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Individual Differences and Contribution Sequences in Threshold Public Goods*

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Following the notion that organizations often face public good dilemmas when collective action is needed, we use a real-time provision-point mechanism to experimentally explore the process of achieving cooperative equilibria. Specifically, besides exploring group outcomes, we identify individual antecedents for the timing of the contribution to the public good. In addition, we study the role of different situational factors for sustaining high rates of cooperation: information about others' actions and the number of individuals necessary for public good provision. We find that contribution and implementation rates are relatively high, with only a moderate decline over time, and that social value orientation as well as several personality traits help to explain the observed contribution sequences.

Keywords: Provision-point mechanism; real-time protocol; personality traits

JEL Classification Numbers: C92, D70, H41

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1. Introduction

As "[s]ome of the most fundamental questions about the organization of society center around issues raised by the presence of public goods" (Ledyard, 1995, p.112), public goods games are among the most studied topics in experimental economics in the lab as well as in the field. Indeed, the plethora of studies in economics and neighboring disciplines like sociology, political science, or psychology reflects the variety of situations characterized by the social dilemma inherent in public goods provision: the free-rider problem. The reason for the persistent interest stems from the fact that abstract features of the game serve as a metaphor for many economic situations spanning from defense, public infrastructure, or health to more specific problems in organizational economics like intellectual property rights or team production (Ledyard, 1995).

The leading paradigm in most of this literature has been to focus on final outcomes, which is why the public goods situation is mostly modeled as a simultaneous-move game. Within this general framework, a variety of adaptions have been suggested to solve the free-rider problem. A non-exhaustive list of those variations includes partner design, communication, monetary and non-monetary punishment, or heterogeneous endowments (Chaudhuri, 2011; Zelmer, 2003). While these approaches often alleviate the free-rider problem and facilitate cooperation, some of the most interesting public goods in social and organizational reality have a different temporal structure: processes like team work in organizations or fund raisers have a real-time aspect instead of simultaneous contributions.

In arguing that it is crucial to focus on the process of public goods provision instead of final outcomes, our study contributes to several strands of literature. First, in ameliorating the free-rider problem, some experimental public goods studies have started to deviate from the simultaneous-move setup and introduced the real-time protocol. However, relatively few studies employed this mechanism, reporting mixed results – while public goods implementation is enhanced in some studies, others fail to find this effect (Dorsey, 1992; Goren et al., 2003; Friedman and Oprea, 2012; Oprea et al., 2014).

Second, there has been a growing interest in looking at the effects of (endogenous)

leadership (Dannenberg, 2015; Potters et al., 2005, 2007; Rivas and Sutter, 2011; Sutter et al., 2010). These studies are concerned with exploring if and why individuals volunteer to make the first move (i.e., leading by example without formal authority), finding that while having individuals volunteering to go first increases implementation success, few individuals are willing to do so. However, little is known about the theoretical rationale to explain an individual's position in the resulting contribution sequence. Our point of departure is that we are explicitly interested in those sequences. Thus, we contribute to the literature on the real-time protocol by examining the effect of visible contributions while not only focusing on the ultimate result, that is, the implementation of the public good, but also on the process leading to it. We contribute to the literature on endogenous leadership by exploring who volunteers to go first in a richer setup where contribution sequences are endogenous.

Third, while economic theory is silent concerning those contribution sequences, the focus on the role of heterogeneous tendencies to participate in collective action has long been discussed in sociological theories of collective behavior (Oliver, 1993). For our purpose, we draw on a specific model, referred to as threshold theory (Granovetter, 1978; Granovetter and Soong, 1983). This theory delivers utility-based arguments why some individuals tend towards earlier and others towards later decisions. In fact, Braun (1994) attributes individual threshold heterogeneity to differences in behavioral determinants. While he mainly focuses on the benefits, costs, and network properties of the decision context, individual differences are neglected (Braun, 1995; Watts and Dodds, 2011). The present study aims at closing this gap between sociological theories of collective behavior and economic experiments by investigating the role of individual differences in endogenous contribution sequences in a real-time public goods context.

Fourth and related, we also add to the literature investigating how individual differences influence behavior in public goods situations. More specifically, several studies have investigated how heterogeneity in personality (Hilbig et al., 2014, 2012; Zhao and Smillie, 2015), distributional preferences (Balliet et al., 2009; Dijkstra, 2013; Murphy and Ackermann, 2014), or risk aversion (Fung et al., 2012; Teyssier, 2012) affect contribution decisions. We build on and extend these studies by measuring participants'

personality traits and distributional preferences and relating them to individual heterogeneity in contribution behavior in the real-time public goods game.

Thus, we employ a simple provision-point mechanism in the laboratory and use the real-time protocol; that is, participants do not make decisions simultaneously, but are able to freely decide when to make their choice within a given time frame. This way, we are able to examine the effect of having information about others' actions on the one hand while being able to identify individual differences in behavior in these real-time public goods situations and relate them to personality traits and economic preferences on the other hand. Indeed, we are able to show that if we provide information about others' behavior in real time, implementation of the public good is facilitated, at least when the target is sufficiently difficult to reach. In addition, we find endogenous contribution sequences, i.e., individuals reacting to real-time information about their fellow group members. While distributional preferences alone explain participation decisions, the sequencing of contributions is influenced by a broader array of individual differences.

The rest of the paper is structured as follows. First, we discuss related literature by elaborating on how individual timing and individual differences are intertwined. Second, we explain both the laboratory design and procedure. After having presented our main experimental results, we discuss their relevance in light of potential limitations. Finally, we conclude.

2. Related Literature

The conflict between individual and collective rationality has drawn the attention of various research disciplines. Sociologists have long been interested in the formation of collective behavior, such as social movements (Smelser, 1963; Udéhn, 1993), psychologists have been studying helping and organizational citizenship behavior (Organ, 1994; Smith et al., 1983) as well as various forms of mixed-motive social dilemmas (Dawes, 1980; Komorita and Parks, 1995; Lange et al., 2013), and economists have been examining different versions of inter-individual coordination or behavioral cascades (Anderson and Holt, 1997; Bikhchandani et al., 1998; Chaudhuri, 2011; Ledyard, 1995).

Despite important differences, these approaches all tackle the problem of interpersonal coordination and the conflict between individual and collective rationality (Dawes and Messick, 2000; Kollock, 1998).

Apart from the more general examples mentioned above, specific applications to organizational reality have been discussed, arguing that "in fostering cooperation among employees, managers usually face a public good dilemma" (Bridoux et al., 2011, p.711). Relevant phenomena of organizational behavior and work group productivity, such as strategic initiatives (Lechner and Kreutzer, 2011) or organizational task forces (Gersick, 1988), closely resemble those social dilemmas for three reasons. First, strategic initiatives and organizational task forces evolve along a collective sequence made up of individual contribution decisions and both require concerted voluntary efforts of the individuals involved, while not allowing for perfect observability of individual behaviors without incurring high monitoring costs (Goren et al., 2003). Second and related, due to their highly interdependent nature, it may be hard to exclude any individual from enjoying the (long-term) benefits of the public good, while the short-term costs are only incurred by the cooperating individuals (Bridoux et al., 2011; Lechner and Kreutzer, 2011). Third, their success typically increases with the investments of time and effort by their members and they are of temporary nature, which means that they typically have to be successfully accomplished until a certain deadline, or else fail.

In the following paragraphs we will develop two distinct, yet related sets of hypotheses. First, we will discern how institutional changes influence public goods provision. Second, we derive a set of hypotheses to explain endogenous contribution sequences.

2.1. The Influence of Institutional Changes on Public Goods Provision

Abstract versions of these phenomena described above have been implemented in the experimental laboratory. In standard experimental public goods contexts, the voluntary contribution mechanism (VCM) has emerged as the dominant way of representing public goods provision in experimental studies in economics and psychology (Chaudhuri, 2011; Ledyard, 1995; Zelmer, 2003). Under the VCM, all individuals voluntarily decide

to either invest resources in the public account or to keep them in their private account. Afterwards, all investments to the public account are multiplied by a given factor and distributed among all individuals, including the defectors. Hence, in this simple game, keeping all resources in the private account is the individually dominant strategy, while investing everything in the public account is socially optimal. It has been shown that, on average, contribution rates under the VCM are between 40% and 60% of the social optimum, while contributions tend to decrease over repeated periods of the game (Chaudhuri, 2011; Goren et al., 2003).

As already pointed out in the previous section, to alleviate this prevalent free-rider problem, several institutional solutions have been proposed. While several variants of the standard VCM have been discussed in that regard, the provision point mechanism (PPM) is of particular interest for studying public goods because it is more comparable to organizational reality, keeping in mind the above-described strategic initiatives and organizational task forces. We argue that using the PPM enhances both mundane and experimental realism because it differs from the VCM in two notable features (Abele et al., 2010; Croson and Marks, 1998; Marks and Croson, 1999).[1] First, the public good is not provided unless a given threshold t of contributions is reached (i.e., for a project to be conducted, a certain number of people need to participate). Second, while under the VCM contributions to the public account are typically continuously divisible, the PPM mostly employs all-or-nothing contributions (i.e., team members either participate in a proposed project or not). More specifically, under the PPM, participants play in groups of n players where every player has an endowment of E units. Subsequently, the players choose a contribution level $c_i \in \{0; 1\}$. If t or more players choose to invest their endowment in the public account, the public good of value G is provided and every group member receives a reward of $\frac{G}{n}$ units. Additional contributions do not further increase the value G. If t is not reached, the public good is not provided and the contributors lose their investment to the public account. Non-contributors keep their initial endowment in both cases. Thus, in adding a contribution target to be reached, a

[1] While the former aims at resembling the real world in an experimental investigation, the latter is concerned with how well the experimental situation captures the theoretical constructs under scrutiny (Colquitt, 2008). Most often critique of experimental settings is targeted at low mundane realism, while experimental realism should be the focus of attention (Highhouse, 2009).

coordination problem arises. Typically, all parameters of the game (n, t, G, and c) are common knowledge.

