Fostering Collaboration through IT Tools:

An Experimental Study of Public Deliberation on Water Sustainability

by

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ABSTRACT

Most of challenges facing today's government cannot be resolved without collaborative efforts from multiple non-state stakeholders, organizations, and active participation from citizens. Collaborative governance has become an important form of management practice. Yet the success of this inclusive management approach depends on whether government agencies and all other involved parties can collectively deliberate and work toward the shared goals. This dissertation examines whether information technology (IT) tools and prior cooperative interactions can be used to facilitate the collaboration process, and how IT tools and prior cooperative interactions can, if at all, get citizens and communities more engaged in collaborative governance. It focuses on the individual and small groups engaged in deliberating on a local community problem, which is water sustainability in the Phoenix metropolitan area.

Experiments were conducted to compare how people deliberate and interact with each other under different IT-facilitated deliberation environments and with different prehistory of interactions. The unique experimental site for this research is a designed deliberation space that can seat up to 25 participants surrounded by the immersive 260-degree seven-screen communal display. In total, 126 students from Arizona State University participated in the experiment. The experiment results show that the deliberation spaces can influence participants' engagement in the collaborative efforts toward collective goals. This dissertation demonstrates the great potential of well-designed IT-facilitated deliberation spaces for supporting policy deliberation and advancing collaborative governance. This

dissertation provides practical suggestions for public managers and community leaders on how to design and develop the desired features of IT-facilitated interaction environments for face-to-face and computer-mediated online public deliberation activities. This dissertation also discusses lessons and strategies on how to build a stronger sense of community for promoting community-based efforts to achieve collective goals.

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> Public policies and programs in the United States and elsewhere are being administered…through complicated webs of states, regions, special districts, service delivery areas, local offices, nonprofit organizations, collaborations, networks, partnerships and other means for the control and coordination of dispersed activities (Lynn, Heinrich, & Hill, 2001, p. 306).

Most of challenges facing today's government cannot be resolved without collaborative efforts from multiple non-state stakeholders, organizations, and active participation from citizens. With the growing trend of globalization, economic independence, resource scarcity, and advances in technology, collaborative governance (or collaborative public management) has become a prominent form of government practice in the United States (O'Leary & Bingham, 2009; O'Leary, Gerard, & Bingham, 2006). It is common for one public agency to collaborate with other community stakeholders to provide a wide range of public services, including but not limited to community policing (Trojanowicz, Kappeler, Gaines, Bucqueroux, & Sluder, 1998), environmental protection (Beierle & Cayford, 2002; Ostrom, 1990), and urban economic renewal (Walsh, 1996). Public managers need to be able to initiate, facilitate, sustain, and manage the collaboration process.

Collaboration is a challenging process due to difficulties coordinating the interests and incentives for participation among individuals, groups, and organizations. Using a micro-level lens, this dissertation focuses on how the individual and small groups engaged in deliberating on shared problems to

explore the impact of social interactions on people's collaboration and the potential of a designed IT-facilitated deliberation space to promote collaborative behavior for addressing collective challenges.

On one hand, building on the assumption that individuals are rational actors, economists argued for the difficulty of successful collective action. Garrett Hardin, in the influential article "The Tragedy of the Commons," argued that individuals will exploit common resources lavishly to maximize their own benefits (1968). Mancur Olson, in his seminal book, *The Logic of Collective Action: Public Goods and the Theory of Groups*, noted that without coercion or incentives, "self-interested individuals will not act to achieve their common or group interests" (1971, p. 2). Furthermore, the collaboration process gets more complicated as the number of involved actors and organizations increases when it comes to solving crucial public policy problems such as water sustainability, which will be the specific policy scenario examined in this dissertation.

On the other hand, public administration scholars argued that public interests do exist and both citizens and bureaucrats can develop a sense of public service (Goodsell, 1994). Great efforts in the public administration field have been made to encourage public participation, collective action, and multi-party collaboration to resolve a wide range of public problems. Collaboration occurs more frequently when issues involve multiple stakeholders cross different jurisdictions and directly affect daily lives of those citizens. Environmental protection, water management, and land conservation belong to this category of cross-jurisdiction issue, in which a variety of collaborations have occurred, including but not limited

to public-private partnerships, public-nonprofit partnerships, and community-based efforts.

Engaging citizens in public affairs has been seen as the cornerstone of participatory and representative government (Barber, 1984; Dahl, 1989). Citizen participation can enhance administrative effectiveness and social stability, but also educate individuals to understand their roles in society and increase citizens' civic identity and sense of community (Bjur & Siegel, 1977; Fung, 2006; Kathi & Cooper, 2005). It has been argued public deliberation as a form of direct citizen participation is an effective way to allow citizens to express their needs and perspectives, to understand others' concerns and expectations, and to enhance public trust in democracy and government (Roberts, 2004). More importantly, public deliberation can help produce collective decisions and serve as tools to reconcile conflicting interests (Chambers, 2003; Roberts, 2004; Thompson, 2008).

Collaboration is a multidimensional concept, involving diverse antecedents, nonlinear collaboration processes, and various levels of outcomes (Ansell & Gash, 2007; Thomson & Perry, 2006). In practice, collaborations take on various forms across the public service domain. Among the multiplicity of factors that contribute to the success of collaboration and collective action, communication lies at the center and is one of the foci of this dissertation (Ansell & Gash, 2007; Balliet, 2010). Despite the disagreement on whether institutional design, administration, and facilitative leadership should be included as part of the collaboration process itself, scholars stress the importance of mutuality, trust building, shared understanding, and commitments for collaborative governance

(Ansell & Gash, 2007; Bryer, 2009; Bryson, Crosby, & Stone, 2006; Chrislip & Larson, 1994; Huxham & Vangen, 2000; Thomson, Perry, & Miller, 2007; Wood & Gray, 1991). Previous research in social psychology and behavioral economics has also shown that social norms, social identity, and social connections can encourage cooperative behavior and shift individual behavior from maximization of self-interest toward a more collective outcome (Brewer & Kramer, 1986; De Cremer & van Dijk, 2002; De Cremer & Van Vugt, 1999). This dissertation selects water sustainability as the issue of deliberation in order to put into context and explore the potential of community-based efforts and public deliberation of small groups on a water sustainability policy scenario. This dissertation aims to shed light on the collaboration process by exploring whether different IT-facilitated deliberation environments can influence people's social orientation and collaborative behavior in a social goods dilemma, and if so to what extent.

Collective Action to Pursue Water Sustainability

The problem of water sustainability has received enormous attention across the world. Water shortages, even in developed and water-affluent countries such as the United States, are a lurking problem and receive great attention from policy makers (Blaney, 2006). According to the U.S. Bureau of Reclamation (2003), the American southwest in general and Arizona in particular face a potential water supply crisis by 2025 when existing supplies of water may be inadequate to meet the demands of society. Besides the impending water scarcity, another big challenge of water sustainability comes from the unique attributes of water

resources. Water naturally exists in lakes, rivers, and underground, yet, the infrastructure to store, allocate, and purify water is expensive. It is costly to build the infrastructure to allocate water. And it is difficult to distribute the cost accordingly. Scholars often refer to this type of natural resource system as a "common pool resource" (CPR) because it is "sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use" (Ostrom, 1990, p. 30).

To achieve collective goals such as water sustainability, no easy solution exists to encourage more collaboration and ensure the success of collaboration between communities and government, and even the collective action of members within the community. Government regulations, markets, and community-based efforts have all played crucial roles in managing water resources. Numerous cases exist in which citizens actively get involved in the preservation of natural resources, such as water, fishery, forests, and land (Connick & Innes, 2003; Ostrom, 1990). Great efforts have been made to encourage public participation, collective action, and multi-party collaboration in resolving water-related challenges. In California, citizens get involved in water policy making through the San Francisco Estuary Project, the CALFED Bay-Delta Program, and the Sacramento Area Water Forum (Connick & Innes, 2003). These projects have increased social and political capital, developed shared understandings of the water challenge, and a sense of collective responsibility. In Ostrom's seminal book, *Governing the Commons: The Evolution of Institutions for Collective Action*, she provided detailed cases in which small communities made voluntary

efforts to manage their lakes, watersheds, and fishery in a sustainable manner (1990).

Building social orientation and facilitating community-based efforts. Shared understanding, trust, and commitment have been seen as the fundamental factors to the success of the collaboration process (Ansell & Gash, 2007; Thomson, et al., 2007; Vangen & Huxham, 2003).

In recent decades, there have been research studies that highlight the crucial roles of social norms (Chen, Wasti, & Triandis, 2007), social processes (Van Vugt, 2002), collaboration, and public deliberation in working toward a sustainable environment (Dietz, Ostrom, & Stern, 2003; Ostrom, 1990). Since the 1980s, a large group of scholars has applied the social psychology approach to studying the management of natural resources (De Cremer & van Dijk, 2002; De Cremer & Van Vugt, 1999; Fielding, Terry, Masser, & Hogg, 2008; Kramer & Brewer, 1984; Postmes, Haslam, & Swaab, 2005; Van Dijk, De Kwaadsteniet, & De Cremer, 2009; Van Vugt, 2009). Different from economists who adopt the economic rational models that emphasize the role of monetary incentives or regulations, the social psychology scholars study the role of social norms, communication and the social process in influencing peoples' attitudes and behavioral choices in social dilemma scenarios. These scholars proposed that building stronger social connections through the social process may enhance peoples' commitment to more sustainable behaviors when facing social dilemmas (Biel & Thøgersen, 2007; De Cremer & van Dijk, 2002; De Cremer & Van Vugt, 1999; Fielding,

Terry, Masser, & Hogg, 2008; Kramer & Brewer, 1984; Postmes, Haslam, & Swaab, 2005; Van Dijk, De Kwaadsteniet, & De Cremer, 2009; Van Vugt, 2009).

