Introduction and theory

Can reputation drive cooperation? The effect of network control

Thom Volker (5868777)*

Supervisors: Prof. dr. ir. Vincent Buskens & Prof. dr. Werner Raub

Sociology and Social Research Master's programme

Utrecht University

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Contents

1 Introduction **2**

2 Control effects on trust: The effect of network control **8**
2.1 The Trust Game 8
2.2 Network control effects on trust 10
2.3 Differences between network control effects for trustors and trustees 13

3 Literature **14**

1 Introduction

Social dilemmas manifest themselves throughout everyday life. When you plan to have dinner in a restaurant this Monday, you will have to trust the chef that the ingredients are fresh and of good quality. If this is indeed the case, you will enjoy an exquisite dinner that you happily pay for. The chef, who had no chance to get rid of the entire bulk of food ordered before the weekend, however, prefers to sell the leftovers, rather than tossing these into the bin (Bourdain 2013). If you are not particularly a connoisseur, you might not even notice until you experience the discomfort later that night. Foreseeing this unpleasant situation, you may cancel your reservation and decide to cook dinner yourself. This decision would leave you, who fancied a fabulous dinner over your home-cooked meal, and the chef, who preferred to have more customers, worse off compared to the situation in which you would dine in the restaurant that solely uses the best ingredients, qualifying the situation as a social dilemma (Kollock 1998; Ostrom 1998).

As outlined by Buskens and Raub (2002), such dilemmas are exemplary of many economic or social exchange situations. In many buyer-seller relations, for instance, the quality of the product that is provided cannot be evaluated before the product is paid for, allowing the seller to sell a low-quality product. The buyer may anticipate on this behavior, and refuses to engage in the transaction in the first place. Consequently, the collective returns will be lower as compared to the situation in which the transaction materialized. As an example of social exchange (Blau 1964; Cook

et al. 2013), someone may help a neighbor, expecting that this favor will be returned in the future. However, when the time is there, it is in the neighbor's self-interest to not provide help anymore, because it is costly in terms of time and other resources. If one anticipates on this opportunistic action, help may not be provided in the first place, leaving both actors worse off than they could have been. These dilemma situations show that the actors involved can achieve a collectively better outcome, but that this outcome may not be reached because at least one of the actors has an incentive to act otherwise. Hence, solving such dilemma situations can improve the efficiency of many social and economic interactions (Buskens and Raub 2002; Dasgupta 1988).

The examples resemble a trust problem in the sense of Coleman (1990). Coleman distinguishes between a trustor, resembling the guest, the buyer or the person who helps a neighbor, and a trustee, like the chef, the seller or the neighbor. If the trustor does not place trust, the trustee has no opportunity to honor or abuse trust, and the interaction ends. If the trustor is trustful and places trust, the trustee may honor or abuse trust (i.e., decide whether to act trustworthy). For both the trustor and the trustee, placing and honoring trust is preferred over not placing trust. However, the trustee prefers the outcome of abused trust over the outcome of honored trust, which would leave the trustor worse off than if no trust was placed. A trustor might anticipate on the trustee's incentives to abuse trust, and therefore withhold trust. Additionally, Coleman (1990) remarks that the trustor cannot rely on "real commitment," in the sense of contractual agreements. Note that in many transactions, specifying a contract that covers all possible contingencies is costly or infeasible (see Dasgupta 1988 for a similar argument).

The trust problem can be analyzed in a game-theoretical framework using the Trust Game (e.g., Camerer and Weigelt 1988; Dasgupta 1988). Much in line with the previous sketch of a trust problem, such an analysis shows that trust is difficult to achieve in isolated encounters (Buskens and Raub 2002, 2013). Similar results hold for a wide variety of other games, such as the Prisoner's

Dilemma, the Helping Game or the Public Goods Game, which can be used to represent different dilemma situations. In these games, pro-social behavior is generally referred to as cooperation rather than trust, while distrust is generally referred to as defection. However, many everyday interactions are hardly isolated encounters, as they are often embedded in some social context (Granovetter 1985). People may go to the same restaurant or the same store repeatedly or may know other customers as well. People have recurring interactions with their neighbors and others who know these neighbors. Embeddedness operates on two different levels: the level of the dyad, which refers to the same two actors interacting repeatedly, and the level of the network, which refers to two actors interacting with common third parties as well (e.g., Buskens and Raub 2002, 2013). On both of these levels, embeddedness can foster trustful and trustworthy behavior through two mechanisms: learning and control (Buskens, Frey, and Raub 2018; Buskens and Raub 2002, 2013; Yamagishi and Yamagishi 1994).