However, there are also two notable differences from a game theoretic perspective. First, in comparison to the VCM, there is not just a single Nash equilibrium for contributing nothing, but additional equilibria for exactly t players contributing exist. Second, while in the continuous form everyone contributing is the Pareto efficient solution, the second Nash equilibrium where everybody is keeping their endowment is not. In the step-level form, any coordination solution that reaches the provision point is Pareto efficient (Abele et al., 2010). Consequently, under the PPM, contribution behavior has been shown to be much more rugged in comparison to the VCM: while overall efficiency and total contributions are increased, it is found to be more susceptible to changes in induced value (Rondeau et al., 2005). In addition, contributions do not always decrease over repeated periods of the game (Abele et al., 2010).

One important driver of contribution decisions to public goods is the value of the public good relative to that of the forgone private good, which has been formalized as marginal per-capita return and demonstrated to influence the provision of linear public goods. A comparable feature of threshold games is the step return. Empirical results show that comparing the step returns between games yields comparable results to utilizing the marginal per capita return under the VCM: a higher step return encourages contributions (Croson and Marks, 2000). As the step return increases in t, we propose the following hypothesis:

Hypothesis 1. *Implementation rates are lower when the provision point is increased.*

Moreover, while most public goods experiments have been conducted under the simultaneous protocol of play where decisions are made simultaneously, anonymously and in private (Chaudhuri, 2011), this does not resemble strategic initiatives and organizational task forces very well. This because in organizations, individuals normally possess at least partial information about the decisions of other group members and consider this information before making their own decisions. As an alternative, the real-time protocol is better suited to capture the inherent decision sequence of endogenous in-

dividual timing present in organizations. Until now, comparably few studies employed this mechanism under the VCM and the PPM. Using the real-time protocol, the differences between coordination and cooperation are unclear and multiple equilibria exist, which raises the question whether participants are able to coordinate efficiently or not (Abele et al., 2010; Oprea et al., 2014). While most studies find enhanced implementation rates, others fail to find this effect (Berninghaus and Ehrhart, 2001; Dorsey, 1992; Goren et al., 2003, 2004; Kurzban et al., 2001). Those empirical inconsistencies are due to two reasons: First, the results stem from different games, thereby inhibiting comparability. Second, while most studies on coordination use revocable investments to the public account (e.g., Leng et al., 2016), we employ irrevocable commitments to avoid cheap talk (Farrell and Rabin, 1996). Theoretically, it has been argued that continuous games approximate an array of discrete games with the grid length going to zero (Simon and Stinchcombe, 1989). Thus, this form of repeated interaction should increase cooperation.[2] Therefore, we posit the following hypothesis:

Hypothesis 2. *Implementation rates are lower when individuals have no information about others' behaviors.*

However, behavior is not only driven by institutional arrangements or incentives, but also by individual heterogeneity. Albeit being unified in these central building blocks underlying behavior formation, economists and psychologists differ with regard to how this heterogeneity is conceptualized. While psychologists use the different facets of personality (Rabin, 1998; Rustichini, 2009), economists rely on using heterogeneity in stable and exogenous preferences like risk or time, and have long been skeptical about the usefulness of those personality dimensions. Albeit they have long questioned their stability, extant research suggests that these qualms are uncalled-for (Almlund et al., 2011). Indeed, it has been shown that personality could be a worthwhile adjunct to experimental measures of economic preferences in increasing predictive power (Rustichini et al., 2012) and are thus complementary (Becker et al., 2012). Adding to that

[2] Theoretical predictions are difficult at this point because extant reasoning in economics does not allow for clear-cut hypotheses. However, following social interdependence theory (Abele et al., 2010; Kelley and Thibaut, 1978), one can argue that if participants are missing any form of information used to infer the behavior of others, coordination failure is more likely (Puranam et al., 2012).

literature, we argue that while the pertinent situation is a substantial influencing factor for behavior formation, another focus of our paper is on predicting contribution sequencing using individual differences, which will be elaborated on in the following.

2.2. Explaining Endogenous Contribution Sequences

There has been substantial research to predict public goods contributions under the VCM using individual differences, which can be either distal or proximal to overt behavior (Kanfer and Ackerman, 1989). While the former include broad factors, such as general personality structure (Hilbig et al., 2014; Hilbig and Zettler, 2009), the latter comprises more specific determinants of behavior like social value orientation (SVO) (Murphy et al., 2011) or risk preferences (Fung et al., 2012). As mentioned before, the game-theoretic predictions are fundamentally different under the PPM, yielding two types of pure-strategy Nash equilibria and thus a coordination problem to solve. Hence, the role of determining factors is less clear and evidence is scarcer. While using the real-time protocol of play should mitigate coordination failure, the availability of real-time information about contributors adds an additional strategic dimension to the game: moving early can be used to signal a cooperative social norm, but waiting for others to move first and updating beliefs about the probability of implementation with and without one's own contribution on a rolling basis is also possible. In contrast, without real-time information about contributions available, subjects have no way of updating beliefs and less need to behave strategically, i.e., based on what others are doing. In essence, all group members base their decision on less information and thus take less time to choose whether to contribute or not. Therefore, we propose the following hypothesis:

Hypothesis 3. *The time to contribute is shorter when individuals have no information about others' decisions.*

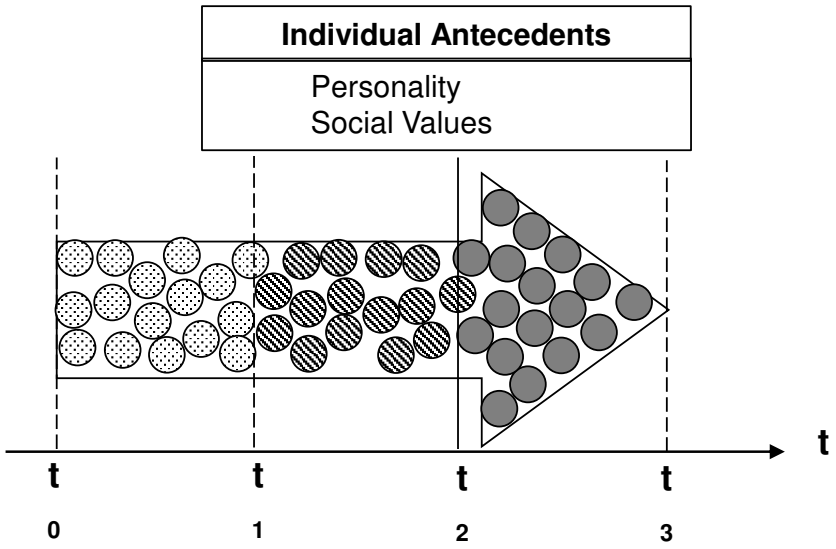
In the case of symmetric agents, successful coordination is a stochastic process, as it is unknown ex ante which people are going to contribute and at which position in the

behavioral sequence (Au and Budescu, 1999). While the role of asymmetric agents under the VCM has been studied extensively (e.g., Reuben and Riedl, 2013), economic and game-theoretic reasoning has mostly treated this kind of variance in coordination games as noise (Mäs and Nax, 2016). As such, differential effects of individual heterogeneity on coordination have only seldom been studied (e.g., Diekmann and Przepiorka, 2016). However, in sociology and psychology, there exists a broad range of theories specifically concerned with these processes. Specific variants of such models of collective behavior, such as bandwagon or hazard models, are often used to conduct research on conformity behavior, behavioral contagion, or on diffusion of innovation in a business setting (Centola and Macy, 2007; Oliver, 1993). In psychology and sociology, it is often assumed that individuals prefer social conformity, equality, or identity affirmation (Ashforth and Mael, 1989; Simon et al., 2008; Simpson, 2006), while in economics and economic sociology, the underlying assumption is that information is derived from behavior of (relevant) others (Anderson and Holt, 1997; Bikhchandani et al., 1998). While those accounts differ with regard to the driving force behind social interdependence, they are unified by their basic tenet of proposing that the uptake of beliefs or the adoption of an innovation depends on other people's behavior. Therefore, we posit the following hypothesis:

Hypothesis 4. *There is a cascading process in contribution decisions.*

A specific specimen of the broad family of theories described above is the threshold model of collective behavior (Granovetter, 1978; Granovetter and Soong, 1983). Here, individual heterogeneity in contribution timing is assumed to manifest as a behavioral threshold which is defined as "the number or proportion of others who must make one decision before a given actor does" (Granovetter, 1978, p.1420). As shown in Figure 1, some individuals actively contribute very early in the process (i.e., instigators, dotted circles), others may wait and see whether or not any collective movement begins to form (i.e., moderates, striped circles), while again others may need to see a lot of other individuals acting before contributing (i.e., reluctant, filled circles). Broadly speaking, an individual's behavioral threshold represents that person's behavioral tendency to participate in a collective action.

Figure 1: *Individual differences, behavioral thresholds, and contribution decisions*



While the original model suggests that thresholds are solely based on cost-benefit calculations and availability of information, it has been pointed out that individual differences also drive threshold formation. This way, individuals are assumed to differ in their behavioral tendency to cooperate because of heterogeneous personality factors, diverse ideologies or beliefs, varying economic motives as well as differing susceptibility to conformism. In the context of this paper, we focus on personality factors, as various studies have related personality to public goods contributions as well as to a broad range of work- and non-work-related attitudes and behaviors (cf. Ozer and Benet-Martînez, 2006). While the so called five-factor model has emerged as the most widely used model of personality (Barrick and Mount, 2012), the HEXACO model is more suitable for research on social dilemmas (Hilbig and Zettler, 2009; Ross et al., 2003) as it clearly distinguishes the domains of honesty and agreeableness. This reflects an intensive debate in personality psychology whether the five-factor model should be complemented with a sixth factor capturing honesty or integrity (Hough et al., 2015). While this general issue has not been fully resolved yet, this distinction is important for the present study because it enables disentanglement of active (i.e., honesty in HEXACO) and reactive cooperation (i.e., agreeableness in HEXACO), both captured by agreeableness in the five-factor model (Hilbig et al., 2014). Individuals with a tendency for active coop-

eration are likely to contribute earlier, whereas individuals with a tendency for reactive cooperation are likely to contribute later because of their rather responsive nature.