Participatory and deliberative approaches to managing natural resources are necessary for environmental policy-making. Involving citizens and communities in environmental management is necessary and is often required in practice not only because of the central role of citizen participation in democracy but also because of the high levels of uncertainty and complexity involved in managing natural resources. Inclusive deliberation in environmental management can help improve policy effectiveness by eliciting contextual information and localized knowledge about the scenarios from multiple stakeholders, and reducing public opposition and achieving support (Holmes & Scoones, 2000).

The high uncertainty and complexity of environmental problems makes expertise-based decisions insufficient for managing natural resources. Using water management as an example, one can acknowledge how various unpredictable factors such as climate changes influence the availability of water. In addition, water resources often spread across geographical and jurisdictional borders, which make cross-sectional and multiparty collaboration necessary. As Priscoli (2004) noted, public participation serves as "the driving force for the vertical (state, local, and regional) as well as horizontal (across agency) negotiations vital to decisions, which rarely fit traditional jurisdictional boundaries" (p. 225) .

Role of communication and information in public deliberation and community-based efforts. Despite the large number of cases in which public

deliberation and community-based efforts effectively contribute to the solving of environmental problems, the success of these efforts is contingent upon numerous factors and institutional arrangements.

This dissertation focuses on the role of information and communication in fostering cooperation to facilitate community-driven efforts and public deliberation activities, and to encourage collaboration for pursuing collective interests. Systematic discussions of the various factors that contribute to the cooperation among multiple parties go beyond the scope of this dissertation.

Ostrom (1990; 2000) critiqued the argument that collective action does not work for solving environmental problems due to individuals' maximizing of their own interests. She noted that community-based efforts can contribute to resolving the CPR problem given necessary conditions are met. Among these conditions, she emphasized the importance of communication in social dilemma scenarios and noted that when communication is allowed and occurs frequently among parties involved, they can develop shared norms and trust, accumulate social capital and finally establish institutional arrangements for solving the CPR dilemmas.

Balliet (2010) conducted a meta-analysis of social dilemma research and found that "the most researched solution to social dilemmas is communication" (p.39). He noted that communication has exerted statistically large positive effects on cooperation in social dilemma scenarios and called for systematic investigation into the impacts of different communication media on cooperation.

After conducting a comprehensive meta-analysis of 137 cases of collaborative governance across diverse policy domains, Ansell and Gash (2007) proposed a "contingency model" of collaborative governance and noted that the collaboration process is not linear, but a cyclical or iterative process in which "communication," "trust building," "commitment to the process," and "shared understanding" play important roles in bringing out positive outcomes (2007, pp. 16-18). They further pointed out that communication lies at the center of a collaboration process.

IT-facilitated public deliberation. Advances and the thoughtful applications of information technology (IT) have spurred tremendous transformative changes in how we interact and communicate with each other .The ubiquity of information technology makes it a focal point of scholarly research in the social science field. Information technology has demonstrated great potential in developing social capital, sense of communities, and encouraging civic engagement (Blanchard & Haran, 1998; Pigg & Crank, 2004; Rheingold, 2000). Citizens utilize the Internet and other social media techniques not only to distribute and retrieve information, but also to raise awareness of public concerns and issues, and to deliberate on public policies (Kavanaugh et al., 2005).

Compared with the voluminous studies that focus on the distributed communication via IT tools and virtual communities, studies on face-to-face IT-facilitated deliberation have received less attention. Among the various types of i, computer simulations and information display technologies have great potential for facilitating group interactions and public deliberation activities. Research has

shown that though the large, single shared display may not contribute to the efficiency of accomplishing task work, it has advantages in increasing people's awareness of other collaborators' activity (Koch, 2005; Liu & Kao, 2005; Wallace, Scott, Stutz, Enns, & Inkpen, 2009), enabling communication and collaboration among multiple users (Stewart, Bederson, & Druin, 1999), and facilitating building a shared understanding of the workspace and the common tasks (Scott, Mandryk, & Inkpen, 2003; Swaab, Postmes, Neijens, Kiers, & Dumay, 2002). Hence, it is noteworthy to explore the potential of an IT-facilitated communication environment for facilitating face-to-face public deliberation activities on a local policy scenario.

Research Question and Significance of the Research

This dissertation explores how IT tools facilitate public deliberation on environmental issues and examines the impacts of deliberation environments and social interactions on people's behavioral choices when facing social dilemmas. This dissertation uses the deliberation activity of collective efforts to seek water sustainability as the research context. This dissertation also explores effective community-building strategies that can be used to enhance a sense of community and to encourage community members' participation in local community affairs.

Research questions. In detail, this dissertation conducts experiments to answer two primary research questions:

Question1: Do different IT-facilitated deliberation environments influence people's deliberation and interactions, their formation of their social identity, shared understanding, and collaborative behavior, and if so, to what extent?

Question 2: Does prior cooperative interactions through a community-building activity affect people's deliberation and interactions, their building of social identity, and collaborative behavior, and if so, to what extent is it a factor?

Significance of the research. Existing collaborative governance scholarship stressed the importance of shared understandings, commitments, and social norms to the success of the collaboration process. This dissertation examines these key constructs and theoretical relationships that have been proposed in collaborative governance research from a different vantage point, which is the influence of IT tools on the collaboration process. Unlike other studies which examine collaboration among organizations on the macro level, this dissertation focuses on IT-facilitated deliberation activities to study the micro-level behavioral foundation of individuals in small groups facing a social dilemma scenario.

Drawing concepts and theories from multiple disciplines, including public administration, environmental studies, communication, human-computer interaction (HCI), and social psychology, this dissertation builds and applies an integrated conceptual framework to explore the effective pathways and IT tools for public deliberation on common challenges such as environmental issues. Using this framework, this dissertation examines how different IT-facilitated deliberation spaces and people's prior cooperative interactions impact their deliberation and collaborative behavior.

Although public deliberation can take on various forms, face-to-face public deliberation remains one of the most crucial venues for the public to engage in local community affairs. Yet existing e-government or e-governance research and social media research focus too much attention on the distributed communication via IT tools and virtual communities. Little attention has been paid to IT-facilitated face-to-face communication. This dissertation explores the role of information technologies in facilitating face-to-face public deliberation activities to build strong social connections and to encourage collaborative behavior. The experiment results can provide guidelines on how to develop and design the desired features of deliberation environments or information infrastructures in general for future public deliberation activities and civic engagement.

This dissertation also explores strategies for community development through embedding a warm-up activity in the experiment to study people's interactions and their following identity with the group. Unlike many social identity studies focusing on how different levels of social identity affect people's behavioral choices in social dilemmas, this study concentrates on how to utilize information technology and practical strategies to facilitate public deliberation activities and to build strong social connections and social orientation. This study goes beyond "the deductive process" to examine the impacts of salient social identity on group processes and behaviors to include "the inductive process" to see how the sense of social identity may derive from the process of building shared cognitions (Postmes, et al., 2005; Swaab, Postmes, Van Beest, & Spears, 2007). Furthermore, instead of using a "common fate" strategy (Brewer &

Kramer, 1986) and simply assigning participants to different groups, this study examines a new way to cultivate people's social identity by asking people to participate in a community-building activity prior to the actual task. Therefore, this dissertation also provides public administrators and community leaders with practical suggestions and possible strategies on how to build a strong sense of communities among citizens, to break down barriers for collaboration that prohibit collective action, and to engage citizens in the making and implementation of public policy issues.

Methodologically different from conventional public administration research designs that use case studies, interviews, and survey questionnaires, social experiments are used instead in this dissertation. The use of a social experiment contributes to the diversity of research methods in public administration scholarship. Social experiments can exclude or at least reduce the effects of extraneous variables such as age, race, and education, which in turn helps enhance the validity of causal inferences about the impacts of different IT-facilitated deliberation environments on peoples' interaction process and their deliberation activities. Additionally, this dissertation examines the details of IT-facilitated public deliberation by directly observing people's communications and interactions with each other in a public deliberation activity on an environmental issue, with a particular emphasis on the role information presentation environments play in facilitating people's face-to-face dialogues, debates, and building of shared understandings. The data collection process that was done

through social experiments will benefit future scholars and practitioners who are interested in replicating the experiment with similar research contexts.

The Overall Structure of the Dissertation

This dissertation consists of five chapters. Chapter two reviews the literature on collaborative governance, social dilemmas, social identity and IT-facilitated communication to lay the theoretical conceptual framework for the entire dissertation, and the research propositions are also elaborated in this chapter. Chapter three covers the methods of data collection and data analyses, explains why the experiment was chosen for this study and how the experiment was designed and implemented in detail. This chapter also discusses the measures of the key variables and the methods of data analyses. Chapter four reports the experiment results and discusses whether and why the research hypotheses are supported or not. Chapter five concludes the entire dissertation with key research findings, policy implications for public administration practitioners, research limitations, and future research work.

Chapter 2: Literature Review, Research Propositions, and the Conceptual Framework

> As the collective idea and the collective will, right and purpose, are born within the all-sufficing social process, so here too the individual finds the wellspring of his life.… The relationship of the individual to society is not action and reaction, but infinite interactions by which both individual and society are forever a making" (Follett, 1995, pp. 254-256).

This chapter first reviews studies that examine the role of community-based efforts and public deliberation in providing public services. Then, it reviews studies on the collaboration process in collaborative governance literature. This chapter also summarizes studies in behavioral economics and social psychology exploring the role of the social process and social connections in promoting collective action to resolve social dilemma issues, such as managing natural resources. Next, it discusses the importance of communication in collective action and the roles of information technologies in facilitating people's communication and interactions in collective action. Building on previous studies, the last section of this chapter lays the conceptual framework for the entire dissertation and proposes the research propositions.