When people are embedded, they can learn about their partner's past actions through own experiences or through experiences of their acquaintances. This information may be useful for inferring how one's partner will behave in the current interaction, so that one can adapt one's own behavior accordingly. Obviously, no one wants to consume goods of inferior quality, and it is unlikely that someone who does not keep one's promises can count on much leniency on behalf of the neighborhood. Yet, if you have had many good experiences with a restaurant, or you know of others who had good experiences, you may be more inclined to eat there as well. Theoretical as well as empirical support for such learning effects have been well documented in the sociological and economic literature, both under dyadic and network embeddedness (see Buskens, Raub, and Van der Veer (2010), Camerer and Weigelt (1988), Neral and Ochs (1992), Anderhub, Engelmann, and Güth (2002), Mao et al. (2017) and Embrey, Fréchette, and Yuksel (2018) for dyadic learning effects; and see Seinen and Schram (2006), Engelmann and Fischbacher (2009), Buskens, Raub, and

Van der Veer (2010), Bolton, Katok, and Ockenfels (2004) and Wedekind and Milinski (2000) for network learning effects).

The control mechanism refers to the fact that the trustee's long-term incentives are partly under control of the trustor (Buskens and Raub 2002). When deciding how to behave, people have to take into account that their behavior now will affect their reputation, which affects how others will treat them in the future. Specifically, those who take advantage of others today can be sanctioned in the future, for example because they will not be helped or trusted anymore, while those who act kind today can be rewarded by helping them in the future. Both sanctions and rewards can be implemented by the person towards whom the behavior was directed in the first place (dyadic control), but this person might also inform others who can then base their own future behavior on this information (network control). You may, for instance, return to a restaurant you have had good experiences with, but you could also recommend this place to others. Hence, if the long-term consequences of a poor reputation outweigh the short-term gains of opportunistic behavior, it might be beneficial to behave accordingly. Theoretical as well as empirical results show that cooperative behavior is more likely when people have future interactions with the same partner, which demonstrates the presence of dyadic control effects (Buskens, Raub, and Van der Veer 2010; Dal Bó 2005; Dal Bó and Fréchette 2011, 2018; Embrey, Fréchette, and Yuksel 2018). Yet, despite similar theoretical results for dyadic and network control effects (e.g., Kandori 1992; Raub and Weesie 1990), the empirical evidence is much more ambiguous for network control effects (Bolton, Katok, and Ockenfels 2004; Buskens, Raub, and Van der Veer 2010; Corten et al. 2016; Van Miltenburg, Buskens, and Raub 2012).

The first goal of this paper is to get a clearer picture of the empirical evidence concerning network control effects, using the data on network embeddedness from multiple studies. Although all of these studies assessed network embeddedness in some form, only part of these studies assessed

network control effects, and an even smaller subset found evidence for such effects. We will first statistically summarize the empirical evidence on network control effects by reanalyzing the data from a larger set of past studies. Additionally, some empirical evidence suggests a difference in network control effects according to the role of an actor. Some studies showed that network control opportunities had an effect on the trustworthiness of those in the position to exploit their partner (i.e., the trustees), but not on the trustfulness of those who were not in this position (i.e., the trustors; Barrera and Buskens 2009; Buskens, Raub, and Van der Veer 2010; Frey, Buskens, and Corten 2019). Therefore, our second goal is to explore and quantify whether there is indeed more evidence for network control effects for trustees than for trustors. These topics have not been addressed in all experimental studies under consideration, and we will thus reanalyze the data collected from past studies using a consistent analysis plan.

The included studies differ considerably with respect to experimental conditions, such as the type of game (e.g., Trust Game, Investment Game, Prisoner's Dilemma and Helping Game), network size, number of transaction partners and duration of the game. Yet, all these studies assessed network embeddedness and allow to test for network control effects. Hence, although not explicitly designed as such, these studies can be considered conceptual replications. Conceptual replications allow to assess the validity of research findings by investigating whether conclusions hold under alternative conditions, using varying measurement instruments or operationalizations (Nosek, Spies, and Motyl 2012). While previous research has particularly stressed the importance of exact, direct or close replications, which address the statistical reliability of research findings (e.g., Camerer et al. 2016, 2018; Klein et al. 2014; Nosek et al. 2021; Open Science Collaboration 2015), conceptual replications add to direct replications by using multiple research designs with different strengths and weaknesses (Lawlor, Tilling, and Davey Smith 2017; Munafò and Smith 2018). A robust line of evidence that allows for greater generalizability is built by combining various ways of testing the same hypotheses,

using different sources of data and different methodologies and hence benefits from the synthesis of multiple conceptual replications (e.g., Buskens and Raub 2013; Jackson and Cox 2013; Lawlor, Tilling, and Davey Smith 2017; Munafò and Smith 2018). However, conventional approaches such as meta-analysis do not allow for the resulting heterogeneity between studies (Cooper, Hedges, and Valentine 2009; Lipsey and Wilson 2001; Sutton and Abrams 2001). To overcome these problems, we will use a novel method called Bayesian Evidence Synthesis (Kuiper et al. 2013).