Honesty. Honesty "represents the tendency to be fair and genuine with others, in the sense of cooperating with others" (Ashton and Lee, 2007, p.156). Empirical evidence shows that honesty is positively related to prosocial behavior, for instance in dictator (Hilbig et al., 2014; Hilbig and Zettler, 2009) and public goods games (Hilbig et al., 2012). More specifically, honest individuals are prone to cooperate early when the decision timing is left to their choice (Hilbig et al., 2013b). Therefore, we propose the following hypothesis:

Hypothesis 5. *Honest individuals contribute earlier in the contribution sequence.*

Emotionality. Emotionality is typically described as being "vulnerable, sensitive and anxious", while individuals scoring low on this trait are rather "fearless, tough, independent, and unemotional" (Ashton et al., 2014, p.140). Thus, it is linked to empathy and attachment (Hilbig et al., 2013a). As empirical investigations have found a negative link between emotionality and contributions in a public goods context (Clark et al., 2014; Hilbig et al., 2012), we propose:

Hypothesis 6. *Emotional individuals contribute later in the contribution sequence.*

Extraversion. Also belonging to the proactivity domain, extraverted individuals show proactive behaviors and have been described as being outgoing, lively, sociable, talkative, cheerful and active (Ashton and Lee, 2007). Empirical investigations yielded mixed results regarding extraversion and behavior in social dilemmas, which has been attributed to divergent theoretical linkages of social dominance and sociability. While the former is likely to foster free riding (Zhao and Smillie, 2015), the latter suggests that extraversion enhances contributions to the public good (Clark et al., 2014; Hilbig et al., 2012). As extraversion has also been found to increase proactive behavior (Onyemah, 2008) and organizational citizenship behavior (OCB) (Bourdage et al., 2012), we propose:

Hypothesis 7. *Extraverted individuals contribute earlier in the contribution sequence.*

Agreeableness. In the HEXACO model, agreeableness is linked to traits like tolerance and forgiveness even in the face of being exploited (Ashton and Lee, 2007), as well as flexibility and patience (Ashton et al., 2014). While agreeable individuals are also inclined to cooperate, it is a rather reactive form of cooperation (Hilbig et al., 2012, 2013a; Zhao and Smillie, 2015). Empirical research supports this differentiation, since agreeableness was positively related to reactive cooperative behavior in ultimatum games and only weakly related to active cooperation (Hilbig et al., 2013a). Therefore, we propose the following hypothesis:

Hypothesis 8. *Agreeable individuals contribute later in the contribution sequence.*

Conscientiousness. Conscientiousness is seen as "[...] socially prescribed impulse control that facilitates [...] thinking before acting" (John et al., 2008, p.120). Thus, conscientious individuals often show traits, such as thoughtfulness, deliberateness, and planning (John et al., 2008; McCrae and Costa, 1987). Tan and Tan (2008) report a significant negative (positive) relation between conscientiousness and social loafing (OCB). While conscientiousness has also been positively linked to individual contributions in public goods games (Clark et al., 2014; Hilbig et al., 2012), others have found no correlations to cooperative intentions (Ross et al., 2003). Taken together, we propose the following hypothesis:

Hypothesis 9. *Conscientious individuals contribute later in the contribution sequence.*

Openness. As a trait, openness to experience depicts a person's artistic or aesthetic character, her curiosity, or creativity (Ashton and Lee, 2009). Due to the inherent nature of the measurement of openness in the HEXACO model, it seems not plausible to form a specific hypothesis. While we include openness in our analysis, this is rather exploratory.

Social Value Orientation. Apart from distal personality traits, behavioral thresholds should also be influenced by more proximal individual preferences. Under the general label of social preferences, heterogeneity in distributional preferences has been studied

in a variety of settings in economics (Fehr and Schmidt, 2006). Psychologists, however, have measured these preferences as SVO or closely related constructs (e.g., prosocial values, other orientation, or collective orientation). Building on decomposed dictator games, SVO offers a more fine-grained approach and has been shown to explain heterogeneity in individual behavior in public goods games (Balliet et al., 2009; Murphy and Ackermann, 2014). SVO measures the relative importance of own and others' payoffs (McClintock and Allison, 1989). Typically, specific types (i.e., altruistic, cooperative, competitive, and individualistic) are identified, which are in turn used to explain individual heterogeneity in behavior formation. This way, it has been shown that prosocials (i.e., cooperative or altruistic types) are more likely to cooperate in social dilemmas than proselfs (i.e., individualistic or competitive types) (Abele et al., 2010; Balliet et al., 2009; Bogaert et al., 2008). Albeit SVO has been shown to have a smaller effect in step-level public goods compared to continuous public goods (Abele et al., 2010), we propose the following hypothesis:

Hypothesis 10. *Prosocial individuals contribute earlier in the contribution sequence.*

Having described the hypotheses, we now turn to the laboratory design and procedures before we report the results of our study.

3. Experimental Design

The experimental procedure consists of four parts: Upon arriving at the laboratory, participants were randomly assigned to cubicles. Then, having been introduced to the general procedures of the experiment, the public goods game was explained in detail by using neutrally framed instructions.[3] After that, participants were asked to answer four control questions to ensure common understanding of the proceedings of the public goods game. Arising questions were dealt with by the experimenter in private. The next stage only started after all 24 participants in a session had managed to answer all control questions correctly. After that, ten rounds of a public goods game using

[3] A translated version of the full instructions can be found in Appendix C.

Table 1: *Overview of the treatment conditions*

		Information	
		Full	None
Provision Point	5	Baseline	No Info
	7	High Provision Point	Combined

the PPM under the real-time protocol were played. In our specific case, participants faced a PPM as described above with $n = 8$, $G = 3500$ tokens, and $c = 100$ tokens. After every round, groups were randomly rematched to mitigate reputation effects. To make strategic behavior and end-of-period effects less pronounced, every round lasted between 60 and 90 seconds with equal probability of termination in between, thus leaving it unclear ex ante how long the round would exactly be. For similar reasons, subjects were not told in advance that there would be exactly ten rounds. In each round, investment decisions of each player in a group were made known to all others in real time. Additionally, all subjects were informed that one round would be randomly selected to become payoff-relevant at the end of the experiment.

To explore the causal effect of institutional changes on our variables of interest, we used a 2x2 design altering the provision point, the level of information provided to participants, and a combination of both. While the former could be either low or high (i.e., $t = 5$ vs. $t = 7$), the latter could be either full or none (i.e., full but anonymized feedback vs. no feedback).[4] This yields the different combinations depicted in Table 1 to which subjects were randomly assigned.[5]

After having played ten rounds of the public goods game, two other behavioral measures were employed. Specifically, participants' SVO and risk attitudes were elicited. For the former we used the slider-measure approach (Murphy et al., 2011) where each participant has to indicate distributional preferences by allocating a given endowment between herself and another person. In comparison to older measures of the construct,

[4] We decided to use extreme cases instead of subtler changes to the institutional environment to receive maximum treatment effects (List, 2011).

[5] Due to administrative issues, we conducted twice as many sessions of the *Baseline*.

this approach does not only yield behavioral types, but the SVO angle, a much more fine-grained measure on a ratio scale. The participants faced 15 of such decomposed games yielding a position on a circular plane of all possible allocation-based positions and defining the SVO (see Murphy et al., 2011, for a detailed description).

Following the approach by Holt and Laury (2002), individual risk aversion was assessed by having the participants choose between ten pairs of investment options A and B, one having a greater payoff spread than the other. Basically, the measure allows to identify a person's risk aversion by observing the point at which an individual switches to choose the riskier option B over option A. For example, a person is classified as risk-neutral when choosing option A for the first four times and then switching to option B, because then the expected payoff difference between option A and B turns negative for the first time. In general, the earlier an individual chooses the riskier option B over option A, the more risk seeking this person is. Again, participants were informed ex ante that one decision would be randomly selected to determine payoff from this part.

As a last part, participants were asked to fill in several questionnaires. First, the German version of the HEXACO-60 personality inventory (Ashton and Lee, 2009; Moshagen et al., 2014) was used. Additionally, besides risk aversion, several control variables were elicited as collective behavior may also be influenced by other individual characteristics. Specifically, the controls included participants' gender and age, their study major, math grade as crude proxy for general mental ability, and measures for generalized trust as well as positive and negative reciprocity norms. While the former has been extensively studied as an antecedent of cooperativeness (Ostrom and Walker, 2003), the latter are also frequently mentioned, since they account for rather reactive forms of behavior (Chaudhuri, 2011). For example, generalized forms of retaliation for past behavior of anonymous others may also explain an individual's behavior over time. These measures deploy additional control for non-specific retaliation caused by general anger concerning defection of others. For reasons of parsimony, these controls were measured using three-item scales from the German Socioeconomic Panel (SOEP) (Caliendo et al., 2012; Dohmen et al., 2008). Then, individual payoffs from all parts were determined and all subjects received their payment in private.

4. Results

The experiment was conducted at MELESSA, the experimental laboratory of the University of Munich, in September and October 2015. 360 participants recruited using Orsee (Greiner, 2015) took part in 15 sessions which lasted about 75 minutes each. The average age of participants was 25.7 years; the youngest participant was 18 and the oldest 62 years old. The majority of participants was female (60%) and students (90%); 31% pursued a major in business and economics. All sessions were computerized using the software z-Tree (Fischbacher, 2007). During the experiment, participants could earn experimental points that were exchanged into € at the end. On average, subjects earned 13.71 €, including a show-up fee of 4 €.

In the next section, we present our main results. Our findings are structured as follows: First, we present descriptive results. We do so by describing our data set and investigating group-level outcomes before scrutinizing individual-level decisions, which are the foundation for the macro-level outcomes described before. After that, we turn to test our hypotheses. We start by looking at treatment effects of the institutional changes described above. Then, we delineate whether we actually observe cascading in our data as predicted and test which antecedents may be used to predict the position in the behavioral sequence.

4.1. Descriptive Results

Information about the descriptive statistics are displayed in Table 2, while individual differences and intercorrelations across treatments are depicted in Table 6 and Table 7 in Appendix A, respectively. By and large, the patterns we find for our variables correspond to those in the literature.