Collaborative Governance, Community-Based Efforts and Public Deliberation Activity

Collaborative public management is not new. There is a rich history of theory and practice of intergovernmental collaboration, coproduction of public services, and inter-sector cooperation. Yet the increase in the scope, depth, and new developments of collaborative public management have been remarkable during the past two decades (O'Leary & Bingham, 2009). New phrases such as

collaborative governance and network governance have been used to describe the new era of public administration, as discussed in depth in Ansell and Gash's comprehensive review of collaborative governance (Ansell & Gash, 2007; Provan & Kenis, 2008). According to Ansell and Gash's study, collaborative governance is:

> A governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets (Ansell & Gash, 2007, p. 2).

Among the variety of collaborations between the government and non-state stakeholders, citizen engagement (including public deliberation) receives great attention and plays a crucial role in collaborative public management (Cooper, Bryer, & Meek, 2006). Democracy works only if citizens and communities are involved in most deliberation processes, and especially those processes regarding shared challenges (Johnston, Hicks, Nan, & Auer, 2010). Citizens get involved in national and local public policy making and implementation through traditional participation avenues such as public hearings, citizen advisory boards, commissions, and task forces, as well as innovative mechanisms such as direct dialogues and deliberation over public policy issues and delivery of public services (Roberts, 2004).

Communities have been essential to encourage citizens to get directly involved in local public affairs. Community-based efforts are abundant in a wide range of public domains, including community policing (Trojanowicz, et al., 1998), environment protection (Beierle & Cayford, 2002; Ostrom, 1990) and

urban economic renewal (Walsh, 1996). Citizen engagement is particularly active in environmental protection to preserve water, fishery, forests, and land through a variety of community-organized efforts (Connick & Innes, 2003; Ostrom, 1990).

The following two cases demonstrate how citizens directly get involved in water management.

In California, residents participated in the ecosystem restoration project through a program called "the CALFED Bay-Delta Program":

> In California, the CALFED Bay-Delta Program involved 15 state and federal agencies and more than 2,000 residents in developing a collaborative agreement to restore ecological health and improve water management in the San Francisco Bay Delta. It encompasses 70 percent of California and is the largest ecosystem restoration project in the United States (O'Leary, et al., 2006, p. 7).

At Mutyalapadu, India, farmers participated in water management through:

> taking part in the project measure and record rainfall, the water table, withdrawals and other data for their land.… They then sit down together in groups—there are several of these for each hydrological unit—and draw up a water budget. Details of the eventual agreement, showing who should grow what and how, are displayed on a wall in the village and updated over the year with information about rain, harvests and even revenues. No one is compelled to take part; the enterprise is voluntary and collaborative. But so far most farmers, and their families, seem pleased.… Overdrawing is judged to be under control, partly because everyone knows what is happening (*The Economist*, 2010, pp. 11-12).

Community-based efforts are important for providing local public goods and services because community members have local knowledge about "other members' behaviors, capacities, and needs" (Bowles & Gintis, 2002, p. 243). This type of local knowledge also helps build and sustain behavioral norms in the community. Compared with the market mechanisms and government regulations,

communities are in an advantageous position to build support, trust, social capital, and social norms through the ongoing interactions and relationships between community members (Bowles & Gintis, 2002). The process of engaging citizens to making and implementing local public policies allows citizens to express their needs and perspectives, understand others' concerns and expectations, reconcile conflicting interests, and enhance public trust in democracy and government (Chess, 2000; Renn, 2006).

The value and necessity of engaging citizens in environmental management has been intensively discussed in public administration literature. Most studies that examine public deliberation in environmental management are case studies. (Beierle & Cayford, 2002; Chess, 2000; Renn, 2006). These studies indicate that public deliberation, or engaging citizens in the conversation on environmental policy issues can help build shared understandings of the challenges, increase awareness of the uncertainty and complexity related to environmental issues, and mitigate potential conflicts among different stakeholders. As Renn (2004) noted, compared with expert judgment and majority votes, the public deliberation process can help produce "a common understanding of the issues or the problems based on the joint learning experience" and "a common understanding of each party's position and reasoning," and explore "new options for action and solutions to a problem" (p. 36). He noted that the policy deliberation process can help produce agreements and research consensus because it allows for exploring "the full scope of ambiguity associated with environmental problems" (p. 36).

Importance of shared understanding, trust, commitment in fostering collaboration. A large number of studies have been conducted to conceptualize collaborative governance, most of which take a process perspective or develop stage models (Ansell & Gash, 2007; Bryson, et al., 2006; Thomson & Perry, 2006; Thomson, et al., 2007; Wood & Gray, 1991). The framework of collaborative governance usually starts with diverse initial conditions, followed by the collaboration process and collaboration outcomes (Ansell & Gash, 2007; Bryer, 2009; Huxham, 2003; Thomson, et al., 2007). A central focus in the collaborative governance literature is on the collaboration process, which was described as the "black box" by Thomson and Perry (2006) in their comprehensive review of collaborative governance literature and follow-up empirical studies (Thomson, et al., 2007). Despite the differences, building on both theory development and empirical studies, scholars agree that the collaboration process is a dynamic and nonlinear process, and that shared understandings, shared norms, trusts, and commitments are crucial factors to the successful collaboration process (Agranoff, 2003; Ansell & Gash, 2007).

Bryson, Crosby and Stone (2006) built an extensive literature review and developed 20 propositions around the initial collaboration conditions, collaboration process, and structure and governance, and outcomes. In discussing the collaboration process, they noted that "cross-sector collaborations are more likely to succeed when trust-building activities (such as nurturing cross-sectoral and cross-cultural understanding) are continuous" (Bryson, et al., 2006, p. 48). In a meta-analysis of 137 articles on collaboration across diverse policy domains,

Ansell and Gash (2007) proposed a contingency model and argued that the success of collaboration at all stages depends on "achieving a virtuous cycle between communication, trust, commitment, understanding, and outcomes" (2007, p. 16). Thomson and Perry (2006) studied the "black box" of the collaboration process through a comprehensive literature review. They argued that the collaboration process is composed of five dimensions, including "governance," "administration," "organizational autonomy," "mutuality," and "norms" (p. 20). They also emphasized the importance of information sharing, shared visions, commitment, and responsibility, and building norms of trust and reciprocity. They argued that:

> A shared vision and commitment to a superorganizational goal allows them to move toward problem solving rather than problem blaming.… Sharing information needs to be seen in terms of increasing partners' understanding of the problem they are jointly seeking to address" (Thomson & Perry, 2006, pp. 25-26).

Besides theory work, there are also empirical studies that stressed the importance of shared understandings in fostering collaboration. After studying 76 western watershed partnerships in the U.S. States of California and Washington, Leach (2006) proposed a normative "framework for evaluating the democracy of collaboration" that include seven democratic values including "inclusiveness," "representativeness," "impartiality," "transparency," "deliberativeness," "lawfulness," and "empowerment" (p. 100). He argued that a deliberation process is critical because it can allow participants "to brainstorm, critically examine each other's arguments, identify common interests, and build a base of shared knowledge and social capital" (Leach, 2006, p. 103).

Through examining the on-going interactions between representatives of Los Angeles, neighborhood councils and government agencies (Department of Public Works and Department of Transportation) in California, Bryer (2009) proposed seven propositions to explain the variations of administrative responsiveness and effectiveness of collaboration, three of which highlight the importance of commitments, trust, and shared goals:

> The more administrators are interested in long-term relational commitments with citizens, the more responsive they will be to citizens in a collaborative process…. The more administrators trust citizens, the more responsive they will be to citizens in a collaborative process…. The more administrators share the same goals with citizens, the more responsive they will be to citizens in a collaborative process (Bryer, 2009, p. 278).

In summary, despite the large number of complicated and divergent frameworks proposed to study collaborative governance, existing research suggests that it is crucial to build shared understanding, trust, and commitments in order to encourage collaborative efforts to achieve the collective goals.

Social dilemmas and managing natural resources. No easy solution exists to encourage collective action and to ensure the success of collaboration between communities and government, or collaborative efforts of members within the community. Researchers have intensively studied the diverse types of social dilemmas to understand the difficulty of collective action and to explore possible solutions (Ostrom, 1990; 2000). The concept of social dilemma refers to situations where individuals' interests conflict with collective interests and individuals' rational behavior may lead to the worsening of collective welfare (Dawes, 1980). Social dilemmas can take on different formats, such as "prisoner's

dilemma" (where two persons decide to defect or cooperate), "public goods dilemma" (where individuals can benefit from the resources or free-ride without any contribution), and "common pool dilemma" (where individuals overuse the resources to maximize individual benefits) (Kollock, 1998). An example of a public goods dilemma is donating money to public radio. Those who do not donate can still enjoy the programs without any cost. Yet if no one donates money, there will be no public radio and everyone will suffer from the loss. Natural resources provide common pool dilemmas. For instance, due to the fact that natural resources (such as water) are usually "sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use," scholars often refer to this type of natural resource system as "common pool resource" (Ostrom, 1990, p. 30).

