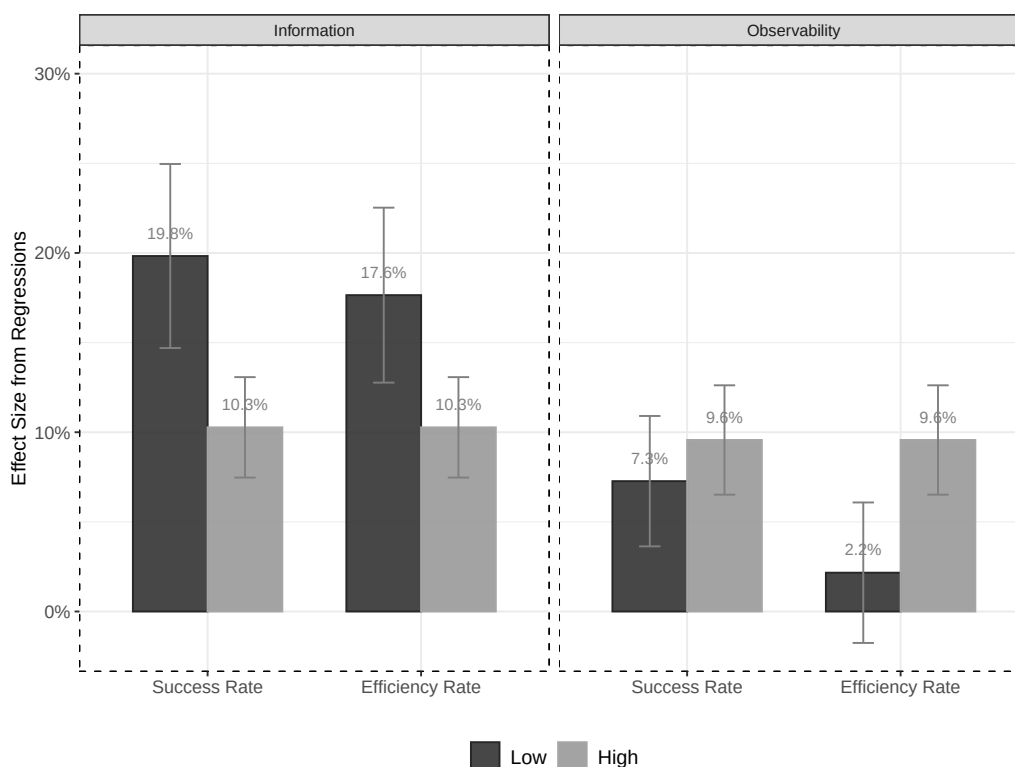


Figure 3: Comparing the information and observability effects across low and high thresholds.

Notes: Dark bars represent low threshold conditions, while gray bars represent high threshold conditions. Error bars indicate confidence intervals for each estimate.

Information Status and Treatment Effects How do information and observability effects vary based on pairs' information acquisition status? In our experiment, pairs can have three distinct information statuses: no information (neither participant has acquired information), partial information (only one participant has acquired information), or full information (both participants have acquired information). In Table 5, we also present treatment comparisons for public good provision performance, stratified by these information statuses.

²⁴The identical magnitudes of effect sizes for success and efficiency rates under the high threshold are not coincidental. When the threshold is high, the public good can only be successfully provided if both players allocate their full endowment, which is the same condition required for efficiency.

The information effect (comparing *PrivateEndo* to *Baseline*) strengthens with greater information acquisition within pairs. Uninformed pairs show slightly higher but statistically insignificant pair allocations, with similar success and efficiency rates. Partially informed pairs demonstrate moderate improvements, with pair allocations of 8.07 compared to 6.35 in *Baseline*, accompanied by a statistically significant 5% efficiency rate increase, despite no significant change in success rate. The most substantial information effect is observed in fully informed pairs, who allocate significantly more (9.21 compared to 6.35 in *Baseline*), achieving markedly higher success rates (54% versus 27%) and efficiency rates (43% versus 17%), effectively doubling these two performance metrics.

The observability effect (comparing *PublicEndo* to *PrivateEndo*) manifests primarily when both players acquire information. The directional differences observed in uninformed and partially informed pairs between *PublicEndo* and *PrivateEndo* are not statistically significant. However, fully informed pairs demonstrate dramatic enhancements: pair allocations increase substantially in *PublicEndo* (12.30 versus 9.21), driving significant gains in success (69% versus 54%) and efficiency rates (55% versus 43%). These metrics even exceed those under the *Certainty* condition, our upper benchmark for public good provision performance.²⁵ Notably, the proportion of the fully informed pairs increases from 39.6% in *PrivateEndo* to 54.4% in *PublicEndo*. It suggests that observability not only improves investment coordination but also incentivizes greater information acquisition at the pair level.²⁶

Finding 4 (Information Status Mediation). *The information status within pairs mediates treatment effectiveness: the information effect intensifies with greater information acquisition, while the observability effect reaches its full potential only when both players acquire information.*

This finding explains why the observability effect is robust and becomes more particularly impactful when the threshold is high and demanding—situations that require a greater extent of coordination. The combination of information acquisition and observability not only amplifies pair performances for public good provision but also highlights the critical role of observability in overcoming coordination failures due to threshold uncertainty.

²⁵In the *Certainty* condition, half of the choices were made for a low threshold, while the other half were for a high threshold. This ensures an identical distribution of thresholds for the fully informed pairs in *PublicEndo*.

²⁶Note this result does not directly contradict our Hypothesis 1 as the hypothesis pertains to acquisition decisions at the individual level. We will provide a formal test in subsection 4.3.1.

4.3 Mechanisms of Information and Observability Effects

Our pair-level analysis identifies fully informed pairs as the primary driver for improved public good provision in both information treatments. This provides empirical support for how information acquisition and observability crucially influence equilibrium selection. In particular, a substantial fraction of fully informed pairs adopts favorable information-contingent strategies: choosing intermediate allocations after low-threshold signals and high allocations after high-threshold signals. This aligns with our theoretical framework: endogenous information acquisition facilitates coordination via correlated signals, while observability amplifies these benefits by establishing common knowledge of coordination intentions. We now examine two crucial individual-level mechanisms: patterns of information acquisition and subsequent signal-contingent allocation decisions.

4.3.1 Information Acquisition Patterns

In our two information treatments, participants could acquire a 90%-accurate signal about the true threshold for 10 cents, substantially reducing state uncertainty. Figure 4a tracks the evolution of acquisition rates across these two treatments. Acquisition rates in the first period are notably higher (about 75%) as participants try to explore the effect of information, but they stabilize rapidly thereafter. It suggests that participants overall developed consistent information acquisition strategies. On average, participants in *PrivateEndo* acquired information in 63% of cases, while those in *PublicEndo* did so in 71% of their decisions. The individual-level distribution (Figure 4b) reveals that 40% of participants in *PublicEndo* consistently acquired information across all periods, compared to 33% in *PrivateEndo*. The remaining participants showed similar distributions across all levels of acquisition frequencies, indicating individual heterogeneity in acquisition patterns.

Our statistical analysis provides limited evidence to support Hypothesis 1, which predicted lower acquisition rates in *PublicEndo* than in *PrivateEndo*. While a one-sided Mann-Whitney U test indicates a higher acquisition rate in *PublicEndo* instead (with a p -value of 0.07), this difference disappears when accounting for individual-level clustering in the linear probability model (1) in Table 6. Models (2) and (3) confirm that the observability of acquisition decisions does not significantly influence acquisition choices, even after controlling for time trends and first-period exploration behavior. Model (4) reveals strong history dependence: prior signal ac-

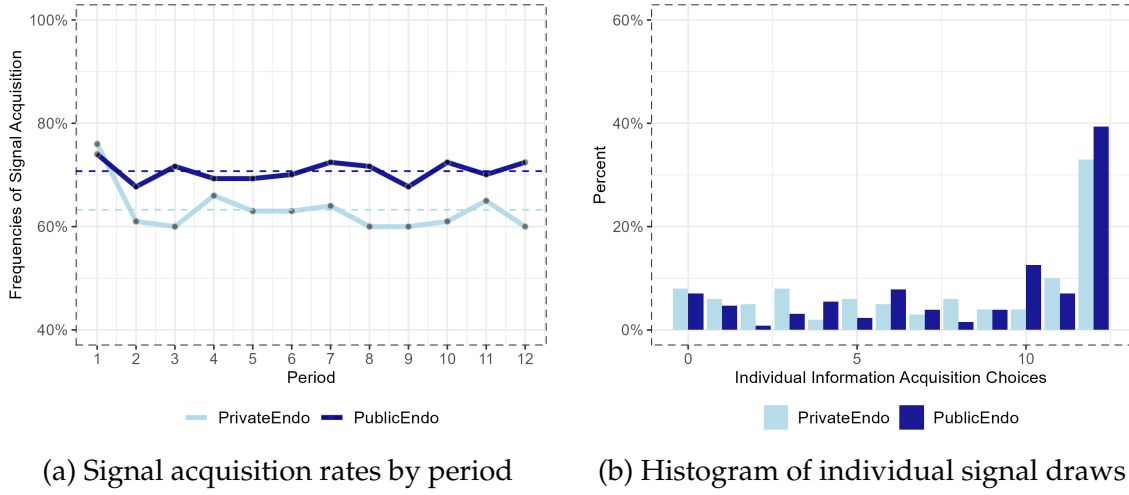


Figure 4: Signal acquisition patterns across treatment conditions.

Notes: Panel (a) shows the evolution of signal acquisition rates across periods, with the dashed lines representing the overall average acquisition rates in two treatments. Panel (b) displays the distribution of individual signal acquisition frequencies over all 12 periods by treatment.

quisition strongly predicts subsequent information purchases, suggesting persistent individual information-acquiring behavior. Successfully reaching the threshold in the previous period also slightly increases information acquisition.

Table 6: Regressions for individual information acquisition decisions

	Dependent Variable: Signal Acquisition Dummy			
	(1)	(2)	(3)	(4)
Constant	0.63*** (0.04)	0.67*** (0.04)	0.64*** (0.04)	0.26*** (0.03)
PublicEndo	0.07 (0.05)	0.03 (0.05)	0.03 (0.05)	0.04 (0.02)
Period		-0.01 (0.003)	-0.003 (0.004)	
FirstPeriod			0.09** (0.03)	
PublicEndo * Period		0.01 (0.004)	0.01 (0.004)	
AcquisitionPreviousPeriod				0.55*** (0.04)
SuccessPreviousPeriod				0.04* (0.02)
Observations	2,724	2,724	2,724	2,497
R ²	0.01	0.01	0.01	0.32

Notes: This table reports linear probability models with information acquisition (1=signal acquired, 0=no signal acquired) as the dependent variable. *PrivateEndo* serves as the reference category for treatment comparisons. All standard errors are clustered at the individual participant level. Significance levels: *p<0.05; **p<0.01; ***p<0.001.

The similar information acquisition rates observed in both *PublicEndo* and *PrivateEndo* treatments indicate comparable individual knowledge about state uncertainty across treatments. This suggests that the positive observability effects should be attributed to more successful and efficient allocation coordination enabled by public information acquisition rather than to differences in how frequently

participants acquired information. However, we would like to point out that modest differences in individual acquisition rates can transform into substantial variations in pair information status through random matching. Most notably, the proportion of fully informed pairs increases markedly from 39.6% in *PrivateEndo* to 54.4% in *PublicEndo* as shown in Table 5. A chi-squared test confirms that the distribution of pair information status differs significantly between the two treatments with a p -value lower than 0.001. This shift in pair-level information composition, rather than individual acquisition propensities, potentially contributes to the information effects.

Finding 5 (Information Acquisition). *We cannot reject Hypothesis 1. Participants in the PublicEndo and the PrivateEndo treatments exhibited similar propensity and patterns in acquiring information. Moreover, the proportion of fully informed pairs was substantially higher in the PublicEndo compared to the PrivateEndo treatment.*

This deviation from theoretical predictions reflects the interplay between strategic complexity, bounded rationality, and learning dynamics. Participants' self-reported motivations for acquisition (and non-acquisition) choices and their perceptions of social norms provide further insights. In *PrivateEndo*, frequent acquirers primarily cited instrumental motives: resolving uncertainty (54.3%) and enabling contingent decisions (36.2%).²⁷ Frequent acquirers in *PublicEndo* acknowledged these same instrumental benefits (32.5% and 23.7% respectively), but also explicitly recognized coordination benefits (21.3%) and the signaling value of acquisition (17.2%).²⁸ Social norm perceptions deepen this divergence. While both treatments recognized the value of information for uncertainty resolution (62.5% in *PrivateEndo*, 29.2% in *PublicEndo*) and contingent allocation planning (33.9% in *PrivateEndo*, 26.4% in *PublicEndo*), only *PublicEndo* participants internalized its coordination value. In particular, 34.7% of *PublicEndo* participants believed the most popular motivation for acquiring a signal is: "If I draw a ball and when I know that the other participant also draws a ball, we are more likely to draw the same color and thus are more likely to agree on the minimum fund". This coordination motivation was entirely absent from top responses in *PrivateEndo*. Surprisingly, this difference in coordination motivations cannot be attributed to differential compre-

²⁷The corresponding motivation options are: "Drawing a ball helps me learn whether the minimum fund is more likely to be 10 or 20, which helps me make better allocation decisions." and "If I draw a ball, I am able to make different allocation decisions for different likelihoods for the minimum funds."