Personality was measured on a five-point scale with 60 items (i.e., six dimensions, ten items each) of the established and validated HEXACO questionnaire (Moshagen et al., 2014) to assess the extent to which respondents were honest (α = .76), emotionally stable (α = .76), extraverted (α = .80), agreeable (α = .74), conscientious (α = .77),

Table 2: *Descriptive statistics of the explanatory variables*

	Mean	SD	Min	Max	Alpha
Honesty	3.30	0.73	1	5	0.76
Emotionality	3.17	0.68	1	5	0.76
Extraversion	3.47	0.65	1	5	0.80
Agreeableness	3.13	0.63	1	5	0.74
Conscientiousness	3.74	0.61	1	5	0.77
Openness	3.64	0.62	2	5	0.69
SVO angle	17.18	12.73	-16	46	–
Risk aversion	6.38	1.52	0	10	–
Trust	3.20	0.90	1	5	0.74
Negative reciprocity	2.55	0.92	1	5	0.77
Positive reciprocity	4.43	0.57	1	5	0.61

and open to experience (α = .69). While there is some variation in internal consistency, all alpha values are comparable to those reported by Moshagen et al. (2014).[6] Figure 6 in Appendix A depicts the distribution of scores on the six HEXACO dimensions in our sample.

Concerning SVOs, our results and distributions are comparable to those reported by Murphy et al. (2011), who also indicated clustering around the individualistic type and no representation of purely altruistic individuals. See Figure 7 in Appendix A for the distribution of angles in our sample.

Regarding our control variables reciprocity, trust and risk aversion, patterns are also quite similar to the literature. While positive reciprocity (α = .61) only has questionable internal consistency, negative reciprocity (α = .77) and trust (α = .74) show acceptable levels of internal consistency. Compared to Caliendo et al. (2012), who also report questionable internal consistencies for negative and positive reciprocity and good internal consistency for trust, our results are in line considering the differences in sample

[6] Furthermore, we conducted a confirmatory factor analysis to evaluate the underlying factor structure of the HEXACO model. The results are described in Appendix B.

size.[7] As the internal consistency depends on the number of items used and considering the fact that we include reciprocity and trust only as control variables, this is a caveat, but should not limit the interpretation of our results in general.

Regarding risk preferences, the average participant in our sample is risk averse, while 40 participants showed either an inconsistent choice pattern (i.e., more than one switching point) and/or failed to choose the higher monetary outcome when confronted with a choice between 200 points and 385 points with probability one, respectively. As excluding these subjects from our analyses does not change the results substantially and risk preferences are a control rather than a variable of interest, we decided to include all subject in our analysis.

Overall, the independent variables measured in our sample resemble those established in the literature, encouraging use of all of the variables for further analysis.

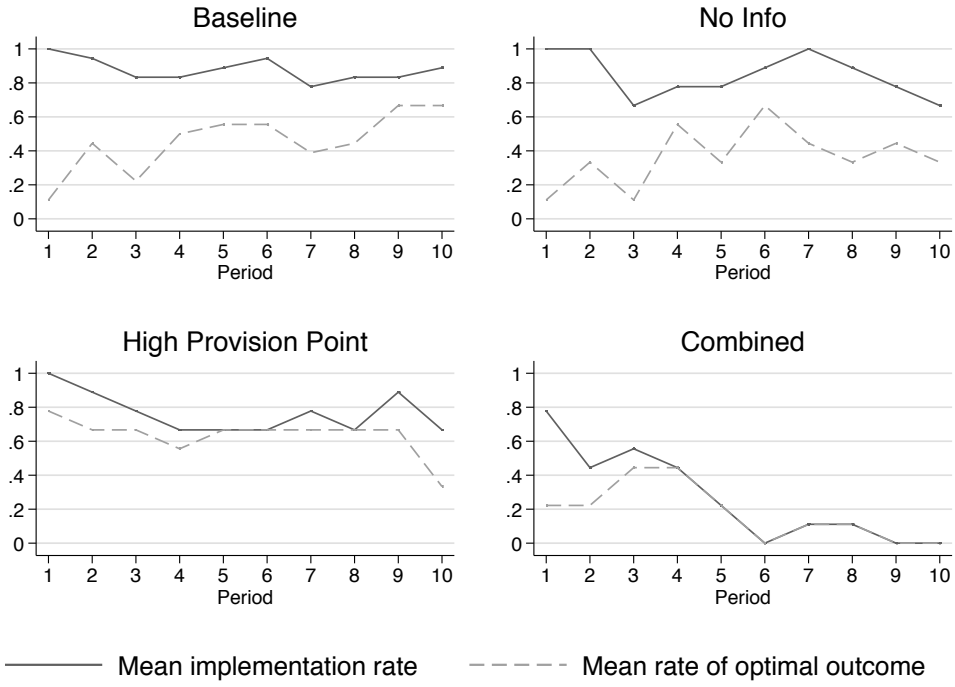
4.1.1. Group-Level Outcomes

Before explicitly testing our hypotheses, we give a general description of the group-level outcomes and how they are shaped by individual contribution decisions. We do so by describing the implementation rates as well as the mean rate of optimal outcome across all ten periods.

Figure 2 displays the rate of cases out of all group observations in each of the ten periods in which the public good was successfully implemented (solid line) across all four treatments (i.e., at least five (seven) out of eight group members contributed their endowment). It also contains the rate of cases in which the theoretically optimal outcome (dashed line) was reached (i.e., exactly five (seven) out of eight group members contributed). Note that due to the way these two measures are constructed, the mean rate of optimal outcome is a proportion of the total mean implementation rate, which also includes the cases in which six, seven or even all eight group members contributed. These cases lead to the implementation of the public good as well, but to a lower total

[7] A confirmatory factor analysis was conducted to evaluate the factor structure (RMSEA = .049, SRMR = .038, CFI = .987); model fit is acceptable (Bentler and Bonett, 1980; Brown, 2006).

Figure 2: *Average implementation rates by treatment*



Notes: Figure depicts average rates of successful (public good provided) and optimal implementation (threshold reached exactly) by period. Calculations based on 450 groups.

payoff because the additional contributions are lost. Thus, the upper limit for the mean rate of optimal outcome is given by the mean implementation rate.

Overall, it is evident that in our setting, the mean implementation rate is quite high. This rate of successful public good provision is substantially larger than in other experiments using the PPM (e.g., Croson and Marks, 2000). This indicates that the real-time protocol sustains cooperativeness in socially complex settings. In general, implementation does not seem to become more unlikely over the course of the experiment. Moreover, most of the participants seem determined to contribute in the first period, resulting in implementation in all groups, but also in a very low proportion of groups with exactly five (seven) individuals contributing (i.e., the optimal solution). In the *Baseline*, implementation rates stay high at all times, while the number of groups that manage to coordinate efficiently increases. Judging by the graphs alone, differences in availability of information about contribution decisions of others seem to have little influence

on the groups' ability to effectively coordinate for collective success as long as the step return remains constant (*Baseline* → *No Info*). In comparison, only manipulating the step return seems to affect collective success more strongly (*Baseline* → *High Provision Point*), as these groups' average implementation rate across all rounds is lower. When stakes are high for the groups, unavailability of information has a strong effect on their ability to effectively coordinate for collective success (*High Provision Point* → *Combined*). Moreover, the groups' coordination ability drops dramatically when simultaneously confronted with a lower step return and unavailability of information (*Baseline* → *Combined*). Although there is some variation over periods, the only treatment with a clear decline over time is *Combined*.

While there is more variation in *No Info* compared to the *Baseline*, there are still some groups in the *Baseline* with excess contributions although subjects should know that they burn money. To check whether subjects were behaving irrationally, we take a closer look at seemingly irrational contributions in the *Baseline* and *High Provision Point* treatments, where subjects receive real-time information about whether there are enough contributions for the provision point to be reached. Out of 1510 observations in the two relevant treatments, 84 are seemingly irrational (i.e., it was visible there were already enough contributions for the public good to be implemented), which is a percentage of 5.5%. Of these contributions, 56 were made more than one second after the provision point was reached. Thus, only 3.7% of contribution decisions were not in accordance with standard assumptions. In light of the fact that this is only a very small fraction of choices and that one could possibly rationalize these choices when non-standard preferences like inequity aversion are considered, we use all observations for our analysis.

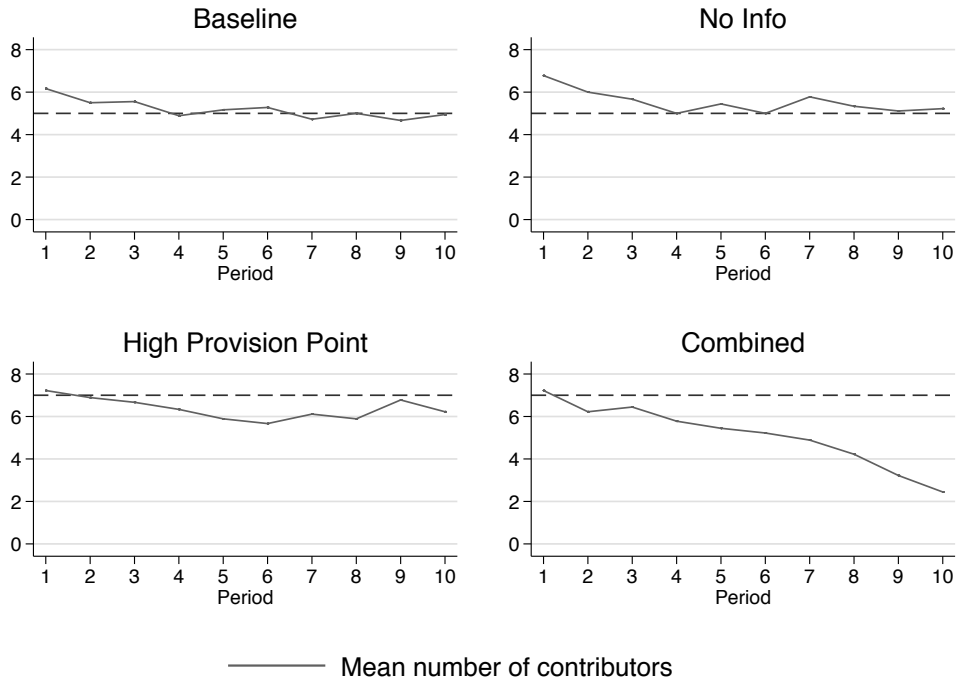
4.1.2. Individual Contributions

Figure 3 depicts the average number of contributors for each treatment across the ten periods. Notably, albeit the number of contributors fluctuates, it is quite high in general. While the average number of contributors slightly decreases over time across all treatments, this does not automatically indicate a negative trend of collective success. For

instance, in the *Baseline* treatment, the high average number of contributors in the beginning (rounds one to three) drops to converge around the optimal rate of contributors indicated by the dotted line. In addition, the graph provides some suggestive evidence that only in the *Combined* treatment the number of contributors strongly decreases below the provision point over time.