According to Van Vugt's (2001, 2002) research, the large range of studies of collective action can be categorized into two research streams. One research stream adopts the "self-interest" perspective and the rational economic model, and proposes a structural approach to mitigate the competition between individual and collective interests by intervening in the outcome structure (such as introducing financial incentives, coercive regulations, privatization, or centralization) (Samuelson, 1993). The second research stream adopts the "community" perspective and pays close attention to multiple motives beyond self-interest. Studies in the second research stream emphasize the roles of community, social norms, and social connection in promoting pro-environmental behaviors (e.g. Brewer & Kramer, 1986; Kramer & Brewer, 1984; Van Vugt, 1999; 2001; 2002;

etc.). Yet categorizing research into two communities can easily ignore the fact that the rationality of human behavior and social norms can interact and influence each other. Individuals, rational or irrational, interact with each other through all kinds of social processes, and behave under the influence of social norms, market forces, and government regulations and laws. In addition, as Lessig noted in his book *Code: And Other Laws of Cyberspace,* four constraints regulate individual behavior including "the law, social norms, the market, and architecture" and "some constraint will support others; some may undermine others" (2009, p. 123). In the case of using collective action to resolve environmental challenges, such as water shortages, market mechanisms (price of water), regulations on water supply and demand, social norms on appropriate water use, and the infrastructure of providing and purifying water can all influence individuals' behavior.

Social identity, social connections, communication and collective action. Scholars have critiqued the rational economic models on resource dilemma issues from both theoretical and applied research perspectives (Van Vugt, 2009; Weber et al., 2004). Scholars in social psychology and experimental economics challenged the dominance of the rational choice model of human behavior through experiments (Van Vugt, 2009). They suggest that there are a multiplicity of motives beyond self-interest and that social relationships and social processes can influence human decision-making in social dilemma scenarios (Weber et al., 2004; Van Vugt, 2009). Researchers have found cases in which community members successfully self-govern the use of natural resources of agricultural land, lakes and fisheries (Dietz, et al., 2003; Ostrom, 1990).

As Mary Park Follett noted in *Prophet of Management*, the individual constantly interacts with society and "the individual finds the wellspring of his life" (Follett, 1995, p. 54). Since the 1980s, an increasing number of studies have been devoted to studying the role of social norms, communication, and the social process in influencing peoples' behavioral choices in social dilemmas. Despite the diverse research designs and research contexts, one common finding has been that developing a shared social identity and strong social connections can increase individuals' willingness to behave in favor of collective welfare (Brewer & Kramer, 1986; Chen, et al., 2007; Kramer & Brewer, 1984; Van Vugt, 2001). In 1984, Kramer and Brewer conducted a series of laboratory experiments and concluded that individuals with salient collective identity were more likely to cooperate when they were asked to participate in the replenishable-resource task developed by Messick et al. (1983). Later on, scholars added other important factors as control or moderating variables to the framework, such as group size, decision framing (Brewer & Kramer, 1986), feedback, communication(Balliet, 2010; Dawes, Kragt, & Orbell, 1988), social value orientation (De Cremer & van Dijk, 2002; De Cremer & Van Vugt, 1999), and individual cultural orientation (Chen, et al., 2007). As shown in Table 1, these studies all suggested that high social identity promotes cooperation and collaborative behaviors, although the positive relationship may be moderated by group size, social value orientation, and communication or feedback.

Table 1.

Social Identity and Cooperative Behavior in Social Dilemma Studies

Author (Year)	Dependent Variable	Different Social Identity	Other variables	Research Outcomes
Kramer & Brewer (1984)	Resource utilization behavior	Superordinate vs. subordinate group identity	Scarcity of resources	"Awareness of common group identity help individuals to resolve this conflict in favor of group welfare" (p.1055).
Brewer & Kramer (1986)	Choice behavior in social dilemmas	Individualist vs. collective social identity	Decision frames (task structure), group size	Under resource scarcity conditions, social identity influences individual's choice behavior.
Dawes (1988)	Cooperation rates in social dilemma situations	Other group members vs. strangers	Discussion; Rules to allocate the bonus	"With no discussion, egoistic motives explain cooperation; with discussion, group identity-alone or in interaction with verbal promises-explain its dramatic increase" (p. 95).
De Cremer & Van Dijk (2002)	Contributions in a public goods dilemma	Inter-group versus interpersonal comparisons	Social value orientation; feedback on contribution	Provided feedback of group failure, people with salient group identity will increase contributions whereas people with salient personal identity will decrease contributions.

Author (Year)	Dependent Variable	Different Social Identity	Other variables	Research Outcomes
Van Vugt (2002)	Real-life water conservation behavior	Place identification	Water Price (tariff structure)	Where there is water shortage and fixed tariff, low community identification is associated with more water use.
Chen, Wasti & Triandis (2007)	Contributions in a public goods dilemma	Warm-up activity to enhance group identity	Cultural orientation, social norms	"Indiocentrism and allocentrism moderated the relationship between perceived group norm and cooperation but not between group identity and cooperation" (p.259).

Social identity theory was first proposed by Tajfel (1978; 1979), and later was developed by Turner (1987) as "social psychological theory that attempts to explain cognitions and behavior with the help of group processes" (Trepte, 2006, p. 256). According to social identity theory, people live within all kinds of social groups and their behaviors are influenced by the groups they identify with due to the needs of developing self-esteem from the groups and communities (Ellemers, Spears, & Doosje, 2002; Hogg & Terry, 2000). De Cremer and van Dijk (1999, 2002) proposed and tested the "goal-transformation hypothesis," arguing that "a strong group identity transforms people's motives from the personal to the collective level" (p.435).

Besides the experimental studies, scholars also conducted field studies to explore the relationships between identity and cooperative behavior in managing natural resources. Van Vugt's (2001) survey of 278 households in the United Kingdom and field experiments suggest that when water resources are valuable and the fixed tariff is in use, low community identification is associated with more water use and high community identification is associated with less water use. He later noted that "a strong sense of community identity facilitates cooperation between individuals and brings their values and goals closer to those of the community they are part of" (Van Vugt, 2002, p. 790). Uzzell, Pol, and Badenas (2002) conducted surveys in two neighborhoods in Guildford and Surrey, England and found that "place-related social identity", along with other social factors such as social cohesion and residential satisfaction can contribute to positive environmental attitudes and sustainable behaviors (p. 50). Carrus, Bonaiuto, and

Bonnes (2005) conducted field studies to investigate the "relations between environmental concern, regional identity, and support for the institution of natural protected areas" (p. 237). They also found that regional identity is positively related with the support for the protected areas.

In the aforementioned laboratory studies, individual social identity was manipulated by either assigning participants to different groups (Brewer & Kramer, 1986), building a common fate (Brewer & Kramer, 1986; Dawes, et al., 1988; Kramer & Brewer, 1984), or introducing the warm-up activities (Bouas & Komorita, 1996; Chen, et al., 2007). Yet research remains limited on how to apply experimental ways of building social identity to a real-world practice of cultivating social connections, a sense of community, and a sense of common challenges. This dissertation employs "the inductive process" to see how the sense of social identity might derive from the process of building shared cognitions via an IT-facilitated public deliberation activity and a community-building activity (Postmes, Haslam, & Swaab, 2005; R. Swaab, Postmes, Van Beest, & Spears, 2007).

Community building, capacity building, and sense of community. A comprehensive review of "community," "sense of community," and "community building" would go beyond the scope of this dissertation (for comprehensive reviews, see Chipuer & Pretty, 1999; Chaskin et al., 2001, 2010). This section mainly focuses on the relationships between sense of community, community participation, and a relation-based approach to community building (Chaskin, 2001).

Community itself is a multidimensional construct, conceptualized in different contexts. In the context of urban neighborhoods, community can be conceptualized as "symbolic and affective units of identity and belonging," or "functional sites for the production and consumption of social goods and processes," or "contexts for the development and utilization of social norms, social networks, and social capital" (Chaskin & Joseph, 2010, p. 300). A number of studies have discussed the reciprocal relationships between sense of community and participation in community organizations, community activities, and public affairs (Chavis & Wandersman, 1990; Fraser, Lepofsky, Kick, & Williams, 2003).

Sense of community (SOC) is a widely discussed theoretical construct in the field of community psychology. SOC has been studied in an array of contexts, including neighborhoods, community organizations, and communities of interests (Chaskin & Joseph, 2010; Peterson, Speer, & McMillan, 2008). McMillian & Chavis (1986) defined SOC as "a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together" (p. 9). SOC has four components, "membership," "influences," "integration and fulfillment of needs," and "shared emotional connection" (McMillan & Chavis, 1986, p. 9). McMillian and Chavis provided a detailed explanation on the four components of SOC:

> The first element is membership. Membership is the feeling of belonging or of sharing a sense of personal relatedness. The second element is influence, a sense of mattering, of making a difference

> to a group and of the group mattering to its members. The third element is reinforcement: integration and fulfillment of needs. This is the feeling that members' needs will be met by the resources received through their membership in the group. The last element is shared emotional connection, the commitment and belief that members have shared and will share history, common places, time together, and similar experiences (McMillan & Chavis, 1986, p. 9).

A series of studies (such as Chipuer & Pretty, 1999; Long & Perkins, 2003) followed, testing the validity of the factor structure and exploring new factors of the concept of SOC. McMillan and Chavis's four-dimension model remains one of the most influential models in community-related studies (McMillan, 1996; Peterson, et al., 2008). This dissertation examines one major dimension of the SOC and studies how participants feel about the group and group members, and how these feelings of belonging might affect their collaborative behavior.

According to Chaskin (2001), community capacity is "the interaction of human capital, organizational resources, and social capital existing within a given community that can be leveraged to solve collective problems and improve or maintain the well-being of a given community" (p. 295). In his definition, sense of community is one critical characteristic of community capacity, along with "level of commitment" to collective action, "ability to solve problems," and "access to resources" (Chaskin, 2001, p. 297). Numerous studies explore strategies for building community and developing community capacity, including developing leadership in communities, fostering collaboration among community organizations and government agencies, developing individuals' capacity in participating in community affairs, and enhancing social interactions and social ties among community members (Chaskin & Joseph, 2010; Warren, 2001). A

relation-based approach to community building emphasizes "the participation of individual community members in a process of relationship building, community planning, decision making, and action" (Chaskin, 2001, p. 292). It is through the interaction process that local community members can foster close social connections and develop civic capacity to address collective challenges such as poverty and sustainability of natural resources. In this dissertation, a five-minute warm-up activity is arranged to initiate friendly conversations among participants in the group and to cultivate a group identity. A deliberation activity on water sustainability in Phoenix is included to get participants involved in local public affairs.