²⁸The corresponding motivation options are: "If I draw a ball and when I know that the other participant also draws a ball, we are more likely to draw the same color and thus are more likely to agree on the minimum fund." and "If I draw a ball, I can implicitly tell the other participant that I am willing to allocate funding to the project."

hension of signal correlation. Our post-experimental questionnaire revealed no significant difference between treatments in calculating the probability of two acquirers receiving the same signal. In *PrivateEndo* and *PublicEndo*, approximately 20% of subjects answered correctly, and 53% provided answers within 5 percentage points of the correct value of 82%.

Meanwhile, frequent non-acquirers across both treatments shared similar concerns, primarily about strategic uncertainty regarding opponents' allocations (31% in both treatments) and acquisition decisions (24.0% in *PrivateEndo* and 16% in *PublicEndo*).²⁹ Notably, 9.5% of frequent non-acquirers in *PublicEndo* specifically worried about potential exploitation by opponents if they acquired signals—predicted by non-symmetric equilibria in PublicTPGG.

These motivations and norm patterns highlight how observability introduces coordination and signaling considerations absent in private acquisition settings. Although information acquisition theoretically dominates non-acquisition in *PrivateEndo* as informed players can always mimic uninformed behavior by setting identical allocations for different signals, participants in general struggle with this contingent reasoning (Xu, 2022, September). Compared to the public environment, private information acquisition substantially expands allocation strategy spaces and increases game complexity. The cognitive burden of formulating state-contingent strategies may obscure the dominance relationship in *PrivateEndo* (Gabaix et al., 2006), leading boundedly rational participants to default to simpler non-acquisition strategies. Conversely, in *PublicEndo* with observability, acquiring a signal serves as a salient focal point that promotes coordination on favorable outcomes. Our empirical evidence of strong history dependence in information acquisition and the positive effect of successful coordination on subsequent acquisition decisions suggests an experiential learning process where participants adapt their strategies based on observed outcomes rather than through ex-ante strategic calculations (Erev and Roth, 1998).

²⁹The corresponding motivation options are: "Even though the color of the ball implies whether the minimum fund is more likely to be 10 or 20, I am not sure how the other participants will decide the allocation." and "I do not think drawing a ball is useful since I do not know whether the other participant will also draw a ball or not. (or I believe that the other participants are more likely to choose not to draw a ball as well for the *PublicEndo*)"

4.3.2 Allocation Choices

We estimated how individual allocations (those ultimately implemented in the TPGGs) differ across various information acquisition and observability conditions and summarized the estimates in Figure 5.³⁰ The information effect (left panel) operates almost exclusively through participants who actively acquire information. Acquirers in *PrivateEndo* increase their allocations by 1.55 on average compared to *Baseline* participants, while non-acquirers show virtually no difference in allocation choices. This information premium represents a substantial 49% increase over the *Baseline* mean allocation of 3.17, demonstrating the value of information in resolving state uncertainty.

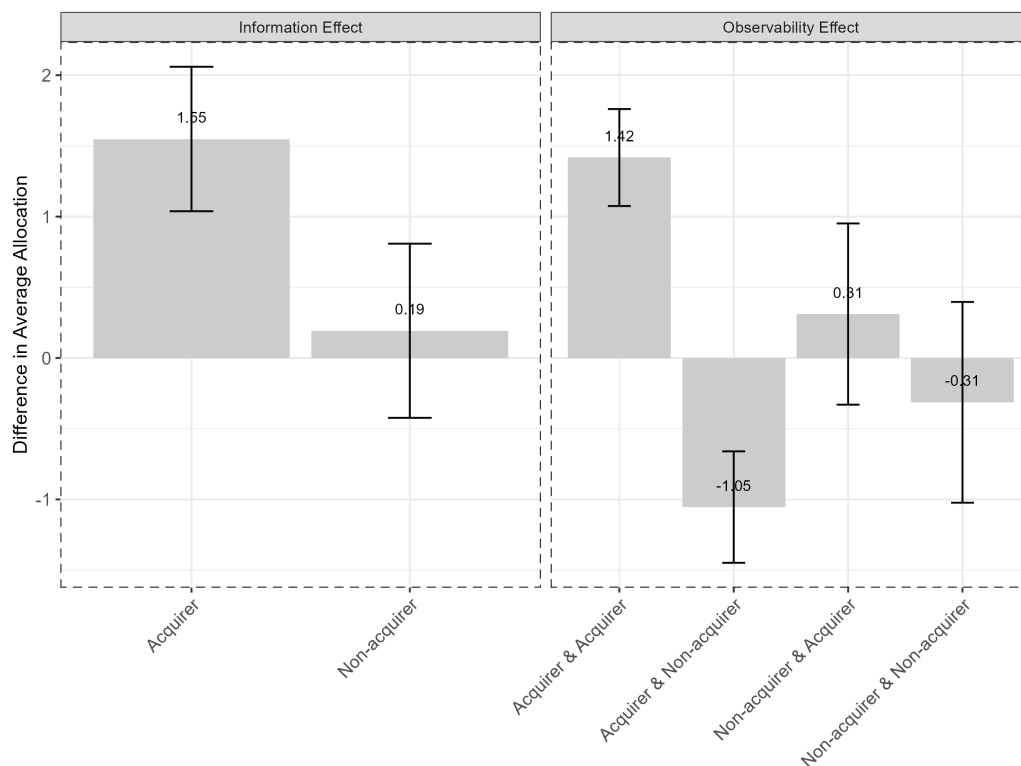


Figure 5: Comparing the information and observability effects of individual allocations across acquisition and observability conditions.

The observability effect (right panel) reveals a more nuanced pattern of strategic conditioning on opponents' information acquisition status. Acquirers in *PublicEndo* adjust their allocations based on their partner's decision: they increase allocations by 1.42 when paired with fellow acquirers but reduce them by 1.05 when paired with non-acquirers. This bidirectional response shows that mutual

³⁰The detailed regression results are presented in Tables B.5.1, B.5.2, and B.5.3. The coefficients reported in Figure 5 are obtained from column (2) of these three regression tables.

information acquisition with observability serves as a coordination device, fundamentally reshaping strategic expectations. Our post-experiment questionnaire confirms this mechanism. Among frequent acquirers, 72.2% in *PublicEndo* recommended contributing 10 after high signals when both acquired (vs. 46.4% advising 0 in *PrivateEndo*) while 76.4% expected their opponents would contribute 10 (vs. 41.1% in *PrivateEndo*).³¹ This strategic and expectational alignment facilitates favorable equilibrium outcomes in the $G(1, 1)$ subgame where informed players implement higher allocations needed for high thresholds. The reduction when paired with non-acquirers may reflect the non-symmetric equilibria prediction. Acquirers should adopt a (10, 0) strategy when facing non-acquirers who intend to free-ride by deliberately remaining uninformed. In contrast, non-acquirers show minimal strategic responses to observability, suggesting limited sophistication in using public non-acquisition as an equilibrium selection device for the resulting $G(0, 0)$ subgame.

These effects remain robust when controlling for several factors including time trends, historical allocations outcomes, and contribution types identified in introductory TPGG tasks.³² Individual allocations generally decrease over time, exhibit strong history dependence on their own and their opponent's previous allocations, and vary with participant heterogeneity identified through their decisions in part one of the experiment, particularly among participants whose unconditional contribution to a high threshold is 10. Our findings partially align with theoretical equilibrium predictions. Private information acquisition cannot select favorable from unfavorable coordination outcomes. Public information acquisition enables acquirers to coordinate on favorable outcomes when facing fellow acquirers. However, we observe limited strategic adaptation when acquirers face non-acquirers and minimal strategic sophistication among non-acquirers themselves.

Participants' questionnaire responses also revealed the asymmetry between acquirers and non-acquirers in strategic sophistication. In *PublicEndo*, most frequent acquirers aligned on high contributions, with 72.2% recommending and 76.4% ex-

³¹The corresponding advice question is: "Suppose a person chose to draw a ball in a round, and the other participant matched with this person also chose to draw a ball. Based on your experience playing the game, which allocation advice would you give this person? (In case of a red and a blue ball)". The corresponding expectation question is: "Suppose you chose to draw a ball in a round, and the other participant also chose to draw a ball. What is your expectation of their behavior? (In case of a red and a blue ball)". Comparisons are limited to frequent acquirers, who acquired signals more frequently than their session medians.

³²See regression Tables B.5.1, B.5.2, and B.5.3. We also present Figure B.5.1, which displays allocation frequencies over time across three treatments and under three signal conditions: No Signal, Low Signal, High Signal.

pecting 10 contributions after high signals. Conversely, in *PrivateEndo*, strategic consensus on high coordination was weaker, with 53.6% recommending 0 and 58.9% expecting other acquirers to contribute nothing. When paired with non-acquirers, while frequent acquirers in both treatments often recommended non-acquirers to contribute 0 after high signals (85.7% in *PrivateEndo*, 88.9% in *PublicEndo*)³³, their expectations that non-acquirers would actually contribute 0 were moderate (67.9% in *PrivateEndo*, 55.6% in *PublicEndo*)³⁴. Non-acquirers exhibited even less strategic adaptation—when advising other non-acquirers facing acquirers, only 34.1% in *PrivateEndo* and 45.5% in *PublicEndo* recommended the theoretically optimal 0 contribution. Furthermore, 59.1–65.5% advised non-acquirers to contribute 0 when both were uninformed.

Finding 6 (Acquirer-driven Effects). *Information effects operate primarily through participants who acquire signals, while observability effects manifest when acquirers observe their opponents to acquire signals as well. Non-acquirers in various conditions exhibit similar behaviors as in Baseline.*

Table 7 provides a deeper examination of participants' allocation strategies. In *PrivateEndo*, we observe precisely the coordination failure predicted by Proposition 3's multiple equilibria: 51% of acquirers adopted the unfavorable (5, 0) strategy while only 35% selected the favorable (5, 10) strategy. Despite substantial information acquisition, not observing each other's acquisition choices prevented coordination on the most efficient outcomes. *PublicEndo* demonstrates a remarkable breakthrough in equilibrium selection when both players acquired information: 68% chose the favorable (5, 10) strategy compared to just 35% in *PrivateEndo*. This improvement confirms our theoretical prediction that observability facilitates the selection of the favorable outcomes in $G(1, 1)$.

The critical divergence between private and public treatments emerges specifically in high-threshold responses—observable acquisition effectively signals coordination intention on high investment, thereby resolving the strategic uncertainty that private information alone cannot address at likely high thresholds. However, theoretical predictions fare less well in asymmetric information-acquiring or non-acquiring scenarios: acquirers facing non-acquirers adopted the predicted (10, 0) strategy only 19% of the time, while non-acquirers predominantly allocated zero

³³Question: "Suppose a person chose to draw a ball in a round, and the other participant matched with this person chose not to draw a ball. Based on your experience playing the game, which allocation advice would you give this person (in case of a signal suggesting the high threshold)?"

³⁴Question: "Suppose you chose to draw a ball in a round, and the other participant chose not to draw a ball. What is your expectation of their behavior?"

Table 7: Frequencies of allocation strategies across acquisition and observability conditions

Treatment	Information	Observability	Mean Allocation	Favorable	Freq.	Unfavorable	Freq.
<i>Baseline</i>	–	–	3.17	5	0.21	0	0.57
<i>PrivateEndo</i>	Non-acquirer (37%)	–	3.37	5 [‡]	0.27	0 [‡]	0.53
	Acquirer (63%)	–	4.72**	(5, 10)	0.35	(5, 0)	0.51
<i>PublicEndo</i>	Non-acquirer (29%)	Other: non-acquirer (41%)	3.05	5	0.23	0 [‡]	0.58
		Other: acquirer (59%)	3.68	0	0.51	5 [‡]	0.25
	Acquirer (71%)	Other: non-acquirer (24%)	3.67***	(10, 0)	0.19	(5, 0) [‡]	0.40
		Other: acquirer (76%)	6.14***	(5, 10)	0.68	(5, 0) [‡]	0.24

Notes: Frequencies are computed within each subgroup and may not sum to 1 because some strategies are omitted. The *favorable* and *unfavorable* equilibrium strategies are derived in Section 2. For the convenience of treatment comparison, we also present non-equilibrium strategies, which are noted with a superscript symbol [‡]. Participants who acquired information choose a contingent allocation plan (a_l, a_h) , giving allocations for both low and high signals; participants who did not acquire a signal choose a single, non-contingent allocation a_ϕ .

and showed no significant difference from the *Baseline* across all conditions. The benefits of observability concentrate in mutual-acquisition scenarios, while the theoretical advantages of public non-acquisition remain largely unrealized. This pattern explains the superior performance of *PublicEndo* despite incomplete alignment with all theoretical predictions.