Having given a first impression of what our data look like, we now turn to test our hypotheses in the next paragraph.

Figure 3: *Average number of contributors by treatment*



Notes: Figure depicts average number of contributions made by period. Dashed line indicates threshold. Calculations based on 360 subjects.

4.2. Test of Hypotheses

4.2.1. Institutional Changes

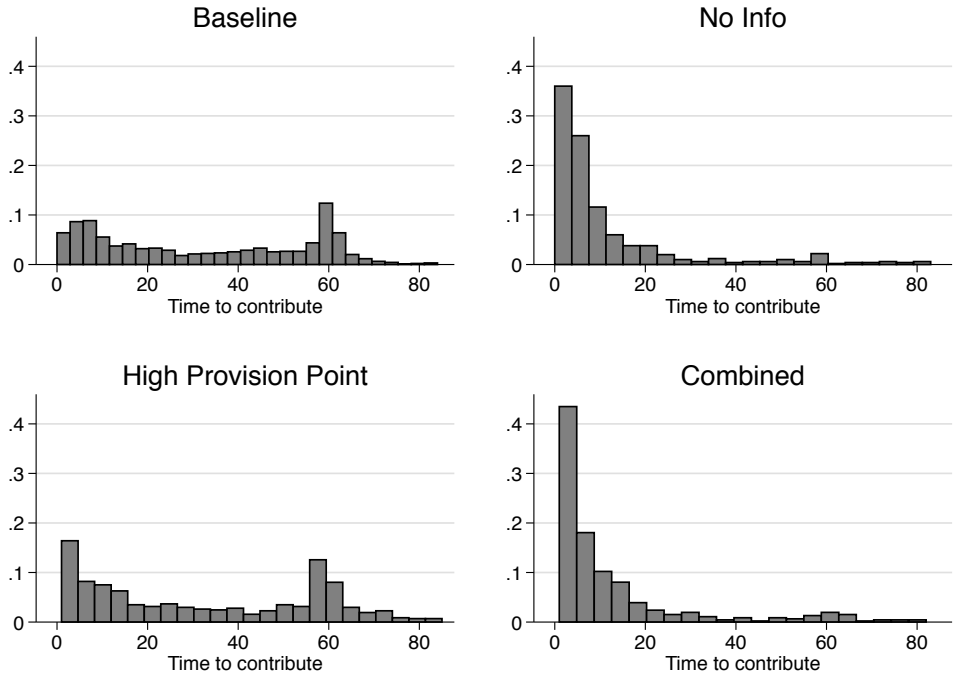
We now investigate differences in implementation of the public good across the different treatment conditions described above. While overall average implementation rates are quite high in all treatments except for *Combined* (*Baseline*: 88%; *No Info*: 84%; *High Provision Point*: 77%; *Combined*: 27%), the patterns described above and depicted in Figure 3 already provide suggestive evidence for Hypothesis 1 and Hypothesis 2.

The general impressions regarding the group-level success trajectories are supported by Fisher exact tests comparing the mean implementation rates of the public good across treatments. In particular, we find significant differences between all treatments except for the comparison between the *Baseline* and *No Info* treatments. In particular, the differences between *Combined* and all other conditions are highly significant ($p < 0.001$). The difference between the *Baseline* and the *High Provision Point* treatments is significant as well ($p = 0.022$), while the Fisher exact test fails to detect a significant difference between the *Baseline* and *No Info* ($p = 0.453$). In addition, we ran a probit regression predicting implementation success at the group level by provision point and availability of information. Details can be found in Table 8 in Appendix A. The results mirror the Fisher exact tests: while a high provision point significantly decreases implementation success, the coefficient for lack of real-time information is negative, but insignificant. Thus, we find support for Hypothesis 1 but not for Hypothesis 2. However, we find a negative and significant interaction effect, indicating that the interplay of a high provision point and no information leads to an additional decrease in implementation success. Summing up, we find that lowering the step return leads to lower implementation rates, while removing information about what the other group members do does not. In addition, the combination of a lack of information and a high provision point also significantly reduces implementation rates.

4.2.2. Explaining Endogenous Contribution Sequences

In Hypothesis 3, we posited that removing information about group member's behavior would decrease individual decision timing. In principle, the coordination problem with the real-time protocol allows for the groups to exhibit different behavioral trajectories at the individual level, which then may or may not cause similar levels of collective success. Therefore, in Figure 4, we graphically explore individual decision timing.

Figure 4: *Average timing of contributions by treatment*



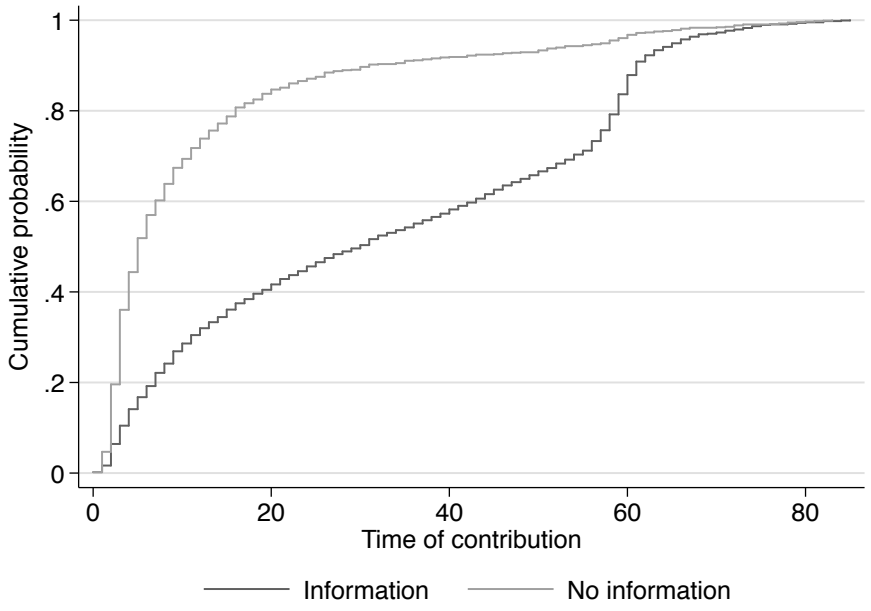
Notes: Figure depicts the distribution of time in the period when a contribution was made. Calculations based on 2,470 observations.

Some features are especially noteworthy when comparing the distribution of individual decision timing between the treatments with and without available information (i.e., *Baseline* and *High Provision Point* vs. *No Info* and *Combined*). In the treatments without information (*No Info* and *Combined*), almost all of the contributions happen within the first 20 seconds. In the other two treatments (*Baseline* and *High Provision Point*), the underlying pattern is different. In the latter case, a bimodal distribution of individual decision timing unfolds. Two moderate peaks distinguish very early contributions

and those made around 60 seconds, which marks the earliest time where each round could possibly be over according to our design. To explore this further, we compare the average time to contribute using Mann-Whitney U tests. While there is a significant difference between the treatments with and without information about others' behavior (*Baseline* vs. *No Info*: z = 2.32, p = 0.02; *High Provision Point* vs. *Combined*: z = 1.96, p = 0.05), this is not the case between the respective treatments with a low and high provision point (*Baseline* vs. *High Provision Point*: z = -0.26, p = 0.80; *No Info* vs. *Combined*: z = -0.66, p = 0.51).

In addition, to get at the difference in distributions between the contribution patterns, we compare the cumulative distributions of contribution times depending on whether information on others' decision is available or not. Figure 5 depicts the two functions. It is evident that the cumulative distribution function of times to contribute with information first-order stochastically dominates the cumulative distribution function without information. Summing up, we find support for Hypothesis 3.

Figure 5: *Cumulative distribution functions of contribution times*



Notes: Figure depicts cumulative distribution functions of contribution times for treatments with information (dark line) and without information (light line). Calculations based on 2,470 observations.

In Hypothesis 4, we claimed that there is non-random variation with regard to the sequence of decision timing. As explained above, the central notion of threshold models is that one's own contribution depends on the number of active others. For our setting, this implies that there is actually a contribution sequence observable rather than most contribution decisions being made more or less simultaneously right after the start of the period. Thus, for the threshold model to be applicable to our setting, we should observe sufficient variation in the timing of contributions within each round. To explore this, focus on the left side of Figure 4. As already stated above, contributions are spread over the whole period, with two peaks at the beginning of the period as well as around second 60, which marks the boundary between the first minute in which there is still time to contribute and the last 30 seconds in which the round is possibly terminated. The mean time to contribute across all periods is 24.52 seconds with a standard deviation of 23.26 seconds. This shows that we find considerable variation in contribution timing, which is also consistent with the assumption of behavioral heterogeneity in the threshold theory of collective behavior (Granovetter and Soong, 1983). Summing up, contributions are indeed made sequentially when real-time information about others' contributions is available, providing the prerequisite for the analysis of antecedents for decision timing.