Role of communication and information in collaboration and collective action. In social dilemma scenarios, if groups or communities can come together and act toward shared interests, then the groups or communities as a whole benefits and so do the individual community or group members. However, collaboration requires a shared understanding of a common problem, open and meaningful deliberation, and trust in others to act in good faith toward the collective outcome (Johnston, et al. 2010). Among the voluminous studies that explore various factors that can facilitate collective action, the role of communication and information is worth mentioning and exploring further. In the aforementioned water management case in India, citizens living in Mutyalapadu communicate with each other to document the rainfall and availability of water and draw up the water budget together. During this engagement process, everyone in the community is updated on what is happening and the residents feel that

"they are engaged in a sustainable activity" (*The Economist*, 2010, p.12). As a consequence, the water use is under great control and three similar projects in Mutyalapadu are under way.

Ostrom (1990) assumed that when communication is allowed and occurs frequently among parties in a community, they can develop shared norms and trust, accumulate social capital, and finally establish institutional arrangements for solving the CPR dilemmas. Balliet (2010) conducted a meta-analysis of social dilemma research and found that "the most researched solution to social dilemmas is communication" (p.39). Balliet called for in-depth and systematic investigation into the impacts of different communication media on cooperation In a review of 137 cases of collaborative governance, Ansell and Gash (2007) noted that the collaboration process in essence, is a iterative cycle "between communication, trust, commitment, understanding, and outcomes" (p. 16). Echoing Ansell and Gash's emphasis on social norms and communication, Thomson and her colleagues, in their efforts to conceptualize and measure collaboration in public administration, also noted that the process of building "mutually beneficial relationships" and social norms of "reciprocity and trust" is the crucial dimension of the collaboration as a concept and practice (Thomson, et al., 2007)

Scholars have studied in detail the role of discussions in social dilemmas (Bouas & Komorita, 1996; Chen & Komorita, 1994; De Cremer & van Dijk, 2002; Kerr & Kaufman-Gilliland, 1994). Barr (1996) summarized that there are two explanations for the importance of discussions in social dilemma scenarios: "(a) group discussion enhances group identity or solidarity, and (b) group discussion

elicits commitments to cooperate" (Kerr & Kaufman-Gilliland, 1994, p. 515). The two explanations were summarized by De Cremer and Van Dijk (1999, 2002) as the "goal-transformation hypothesis," (with feedback, group identity transforms people's motives from individual to collective) and "goal-amplification hypothesis" (social identity can only influence people with pro-social orientation through enhancing trust). The results have been inconclusive. On one hand, scholars found that communication can promote cooperative behavior only through enhancing trust and commitment and building norms and perceived consensus (Bouas & Komorita, 1996; Chen & Komorita, 1994; Kerr & Kaufman-Gilliland, 1994). On the other hand, researchers found that communication allows the group identity to transform individual goals into collective goals (De Cremer & Van Vugt, 1999). There are also other studies that looked at the impacts of warm-up activities on both group identity and group norms and their consequent contribution to cooperative behavior in social dilemma problems (Chen, et al., 2007).

This dissertation joins the discussion to test whether and to what extent the interaction environment and the group discussions prior to the task might affect people's group identity and, as a consequence, influence their collaborative behavior in a social dilemma.

IT tools for facilitating communication and collaboration. This section mainly explores the impacts of different features of IT tools on people's communication, coordination, and collaboration in HCI and information systems studies. IT has become an integral part of our daily life. Plentiful IT tools or

platforms are available for group communication and group decision-making. As scholars have noted, IT tools (such as Decision Support Systems) would and should not be perceived as means to legitimize policies or decisions of policy makers and scientists, but rather be seen as "contexts" to "initiate and inform debates, dialogues, and deliberations" (Pereira, et al., 2005, p.31).

Scholars studying the online community noted that citizens not only utilize the Internet to distribute and retrieve information, but also use all kinds of online tools (such as virtual communities) as platforms to raise awareness of public issues and to deliberate on policy problems (Kavanaugh, et al., 2005). Research has shown that emerging virtual communities may contribute to the development of social capital, sense of community, and civic engagement since the computer-mediated communication serves as a new venue for people to connect or reconnect with each other (Blanchard & Horan, 1996; Pigg & Crank, 2004; Rheingold, 2000).

Compared with the voluminous studies that focus on distributed communication via IT tools and virtual communities, studies on co-present IT-facilitated deliberation have received less attention. Among the various types of IT, computer simulations and information display technologies have demonstrated great potential for facilitating group interactions and public deliberation activities. While the large single shared display may not contribute to the efficiency of accomplishing task work, it has advantages in increasing people's awareness of other collaborators' activity (Koch, 2005; Liu & Kao, 2005; Wallace, et al., 2009), enabling communication and collaboration among multiple users (Stewart, et al.,

1999), and facilitating the building of a shared understanding of the workspace and the common tasks (Scott, et al., 2003; Swaab, et al., 2002).

Stewart, Bederson, and Druin (1999) studied how the design of an information display can influence people's collaborative behavior when people are physically co-present. He introduced and defined Single Display Groupware (SDG) as "computer programs that enable co-present users to collaborate via a shared computer with a single shared display and simultaneous use of multiple input devices" (p.286). He further described SDG's characteristics as, "shared user interface," "shared feedback," and "coupled navigation" (p. 289). In his experiments, he compared one input device with multiple input devices and found that more children (participants) enjoyed the multiple input devices because it allows parallel work and does not require turn taking (p.292). Yet he did not test the impacts of single-shared display on people's communication, coordination, and collaboration. Later, Birnholtz, Grossman, Mak, and Balakrishnan (2007) investigated how two input configurations affect groups in performing a negotiation task on a shared high-resolution large display. Birnholtz et al. (2007) have found that multiple mouse improve efficiency, whereas people perceive higher discussion quality and have more discussions when provided with a single mouse.

Wallace, Scott, Stutz, Enns, and Inkpen (2009) conducted experiments to explore the differences in task work and teamwork where participants are arranged to interact with single and multi-display groupware systems. The teamwork is measured by "communication," "awareness," and "coordination"

(Wallace, et al., 2009, p. 571). While the final experiment result did not find significant differences in communication, coordination, and awareness in single and multi-display groupware systems, the researchers noted that the qualitative data (participants' comments) did suggest that single display can bring more awareness of other collaborators' activities and intentions although the single display might not contribute to the efficiency of accomplishing the designated tasks (Wallace, et al., 2009). The awareness is measured by asking the users to rate "how aware they were of their collaborator's actions, and how aware they felt their collaborators were of their own actions" (Wallace, 2009, p.576). DiMicco, Pandolfo, and Bender (2004) also found that a shared display of participation rates encouraged the "over-participators" to talk less though the shared display does not increase the under participator's contribution. Liu and Kao (2005) investigated whether adding the shared display to the handheld devices in the classroom can encourage communication and promote collaboration. They found that compared with the tablet-PC-only setting, students with shared display have higher participation rates, exhibit a close-to ideal communication pattern (almost all members are actively involved), display more hand-pointing behavior, interact with one another more naturally, build stronger shared understanding of the tasks, and increase awareness of other partners' activities (Liu & Kao, 2005).

Besides the aforementioned experimental studies, the shared display has been utilized in real-life scenarios, such as spatial planning negotiation and community outreach (Koch, 2005; Swaab, et al., 2002). Swaab, Postmes, Neijens, Kiers, and Dumay (2002) investigated the effect of a visualization system, which

provides a shared visualization of different spatial planning scenarios, on the negotiation process. They found that compared with the distributed information presentation, a shared visualization of information can bring in "positive socio-emotional consequences in terms of increasing cohesiveness and entitativity," facilitate the formation of "shared mental models" of common tasks, plans, and consequences, and finally contribute to the building of consensus (Swaab, et al., 2002, p.143). Koch (2005) introduced how public shared displays, as a new format of electronic community support tools, can serve as a medium for communication for information exchange and distribution, and a platform to increase awareness of others in the community and to help cultivate possible cooperation in the future.

ASU Decision Theater (DT) is the IT-facilitated deliberation space that is used for this dissertation. This designed deliberation space provides an immersive computer-simulated environment that incorporates real-time human-computer interface, interactive group support systems, networked laptops, and high-fidelity video-recording equipment. In the United States, this type of immersive environment has been used in training, education, entertainment, manufacture, information visualization, design for architecture and engineering, urban planning, etc. (Bourdakis; Burdea & Coiffet, 2003; Isdale, 2003). Nevertheless, most of these applications focus on utilizing the immersive environment to visualize the abstract scientific data or concepts, to enhance the vividness of multidimensional objects, or to simulate the uncertain and complex scenarios. These applications did not explore the potential of an immersive environment for public deliberation

activities, let alone policy deliberation on collective community challenges. In recent years this type of designed deliberation space has been used as the platform for community leaders, policy makers, and citizens to get together to prepare the communities for the emergency scenarios, to discuss the school redistribution, to make land use plans and energy plans, and to deliberate on water sustainability (see http://dt.asu.edu/solutions/research). Recent studies have examined how the visualization techniques influence people's perceptions and decision making on complex policy issues, such as water problems and public health (Edsall & Larson, 2006; Hahn, Shangraw, Keith, & Coursey, 2007). While these studies highlight contextual and methodological influences of using the space, more research is needed to understand the dimensions, conditions, and magnitude of its influence.