Bayesian Evidence Synthesis (*BES*) is built upon the foundation of the Bayes Factor (Kass and Raftery 1995). *BES* allows researchers to pool evidence for a specific hypothesis over multiple studies, even if their designs differ. Using *BES*, the evidence in favor of a network control effect over these studies can be summarized statistically. In every study, a hypothesis on the effect of control through network embeddedness can be constructed, and its support can be quantified using a Bayes Factor (BF). The study-specific BF's can subsequently be combined to quantify the overall amount of evidence for the overarching hypothesis that network control fosters trust, regardless of the study-specific differences with regard to design and operationalizations of key variables. Rather than pooling effect sizes, *BES* allows to quantify the evidence over studies in favor of a more general scientific theory, and provides the relative amount of support for the hypotheses under consideration over all data combined. Hence, besides contributing substantively, we aim to contribute methodologically, by outlining how *BES* can be used to statistically summarize the evidence in favor of a hypothesis over conceptual replications, and how this statistical synthesis of results should be interpreted.

In the upcoming section, we will outline the theoretical foundations of network control effects. In the third section, we will shortly describe the studies that are incorporated in our synthesis. Subsequently, we will outline the methodological foundation of *BES* and describe how this method should be applied. In the final sections, we will apply *BES* to the data collected in the studies that

are considered, and discuss our empirical and methodological findings.

2 Control effects on trust: The effect of network control

We will first introduce the Trust Game as a formal representation of the social dilemmas outlined in the introduction, and use it to theorize about control effects. We will restrict ourselves to an informal discussion of control effects, while referring to game-theoretical foundations of our arguments. With only small modifications, similar reasoning can be used to theoretically analyze different dilemma situations that can be represented by different games, such as the Investment Game, Prisoner's Dilemma and Helping Game. Because of these similarities, we will not explicitly formulate theoretical arguments for network control effects in these games, but we will address the expectations that can be derived from such theoretical arguments.

2.1 The Trust Game

The standard Trust Game in Figure 1 captures the core elements of the dilemma situations sketched in the introduction (e.g., Camerer and Weigelt 1988; Dasgupta 1988). The Trust Game involves two actors, actor 1 resembles the trustor, and actor 2 resembles the trustee. The trustor first decides whether to place trust. If no trust is placed, the game ends and the trustor and trustee receive P_i $(i = 1, 2)$, respectively. If trust is placed, the trustee can honor or abuse trust. Honored trust yields the payoff R_i, which is better for both actors than the situation in which is no trust is placed $(R_i > P_i)$. Abused trust however yields $T_2 > R_2$ for the trustee, which shows why the trustee has an incentive to behave untrustworthy. Given that abused trust is associated with payoffs $(S_1 < P_1)$ for the trustor, anticipating on the trustee's incentives to abuse trust, the trustor is better off by not placing trust in the first place.

The Investment Game, Prisoner's Dilemma and Helping Game can be analyzed similarly (e.g.,

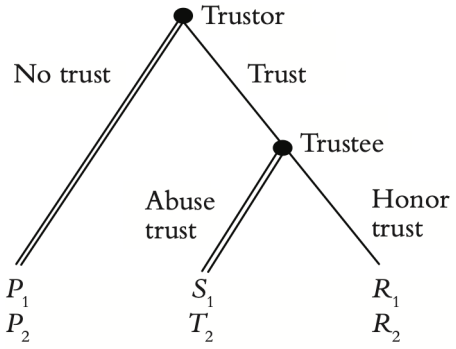

Figure 1: Extensive form of a one-shot Trust Game, with $T > R > P > S$. The doubled lines indicate the equilibrium path of play.