To subsequently test the rest of our hypotheses, we estimated the effects of personality and SVO on contribution decisions and contribution order in a regression framework. The individual behavioral threshold, our main dependent variable, was created following Granovetter (1978). We measure an individual's behavioral threshold "[...] by the exact number of others who have made a decision before he does" (Granovetter, 1978, p.1440). Thus, for each round, an individual-level variable (obsCon) was created, which represents the number of other group member's contributions to the public account before the respective individual contributed him- or herself. For example, before making a contribution, a random individual may have observed nobody in the first round, two contributions in the second round, four contributions in the third round and so on. This individual's values of obsCon would then be 0, 2, and 4, respectively. Thus, each individual can have a maximum of 10 values for obsCon over the course of each

session, which can range from 0 to 7 within each round, as all groups contain exactly eight participants. As this procedure only yields values for cases in which individuals actually contributed to the public good, our analyses are limited to those cases. When conducting our analyses, we generally controlled for risk aversion, trust, reciprocal inclinations, and several socioeconomic factors.[8] In addition, we included period fixed effects to capture time trends and overall learning in our regressions.

As a benchmark, we start by regressing a binary variable indicating whether an individual made a contribution or not on our variables of interest and set of controls. Table 3 reports the model using the whole sample including treatment indicators in column (1) as well as separate regressions for each of the four treatments in columns (2) to (5). Here, it can be seen that an individual's SVO angle significantly increases the probability to make a contribution to the public account, while the HEXACO dimensions turn out to be non-significant predictors for contribution propensity. Thus, distal personality measures do not influence contribution decisions on the extensive margin in our setting. However, as we are primarily interested in the intensive margin, that is, how personality factors influence contribution order, this is not discouraging per se.

Next, we turn to the exploration of antecedents of contribution order. As obsCon can take eight possible values, but is an ordinal variable, we employ a panel ordered probit approach. As with contribution decisions, we report an estimation using all observations and including an indicator variable for the provision point as well as separate estimations for the *Baseline* and *High Provision Point* treatments. The estimation results for all specifications are summarized in Table 4. Looking at the overall model in column (1), four predictors turn out to be significant: The treatment indicator is significant by design. As predicted, a larger SVO angle, that is, a more prosocial orientation, is associated with earlier contributions. Interestingly, while the coefficients for both agreeableness and honesty-humility turn out to be insignificant, two other HEXACO personality dimensions are significant predictors for contribution sequence: while extraversion and the number of observed contributions are significantly negatively related, meaning that individuals with higher extraversion scores contribute earlier, conscientiousness

[8] These include gender, age, subject of study, and general mental ability proxied by math grade.

Table 3: *Panel probit regressions for contribution decisions*

	(1)	(2)	(3)	(4)	(5)
DV: Contributor	Overall	Baseline	High Provision Point	No Info	Combined
Openness	6.55e-05	-0.0250	-0.00156	0.0460	-0.0149
	(0.0268)	(0.0436)	(0.0479)	(0.0588)	(0.0525)
Conscientiousness	-0.0374	-0.0358	0.00419	-0.0646	-0.0539
	(0.0252)	(0.0348)	(0.0497)	(0.0602)	(0.0555)
Agreeableness	0.000234	-0.00553	0.00630	0.0215	0.0372
	(0.0275)	(0.0450)	(0.0569)	(0.0643)	(0.0603)
Extraversion	0.00903	0.0247	0.00263	-0.0333	-0.0217
	(0.0246)	(0.0383)	(0.0484)	(0.0561)	(0.0604)
Emotionality	0.0136	-0.0248	-0.0109	0.107**	0.0158
	(0.0254)	(0.0366)	(0.0551)	(0.0532)	(0.0595)
Honesty	0.0132	0.0718**	-0.0119	0.0240	0.0399
	(0.0238)	(0.0354)	(0.0487)	(0.0634)	(0.0424)
SVO angle	0.00523***	0.00603***	-0.000656	0.00544*	0.00717***
	(0.00114)	(0.00175)	(0.00225)	(0.00299)	(0.00273)
High PP = 1	0.0508*				
	(0.0285)				
No Info = 1	-0.0197				
	(0.0309)				
High PP	-0.191***				
# No Info	(0.0616)				
Observations	3,600	1,440	720	720	720
Groups	360	144	72	72	72
Wald Chi^2	139.1	75.31	45.14	57.12	103

Notes: The table reports marginal effects after panel probit regressions. Controls include trust, positive and negative reciprocity, risk aversion, gender, age, subject of study, mental ability, and period fixed effects. Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: *Panel ordered probit regressions for contribution order*

	(1)	(2)	(3)
DV: obsCon	Overall	Baseline	High Provision Point
Openness	0.0581	0.00525	0.155
	(0.118)	(0.143)	(0.214)
Conscientiousness	0.261***	0.306***	0.221
	(0.0998)	(0.117)	(0.203)
Agreeableness	-0.103	-0.0805	-0.0701
	(0.123)	(0.131)	(0.229)
Extraversion	-0.217**	-0.345***	-0.0414
	(0.109)	(0.126)	(0.186)
Emotionality	0.0687	0.0560	0.116
	(0.0986)	(0.111)	(0.207)
Honesty	-0.123	-0.281**	-0.00172
	(0.107)	(0.139)	(0.197)
SVO angle	-0.0198***	-0.0243***	-0.0152*
	(0.00505)	(0.00595)	(0.00900)
High PP = 1	0.527***		
	(0.151)		
Observations	1,510	937	573
Subjects	214	142	72
Wald Chi^2	60.82	53.39	47.23

Notes: Table shows raw coefficients after panel ordered probit regressions. While all relevant observations are used in column (1), estimation in column (2) uses *Baseline* treatment observations only, and column (3) uses *High Provision Point* Treatment observations only. Controls include trust, positive and negative reciprocity, gender, age, subject of study, mental ability, and period fixed effects. Standard errors are clustered at the individual level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

has a positive impact, meaning that individuals with higher conscientiousness scores contribute later in the sequence. Thus, the estimation results partially support our hypotheses: while we find support for Hypotheses 7, 9 and, 10, the rest (Hypotheses 5, 6, and 8) cannot be supported. Hence, in our sample, more prosocial individuals are more likely to contribute earlier, indicating lower behavioral thresholds. With respect to the more distal personality traits, emotionality as well as honesty and agreeableness have no impact on contribution behavior. However, we find that extraversion and conscientiousness influence the propensity to contribute early.

4.3. A Closer Look at Behavioral Types

Finally, we take a closer look at different behavioral types to gain further insights into what might determine contribution behavior in our setting.

First, we rerun our main analysis of contribution order, but exclude all pivotal contributions, because these contributions are strategically fundamentally different from the others as unlike for every contribution before that, there is no uncertainty about whether the provision point is going to be reached or not – if the pivotal contribution is made, the public good is going to be implemented for sure. The results are presented in column (1) of Table 5, revealing a similar pattern to the analysis comprising all contribution decisions without accounting for their distinct strategic nature. Again, the coefficients for SVO angle and extraversion are significantly negative, while the coefficient for conscientiousness is significantly positive. Hence, even when only looking at contributions under uncertain conditions, we still find that individuals with a more prosocial attitude and more extraverted individuals contribute earlier in the sequence, while more conscientious individuals contribute later.

Next, we take a closer look at pivotal contributions only, following the rationale explained above. More specifically, we compare all non-pivotal contributions to those that directly lead to implementation of the public good using a probit regression. As can be seen in column (2) of Table 5, the propensity of making a pivotal rather than another contribution is significantly increasing in the degree of conscientiousness of decision

Table 5: *Subgroup regressions*

DV:	(1) Uncertain obsCon	(2) Pivotal (Y/N)	(3) Leader (Y/N)
Openness	0.0521	0.0190	-0.0247
	(0.123)	(0.0255)	(0.0299)
Conscientiousness	0.182*	0.0581**	-0.0626***
	(0.101)	(0.0227)	(0.0243)
Agreeableness	-0.0723	-0.0209	0.0201
	(0.124)	(0.0277)	(0.0313)
Extraversion	-0.184*	-0.0163	0.0383
	(0.109)	(0.0236)	(0.0244)
Emotionality	0.153	0.000157	-0.0495*
	(0.0948)	(0.0250)	(0.0258)
Honesty	-0.00538	-0.0289	0.0108
	(0.108)	(0.0254)	(0.0262)
SVO angle	-0.0148***	-0.00412***	0.00344***
	(0.00497)	(0.00114)	(0.00109)
High PP = 1	0.758***	-0.0316	-0.0207
	(0.158)	(0.0295)	(0.0344)
Observations	1,193	1,510	1,510
Number of Subjects	200	214	214
Wald Chi^2	56.11	37.15	26.75

Notes: Column (1) shows raw coefficients after panel ordered probit regression, while columns (2) and (3) depict marginal effects after panel probit regressions. Controls include trust, positive and negative reciprocity, gender, age, subject of study, mental ability, and period fixed effects. Standard errors are clustered at the individual level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

makers, while it is significantly decreasing in SVO angle. Thus, more conscientious and less prosocial individuals are more likely to make pivotal instead of uncertain contributions to the public account.

In addition, we also explore which factors influence the decision to make the first move in the group, that is, to contribute before anyone else does. As expected, the coefficients for SVO angle and conscientiousness depicted in column (3) of Table 5 mirror those for the other obsCon regressions, indicating that individuals with a higher prosocial attitude and lower conscientiousness are more likely to be first movers. Surprisingly, however, the coefficient of emotionality is also significant and negative, indicating that higher scores in emotional stability decrease the propensity to make the first move.

5. Discussion

Summing up, our laboratory experiment yields some interesting insights. First, while implementation success is higher when the provision point is lower, i.e., only five rather than seven contributing individuals are needed for the public good to be implemented, availability of real-time information about others' behavior does not automatically facilitate efficient coordination and implementation success. While this is somewhat surprising in light of our hypotheses, it is also in line with what has been reported in the literature in slightly different settings. A specific explanation in our setting might be a possible ceiling effect: As compared to the literature our implementation rates are very high, especially when the provision point is set at five contributions. Consequently, the relatively easy goal of finding these five individuals implies that real-time information cannot make a big difference in facilitating implementation success. However, we do find that the combination of a high provision point and a lack of availability of real-time information leads to a steep decrease in group success. Thus, overall, our results reveal that the institutional environment matters for group outcomes.