In addition, a computer simulation was used to provide the common problem scenario as the deliberation context. Simulation is "a young and rapidly growing field in the social sciences," yet, it has demonstrated great application potential in "prediction, performance, training, entertainment, education, proof, and discovery" (Axelrod, 1997, p. 16). The application of simulation to social science education allows users to explore the dynamic relationships, interactions, and principles through experiencing the simulated scenarios by themselves (Axelrod, 1997). Simulation challenges the traditional assumptions that human behavior is rational and there are static, linear relationships among diverse factors and sectors within social activities. Simulation focuses on the dynamic interactions among different actors in society (Gilbert & Tioitzsch, 2005). The dynamic simulation modeling allows researchers to apply new frameworks to explore a wide array of social

problems, such as small group collaboration, public service delivery, civic collaboration, and crime policies (Johnston, Kim, & Ayyangar, 2007).

This dissertation examines how informatics advances might influence the public deliberation process by comparing people's interactions and communications in two different IT-facilitated deliberation environments. Half of the participants deliberate on a local community challenge at a space with a communal display of the problem scenario and a single mouse control. The communal display can seat up to 25 participants surrounded by the 260-degree seven-screen integrated display (see the Figure 1. below). The other participants deliberate in an environment with regular individual laptop display and multiple mouse controls.

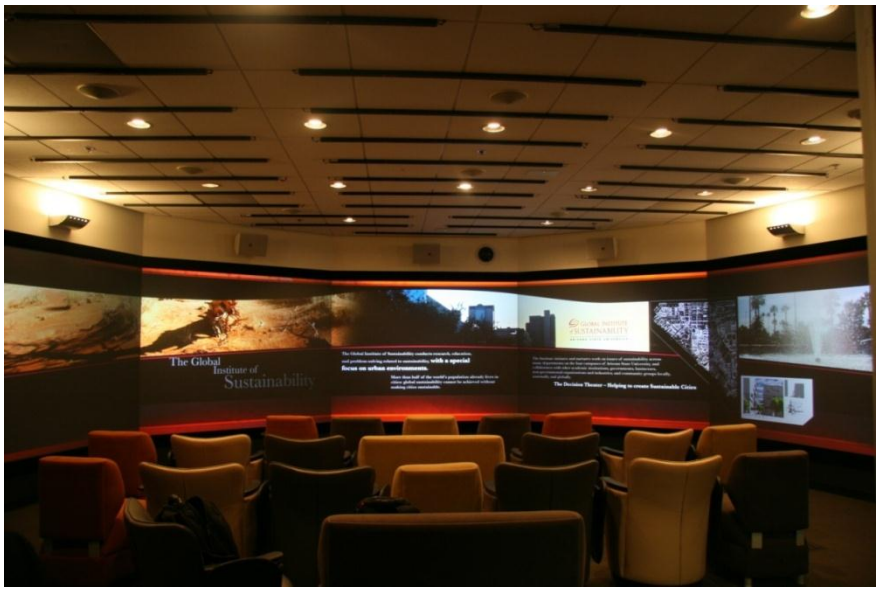

Figure 1. The seven-screen communal display in Decision Theater at Arizona State University (source: http://dt.asu.edu/)

The Conceptual Research Framework and Research Propositions

Drawing upon the key concepts from research on collaborative governance, social identity, social dilemmas, e-governance, and human-computer interaction, the dissertation's overall conceptual framework is proposed as follows (see Figure 2).

The key constructs studied in this dissertation include IT-facilitated deliberation environments, warm-up interactions, social identity, shared understanding, and collaborative behavior. The IT-facilitated deliberation environments are equipped with computer simulations and information display devices to facilitate people's communication and interactions. Shared cognition and shared identity are two related yet different concepts. The concept of shared cognition or shared understanding refers to "the sharedness and/or congruence of knowledge structures that may exist at different levels of conceptualization within a group and relate, for example, to aspects of the group task" (Swaab, et al., 2007). Social identity refers to people's positive attitudes toward their group, including cognitive, affective, and behavioral components (Chen, et al., 2007)

This dissertation mainly examines whether the IT-facilitated deliberation environment and the warm-up interaction encourage the formation of shared understanding and social identity, and promotes collaborative behavior. If so, to what extent do these two factors influence people's shared identity and collaborative behavior?

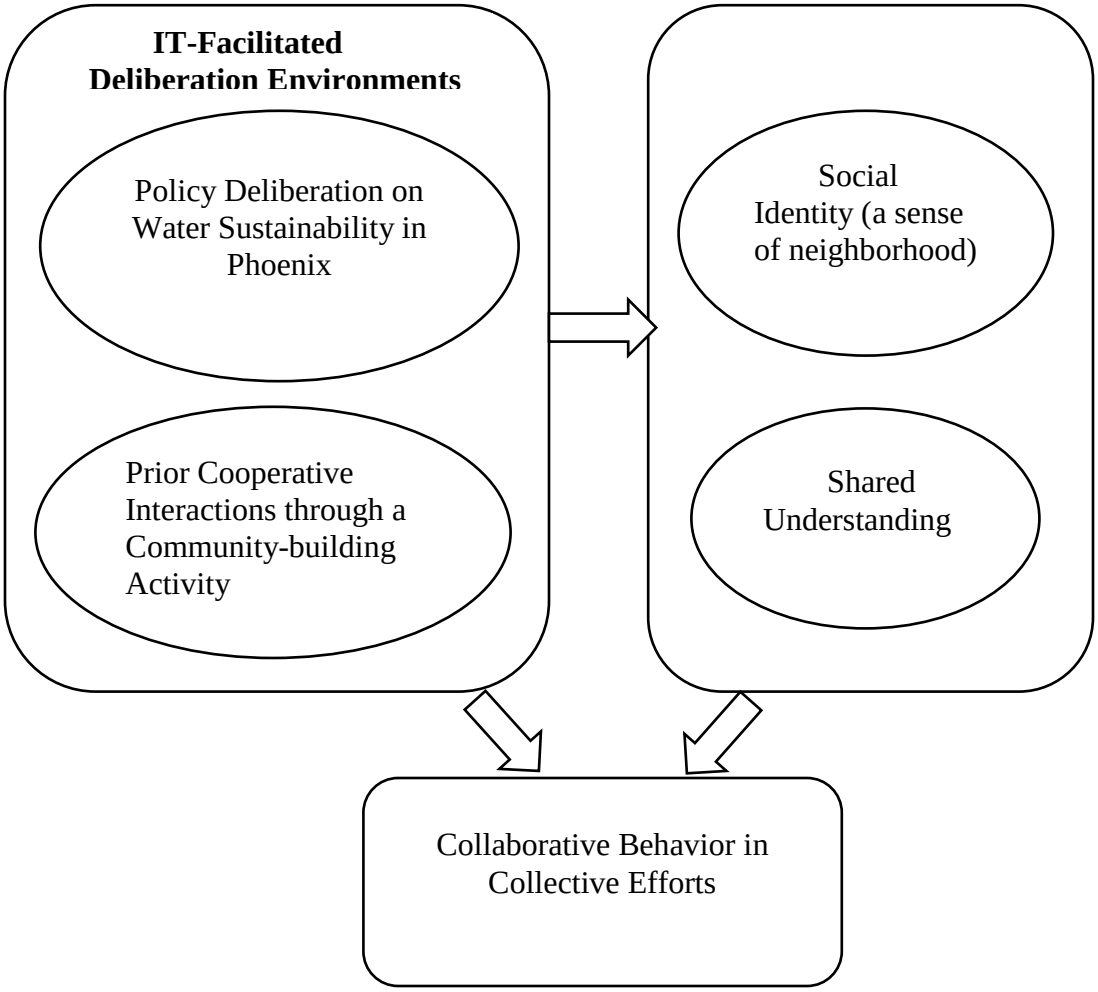

Figure 2. The conceptual framework

It is hypothesized that a more collaborative IT-facilitated deliberation environment and prior cooperative interactions will better facilitate people's communications and interactions; therefore, it will encourage people to collaborate with one another in collective efforts. Four propositions are listed as follows:

Proposition 1: A more collaborative IT-facilitated deliberation environment will encourage more collaborative behaviors.

Proposition 2: A more collaborative IT-facilitated interaction environment will contribute to the building of shared understanding and social identity.

Proposition 3: Prior cooperative interactions will promote the formation of shared identity.

Proposition 4: Prior cooperative interactions will encourage collaborative behaviors.

The conceptual framework proposed here is used to guide the following experimental design and implementation. Chapter four will present the methods by which these propositions and further-defined research hypotheses are tested.

Chapter 3: Methods of Data Collection and Analyses

This chapter covers the methods of data collection and analyses. As discussed in chapter two, this dissertation explores whether and to what extent different IT-facilitated deliberation environments and people's prior cooperative interactions affect people's social identity and their collaborative behavior in a social dilemma scenario. To gauge these effects, a between-subjects two-by-two factorial experiment was conducted in the Decision Theater (DT) at Arizona State University (ASU). In total, 126 ASU undergraduate students participated in the study during April 5th till May 6th, 2010.

Methods

A between-subjects two-by- two factorial experimental design. The experiment method is used mainly because it is appropriate for answering the research question. According to Shadish, Cook, and Campbell (2002), the purpose of conducting experiments is not to provide a complete explanation of a social phenomenon; the purpose is to "identify whether a particular variable or a small set of variables make a marginal difference in some outcome over and above all the other forces affecting that outcome" (p. 457). This dissertation focuses on how two particular factors, IT-facilitated deliberation environments and prior cooperative interactions, affect the collaboration process. This dissertation does not depict the complete picture of collaborative processes and collaborative governance. Hence, the experiment is an appropriate method for this dissertation.