Table 8 isolates signal-dependent strategies among acquirers in *PrivateEndo* and *PublicEndo* treatments, revealing that observability effects manifest primarily in high-signal decisions. For high signals, *PublicEndo* acquirers paired with informed partners significantly increase allocations by 2.88–3.50 relative to *PrivateEndo*, demonstrating the coordination premium when mutual acquisition signals alignment on (5, 10) strategies. The history dependence shown in column (6) indicates dynamic reinforcement of these coordination patterns. Conversely, when facing non-acquirers, they reduce high-signal allocations by 1.58–2.04. This reduction reflects partial adoption of the predicted (10, 0) logic. Table 7 shows only 19% implemented this strategy, while 40% chose (5, 0).³⁵ This suggests that acquirers only partially recognize that non-acquirers, under observability, may strategically remain uninformed to facilitate free riding. For low signals, allocations remain consistent across all conditions with no significant differences, aligning with both favorable and unfavorable equilibrium prescriptions for intermediate investments after low signals. These results demonstrate the primary mechanism of public information acquisition: enabling acquirers to coordinate on higher contributions,

³⁵The limited adoption of the favorable strategy (10, 0) stems from incomplete strategic awareness. Although 55.6% of frequent acquirers in *PublicEndo* recognized non-acquirers would contribute 0, only 27.8% of them recommended contributing 10 after a low signal when facing uninformed partners. Instead, 41.7% recommended 5, and the remaining 30.6% recommended 0.

specifically after high signals, when paired with fellow acquirers, thereby resolving the coordination dilemma that persists in private information environments.

Table 8: Linear regressions for observability effects among information-acquirers

	Dependent variables:					
	AllocationLow			AllocationHigh		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	5.40*** (0.16)	5.70*** (0.19)	5.45*** (0.19)	3.75*** (0.48)	4.70*** (0.59)	0.84* (0.35)
PublicEndo, Other: Yes	−0.09 (0.19)	−0.23 (0.25)	0.004 (0.18)	3.50*** (0.63)	2.88*** (0.74)	3.02*** (0.54)
PublicEndo, Other: No	−0.43 (0.33)	−0.10 (0.47)	−0.41 (0.34)	−1.58** (0.59)	−1.14 (0.85)	−2.04*** (0.51)
Period		−0.05** (0.02)			−0.15** (0.05)	
PublicEndo, Other: Yes * Period		0.02 (0.02)			0.10 (0.07)	
PublicEndo, Other: No * Period		−0.05 (0.06)			−0.07 (0.09)	
AllocationPreviousPeriod			0.01 (0.02)			0.47*** (0.04)
AllocationOtherPreviousPeriod			−0.03 (0.02)			0.17*** (0.04)
SuccessPreviousPeriod			−0.13 (0.13)			−0.20 (0.30)
Observations	1,837	1,837	1,667	1,837	1,837	1,667
R ²	0.01	0.01	0.01	0.16	0.17	0.32

Notes: For the treatment, the reference category is *PrivateEndo* to allow direct comparisons between treatments. Standard errors are clustered at the individual level. *p<0.05; **p<0.01; ***p<0.001

Finding 7 (Observability and Coordinated High-Signal Allocations). *Publicly observable information acquisition facilitates adoption of the favorable (5, 10) allocation strategies among mutual acquirers. Observability effects operate exclusively through coordinated high-signal allocations, enabling efficient public good provision that remains unattainable under private information acquisition, while low-signal allocations show no significant differences across treatments.*

We also conduct parallel analyses of participants' allocations for the two exogenous treatments.³⁶ First, we find that participants who endogenously acquired information allocated significantly more than those who exogenously received it, particularly among information acquirers/receivers in private treatments and especially when paired with similarly informed partners in public treatments.³⁷ This suggests self-selection effects in information acquisition are crucial—those who actively choose to acquire information utilize it more effectively than those who passively receive it, highlighting the strategic value of endogenous information acquisition in threshold public goods games. Second, the information effect disappears

³⁶Details can be found in Appendix B.6.

³⁷See Table B.6.1.

in exogenous treatments, yet the observability effect persists.³⁸ Signal-receivers in *PublicExo* significantly increase allocations by 1.87 when paired with fellow receivers. This demonstrates that less efficient coordination in *PrivateEndo* than in *PublicEndo* is not because of information gaps per se, but due to the inability to interpret others' acquisition choices as signals for efficient coordination.

A further investigation of participants' allocation strategies confirms that mutual observability enhances coordination success.³⁹ When both players receive signals, 50% choose the favorable (5, 10) strategy in *PublicExo* versus only 18% in *PrivateExo*. We also find a contrast in how receivers treat non-receivers across endogenous versus exogenous environments.⁴⁰ Receivers in *PublicExo* adopt the allocation strategy (10, 0) against non-receivers at more than double the rate seen in *PublicEndo* (41% versus 19%), and show no allocation reduction when paired with non-receivers (unlike the -1.05 reduction in *PublicEndo*). This stark difference suggests that exogenous non-receivers are viewed as non-strategic "flukes" whom receivers feel comfortable exploiting, whereas endogenous non-acquirers trigger strategic hesitation, perhaps due to uncertain intent attribution. In addition, coordination collapses in *PrivateExo* despite exogenous information provision (only 18% choose (5, 10)), closely mirroring the failures in *PrivateEndo* and confirming that observability, not information quality or acquisition method, is the binding constraint.

5 Conclusion

This paper resolves a fundamental strategic challenge in threshold public goods provision. Threshold uncertainty creates tension between free-riding and coordination motives. When thresholds might be low, free-riding is tempting, but when they might be high, coordination becomes essential. We demonstrate how endogenous information acquisition, in particular, the publicly observable acquisition, effectively resolves this tension. Observability serves as an equilibrium selection device. It enables agents to coordinate on efficient investment strategies even when acquired information content remains private.

³⁸See Figure B.6.1 and Table B.6.2.

³⁹Table B.6.3 presents participants' strategy frequencies across various information and observability conditions. Table B.6.4 reports the linear regression results for signal receivers' allocation strategies.

⁴⁰See Table B.6.7.

Our experiment yields three key findings that partially align with our theoretical predictions. First, private information acquisition substantially improves provision rates and efficiency, but these benefits accrue exclusively through the behavior of information acquirers. They substantially increase their allocations to the public good. Non-acquirers show negligible behavioral changes, highlighting the strategic value of endogenous information acquisition in resolving threshold uncertainty. Second, the public observability of acquisition decisions yields additional benefits by enabling favorable equilibrium selection among mutually informed pairs. Third, contrary to theoretical predictions, information acquisition rates do not significantly differ between private and public environments. Instead, the benefits of observability emerge through acquirers' strategic conditioning: they increase their allocations when paired with fellow acquirers but decrease them when facing non-acquirers, effectively using observable information acquisition as a credible signal of coordination intent.

The strategic value of information acquisition operates through distinct channels in private versus public environments. When acquisition decisions remain private, information primarily helps resolve threshold uncertainty, allowing agents to condition their allocations based on threshold signals. However, when acquisition decisions become observable, they serve a dual purpose: resolving threshold uncertainty while simultaneously providing credible signals about strategic intentions. This observability transforms information acquisition into an implicit coordination device that reduces strategic uncertainty about others' allocations.

These findings identify a potent but underutilized institutional design lever: transparency about whether information is acquired—not necessarily its content—can resolve coordination failures where full information sharing is infeasible or undesirable. This offers targeted solutions for persistent coordination problems. In climate alliances, nations disclosing participation in joint scientific assessments (e.g., IPCC working groups) signal commitment to coordinated emission cuts without revealing confidential adaptation plans. To enhance financial stability, regulators can require banks to publicly disclose their participation in stress tests. This observability could encourage coordinated capital buffers without inciting market panic over the disclosed results. In R&D consortia, firms sharing pre-competitive research investments build trust for threshold-driven innovation while preserving intellectual property. Each application demonstrates how observable information acquisition behavior serves as a practical coordination tool in domains where strategic tensions between free-riding and coordination are severe.

Several promising directions for future research emerge from our findings. First, our design deliberately excluded direct communication between participants to isolate the pure effect of information acquisition and its observability.⁴¹ Building on our results, future work should examine how direct communication about acquired signals interacts with observable information acquisition—investigating whether these mechanisms function as complements or substitutes in resolving coordination problems. Such research could adapt the approach of Cox and Stoddard (2021), translating their setup from linear to threshold public goods games. Additional valuable extensions would include investigating how the mechanism scales to larger groups and more complex threshold structures, which would test its robustness in settings more closely resembling many real-world public goods challenges. Furthermore, examining how heterogeneity in acquisition costs or signal precision affects the coordination value of observable acquisition would further illuminate the boundaries of this coordination mechanism.

By demonstrating how observable information acquisition simultaneously resolves both threshold uncertainty and strategic uncertainty in public goods provision, this paper advances our understanding of information as a coordination device. Our findings contribute to both public economics and information economics by revealing a novel mechanism through which the observability of information acquisition behavior—rather than information content—can transform intractable coordination problems into more manageable strategic environments, offering new pathways to improve efficiency in the provision of threshold public goods under uncertainty.

⁴¹Extensive literature demonstrates that communication generally improves public goods provision (Cox and Stoddard, 2021; Marini et al., 2020; T. Palfrey et al., 2017; Tavoni et al., 2011).

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A Proofs

A.1 Solving the equilibria for the TPGG with an uncertain threshold

We analyze the pure strategy Bayesian Nash Equilibria (BNEs) for the two-person threshold public goods game specified in Table 1, where players share a common prior p_0 regarding the probability of a low threshold (10) versus a high threshold (20). The expected payoffs for player P1 are presented below, with player P2's payoffs being symmetric.

Table A.1.1: P1's payoffs for the uncertain TPGG with a common prior.

		P2		
		0	5	10
P1	0	10	10	$25p_0 + 10(1 - p_0)$
	5	5	$20p_0 + 5(1 - p_0)$	$20p_0 + 5(1 - p_0)$
	10	$15p_0$	$15p_0$	15

The best response of the player P1 to the strategies of P2, denoted $BR^1(a^2)$, is determined by the common prior. Player P2's best responses are symmetrically structured. In particular, we have:

$$\begin{aligned}
 BR^1(0) &= 0 \text{ if } p_0 \leq 2/3; \text{ 10 otherwise,} \\
 BR^1(5) &= 5 \text{ if } p_0 \geq 1/3; \text{ 10 otherwise,} \\
 BR^1(10) &= 0 \text{ if } p_0 \geq 1/3; \text{ 10 otherwise.}
 \end{aligned}$$

The common prior fundamentally shapes equilibrium behavior. When $p_0 > 2/3$ (high probability of low threshold), the set of BNE strategies is $(0, 10), (5, 5), (10, 0)$, identical to the Nash equilibrium (NE) strategies in the LGame where free-riding concerns dominate. When $p_0 < 1/3$ (high probability of high threshold), the BNE becomes $(0, 0), (10, 10)$, matching the HGame where coordination is paramount.

When the common prior lies between $1/3$ and $2/3$, the set of BNE strategies is $(0, 0), (5, 5)$. The public good is never provided at a high threshold and is only successfully achieved at a low threshold when both players contribute 5. For the specific case of $p_0 = 1/2$, we can calculate the key metrics for each equilibrium.

For the (0, 0) equilibrium, the success rate and efficiency rate are both 0%, with an expected payoff of 10 ECUs (simply keeping the endowment). For the (5, 5) equilibrium, the public good is provided only when the threshold is low, yielding a success rate of 50% and an efficiency rate of 50% (as it exactly meets the low threshold). The expected payoff in this equilibrium is 12.5 ECUs per player (20 ECUs with probability 1/2 when the threshold is low, and 5 ECUs with probability 1/2 when the threshold is high).