Furthermore, our experiment shows that the coordination problem our subjects face leads to contribution sequences as predicted by threshold theory. While some subjects are instigators and actively contribute very early, moderates wait for some collective

movement to begin, while again others are quite reluctant and need to see a lot of other individuals contribute before contributing themselves. Furthermore, our results show that while participation in collective action can be predicted by SVO alone, the sequencing is influenced by a broader array of individual differences (i.e., conscientiousness, extraversion, and SVO). Yet, not all of these individual differences affect behavioral thresholds in the same direction: while extraversion and SVO further individual proactivity, conscientiousness hinders it.

However, the results concerning emotionality, agreeableness, and honesty are somewhat surprising in light of our hypotheses. While both the theoretical rationale as well as the empirical results regarding the VCM were convincing ex ante, their applicability under the PPM seems to be limited. Albeit agreeableness is conceptualized as a rather reactive trait domain, the context may have suppressed this effect. Moreover, our setting does not provide extensive possibility to show strong reactions, such as direct punishment of others or retaliation in future sessions. It might be the case that our treatment interventions were strong enough to override the behavioral tendencies due to distal individual heterogeneity in personality structure. In contrast to the standard trait-based approach, other scholars in psychology have been in favor of more complex person-situation interactions (Hough et al., 2015; Mischel and Shoda, 1995, 2010; Schein, 2015). Using the concept of situational strength, it has been argued that cues provided by the environment heavily influence behavior formation (Dalal et al., 2015; Judge and Zapata, 2015). While in strong situations, personality has only a modest influence on overt behavior, in weak situations which are unstructured, without salient, or very ambiguous cues, personality plays a much stronger role (Meyer et al., 2010). This could be the reason why agreeableness cannot explain additional variation in our experimental setting. A somewhat similar argument can be made for emotionality and honesty. While we are not able to discern an emotionality and agreeableness effect at all, it is interesting that the effect of honesty is at least visible in the *Baseline* of our setting, suggesting an interaction of situation and personality.

However, our results have to be seen in the light of some limitations that offer various opportunities for future research. First, the advantage of controlling for situational

influences in laboratory settings naturally comes at a cost. Random rematching and irrevocable decisions rule out within-group learning, coalition building, and retaliation. Future research may use the real-time protocol including revocable commitments (Goren et al., 2004) in order to extend our results to these decision processes. Second, we investigate behavior formation when individuals are confronted with all-or-nothing contribution decisions. Thus, our results are limited to the basic decision of supporting a project or task by exerting costly effort at all or not. In addition, various forms of teamwork are characterized by a continuous contribution to the public good, which our design does not capture. Third, our design does not include heterogeneity of players with regard to network centrality. It has been reported in the literature on network effects that bandwagon dynamics can be severely impacted if individual contributions of central peers in their respective network have larger impact than more distal players (Chiang, 2007). Fourth, some of our analyses and consequently our implications are based exclusively on those individuals who contributed to the public good. This limitation is becaue albeit we are able to tell that the respective behavioral threshold of individuals choosing not to contribute was not reached, we cannot infer what their exact behavioral threshold would have been. Fifth, while we take into account that personality is a more useful explanation of behavior in weak situations than in strong situations, our treatments may interfere with the situational strength of the social dilemma. Future studies may directly compare group behavior with weak and strong situational cues and interact it with the group's personality mix (e.g., ratio of prosocials). Sixth, future studies may take a closer look at self-selection of individuals into the respective situational contexts. The usage of self-selection rather than authority as a means to allocate tasks throughout the firm has been argued to be one of the true novelties of new forms of organizing (Puranam et al., 2014). In order to build implications for practice, it would be interesting to know if individual differences yield substantial differences for self-selection. Subsequently, the performance implications of sorting may be analyzed by comparing self-selected to exogenously selected groups. According to the attraction-selection-attrition framework (Scheider, 1987) or the person-organization-fit literature (Kristof, 1996), selection into (and out of) organizations is not a random process. Thus,

employee self-selection may severely limit an organization's ability to staff task forces or project teams with the individuals prone to take lead in contribution sequences. As Bridoux et al. (2011) point out, a given mix of motives demands for a differential and nuanced approach regarding the motivational system that needs to be employed to yield maximum contributions. Finally, our study investigates the general causal effect of institutional manipulations on contribution behavior. However, we cannot tackle the exact mechanism responsible for collective results at the individual level. According to Zafar (2011), the general effect of manipulating information about others' behaviors may be due to individuals trying to infer the best choice (social learning), actually gaining utility from acting alike (social comparison), or wanting to gain a positive self-concept (social image).

6. Conclusion

The findings of this experiment suggest interesting implications for theory development, practitioners and future research. For practitioners and applied scholars, it is noteworthy that institutional factors eminent to the environment or malleable by the individual manager matter a great deal towards success and efficiency of project teams or strategic initiatives. It has been shown by the results of our experiment that information provision about group member's behavior can significantly facilitate coordination. What is more, our results support the basic rationale of the threshold model of collective behavior. In fact, individuals show substantial heterogeneity in threshold formation when confronted with the production of a provision point public good with endogenous decision timing. More importantly, our study provides empirical support for the anecdotal argument that this heterogeneity may, in part, be caused by individual differences. Furthermore, our study generally supports the notion that heterogeneous motives matter in the context of collective behavior formation. Given the fact that coordination has been deemed as one of the central tasks of any organization (Okhuysen and Bechky, 2009; Puranam et al., 2014), those mechanisms should be tested under real organizational conditions using for example field experiments or insider econometric studies.