Furthermore, the experiment methodology can help exclude or at least reduce the possible confounding effects of other variables (such as age, race, and education) when making a causal inference (Babbie, 2007; Shadish, et al., 2002). Through random assignment, the treatment and control groups "should be statistically identical on all dimensions, except exposure to the treatment; thus, any differences in outcomes can be ascribed to the treatment" (Greenstone & Gayer, 2009, p. 27). The random experiment can avoid selection bias and provides an unbiased estimate of the average causal effect of the treatments (Shadish, et al., 2002). In addition, among the large number of studies investigating the relationships between group identity, social norms, social connections, and collective action, the experiment is the most used research methodology (see Bouas & Komorita, 1996; Brewer & Kramer, 1986; Chen, et al., 2007; De Cremer & van Dijk, 2002).

Table 2 provides an overview of the experimental design and the number of participants in each condition. A between-subjects two-by-two factorial experiment was conducted. The two factors are IT-facilitated deliberation environments and the warm-up group activity.

Table 2.

Experimental Design and the Number of Participants

IT-facilitated communication environments	Prior cooperative interactions	
	Introduce a warm-up activity	No warm-up activity
One large-screen communal display with a single mouse control	Condition 1 (n = 30)	Condition2 (n = 28)
Individual laptop display with multiple mouse control	Condition 4 (n = 25)	Condition 3 (n = 43)

The experiment was conducted in the ASU Decision Theater, which provided the IT-facilitated deliberation environment for the study. DT has a "Drum," which is a room that can seat up to twenty five participants surrounded by the 260-degree seven-screen communal display. The facility is equipped with real-time human-computer interface, interactive group support systems, networked laptops, and high-fidelity video-recording equipment. Additionally, the regular conference room was employed for the comparison groups that interacted with the individual laptop display and have multiple mouse controls.

Group size and level of analysis. Previous studies have shown that group size influences group interactions and cooperative behavior in social dilemmas, although the conclusion is inclusive (Brewer & Kramer, 1986; Kramer & Brewer, 1984; Olson, 1971). For instance, Brewer and Kramer (1986) found that in commons dilemmas, group size had no effect on cooperative behavior. Whereas, in public goods dilemmas, individuals in small groups (eight participants)

contributed more than their counterparts in the large groups (32 participants) (Brewer & Kramer, 1986). Among the large number of experiments conducted that examine the impacts of group identity and social norms on people's behavior facing social dilemmas, most scholars either include group size as a control variable or adopt a small group size, ranging from three to eight (such as Brewer & Kramer; Chen, et al, 2007). With the focus on interactions among participants within small groups in this dissertation, the groups include three to four people.

Although the experiment invited groups of students to participate, the unit of analysis remains at the individual level. This is because the study mainly focuses on individual participants' interactions with each other and with the information display environment, individuals' formation of group identity, and the socialness of their decision choices in a social dilemma scenario.

Sample Selection & Participant Recruitment

Student participants. The main focus of the experiment is to test the conceptual relationships between IT-facilitated deliberation environments and people's interactions, social identity, and collaborative behavior. This experiment is different from experiments that try to test the different impacts of certain policies or programs on different groups of population, which makes students inappropriate subjects (Croson). No big difference is expected between the adult students and the other general population in their interactions with others and their collaborative behavior. Thus, students are appropriate for the experiment. Furthermore, undergraduate or graduate students are the most common invited

participants in the studies that have a similar research agenda. Thus, participants in this study were drawn from undergraduate student population over 18 years old at Arizona State University. Undergraduate students with different majors, ethnicities, and races were invited to make the student sample as close to representative as possible to the larger population.

According to Cohen's classic discussions on power size, when a medium difference in outcomes is expected, the resulting power analysis suggested a minimum of 114 participants (the significance criterion is set at .05, the statistical power is set at .75, and the effect size is set at .25) (Cohen, 1988; Kinnear & Gray, 2009). The F-test for the ANOVA and ANCOVA is used for the significance test.

A mixed method of recruiting participants. Initially, with a goal of random sampling, students' e-mail addresses were randomly pulled from the ASU database. In the first round, 971 e-mails were sent out to the students on April 1st, 2010. Then, due to the extremely low response rate (around 1%) to the e-mail invitations in the first week, a mixed sampling method of recruiting students was used in the following three weeks, including handing out flyers at the campus cafeteria, making multiple in-class announcements in large-size classes (Biochemistry 360, Management and leadership 300, Sociology 100, etc.), and snowballing. Although strictly speaking, the sample is no longer a random sample, the mixed sampling method helps get students with a wide range of demographic backgrounds during such a short period of time. Only few students knew other group members in the study. Another related problem to the randomization process is that due to the fact that the laptop version of Watersim was under way

by the time the experiments were conducted in early April, students scheduled for the early sessions of the experiment were all assigned to the experimental setting with the shared display and single mouse control. Yet students were not aware of this and therefore cannot choose the experimental setting. Hence, the assignment process remains randomized. In total, over 190 students signed up for the study and 126 participated in the experiment. Altogether, thirty four sessions of experiments were conducted during April 5th and May 6th, 2010.

The experimental procedure and implementation

WaterSim, a dynamic computer simulation interface of water supply and demand for the Phoenix Metropolitan area, was used as the policy deliberation context. This simulation interface, developed by the ASU Decision Center for a Desert City, is an interactive web-based simulation model designed to help all involved stakeholders deliberate and anticipate under conditions of uncertainty. This scenaric device allows people to adjust parameters to explore different scenarios of climate change, population increase, and agricultural water use to see their impacts on water sustainability in 2030. It also has a policy interface that allows users to explore alternative policy choices on indoor and outdoor water use and to receive instant feedback regarding their choices.

We arranged participants to interact with one of two versions of Watersim, one with a large-screen communal display and the other with individual display. A community-building activity was also introduced as the warm-up activity to examine its impacts on people's interactions and their group identity later. At the conclusion of the experiment, groups engaged in a social goods game where there

was a dilemma between protecting individual resources and promoting a collective outcome. Subjects were asked to donate tokens and the outcome of the game was directly tied to the money they were paid at the end of the experiment.

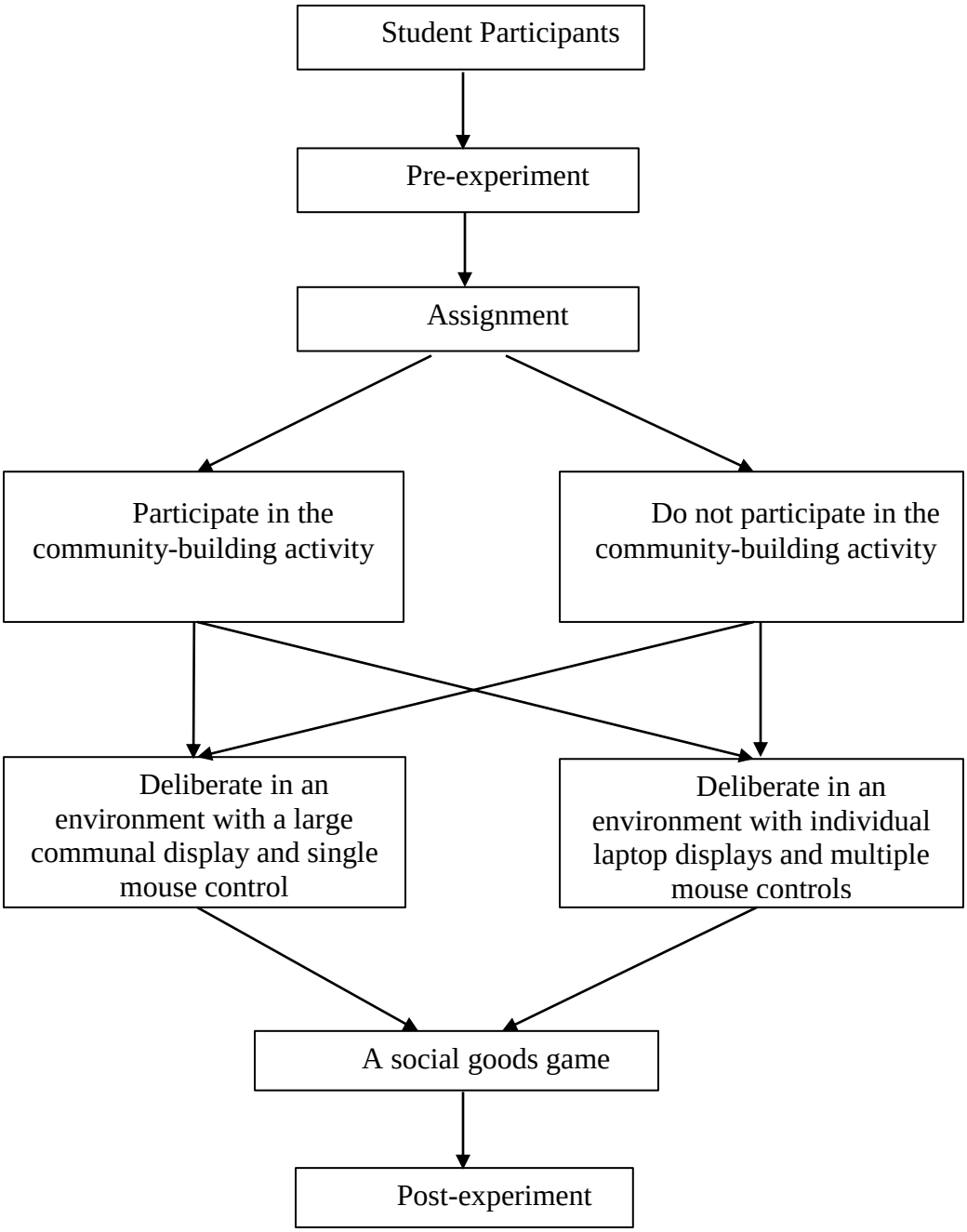

Figure 3. Experimental procedure

Each time, four to six students were arranged for the study to ensure that the group includes at least three people and does not exceed four people. If less than three participants showed up, the study was cancelled and rescheduled. If more than four participants showed up, extra students were offered compensation of five dollars and asked to participate another time. When the scheduled students came to the ASU Decision Theater, they were directed to the experiment site (conference room or the Drum) and given the information packet. As shown in Figure 3, groups of students were randomly assigned to four different conditions: one condition with a communal display and single mouse control and a group warm-up activity (Condition1), one condition with a communal display and without the warm-up activity (Condition 2), one condition with individual laptop display and a warm-up activity (Condition 3), and one condition with individual laptop display and without a warm-up activity (Condition 4). Experiments with Condition 1 and Condition 2 were conducted in the Drum with the seven-screen shared display. Experiments with Condition 3 and Condition 4 were conducted at the regular conference room with individual laptop display. A brief introduction of the study was presented at the beginning of the experiment by the facilitator. Then, students completed an on-line survey questionnaire using computers. There are two treatments (interventions) in the study: a warm-up activity and information display environments (communal display vs. individual display). A three-minute introduction of WaterSim was given on either laptops or a shared seven-screen display, depending on which condition the group was in.