A.2 Solving the equilibria for the PublicTPG game

We solve the PublicTPGG using backward induction. In the second stage of the game, once players learn whether their opponents have acquired a signal about the threshold, the subgame $G(z^i, z^j)$ becomes a Bayesian game. We apply the Bayesian Nash equilibrium concept, which can be viewed as a Nash equilibrium of the "expanded game," where each player's space of pure strategies consists of mappings from their type space to their action space. We extend the signal space for technical convenience to include a signal ϕ for those opting not to acquire a signal. Player i 's type space is $S^i = \{l, h\}$ if they acquire a signal in the first stage, and $S^i = \{\phi\}$ if they do not. A pure strategy for player i represents a contingent plan for each possible type, denoted as $a^i(s^i) \in A^i$. The player i 's belief about the state and the other player's possible types are represented by $p(\theta, s^j \mid s^i)$. The strategy profile $(a^1(\cdot), a^2(\cdot))$ constitutes a Bayesian Nash equilibrium if

$$a^i(s^i) \in \arg \max_{a^{i'}(s^i) \in A^i} \sum_{\theta \times S^j} p(\theta, s^j \mid s^i) u^i(a^{i'}(s^i), a^j(s^j), \theta) \text{ for all } i \text{ and all type } s^i \in S^i,$$

ensuring that each player is choosing the optimal action available to them given the received signal and their belief about the state and the other players' actions that they deduce from their signals.

Two additional technical considerations are worth noting. First, we focus on symmetric pure-strategy Bayesian Nash Equilibria (BNEs), where players who share the same belief about the joint distribution of the state and their opponents' types will adopt the same strategies. Second, we analyze the game under the assumption of costless information acquisition. However, participants in our experiment must pay a fixed cost if they choose to obtain a signal. We have kept this cost minimal to ensure that all theoretical results remain the same despite information costs.

The equilibrium results for the four subgames are summarized in Table 2. Notably, when both players acquire signals, a BNE emerges where players invest at an intermediate level after receiving a low threshold signal and at a high level after a high threshold signal. This results in a 90.5% success rate for the provision of the public good, with group contributions being efficient 81% of the time and the expected payoffs being 16.075—significantly higher than the BNE outcomes in subgames where, at most, one player acquires information. These favorable equilibrium results stem from how information acquisition and its observability shape players’ beliefs, represented as $p(\theta, s^j | s^i) = p(\theta | s^i) \times p(s^j | s^i, \theta)$. The first component, $p(\theta | s^i)$, enhances state resolution, clarifying the balance between free-riding and coordination motives. The second component, $p(s^j | s^i, \theta)$, captures the correlation between players’ signals, facilitating strategic coordination among them.

We continue with players’ information acquisition strategies in the PublicTPG game. The player i ’s strategy profile must specify her information acquisition decision and contribution strategies for both scenarios: when facing an information-acquiring opponent and a non-acquiring opponent. Player i ’s contribution strategies depend on her decision to acquire information. We denote her strategy profile as $(z^i = 1, (a_l^i, a_h^i), (a_l^i, a_h^i))$ when she chooses to acquire a signal, and $(z^i = 0, a_\phi^i, a_\phi^i)$ when she does not. The second element represents her contribution strategy against an acquiring opponent, while the third indicates her strategy against a non-acquiring opponent. By leveraging the best responses derived from the BNE analyses of the four subgames, we can simplify the extensive game into a static game and solve for its Nash equilibria, which are underlined.

Table A.2.1: Static form for the PublicTPG

		P2			
		$(z^2 = 1, (5, 10), (10, 0))$	$(z^2 = 1, (5, 0), (10, 0))$	$(z^2 = 0, 0, 0)$	$(z^2 = 0, 0, 5)$
P1	$(z^1 = 1, (5, 10), (10, 0))$	(<u>16.075</u> , <u>16.075</u>)	(6.825, 14.925)	(<u>11.75</u> , 13.75)	(11.75, <u>13.75</u>)
	$(z^1 = 1, (5, 0), (10, 0))$	(14.925, 6.825)	(13.575, 13.575)	(<u>11.75</u> , <u>13.75</u>)	(11.75, <u>13.75</u>)
	$(z^1 = 0, 0, 0)$	(13.75, <u>11.75</u>)	(<u>13.75</u> , <u>11.75</u>)	(10, 10)	(10, 5)
	$(z^1 = 0, 0, 5)$	(13.75, 11.75)	(<u>13.75</u> , 11.75)	(5, 10)	(<u>12.5</u> , <u>12.5</u>)

The game matrix reveals a fundamental strategic tension between information’s value for uncertainty reduction and its role in facilitating coordination. This tension is manifest in the four distinct equilibria that emerge from our analysis. We first identify a symmetric information-acquiring equilibrium in which both players acquire information and coordinate according to the favorable equilibrium outcomes in the subgame $G(1, 1)$. Specifically, they allocate (5, 10) upon observing that

their opponent has acquired information and $(10, 0)$ when facing a non-acquiring opponent. Along the equilibrium path, both players contribute 5 ECUs after receiving a low threshold signal and 10 ECUs after a high threshold signal. This acquisition-driven coordination achieves a 90.5% success rate for public good provision with an efficient contribution rate of 81%, allowing both players to achieve the highest expected payoff of 16.075 ECUs. This equilibrium illustrates how mutual observability of information acquisition enables correlation-enhanced coordination: players not only resolve uncertainty about the threshold but can reasonably anticipate their opponent received the same signal (with a high probability of 82%), creating aligned expectations and incentives. This allows them to coordinate state-contingent actions: moderating contributions when thresholds are likely low ($s_i = l$), while jointly 'going big' when likely high ($s_i = h$).

In stark contrast, we also identify a symmetric information-non-acquiring equilibrium where both players forgo information acquisition. They allocate 0 ECUs after observing an acquiring opponent and 5 ECUs after encountering a non-acquiring opponent. This represents a "safe" coordination strategy that guarantees moderate success when the threshold turns out to be low. The equilibrium outcomes align with the favorable one in the subgame $G(0, 0)$, where both the success rate and efficiency rate are 50%, with expected payoffs of 12.5 ECUs for each player.

In addition, we find two non-symmetric equilibria where one player acquires information while the other strategically remains uninformed. The acquirer allocates according to the plan $(5, 0)$ when their opponent also acquires information, and $(10, 0)$ otherwise. Conversely, the non-acquirer consistently contributes nothing, regardless of their opponent's information status. These equilibria yield a success rate and efficiency rate of 45%, but with asymmetric payoffs: 11.75 ECUs for the acquirer versus 13.75 ECUs for the non-acquirer who successfully free-rides. By deliberately choosing to remain uninformed—and ensuring their opponent observes this choice—a player can strategically induce their opponent to take sole responsibility for providing the public good when the threshold is likely low. Simultaneously, for the informed player, acquiring information is valuable despite their opponent's free-riding behavior. With information, they can optimize their contribution strategy by investing heavily only when signals suggest a low threshold (where their solo contribution can succeed) and withholding investment when signals indicate a high threshold. This strategic dynamic demonstrates how public observability of acquisition decisions makes strategic exploitation feasible. By publicly refusing information, non-acquirers signal their intent to withhold con-

tributions, forcing their opponents to be acquirers and overcompensate in low-threshold states.

These equilibrium analyses highlight how public observability transforms information acquisition from mere uncertainty reduction into a powerful strategic coordination device. Players signal their intended approach to the coordination problem through their observable acquisition decisions, enabling equilibrium selection that would be impossible if information decisions remained private. This observability can drive groups toward highly efficient outcomes where information enables successful coordination across all states (90.5% success), but it also creates opportunities for strategic non-acquisition that enables free riding.

A.3 Solving the equilibria for the PrivateTPG game

In the PrivateTPG game, a player's strategy space is defined as $A_\phi \cup (A_l, A_h)$. This results in a total of 12 pure strategies available for selection, which are partitioned based on the player's information acquisition choice in the first stage. We denote player i 's strategy as $(a_l^i, a_h^i) \in (A_l, A_h)$ when she chooses to acquire a signal ($z^i = 1$), and as $a_\phi \in A_\phi$ when she opts not to acquire information ($z^i = 0$). We simplify the PrivateTPGG into a Bayesian game as outlined in Table A.3.1, which can also be partitioned according to the four subgames discussed in solving PublicTPGG.

Table A.3.1: Normal form for the PrivateTPGG

		P2	
		$z^2 = 1$	$z^2 = 0$
		(A_l^2, A_h^2)	A_ϕ^2
P1	$z^1 = 1 : (A_l^1, A_h^1)$	G(1, 1)	G(1, 0)
	$z^1 = 0 : A_\phi^1$	G(0, 1)	G(0, 0)

Following the analysis conducted for the PublicTPG game, we adopt the BNE concept and focus on symmetric pure strategy equilibria. By leveraging the established game partition, we can solve the game by focusing on BNE strategies identified in the four subgames $G(z^i, z^j)$ in PublicTPGG. For instance, consider the favorable equilibrium in $G(1, 1)$, where both players allocate 5 after receiving a low threshold signal and 10 after a high threshold signal. If we fix player 2's (P2)

strategy as $(a_l^2, a_h^2) = (5, 10)$, the best response for player 1 (P1), should she choose to acquire a signal in the first stage, is also $(5, 10)$, resulting in an expected payoff of 16.075. However, if P1 does not acquire a signal, the game partitions into a different scenario, $G(0, 1)$. In this case, her best response to P2's strategy of $(5, 10)$ is not to allocate to the public good, yielding an expected payoff of 13.75. We then compare the expected payoffs of these two local best responses to determine the full equilibrium that includes acquisition choices.

We found two pure-strategy symmetric BNEs, both are information-acquiring equilibrium. In other words, for any strategy within the non-acquirer's partition A_ϕ , players can always identify a profitable deviation within the acquirers' strategy partition (A_l, A_h) . The first equilibrium achieves favorable equilibrium outcomes in $G(1, 1)$. In this equilibrium, both players acquire a signal and select the allocation plan $(5, 10)$. The successful rate, efficient rate, and expected payoffs in this equilibrium are identical to those observed in the information-acquiring equilibrium of the PublicTPG game. Specifically, players benefit from a successful rate of 90.5%, an efficient rate of 0.81, and achieve the highest expected payoff of 16.075. The second equilibrium is less attractive and obtains the unfavorable equilibrium outcomes in $G(1, 1)$. In this scenario, both players again acquire a signal but opt for the allocation plan $(5, 0)$. As a result, the success rate and the efficiency rate are reduced to 40.5%, with the expected payoff for both players being 13.575.

B Additional Analyses

B.1 Evaluating the Consequences of the Program Bug

As noted in Section 3, a programming error affected several of our sessions (only 6.3% of the observations within these sessions were affected), causing allocation decisions to be implemented as if signals had 100% accuracy instead of the intended 90%. This appendix demonstrates that this error did not meaningfully influence our results.

We first focus on information acquisition decisions. Table B.1.1 shows information acquisition rates across treatments and bug conditions. Statistical tests reveal no significant differences in acquisition rates between bug-free and bug-affected sessions in either treatment. One potential concern is that experiencing more accurate signals (due to the bug) in early rounds might lead participants to perceive information as more valuable, thereby increasing acquisition rates in later rounds. If this learning effect were present, we would expect to observe larger differences in acquisition rates in the final period. However, the data show that final period acquisition rates remain remarkably similar between bug-free and bug-affected sessions. The absence of such differences, particularly in later rounds, provides strong evidence that the programming error did not systematically alter participants' valuation of information or their strategic acquisition decisions.

Table B.1.1: Information acquisition rates in bug-free versus bug-affected sessions

Treatment	Bug Status	% Acquisition	% Last Period Acquisition
<i>PrivateEndo</i>	Bug-free	65	60
	Bug-affected	63	60
<i>PublicEndo</i>	Bug-free	72	73
	Bug-affected	70	72

We then turn to participants' allocation strategies. An additional challenge in our comparison is that most of the affected sessions occurred in spring with more experienced participants, while bug-free sessions were conducted in fall immediately following the lab's recruitment drive, resulting in a participant pool with a higher proportion of first-year students and less experimental experience. These demographic differences could potentially confound simple comparisons between bug-affected and bug-free sessions, as participant experience may influence strategic behavior independently of the programming error.

To rigorously address these cohort differences and isolate any potential effects of the programming error, we employ session-fixed effects in our analyses of allocation behavior and individual-fixed effects when examining within-subject responses. This methodological approach effectively controls for unobservable session-specific characteristics (such as participant experience levels and timing within the academic calendar) and individual-specific traits, allowing us to identify whether the bug itself—rather than cohort differences—influenced participant behavior.

To analyze allocation strategies, we estimated regression models with session-fixed effects to account for potential cohort differences. Figure B.1.1 displays the coefficients capturing differences between bug-affected and bug-free sessions for allocation decisions under different signals and observability conditions. All 95% confidence intervals contain zero, indicating no significant bug-related effects on allocation behaviors at the session level. The absence of significant coefficients across all strategic scenarios suggests that participants' fundamental decision-making processes remained unaffected by the implementation error.