Raub, Buskens, and Corten 2015). The Investment Game (Berg, Dickhaut, and McCabe 1995) closely resembles the Trust Game, but differs in one respect: the actors' options are continuous rather than dichotomous. Specifically, the trustor obtains an initial endowment, and can decide how much of this endowment to send to the trustee. The amount sent is multiplied by some factor by the experimenter, after which the trustee can decide how much to send back. Hence, the amounts sent and returned reflect the trustor's trustfulness and the trustee's trustworthiness, respectively. Other dilemma situations may more closely resemble two-sided incentive problems. The Prisoner's Dilemma, for example, represents a two-sided incentive problem, in the sense that both actors have incentives to exploit their partner, and likewise have an incentive to protect themselves against exploitation by their partner. This contrasts with the Trust Game, because here only the trustee has an incentive to abuse trust, while the trustor can protect oneself against such behavior by not placing trust. The Helping Game closely resembles the Prisoner's Dilemma, but the actors move sequentially. Actor 1 decides to help actor 2 at a certain cost that is smaller than the benefit for actor 2, while at a later point actor 2 has the option to help actor 1, irrespective of whether actor 1 helped actor 2 in the first place.

The simple theoretical analysis of the Trust Game shows that if both actors aim to maximize their individual returns from an interaction, and the trustor expects the trustee to do so, then

the isolated nature of the interaction yields that trust is difficult to achieve (e.g., Binmore 2007; Buskens and Raub 2013). The key here is that if actors cannot learn about their partner's past actions, and today's actions do not affect future outcomes, people have no incentive to place or honor trust. If the focal interaction is not followed by any future interactions that the actors are involved in, opportunistic behavior cannot be sanctioned, and there are no control opportunities. Hence, if trustees have short-term incentives for abusing trust, there is nothing that withholds them from abusing trust if they are in the situation to do so. Accordingly, if trustors know that trustees have short-term incentives to abuse trust, and that abusing trust has no consequences other than the outcome of the current interaction, they may protect themselves against an unwanted outcome by not placing trust in the first place, leading to a suboptimal outcome of the interaction. Hence, the trustfulness of the trustor is predominantly on expectations regarding the trustworthiness of the trustee (Buskens and Raub 2002). The same reasoning applies to the Investment Game, and similar arguments hold for the Prisoner's Dilemma and the Helping Game. Although the latter two games yield two actors with incentives to behave opportunistically, the key is that if there are no future interactions, exploiting a partner will have no future consequences, which renders cooperation unlikely.

2.2 Network control effects on trust

Taking into account the social context, the incentives of the actors may change. When interactions are embedded, the trustee now has to balance the short-term incentives for abusing trust with the long-term costs. If the same two partners interact repeatedly, the gains from a flourishing partnership may be higher than the gains from exploiting your partner once and being punished for this act thereafter. The fact that some of the trustee's long-term incentives are under control of the trustor may induce a shift in behavior. A trustor can sanction untrustworthy behavior by not

placing trust in any future interaction, and reward the trustee by placing trust otherwise, which is often referred to as conditional cooperation (Taylor 1987) or direct reciprocity (Nowak 2006; Rand and Nowak 2013). Game-theoretical analyses show that if the costs of future retaliation outweigh the short-term gains of abusing trust, it is in the trustee's self-interest to behave trustworthy (Kreps 1990). Accordingly, the trustor might foresee that an abuse of trust would be against the interests of the trustee, which allows for placing trust (for a more formal discussion, see Buskens, Frey, and Raub 2018; Buskens and Raub 2013). Indeed, actors are less likely to exploit partners who they expect to interact with repeatedly, providing clear evidence for control effects in the dyadic case (Dal Bó 2005; Dal Bó and Fréchette 2011, 2018; Embrey, Fréchette, and Yuksel 2018).

When trustees interact with a network of trustors who can share information among each other, rather than a single trustor, the same mechanism holds. If the focal trustor disseminates information about the trustee's behavior to future trustors, the long-term payoffs of the trustee are still partly under control of the current trustor. Hence, these future trustors may sanction or reward the trustee for behavior in the focal game. When future trustors sanction the trustee for abusing trust now, the trustee's long-term losses may still outweigh the short-term gains from the abuse of trust, which may mitigate the incentive for abusing trust. Such network embeddedness can replace (Kandori 1992; Kreps 1990) or complement (e.g., Buskens 2003) dyadic embeddedness. For example, regardless of whether you visit the same restaurant multiple times, you might inform others about experiences with this restaurant. Based on your experiences, other potential visitors may decide whether or not to visit that restaurant. If enough guests decide to avoid that restaurant based on your experiences, selling leftovers will quickly backfire by reducing the future turnover.