Appendix

A. Figures and Tables

Figure 6: *Distribution of HEXACO scores*

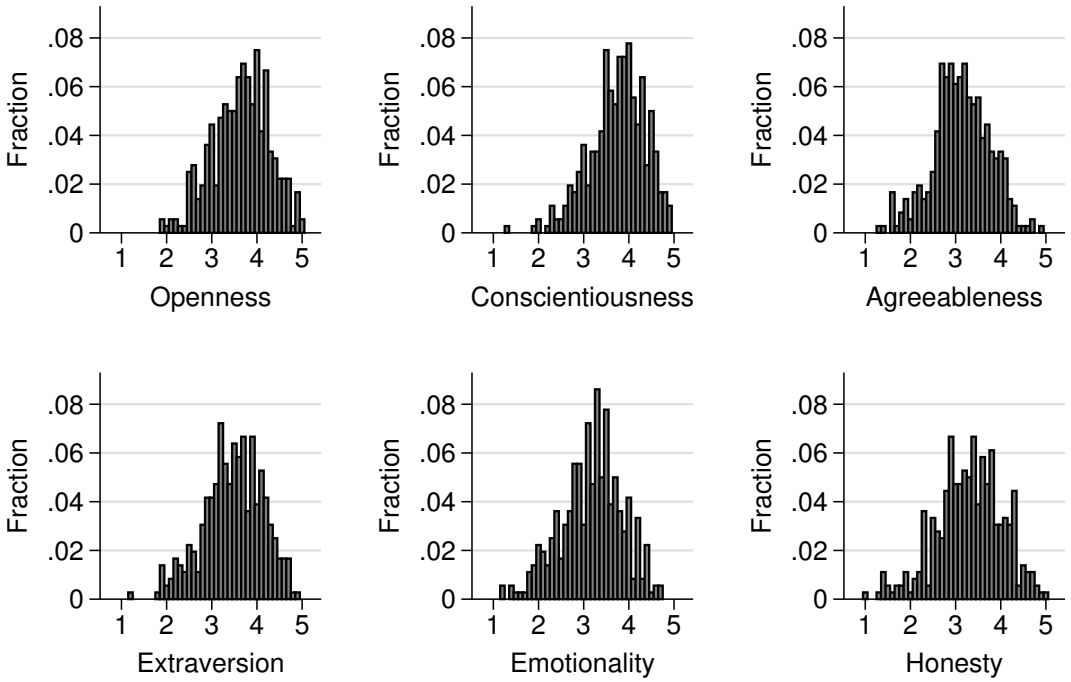


Figure 7: *Distribution of SVO angles*

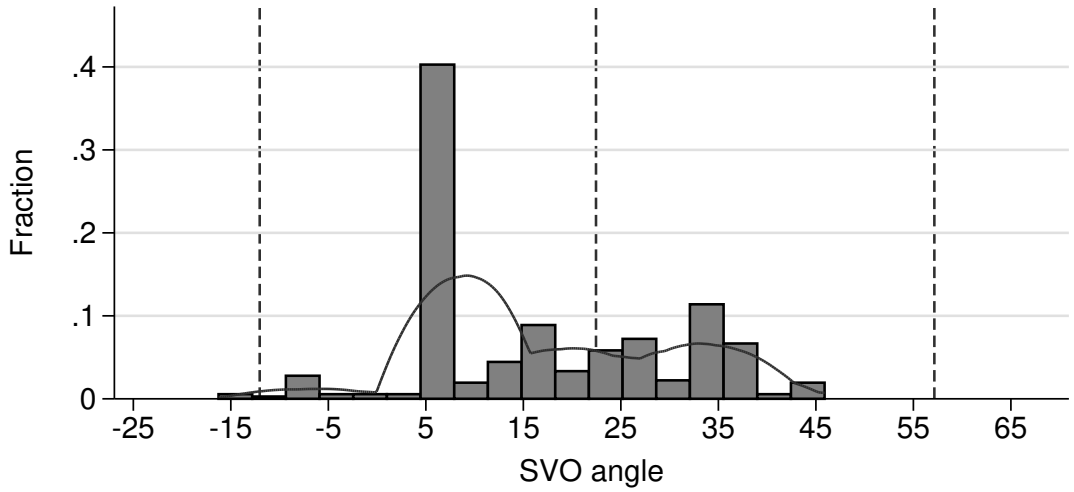


Figure 8: *Distribution of trust and reciprocity scores*

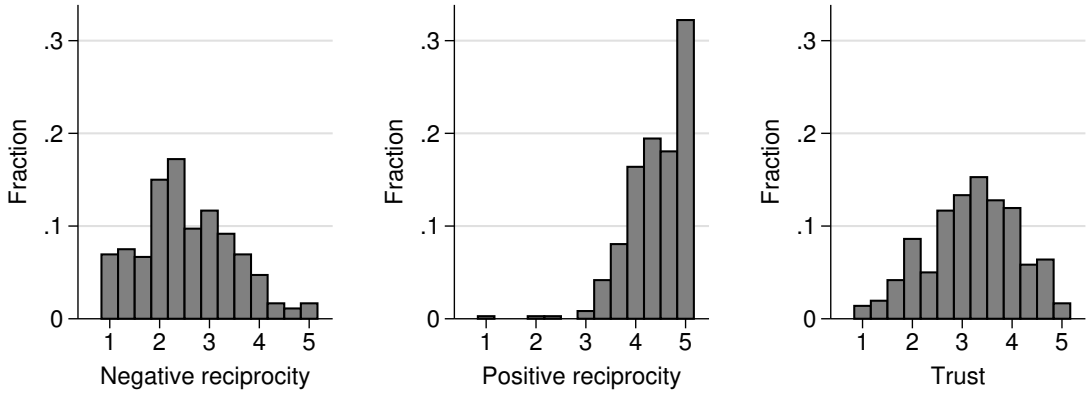


Table 6: *Balancing table*

	Baseline	No Info	High Provision Point	Combined	Chi^2
Gender	0.66	0.56	0.50	0.61	5.75
	(0.48)	(0.50)	(0.50)	(0.49)	
Age	26.78	23.82	25.36	25.71	5.85
	(8.56)	(3.73)	(3.84)	(6.61)	
Student	0.85	0.93	0.96	0.89	6.73*
	(0.35)	(0.26)	(0.20)	(0.32)	
Openness	3.70	3.62	3.54	3.65	4.87
	(0.64)	(0.60)	(0.52)	(0.70)	
Conscientiousness	3.77	3.69	3.74	3.74	1.83
	(0.63)	(0.58)	(0.57)	(0.65)	
Agreeableness	3.07	3.16	3.30	3.06	7.23*
	(0.62)	(0.68)	(0.55)	(0.65)	
Extraversion	3.45	3.48	3.56	3.41	1.89
	(0.68)	(0.66)	(0.59)	(0.67)	
Emotionality	3.21	3.15	3.10	3.20	2.95
	(0.74)	(0.65)	(0.58)	(0.65)	
Honesty	3.25	3.33	3.37	3.31	0.80
	(0.75)	(0.71)	(0.64)	(0.79)	
SVO angle	16.39	17.87	19.28	15.95	3.78
	(12.83)	(12.99)	(12.17)	(12.77)	
Risk aversion	6.52	6.49	6.38	5.99	5.26
	(1.56)	(1.40)	(1.44)	(1.60)	
Trust	3.07	3.25	3.31	3.30	5.82
	(0.88)	(0.93)	(0.88)	(0.91)	
Negative reciprocity	2.57	2.51	2.54	2.56	0.13
	(0.96)	(0.84)	(0.90)	(0.98)	
Positive reciprocity	4.40	4.44	4.44	4.46	2.33
	(0.52)	(0.56)	(0.64)	(0.61)	
Observations	144	72	72	72	

Notes: Table reports variable means by treatment. Standard deviations are reported in parentheses. Column "Chi^2" reports Kruskal Wallis test statistics / Chi^2 test statistics for binary variables. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: *Pairwise correlations between the explanatory variables*

	OP	CO	AG	EX	EM	HH	SVO	Risk	Trust	Neg.
CO	0.059									
AG	0.115*	-0.065								
EX	0.256***	0.089	0.199***							
EM	-0.024	0.064	-0.112*	-0.199***						
HH	0.169**	0.029	0.257***	0.096	0.175***					
SVO	0.077	0.014	0.050	0.019	0.105*	0.221***				
Risk	0.044	-0.009	-0.136**	-0.040	0.107*	0.066	-0.008			
Trust	0.215***	-0.112*	0.408***	0.280***	-0.096	0.240***	0.181***	-0.105*		
Neg.	-0.174***	-0.100	-0.421***	-0.195***	-0.059	-0.459***	-0.249***	0.112*	-0.335***	
Pos.	0.219***	0.074	0.180***	0.249***	0.062	0.183***	0.072	0.003	0.188***	-0.143**

Notes: Table depicts pairwise correlations between the explanatory variables. Abbreviations: OP = Openness to experience, AG = Agreeableness, EX = Extraversion, EM = Emotionality, HH = Honesty-humility, SVO = Social value orientation, Risk = Risk aversion, Neg. = Negative reciprocity, Pos. = Positive reciprocity. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: *Implementation success dependent on treatment condition*

DV: implementation success	(1)
High PP = 1	-0.459**
	(0.197)
No Info = 1	-0.151
	(0.206)
High PP # No Info	-1.375***
	(0.296)
Observations	450
Pseudo R^2	0.282

Notes: Table shows coefficients after probit regression of implementation success on indicators for institutional conditions on the group level. Controls include period fixed effects. Standard errors are robust. *** p<0.01, ** p<0.05, * p<0.1.

B. Factor Analysis

Albeit the root mean square error of approximation [RMSEA] of .060 as well as the standardized root mean residual [SRMR] of .080 indicated an acceptable model fit, the comparative fit index [CFI] of .594 is fairly low, which can be troublesome (Bentler and Bonett, 1980; Brown, 2006). This finding, however, is not unique to our setting, but has been reported for other measures of personality like the five-factor model. As a consequence, the usefulness of CFA to assess the factor structure of personality measures has been questioned (Hopwood and Donnellan, 2010; McCrae et al., 1996; Oswald et al., 2013; Raykov, 1998). However, as a six-factor model yielded significantly better fit than a one-factor model ($\Delta\chi^2 = 2041.12$, $p < .01$), we decided to follow the approach suggested by Ashton and Lee (2009) and conducted an item-level factor analysis applying principal axis extraction with varimax rotation of six factors. The eigenvalues of the first eight factors derived from the 60 items exceeded the value of 1 and specifically were 5.14, 3.81, 3.43, 2.58, 1.98, 1.84, 1.39, and 1.13. There is suggestive evidence for a six-factor solution, as the eigenvalue decreased rather sharply from 1.84 for factor six to 1.39 for factor seven. A varimax rotation ensured that item loadings of all items were primarily on the factor defined by the other items of the respective scale and revealed that the primary item loadings replicated the basic structure of the HEXACO model. Regarding individual factor loadings, one item showed a slightly higher loading on a different factor than proposed by the manual. This was "I worry a lot less than most people do", which loaded higher on conscientiousness than on emotional stability. Apart from item 19, 37, and 49 connected to the openness dimension, and item 5 connected to emotional stability, all primary loadings exceeded the value of .30. As this is in line with what has been found in research on HEXACO personality in general and average scores, standard deviations and interrelations between dimensions are comparable to those reported by Moshagen et al. (2014), we decided to keep the original item structure.

C. Instructions

Welcome to the experiment and thank you for your participation!

Please do not speak with the other participants from now on. Please remain silent throughout the course of the experiment.

This experiment is designed to evaluate economic decision-making behavior. You will be able to earn money which will be paid to you after the experiment privately and in cash.

The entire experiment will last for about 70 minutes and consists of 3 parts. At the beginning of each part you will receive detailed instructions. The parts of the experiment are independent of each other, i.e., decisions in one part do not have any impact on your earnings in the other parts. The sum of your earnings from all parts will be added to your total earnings in this experiment. The total earnings will be paid to you upon completion of the final part, individually and in cash. If there are any questions concerning the instructions or during the experiment, press the red button on your keyboard (F11). One of the experimenter will come to you and answer your questions in private. During the experiment, you will be asked to make several decisions. Some of them will be made in interaction with other participants. This means that both your own decisions and those of the other participants may determine your payoffs.

Payoff During the course of the experiment, payoffs are calculated not in Euros, but in Experiment Points (EP). At the end of the experiment, the sum of your earned EP will be converted to Euros. Here, the following exchange rate applies: 100 EP = 1 €.

In addition to the income that you can earn during the experiment, you receive 4 € for your punctuality and 0.50 € for each page of the questionnaire at the end of the experiment.

Anonymity None of the other participants will be able to observe your choices in this experiment. In addition, the data from the experiment will be evaluated anonymously. At the end of the experiment, you have to sign a receipt for the income you have earned during this experiment. This is only due to accounting issues and cannot be used to associate your personal information with your decisions. Your name cannot be combined with your behavior in the experiment at any time.

Rounds Part 1 consists of a number of mutually independent rounds. In each round, you have between 60 and 90 seconds to make your decision. Each round lasts at least 60 seconds; after this the end of the round is equally likely at any second. A clock will inform you on elapsed time during the first 60 seconds.

Groups In each round, you form a group with seven other participants. The allocation to those groups is random. The groups are dissolved after the end of each round and re-formed randomly. None of the participants will be informed about the identity of the other members of her group.

Decision Task At the beginning of each round, each of the eight members of a group receives an initial endowment of 100 points. During the course of the round each participant can decide freely to keep this amount in her personal account, or to invest it in the group account. As soon as at least five of the eight members of the group have decided to invest their initial endowment in the group account, the investment pays off and grants a profit of 2800 points, which is distributed evenly across all eight members of the group. If fewer than five group members have decided to invest until the end of the round, the investment does not pay off. In this case, the investments in the group account are lost. Each group member then receives only the points from her private account.

During each round, every group member can anonymously follow the decisions of all other group members on the screen.

Earnings You can decide in each round if you want to invest your initial endowment in the group account. This decision you can make at any time the current round by selecting your contribution and click "OK". If you choose to keep your initial endowment and not to invest in the public account, there are two possible results:

- If at least five of the eight members of the group have decided to invest their initial endowment in the group account, in addition to your initial endowment you will receive one eighth of the profit of 2800 points. Overall, your payoff in this case equals $100 + 2800 \div 8 = 450$ points.
- If by the end of the round fewer than five group members have decided to invest their initial endowment in the group account, all you get is your initial endowment of 100 points. If you decide to invest your initial endowment, there are also two possible outcomes:

- If at least five of the eight members of your group have decided to invest their initial endowment in the group account, you will receive one eighth of the profit of 2800 points. Overall, your payoff in this case equals $2800 \div 8 = 350$ points.
- If by the end of the round fewer than five group members have decided to invest their initial endowment in the group account, you do not earn anything in this round.

At the end of the experiment, one of the rounds you played will be randomly selected and paid out.

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