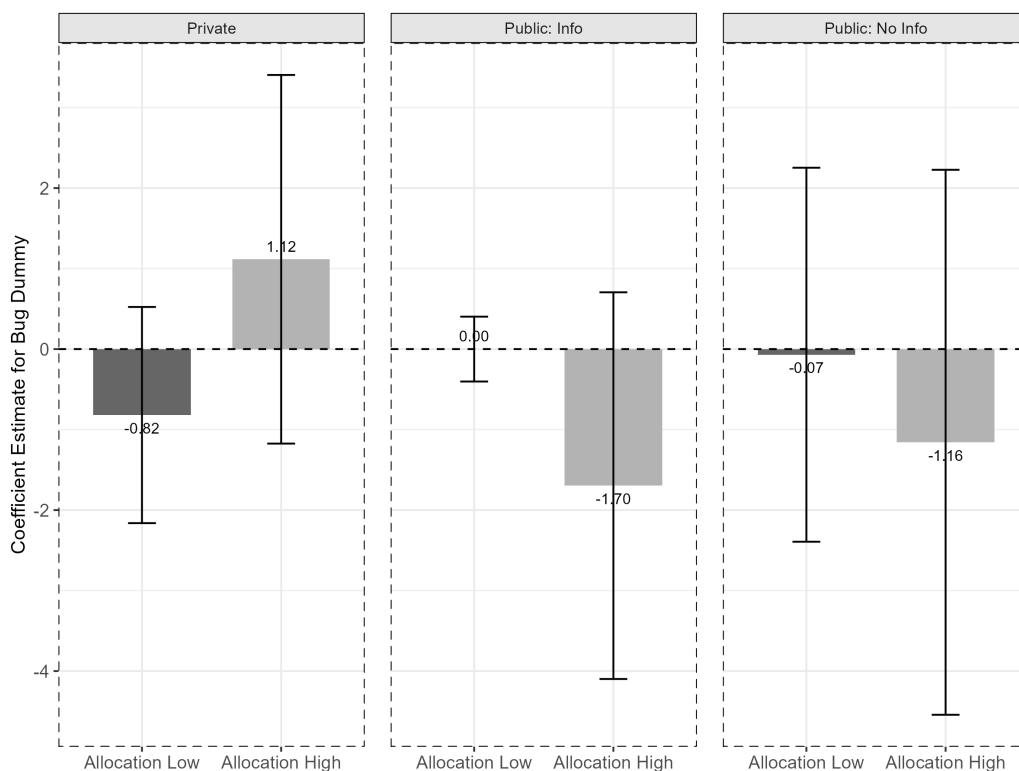


Figure B.1.1: Regression coefficients for bug effects on allocation decisions

Notes: The figure displays coefficient estimates from six separate OLS regressions on an indicator variable for bug-affected sessions. All models include session fixed effects to control for cohort differences. Error bars represent 95% confidence intervals based on standard errors clustered at the individual subject level.

We also conducted individual-level fixed effects analysis to examine whether participants who experienced the bug changed their behavior following their first exposure to it. Table B.1.2 presents these results, showing no statistically significant changes in allocation decisions after experiencing the bug across all treatment conditions. This within-subject analysis provides compelling evidence against bug-induced behavioral changes. Even participants who directly experienced the implementation error—that is, those whose allocations were implemented based on the actual threshold rather than their signal—did not systematically alter their strategic choices in subsequent rounds. This suggests that either participants did not notice the implementation discrepancy or, if they did, it did not meaningfully influence their decision-making strategy.

Table B.1.2: Fixed-effects analysis of bug impact on individual allocation decisions

	<i>Dependent variable:</i>		
	Allocation (1)	Allocation Low (2)	Allocation High (3)
PrivateEndo * Bug	−0.43 (0.50)	−0.08 (0.11)	−0.11 (0.38)
PublicEndo, Other: Yes * Bug	0.15 (0.67)	−0.33 (0.20)	0.19 (0.51)
PublicEndo, Other: No * Bug	−1.20 (0.95)	−0.25 (0.70)	−1.40 (0.93)
Strategic Group Main Effects Omitted	Yes	Yes	Yes
Observations	2,724	1,837	1,837

Notes: All standard errors are clustered at the individual participant level. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

In summary, our analyses confirm that the programming error did not substantively affect our findings or conclusions. The small proportion of affected observations (6.3% in bug-affected sessions), the absence of participant reports noticing inconsistencies, and the consistent null results from our econometric analyses all support our decision to pool the data across all sessions for each treatment. Our results thus reflect genuine strategic behavior in response to our treatment manipulations, rather than artifacts of the implementation error.

B.2 Type Classification based on Conditional Contributions to TPGG with Known Thresholds

As mentioned in Section 3, we developed a classification system for participants' conditional contribution strategies to identify their understanding of the strategic

environment and to exclude participants whose choices appeared driven primarily by confusion rather than strategic considerations. Our classification method measures the Euclidean distance between each participant’s conditional contribution vector and several predefined prototype vectors representing theoretically motivated strategies. A participant is assigned to a specific category when their behavior falls within a fixed threshold distance (set at 5) from the corresponding prototype, allowing for minor deviations while preserving the core strategic pattern. The algorithm operates for both a known low and a known high threshold. Several distinctive non-standard patterns are also identified through exact matching.

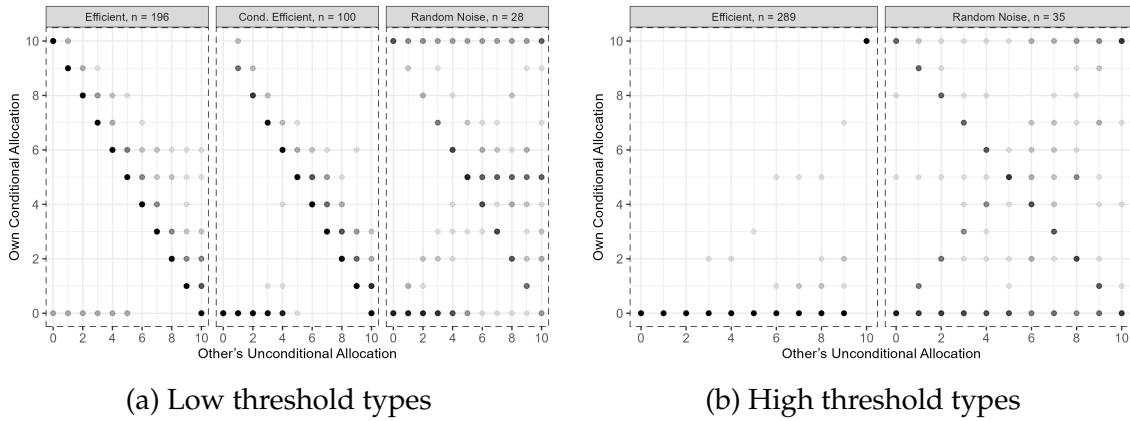


Figure B.2.1: Conditional contribution types

Note: The darker a dot, the more observations it captures.

For the known low threshold condition, we identify three distinct behavioral types. *Efficient* contributors (60% of participants) follow a perfect linear decay pattern, precisely complementing their opponent’s contribution to reach the threshold sum of 10 (e.g., contributing 9 when the opponent gives 1, 8 when the opponent gives 2, etc.). *Conditionally Efficient* contributors (31% of participants) also follow this efficient complementarity pattern, but only after their opponent’s contribution exceeds a minimum threshold—essentially refusing to compensate fully for very low contributor partners. The remaining participants, whose behavior does not closely match either of these patterns, are classified as *Random Noise*.

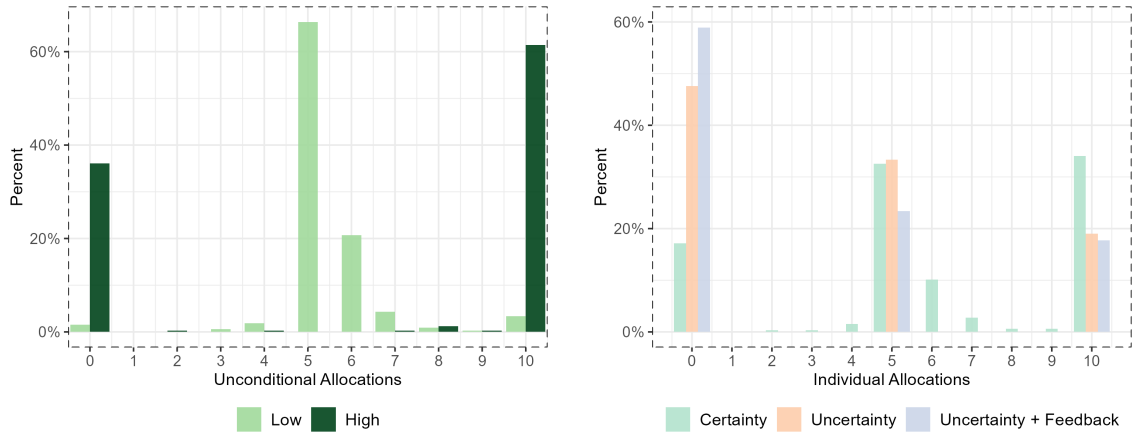
For the known high threshold condition, we employ a simpler two-category classification reflecting the absence of free-riding incentives in this setting. *Efficient* contributors (88% of participants) exhibit threshold-conditional behavior, contributing their full endowment only when their opponent’s contribution is sufficiently high to make reaching the threshold feasible. All other contribution patterns that deviate significantly from this strategic response are classified as *Random Noise*.

These classifications, visualized in Figure B.2.1, confirm that the majority of participants understood the strategic tensions in TPGG games with commonly known thresholds. Their behavior aligns with Nash equilibrium predictions, showing appropriate responses to free-riding incentives when the threshold is low and coordination attempts when the threshold is high.

B.3 Additional Analyses for the Effects of Threshold Uncertainty

Figure B.3.1a displays the distributions of participants' allocations to the public goods under the condition *Certainty*. When the threshold was known to be low, around 96% allocated at least 5 ECUs to the public good, leading to a 94% chance of a successful public good provision. The majority chose 5 ECUs (67%), consistent with the focal point of the NE strategy. A sizable fraction of participants allocated 6 and 10 ECUs—20% and 3%, respectively—causing overprovision and an efficiency rate of 43%. When the threshold was high, the participants' choices became polarized, clustering at 0 and 10 ECUs—36% and 61%, respectively. These choices again align with the risk-dominance and payoff-dominance motives of the NE strategies. Participants were still able to coordinate to reach a successful (and efficient) provision of public good at a rate of 37%. Notably, we also find no correlation (0.02) between participants' behaviors in high- and low-threshold scenarios, suggesting that strategic considerations, rather than individual characteristics, are the main driver for behaviors in these tasks.

Figure B.3.1b illustrates the distributions of the allocation choices under three different uncertainty conditions. When participants had been informed that low and high thresholds were equally likely, their allocations shifted dramatically to zero, occurring more than twice as often in the *Uncertainty* condition (48%) and almost three times as often in the *Uncertainty + Feedback* condition (59%). This is again consistent with the risk-dominance Bayesian Nash Equilibrium (BNE) strategy. Approximately 30% chose the allocation of 5 ECUs, aligning with the payoff-dominance BNE strategy, while a consistent 20% selected the strictly dominated strategy of 10 ECUs. The average allocation decreased significantly from 6.0 to 3.6 under initial uncertainty ($p = 0.002$) and further to 2.9 (though not statistically significantly) with feedback. This progressive shift toward zero allocation demonstrates that feedback and repetition, rather than facilitating learning and coordination, amplified uncertainty's negative effects on strategic behavior.



(a) Allocation choices for certain threshold (b) Pooled allocation choices for certain and uncertain thresholds

Figure B.3.1: Individual allocations: certain versus uncertain thresholds.

Notes: Panel (a) shows distributions of allocation choices when thresholds are known with certainty, with distinct patterns for low threshold (light green) and high threshold (dark green) conditions. Panel (b) compares allocation distributions across three conditions: *Certainty* (green), *Uncertainty* (orange), and *Uncertainty + Feedback* (blue), where *Certainty* refers to unconditional allocations in the introductory part of the experiment, *Uncertainty* denotes the first-period behavior in *Baseline*, and *Uncertainty + Feedback* indicates the subsequent behavior in *Baseline*.