To return to the Trust Game, if future trustors are reliably informed about the trustee's behavior in the current interaction, they can condition their actions on this behavior (which is often called indirect reciprocity; Nowak 2006; Nowak and Sigmund 2005). Accordingly, similar sanctions and

rewards can be applied as in dyadically embedded interactions, but potentially by different trustors. If these sanctions are sufficiently severe, it is in the trustee's self-interest to honor trust. The severity of the sanctions will depend on the likelihood that information about the trustee's past behavior is disseminated, but also on the number of informed future trustors that interact with the focal trustee. That is, the threat of future sanctions must be credible to have bite. If the trustor and the trustee are aware of such control opportunities, the trustee is expected to be more likely to honor trust, allowing the trustor to place trust more easily.

Nevertheless, there are reasons to doubt whether network control effects are indeed as strong as we would expect on the basis of game-theoretical arguments. One problem of such arguments is that information is assumed to be reliable, while incentive problems associated with the supply of information are neglected (e.g., Raub and Weesie 1990). Supplying information however constitutes a second-order social dilemma, because it takes time and effort to do so, while the individual returns from providing information may be small (Bolton, Katok, and Ockenfels 2004). Additionally, information may be inconsistent with one's own experiences, and actors may doubt whether third parties are actually willing to implement sanctions. Lastly, actors may withhold trust until they have received information from others that a partner behaved trustworthy in the past, to further minimize the risk of getting exploited.

Still, as a replacement of dyadic embeddedness, network embeddedness in general has been regularly observed to foster trust (e.g., Bohnet et al. 2005; Bohnet and Huck 2004; Duffy, Xie, and Lee 2013; Huck, Lünser, and Tyran 2012) and cooperation (e.g., Pfeiffer et al. 2012; Seinen and Schram 2006). However, focusing on network control effects specifically, only Bolton, Katok, and Ockenfels (2004) assessed and found network control effects in the absence of dyadic embeddedness, while Corten et al. (2016) did not find network control effects under these circumstances. Some support for network control effects alongside dyadic embeddedness was found by Buskens, Raub,

and Van der Veer (2010), Barrera and Buskens (2009) and Frey, Buskens, and Corten (2019), but not by (Van Miltenburg, Buskens, and Raub 2012). Hence, overall, we expect that trust, and cooperative behavior in general, increase with the network control opportunities. For the Trust Game and Investment Game, this leads to the following hypotheses:

- Hypothesis 1: The trustor's trustfulness increases in the amount of network control opportunities.
- Hypothesis 2: The trustee's trustworthiness increases in the amount of network control opportunities.

Similar arguments on network control effects have been constructed for the Prisoner's Dilemma and the Helping Game (Nowak and Sigmund 2005; e.g., Raub and Weesie 1990). However, because these games do not allow to separate trustfulness and trustworthiness, we will restrict our analyses of studies using these games to a single hypothesis:

- Hypothesis 3: Cooperation increases in the amount of network control opportunities.

2.3 Differences between network control effects for trustors and trustees

Given that both the trustor and the trustee receive the same information before they enter an interaction, all network control opportunities are known to both. Accordingly, game-theoretical assumptions would imply that the network control effects are the same for both types of actors. However, network control opportunities do not need to be evaluated in the same way by both types of actors. In fact, it may be easier to anticipate on network control opportunities for the trustee than for the trustor (Buskens, Raub, and Van der Veer 2010). For the trustee, it may be relatively straightforward to anticipate on the fact that abusing trust in a given round will result in repercussions during later rounds. The reasoning here only requires to think one step ahead: if

future trustors sanction an abuse of trust, abusing trust will be costly, and if these costs outweigh the gains of abusing trust, it is not worthwhile to act opportunistically.

Before having a good reason to act upon network control opportunities, the trustor, however, has to reason one more step ahead. Specifically, the trustor has to speculate on how the trustee's behavior will change according to future sanctions by other trustors. That is, the trustor's trustfulness may increase only if this trustor foresees that the trustee anticipates on how abusing trust now will affect the trustfulness of future trustors, and thus on how future trustors will condition their behavior on the trustee's current actions. If you don't know whether the chef foresees that an unpleasant experience for you may result in others who in turn avoid the restaurant as well, the risk of eating there might be too large, leading you to cook your own meal. In short, people tend to have difficulties overseeing the complex dynamics of situations with multiple interdependent actors, especially if they have no experience with such situations (Binmore 2007; Buskens, Raub, and Van der Veer 2010; Dal Bó 2005; Dal Bó and Fréchette 2011; Milinski et al. 2001). Therefore, we will assess the following conjecture, which can only be assessed for Trust Games and Investment Games:

- Conjecture 1: There is more evidence for a network control effect on trustees' behavior than on trustors' behavior.

3 Literature

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