B.4 Additional Analyses for Information and Observability Effects

Table B.4.1: OLS for pair good provision measures

	Dependent variables:								
	Pair Allocation			Success Rate			Efficiency Rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	6.35*** (0.36)	6.99*** (0.48)	7.70*** (0.78)	0.27*** (0.03)	0.46*** (0.04)	0.34*** (0.06)	0.17*** (0.02)	0.28*** (0.04)	0.15** (0.05)
PrivateEndo	2.07*** (0.43)	2.06*** (0.55)	1.86* (0.94)	0.12*** (0.03)	0.20*** (0.05)	0.07 (0.08)	0.12*** (0.03)	0.18*** (0.05)	0.16* (0.07)
PublicEndo	3.58*** (0.42)	2.72*** (0.54)	3.49*** (0.90)	0.23*** (0.03)	0.27*** (0.05)	0.24** (0.08)	0.19*** (0.03)	0.20*** (0.05)	0.25*** (0.07)
HighThreshold		-1.42* (0.71)			-0.41*** (0.05)			-0.24*** (0.04)	
PrivateEndo * HighThreshold		0.20 (0.86)			-0.10 (0.06)			-0.07 (0.06)	
PublicEndo * HighThreshold		1.86* (0.85)			-0.07 (0.06)			0.0003 (0.06)	
Period			-0.21 (0.11)			-0.01 (0.01)			0.003 (0.01)
PrivateEndo * Period			0.03 (0.13)			0.01 (0.01)			-0.01 (0.01)
PublicEndo * Period			0.01 (0.12)			-0.002 (0.01)			-0.01 (0.01)
Observations	1,584	1,584	1,584	1,584	1,584	1,584	1,584	1,584	1,584
R ²	0.04	0.05	0.05	0.03	0.27	0.03	0.02	0.11	0.02

Notes: For the treatment, the reference category is *Baseline*. Robust standard errors. *p<0.05; **p<0.01; ***p<0.001

B.5 Additional Analyses for Mechanisms of Information and Observability Effects

Table B.5.1: Information effects: linear regressions for allocations of acquirers and non-acquirers in *PrivateEndo*

	Dependent variable:					
	Allocation					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	3.17*** (0.44)	3.17*** (0.44)	3.74*** (0.48)	1.44*** (0.27)	1.14 (0.95)	0.84 (0.61)
PrivateEndo	1.05* (0.50)					
PrivateEndo: Acquirer		1.55** (0.51)	1.54** (0.51)	0.95** (0.33)	1.58** (0.50)	1.00** (0.34)
PrivateEndo: Non-acquirer		0.19 (0.62)	0.21 (0.62)	0.005 (0.38)	0.17 (0.59)	−0.01 (0.39)
Period			−0.09** (0.03)			−0.04 (0.02)
AllocationPreviousPeriod				0.43*** (0.04)		0.41*** (0.04)
AllocationOtherPreviousPeriod				0.11*** (0.03)		0.11*** (0.03)
SuccessPreviousPeriod				−0.30 (0.27)		−0.32 (0.27)
UnconditionalLow=5					0.89 (0.81)	0.30 (0.52)
UnconditionalLow>5					1.83* (0.84)	0.90 (0.55)
UnconditionalHigh=10					1.25** (0.40)	0.71** (0.26)
ConditionalLowCond.Efficient					0.14 (0.42)	0.05 (0.26)
ConditionalLowRandomNoise					0.29 (0.93)	0.22 (0.51)
ConditionalHighRandomNoise					1.00 (0.77)	0.63 (0.48)
Observations	1,704	1,704	1,704	1,562	1,704	1,562
R ²	0.01	0.03	0.04	0.22	0.08	0.23

Note:

*p<0.05; **p<0.01; ***p<0.001

Standard errors are clustered at the individual level.

Table B.5.2: Observability effects: linear regressions for allocations of non-acquirers in *PublicEndo*

	<i>Dependent variable:</i>					
	Allocation					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	3.37*** (0.43)	3.37*** (0.43)	4.29*** (0.48)	1.37*** (0.32)	1.71 (0.98)	1.36 (0.71)
PublicEndo	0.05 (0.59)					
PublicEndo, Other: Acquirer		0.31 (0.64)	0.28 (0.64)	0.15 (0.46)	0.38 (0.63)	0.19 (0.46)
PublicEndo, Other: Non-acquirer		-0.31 (0.71)	-0.34 (0.71)	-0.42 (0.48)	-0.33 (0.70)	-0.46 (0.50)
Period			-0.14*** (0.04)			-0.09** (0.03)
AllocationPreviousPeriod				0.44*** (0.05)		0.41*** (0.05)
AllocationOtherPreviousPeriod				0.10** (0.04)		0.10** (0.04)
SuccessPreviousPeriod				-0.08 (0.36)		-0.15 (0.36)
UnconditionalLow=5					0.70 (0.86)	0.31 (0.59)
UnconditionalLow>5					1.76 (1.01)	1.20 (0.67)
UnconditionalHigh=10					0.49 (0.54)	0.09 (0.36)
ConditionalLowCond.Efficient					0.40 (0.59)	0.14 (0.38)
ConditionalLowRandomNoise					1.42 (1.06)	0.72 (0.78)
ConditionalHighRandomNoise					0.86 (0.97)	0.44 (0.66)
Observations	887	887	887	830	887	830
R ²	0.0000	0.003	0.02	0.22	0.04	0.24

Note:

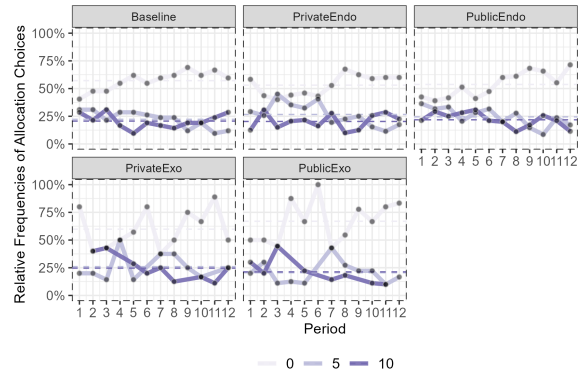
*p<0.05; **p<0.01; ***p<0.001
Standard errors are clustered at the individual level.

Table B.5.3: Observability effects: linear regressions for allocations of acquirers in *PublicEndo*

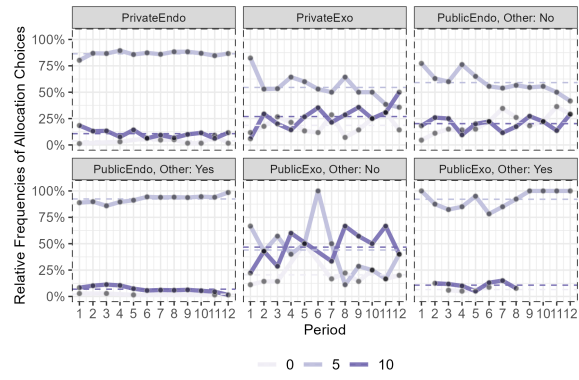
	<i>Dependent variable:</i>					
	Allocation					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	4.72*** (0.26)	4.72*** (0.26)	5.18*** (0.30)	3.31*** (0.25)	3.33*** (0.73)	2.77*** (0.61)
PublicEndo	0.81* (0.32)					
PublicEndo, Other: Acquirer		1.42*** (0.34)	1.43*** (0.34)	1.13*** (0.29)	1.37*** (0.32)	1.14*** (0.27)
PublicEndo, Other: Non-acquirer		-1.05** (0.39)	-1.05** (0.39)	-1.37*** (0.35)	-1.04** (0.39)	-1.34*** (0.35)
Period			-0.07** (0.03)			-0.05 (0.02)
AllocationPreviousPeriod				0.26*** (0.03)		0.23*** (0.03)
AllocationOtherPreviousPeriod				0.06* (0.03)		0.06* (0.03)
SuccessPreviousPeriod				-0.16 (0.24)		-0.21 (0.23)
UnconditionalLow=5					0.54 (0.68)	0.28 (0.54)
UnconditionalLow>5					0.32 (0.72)	-0.02 (0.57)
UnconditionalHigh=10					1.35*** (0.31)	1.09*** (0.27)
ConditionalLowCond.Efficient					0.24 (0.33)	0.31 (0.27)
ConditionalLowRandomNoise					-0.16 (0.50)	0.02 (0.39)
ConditionalHighRandomNoise					0.61 (0.49)	0.51 (0.39)
Observations	1,837	1,837	1,837	1,667	1,837	1,667
R ²	0.01	0.06	0.06	0.13	0.09	0.15

Note:

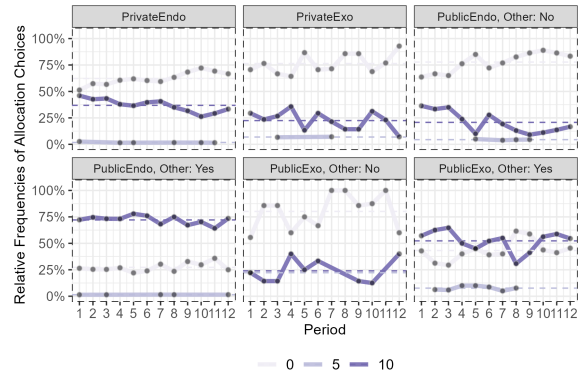
*p<0.05; **p<0.01; ***p<0.001
Standard errors are clustered at the individual level.



(a) No Signal



(b) Low Signal



(c) High Signal

Figure B.5.1: Allocation over time by treatment across signal conditions

B.6 Additional Analyses for Exogenous Treatments

Table B.6.1: Comparison of mean allocations between endogenous and exogenous treatments

Condition	Information	Observability	Mean Allocation
Private: no signal	Endo: Non-acquirer (37%)	–	3.37
	Exo: Non-receiver (32%)	–	2.92
Private: with signal	Endo: Acquirer (63%)	–	4.72
	Exo: Receiver (68%)	–	3.36***
Public: no signal	Non-acquirer (29%)	Other: non-acquirer (41%)	3.05
		Other: acquirer (59%)	3.68
	Non-receiver (27%)	Other: non-receiver (27%)	2.14
		Other: receiver (73%)	2.60**
Public: with signal	Acquirer (71%)	Other: non-acquirer (24%)	3.67
		Other: acquirer (76%)	6.14
	Receiver (74%)	Other: non-receiver (26%)	4.08
		Other: receiver (74%)	5.23***

Notes: Comparison of mean allocations between endogenous and exogenous treatments. Asterisks indicate significant differences between corresponding Endo vs. Exo conditions based on Mann–Whitney U tests: *** $p < 0.001$ (Acquirer vs. Receiver: $p = 9.42 \times 10^{-6}$; Acquirer with Acquirer vs. Receiver with Receiver: $p = 6.93 \times 10^{-4}$), ** $p < 0.05$ (Non-acquirer with Acquirer vs. Non-receiver with Receiver: $p = 0.033$). Percentages in parentheses indicate the proportion of participants in each condition.

Table B.6.2: OLS for pair good provision measures: exogenous treatments

	<i>Dependent variables:</i>								
	Pair Allocation			Success Rate			Efficiency Rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	6.35*** (0.36)	6.99*** (0.48)	7.70*** (0.78)	0.27*** (0.03)	0.46*** (0.04)	0.34*** (0.06)	0.17*** (0.02)	0.28*** (0.04)	0.15** (0.05)
PrivateExo	0.09 (0.64)	0.51 (0.82)	0.16 (1.31)	0.02 (0.05)	0.04 (0.08)	−0.004 (0.11)	0.02 (0.04)	0.03 (0.07)	0.13 (0.10)
PublicExo	2.30*** (0.55)	2.50*** (0.65)	1.94 (1.18)	0.19*** (0.05)	0.31*** (0.06)	0.11 (0.10)	0.18*** (0.04)	0.27*** (0.06)	0.15 (0.09)
HighThreshold		−1.42* (0.71)			−0.41*** (0.05)			−0.24*** (0.04)	
PrivateExo * HighThreshold		−0.64 (1.27)			0.001 (0.09)			0.01 (0.08)	
PublicExo * HighThreshold		−0.33 (1.10)			−0.22** (0.07)			−0.18* (0.08)	
Period			−0.21 (0.11)			−0.01 (0.01)			0.003 (0.01)
PrivateExo * Period			−0.01 (0.19)			0.003 (0.01)			−0.02 (0.01)
PublicExo * Period			0.06 (0.16)			0.01 (0.01)			0.005 (0.01)
Observations	576	576	576	576	576	576	576	576	576
R ²	0.03	0.05	0.05	0.04	0.31	0.04	0.04	0.17	0.04

Notes: For the treatment, the reference category is *Baseline*. Robust standard errors. *p<0.05; **p<0.01; ***p<0.001

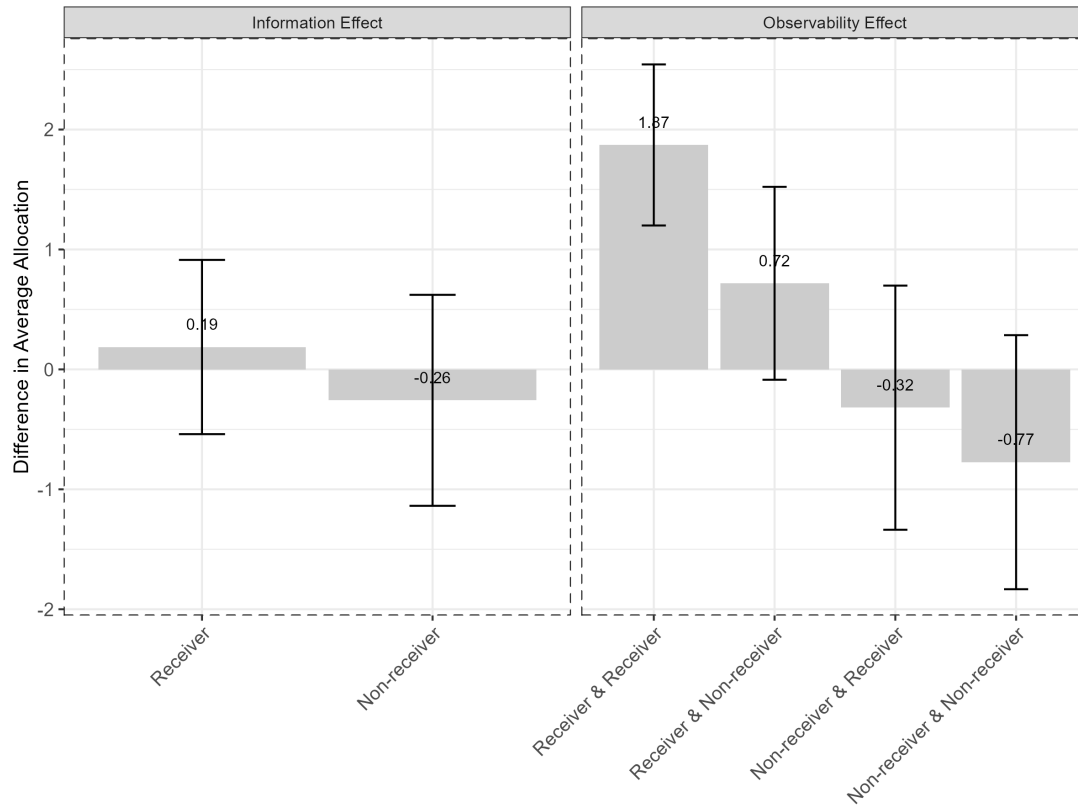


Figure B.6.1: Comparing the information and observability effects of individual allocations across acquisition and observability conditions with exogenous information provision.

Table B.6.3: Frequencies of allocation strategies across information and observability conditions: exogenous treatments

Treatment	Information	Observability	Mean Allocation	Favorable	Freq.	Unfavorable	Freq.
<i>Baseline</i>	–	–	3.17	5	0.21	0	0.57
<i>PrivateExo</i>	Non-receiver (32%)	–	2.92	5 [‡]	0.23	0 [‡]	0.60
	Receiver (68%)	–	3.36	(5, 10)	0.18	(5, 0)	0.36
<i>PublicExo</i>	Non-receiver (27%)	Other: non-receiver (27%)	2.14	5	0.21	0 [‡]	0.68
		Other: receiver (73%)	2.60	0	0.65	5 [‡]	0.18
	Receiver (74%)	Other: non-receiver (26%)	4.08	(10, 0)	0.41	(5, 0) [‡]	0.15
		Other: receiver (74%)	5.23***	(5, 10)	0.50	(5, 0) [‡]	0.38

Notes: Frequencies are computed within each subgroup and may not sum to 1 because some strategies are omitted. The *favorable* and *unfavorable* equilibrium strategies are derived in Section 2. For the convenience of treatment comparison, we also present non-equilibrium strategies, which are noted with a superscript symbol [‡]. Participants who acquired information choose a contingent allocation plan (a_l, a_h) , giving allocations for both low and high signals; participants who did not acquire a signal choose a single, non-contingent allocation a_ϕ .

Table B.6.4: Linear regressions for observability effects among information receivers: exogenous treatments

	Dependent variables:					
	AllocationLow			AllocationHigh		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	5.42*** (0.56)	4.84*** (0.58)	5.35*** (0.67)	2.33** (0.79)	3.06** (1.00)	0.69 (0.52)
PublicExo, Other: Yes	-0.18 (0.57)	0.59 (0.64)	-0.33 (0.56)	3.16** (1.02)	3.01* (1.45)	2.65** (0.91)
PublicExo, Other: No	0.83 (0.84)	0.76 (1.07)	0.79 (0.83)	-0.62 (0.98)	-0.51 (1.45)	-1.20 (0.87)
Period		0.09 (0.07)			-0.12 (0.08)	
PublicExo, Other: Yes * Period		-0.12 (0.07)			0.03 (0.15)	
PublicExo, Other: No * Period		0.01 (0.13)			-0.02 (0.14)	
AllocationPreviousPeriod			0.07 (0.05)			0.41*** (0.08)
AllocationOtherPreviousPeriod			-0.04 (0.04)			0.20** (0.06)
SuccessPreviousPeriod			0.15 (0.35)			-1.21* (0.57)
Observations	1,837	1,837	1,667	1,837	1,837	1,667
R ²	0.01	0.01	0.01	0.16	0.17	0.32

Notes: For the treatment, the reference category is *PrivateExo* to allow direct comparisons between treatments. Standard errors are clustered at the individual level. *p<0.05; **p<0.01; ***p<0.001

Table B.6.5: Information effects: linear regressions for allocations of receivers and non-receivers in *PrivateExo*

	<i>Dependent variable:</i>					
	Allocation					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	3.17*** (0.44)	3.17*** (0.44)	3.85*** (0.52)	1.32*** (0.30)	4.32** (1.50)	2.86** (0.89)
PrivateExo	0.05 (0.71)					
PrivateExo: Receiver		0.19 (0.73)	0.17 (0.73)	0.22 (0.44)	0.01 (0.70)	0.10 (0.45)
PrivateExo: Non-receiver		-0.26 (0.88)	-0.22 (0.87)	-0.24 (0.63)	-0.38 (0.88)	-0.33 (0.65)
Period			-0.10** (0.04)			-0.02 (0.03)
AllocationPreviousPeriod				0.47*** (0.07)		0.44*** (0.07)
AllocationOtherPreviousPeriod				0.10* (0.04)		0.10* (0.04)
SuccessPreviousPeriod				-0.16 (0.48)		-0.12 (0.47)
UnconditionalLow=5					-2.10 (1.50)	-1.87* (0.88)
UnconditionalLow>5					-0.92 (1.31)	-1.26 (0.81)
UnconditionalHigh=10					1.05 (0.73)	0.59 (0.45)
ConditionalLowCond.Efficient					-0.39 (0.81)	-0.26 (0.47)
ConditionalLowRandomNoise					-0.92 (1.54)	-0.18 (0.93)
ConditionalHighRandomNoise					0.66 (1.06)	0.27 (0.66)
Observations	768	768	768	704	768	704
R ²	0.0000	0.001	0.01	0.22	0.04	0.23

Note:

*p<0.05; **p<0.01; ***p<0.001
Standard errors are clustered at the individual level.

Table B.6.6: Observability effects: linear regressions for allocations of non-receivers in *PublicExo*

	<i>Dependent variable:</i>					
	Allocation					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	2.92*** (0.76)	2.92*** (0.77)	4.16*** (0.85)	1.25* (0.57)	1.73 (0.98)	1.06 (1.05)
PublicExo	-0.44 (0.98)					
PublicExo, Other: Receiver		-0.32 (1.02)	-0.43 (1.02)	-0.82 (0.85)	-0.34 (0.97)	-0.85 (0.84)
PublicExo, Other: Non-receiver		-0.77 (1.07)	-0.85 (1.03)	-0.91 (0.89)	-0.64 (1.03)	-0.92 (0.89)
Period			-0.18* (0.07)			-0.15* (0.07)
AllocationPreviousPeriod				0.47*** (0.11)		0.38*** (0.09)
AllocationOtherPreviousPeriod				0.18** (0.07)		0.20** (0.07)
SuccessPreviousPeriod				-1.75* (0.83)		-1.36 (0.75)
UnconditionalLow=5					2.43* (1.12)	2.23* (0.94)
UnconditionalLow>5					1.00 (0.74)	1.18 (0.66)
UnconditionalHigh=10					-1.68 (1.00)	-1.11 (0.86)
ConditionalLowCond.Efficient					-1.71 (1.10)	-1.04 (0.94)
ConditionalLowRandomNoise					0.75 (1.04)	0.61 (1.01)
Observations	189	189	189	174	189	174
R ²	0.003	0.005	0.03	0.21	0.13	0.32

Note:

*p<0.05; **p<0.01; ***p<0.001
Standard errors are clustered at the individual level.

Table B.6.7: Observability effects: linear regressions for allocations of receivers in *PublicExo*

	<i>Dependent variable:</i>					
	Allocation					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	3.36*** (0.58)	3.36*** (0.58)	3.68*** (0.66)	2.21*** (0.47)	2.72*** (0.70)	2.17** (0.77)
PublicExo	1.57* (0.66)					
PublicExo, Other: Receiver		1.87** (0.67)	1.89** (0.68)	1.59** (0.59)	2.33*** (0.56)	2.21*** (0.54)
PublicExo, Other: Non-receiver		0.72 (0.81)	0.72 (0.81)	0.44 (0.77)	1.14 (0.68)	1.01 (0.71)
Period			-0.05 (0.05)			-0.03 (0.06)
AllocationPreviousPeriod				0.24*** (0.07)		0.15* (0.07)
AllocationOtherPreviousPeriod				0.15** (0.04)		0.13** (0.05)
SuccessPreviousPeriod				-0.58 (0.62)		-0.46 (0.61)
UnconditionalLow=5					0.68 (0.52)	0.55 (0.46)
UnconditionalLow>5					0.57 (0.53)	0.43 (0.48)
UnconditionalHigh=10					-1.62** (0.55)	-1.49** (0.50)
ConditionalLowCond.Efficient					-1.16 (1.10)	-0.52 (1.00)
ConditionalLowRandomNoise					2.34** (0.74)	2.36** (0.77)
Observations	471	471	471	431	471	431
R ²	0.04	0.05	0.05	0.11	0.14	0.18

Note:

*p<0.05; **p<0.01; ***p<0.001
Standard errors are clustered at the individual level.

C Experimental Instructions

C.1 General Remarks

Welcome! Thank you for participating in this experiment. Before we start, please be quiet and follow the experimenters' guidance. Below is some important information about the experiment. Please read it carefully.

- If you complete this experiment, you will receive a payment. The magnitude of the payment depends partly on your decisions, partly on the decisions made by other participants you interact with, and partly on chance.
- Please pay careful attention to the instructions. They will help you to understand the experiment better and earn more money.
- You are not allowed to use your phone or similar digital devices throughout the experiment. Please stay focused and do not engage in other activities. You can use the provided calculator.
- During the experiment, if you have questions, please raise your hand, and an experimenter will come to you promptly.

C.2 Experiment Overview

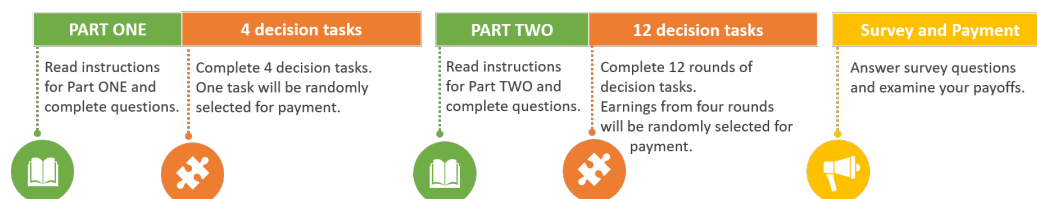


Figure C.2.1: Overview Given to Participants.

The procedure: Today's experiment has a PART ONE and a PART TWO. Each part consists of several decision tasks. Before each part starts, you will receive instructions about the upcoming decisions. Your choices in PART ONE of the experiment will not affect what happens in PART TWO. The experiment ends with a survey.

Your payment: You start the experiment with a balance of 6.50 euros and then your balance can change as you proceed with the experiment. The instructions of each part of the experiment will explain how your payment depends on what happens in that part. Note that earnings will be displayed in the currency of the experiment, “ECU,” which stands for Experimental Currency Unit. At the end of the experiment, your ECUs will be converted to euros, at an exchange rate of 8 ECUs = 1 euro. You need to complete the entire experiment to get paid.

C.3 PART ONE Instructions: Two-Person Funding Game

In PART ONE of the experiment, you will play four funding games with another participant in the room. The funding games are similar to each other but not exactly the same. **Out of the 4 games, 1 game will be selected at random for payment.** All games are equally likely to be selected. Therefore, your decisions in any of them might count for your final earnings. You will learn the outcome of the chosen game only at the end of the experiment.

Before PART ONE of the experiment, the computer will randomly match you with another participant in the room. You will play all the games in PART ONE with this participant. Your identities will remain anonymous to each other.

In a funding game, each participant starts with 10 ECUs and has to make the following decision:

- You have to decide how many of your 10 ECUs you will allocate to a joint Project Account.
- Any ECUs you do not allocate to the Project Account will be automatically allocated to your Private Account.
- The other participant you are matched with faces the same allocation task.

A project requires a minimum amount of funding to be implemented. If there are enough ECUs in the Project Account to finance the project, it will be implemented, and each of the two participants will earn 15 ECUs from the project. If the total amount in the Project Account is less than the required minimum, the project will not be implemented, and there will not be any earnings from that project. In any case, the ECUs that you put in the Project Account will not be transferred

back to your Individual Account (these ECUs are lost if the minimum fund was not reached, and they are used for implementation if the minimum fund was reached).

The required minimum amount will be announced when a funding game starts, and it may vary for different funding games. Please pay attention to the information shown on your decision screen.

Your (Ecu) earnings in a funding game equal the number of ECUs in your Individual Account plus the ECUs you earn from the project. The following examples illustrate how your earnings are determined.

Example 1

- Suppose that the minimum fund required for the project is 12 ECUs.
- You allocate 5 ECUs to the Project Account, leaving 5 ECUs to your Individual Account. The other participant allocates 8 ECUs to the Project Account, leaving 2 ECUs to their Individual Account.
- The total number of ECUs in the Project Account is 13, more than the minimum amount.
- The project will be implemented. You will earn 20 ECUs = 5 (from your Individual Account) + 15 (project return), and the other participant will earn 17 ECUs = 2 (from their Individual Account) + 15 (project return).

Example 2

- Suppose the minimum fund required for the project is 16 ECUs.
- You allocate 7 ECUs to the Project Account, leaving 3 ECUs to your Individual Account. The other participant allocates 0 ECUs to the Project Account, leaving 10 to their Individual Account.
- The project will not be implemented as the total ECUs in the Project Account, 7, is below the minimum amount.
- Therefore, you will earn 3 ECUs = 3 (from your Individual Account) + 0 (project return), and the other participant will earn 10 ECUs = 10 (from their Individual Account) + 0 (project return).

Please answer the quiz questions on your computer screen to proceed.

C.4 PART TWO Instructions for the *PublicEndo* Treatment: Two-Person Funding Game with Unknown Minimum Fund (textual differences in comparison to the *PrivateEndo* treatment are shown in italics)

In PART TWO of the experiment, you will engage in 12 independent rounds of the funding game with other participants in the room. Each round presents the same decision task. Your decisions and outcomes in one round of the game will not affect the progression of the other rounds. **The earnings of 4 rounds will be selected at random for payment at the end of the experiment.** All rounds are equally likely to be selected. Therefore, the earnings from any of them might count for your final payment.

At the beginning of each round, the computer randomly matches you with another participant in the room. That is, **you may interact with a different participant in each round.** Your identity will always remain anonymous to other participants and vice versa.

The funding game you will play resembles that in PART ONE. Each participant will again decide how to allocate 10 ECUs between an Individual Account and a joint Project Account. In this part, however, you can only allocate 0, 5, or 10 ECUs to each account. Again, the sum of ECUs you allocate must total 10.

A project again requires a minimum fund to be implemented. If the amount in the Project Account exceeds this minimum, the project will be implemented. Each player will then earn a return of 15 ECUs from the project. If the minimum amount is not met, the project will not be implemented, and both participants will earn nothing from the project. Again, in any case, the ECUs that you put in the Project Account will not be transferred back to your Individual Account (these ECUs are lost if the minimum fund was not reached, and they are used for implementation if the minimum fund was reached).

Unlike the funding game in PART ONE, the minimum amount for the project is either 10 or 20 ECUs, determined randomly by the computer at the start of each round. **In each round, you need to allocate your 10 ECUs without knowing the exact minimum amount required for the project.**

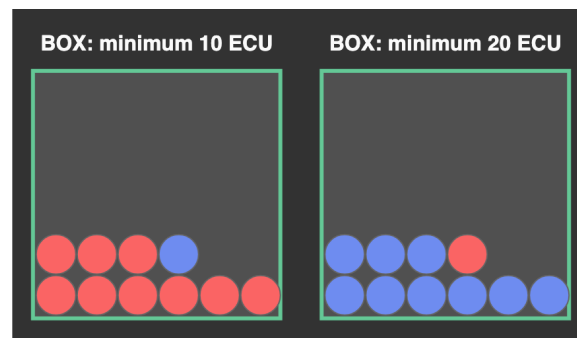


Figure C.4.1: Threshold Illustration for Participants in the *PublicEndo* Treatment.

How does the computer determine the minimum fund? There are two boxes (illustrated in Figure C.4.1). The computer will randomly select one box at the beginning of each round. **The selected box will be the same for you and the participant matched to you.** If the left box is selected, the minimum fund for the two participants in that round will be 10 ECUs; If the right box is selected, it will be 20 ECUs. Each box has a 50% chance of being selected, and the box chosen for a new round will not be affected by those chosen in previous rounds.

The computer will not tell you which box has been selected until you make your allocation decision. However, before that, **you have an option to learn about the selected box** by drawing one ball from it. Each box contains a fixed number of red and blue balls. As you can see, the box on the left always contains 9 red balls and 1 blue ball, and the box on the right always contains 9 blue balls and 1 red ball. After each draw, the ball will be put back into the original box immediately. Each draw will cost you 10 eurocents, which is deducted from your balance.

If you decide to draw a ball, you will only learn its color, not the box it came from. Learning the color of a ball drawn from the selected box will give you a better idea of how likely the minimum amount is to be 10 or 20 ECUs. The reasoning is as follows. First, notice that the box representing a minimum amount of 10 ECUs (left) always contains 9 red balls and 1 blue ball, while the box representing a minimum amount of 20 ECUs (right) always contains 9 blue balls and 1 red ball. If the box on the left is the selected box, you are more likely to draw a red ball. If the box on the right is the selected box, you are more likely to draw a blue ball. Therefore, the color of the drawn ball helps you infer the likelihood of the selected box and the minimum fund to be 10 or 20.

In Figure C.4.2 is an example of the decision page. The computer has already selected a box which is unknown to you. If you choose to draw a ball from the selected box, we will deduct 10 eurocents from your balance. **The cost of the draw**

is non-retrievable. You must pay the cost even if the earnings from this round are not selected for payment. Of course, you do not need to pay 10 eurocents if you choose not to draw a ball.

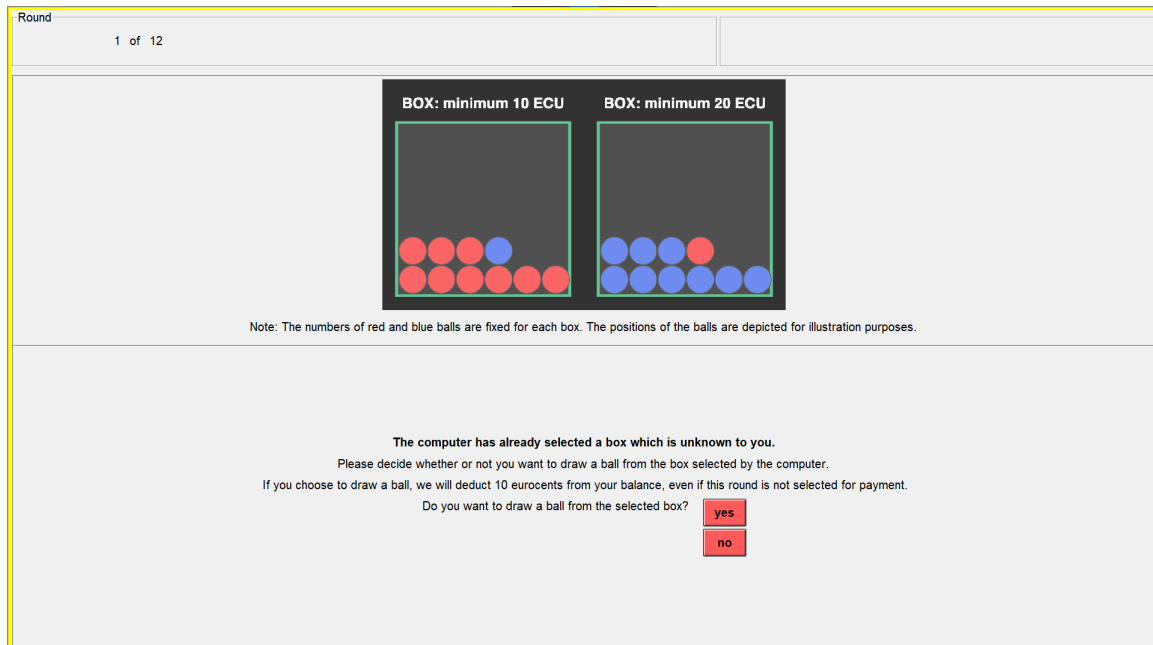


Figure C.4.2: Participants' Information Acquisition Screen in the *PublicEndo* Treatment.

In each round of the game, the other participant matched to you will face the same choices. They also have the option to pay 10 eurocents to draw a ball from the same selected box and decide the allocation of 10 ECUs.

When a new round starts, the computer re-selects a box at random, and each participant may decide to pay for a new draw.

Before you make your allocation decision, you will learn whether the other participant has drawn a ball or not, but not the color of the ball they drew. Vice versa, the other participant will learn whether you made a draw or not before deciding their allocation, but not the result of your draw.

If you choose NOT to draw a ball, your allocation decision page will be like the illustration in Figure C.4.3. The other participant faces the same decision page if they choose not to draw a ball.

If you choose to draw a ball, your allocation decision page will be like the illustration in Figure C.4.4. The other participant faces the same decision page if they choose not to draw a ball.

Round

1 of 12

If this funding game is selected for payment, your earnings = ECUs in your Individual Account + ECUs from the project.

- If the total ECUs in the Project Account are at least the minimum fund, you will earn 15 ECUs from the project.
- If the total ECUs in the Project Account are less than the minimum fund, you will earn 0 ECUs from the project.

The following tables provide your ECU earnings (highlighted in green) for each possible minimum fund and allocations by you and the participant matched to you in this round.

If the minimum fund is 10 ECU

		ECUs allocated to the Project Account by the other participant		
		0	5	10
ECUs allocated to the Project Account by you	0	0	10	5
	5	10	10	25
	10	5	20	20

BOX: minimum 10 ECU

If the minimum fund is 20 ECU

		ECUs allocated to the Project Account by the other participant		
		0	5	10
ECUs allocated to the Project Account by you	0	0	10	5
	5	10	10	5
	10	5	5	15

In this funding game, the minimum fund required for the project is either 10 or 20 ECUs.

You will only learn the color of the ball at the end of this round.

The other participant has **chosen not** to draw a ball from the box selected by the computer.

You and the other participant both have 10 ECUs.

Please decide how many ECUs you want to allocate to the Project Account if a red ball was drawn:

☐ 0

☐ 5

☐ 10

Please decide how many ECUs you want to allocate to the Project Account if a blue ball was drawn:

☐ 0

☐ 5

☐ 10

OK

Figure C.4.3: Participants' Decision Screen in the *PublicEndo* Treatment without Signal Acquisition.

Round

1 of 12

If this funding game is selected for payment, your earnings = ECUs in your Individual Account + ECUs from the project.

- If the total ECUs in the Project Account are at least the minimum fund, you will earn 15 ECUs from the project.
- If the total ECUs in the Project Account are less than the minimum fund, you will earn 0 ECUs from the project.

The following tables provide your ECU earnings (highlighted in green) for each possible minimum fund and allocations by you and the participant matched to you in this round.

If the minimum fund is 10 ECU

		ECUs allocated to the Project Account by the other participant		
		0	5	10
ECUs allocated to the Project Account by you	0	0	10	5
	5	10	10	25
	10	5	20	20

BOX: minimum 10 ECU

If the minimum fund is 20 ECU

		ECUs allocated to the Project Account by the other participant		
		0	5	10
ECUs allocated to the Project Account by you	0	0	10	5
	5	10	10	5
	10	5	5	15

In this funding game, the minimum fund required for the project is either 10 or 20 ECUs.

The other participant has **chosen** to draw a ball from the box selected by the computer.

You and the other participant both have 10 ECUs.

Please decide how many ECUs you want to allocate to the Project Account:

☐ 0

☐ 5

☐ 10

OK

Figure C.4.4: Participants' Decision Screen in the *PublicEndo* Treatment with Signal Acquisition.

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Before learning the color of the ball you drew from the selected box, you need to make your allocation decisions for each possible color of the balls you may draw. At the end of this round, if the ball you drew is indeed a red ball, your allocation decision for the case of a red ball will count for payment. If the ball you drew is instead a blue ball, your allocation decision for the case of a blue ball will count for payment.

Your (ECU) earnings in a funding game equal the number of ECUs in your Individual Account plus the ECUs you earn from the project. Depending on whether the Project Account meets the minimum amount of 10 or 20 ECUs, you will either earn 15 ECUs or nothing from the project.

After each round of the funding game, you will receive all relevant information about that round. The computer will show you the randomly chosen minimum fund, the total ECUs in the Project Account, and both participants' earnings for that round if it is to be randomly selected for payment.

Please answer the quiz questions on your computer screen to proceed.