Factor one: Groups in the Condition 1 and 3 were introduced to the warm-up activity which asked them to imagine that they live in a new neighborhood in the Phoenix Metropolitan area. Then, participants were asked to discuss the features they would like to have and the slogan for the neighborhood entrance for the hypothetical neighborhood. Groups in Condition 2 and 4 were only asked to imagine that they live in a new neighborhood in the Phoenix Metropolitan area. The instructions given to groups in Condition 1 and 3 are as follows: "Imagine that the four of you live in the same new neighborhood located in the Phoenix Metropolitan area. The neighborhood is putting up a sign at its entrance. Spend a few minutes discussing what features you would like your new neighborhood to have. Then, together, write a slogan for your neighborhood's sign (e.g., A Place to Grow). When you have decided on a slogan, please write it on this slogan sheet and return it to me. The slogan sheet will be given to you by the facilitator."

Factor two: Experiments with Condition 1 and 2 were conducted in the "Drum" with a seven-screen communal display and one mouse control. Experiments with Condition 3 and 4 were conducted in the regular conference room with four individual laptops and multiple mouse control devices (see Figure 4 and Figure 5 below).

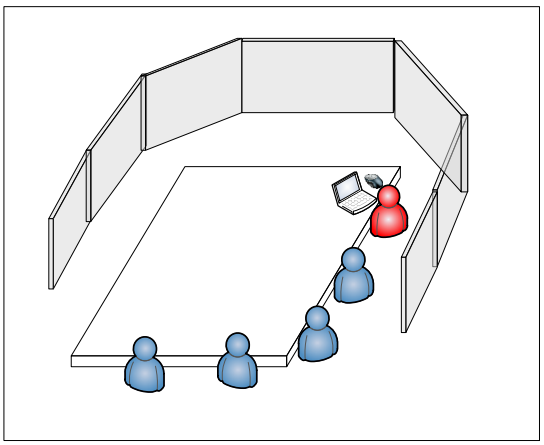

Figure 4. Experimental setting with the communal display and single mouse control. The figure at the upper right is the facilitator for the experiment.

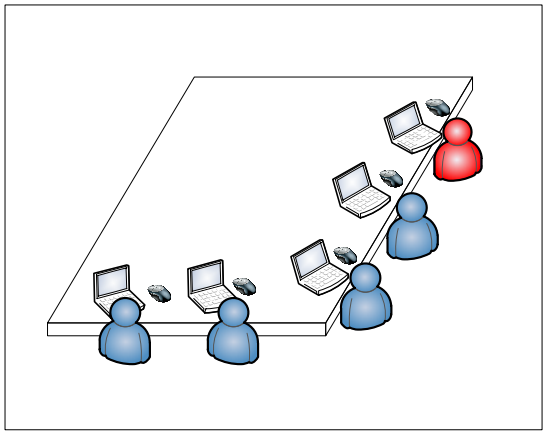

Figure 5. Experimental setting with individual laptops and multiple mouse controls. The figure at the upper right is the facilitator for the experiment.

A group deliberation activity on water use in Phoenix was followed by asking participants to use the computer simulations either on the individual laptops or on the seven-screen communal display to discuss the water problems in Phoenix, their goals for addressing the water problems, and plan for achieving these goals. Then, a social goods game on water recycling was introduced as the second activity. Last, the students were asked to complete the last survey questionnaire.

The entire study was videotaped for future data analyses. Each participant was given a unique participation code to protect their privacy. Data from the survey questionnaire can help answer the question of whether and to what extent different IT-facilitated deliberation environments and prior cooperative interactions have impacts on participant's deliberation, formation of group identity, and their collaborative behavior in a social dilemma scenario. The interactions among group members and their interactions with the computer simulation can be captured through the video data.

Variables

Two factors: independent variables. There are two treatments embedded in the experiment. One is the warm-up activity, and the other is the IT-facilitated deliberation environment. The two treatments comprise four conditions: the communal information display environment with the warm-up activity, the communal display environment without the warm-up activity, the individual laptop display environment with the warm-up activity, and the individual laptop display environment without the warm-up activity. Students are randomly assigned to the four conditions when they signed up for the study.

Dependent variables. The individuals' collaborative behavior in the social dilemmas is measured by the number of water tokens the participants would like to contribute in a social goods game at the end of the experiment. Each participant was given ten water tokens and was told that there is a new water recycling project in their neighborhood where they live. They were asked to decide whether

to contribute their water tokens to the neighborhood water recycling project which will benefit the entire group or keep the water tokens for themselves. The water tokens kept for themselves will keep the original value. The water tokens contribute to the recycling project will double in value, and will be distributed equally across the group, regardless of individual contributions. The final payoff will be the sum of the water tokens individuals keep for themselves and equal share from the water recycling project.

The rationale behind designing this game is that this classic social goods game can capture the dynamics and challenges in community-based efforts to pursue environmental sustainability. There are potential conflicts between the individual benefits and collective interests. While one's engagement in the community-driven programs, such as water recycling program, will benefit others in the community, it costs time, energy, and resources to engage in such community programs. This type of social goods game can also help us understand how the relationships and connections between participants influence their decisions in collective efforts. If their trust in others, or commitment to the collective enterprise is strong, they tend to contribute more to the social goods game. Otherwise, they tend to free ride other's efforts. This social goods game has been widely used by experimental economics to study people's collaborative behavior in collection actions (Brewer & Kramer, 1986; Chen, et al., 2007).

There are two other dependent variables in the study: shared understanding and group identity. The variable of shared understanding is measured by three post-experiment survey questions, which asked participants to what extent they

agree that Phoenix is facing a serious water problem and resident indoor and outdoor water use have great impacts on water sustainability in Phoenix. The group (social) identity is adapted from existing research (such as Chen, et al., 2007; De Cremer & van Dijk, 2002; Hinkle, Taylor, Fox-Cardamone, & Crook, 1989; Kerr & Kaufman-Gilliland, 1994). In this dissertation, an abbreviated version of Hinkle, Taylor, Fox-Cardamone, and Crook's (1989) measurements are used to measure group identity, as seen in Table 3 below. The group identity is defined as members' positive attitudes toward the group, including cognitive, affective, and behavioral components (Hinkle, et al., 1989). Hinkle et al.'s definition and nine-item measurements of group identity have been widely adopted and developed in later research. The perceived group norm is measured by two-item measurements in the post-experiment questionnaire, which asked them how they perceive others' behavior in the social goods game, based on Chen, Wasti, and Triandis's (2007) study that examined the impacts of group norm, group identity and individual cultural orientation on cooperative behavior.

Table 3.

Measurements of the Key Dependent Variables and Control Variables

Variables	Survey items
Confidence in using computers	How confident are you in using computer to search for information?
Identity with Group (Sense of the neighborhood community)	I think of the four of us as a group rather than as four distinct individuals.
	I feel like a group member rather than a distinct individual.
	I feel I belong to this group.
	I see myself as an important part of this group.
Perceived group norm	The other people were making choices to maximize the group interest.
	The other people were making choices to maximize their own payoff.
Identity with Phoenix	I feel strongly attached to the Phoenix area.
	I often talk about the Phoenix area as a great place to live.
Token contribution	The number of tokens he or she would like to contribute to the neighborhood water recycling project.

Control variables: gender, age, and ethnicity. Since participants need to search information on the computers, confidence in using computers is included in the pre-experiment questionnaire to control the effects of different computer experience on their interactions with the computer simulated environment and their evaluations of different information display environments (Lan & Scott,

1996). This variable is measured by a single question asking the participant to indicate on a 1-7 scale how confident he or she is in searching information using computers. Identity with Phoenix is another control variable to measure how participants think of Phoenix.

The demographic variables (gender, ethnicity, and race) are also included in the post-experiment survey to check whether there the groups have similar demographic composition across all four experimental conditions.

Based on the propositions discussed in chapter two, the research hypotheses are listed here:

Hypothesis 1: people who deliberate and interact in an IT-facilitated deliberation environment with the communal display of the water scenario and single mouse control will tend to make more token contributions in a social dilemma scenario of water recycling, than those in an IT-facilitated deliberation environment with individual laptop display of the water scenario and multiple mouse controls.

Hypothesis 2: people who participate in a five-minute discussion on the features and slogan of the neighborhood tend to make more token contributions in a social dilemma scenario of water recycling, than those who did not participate in the warm-up discussion.

Hypothesis 3: People who deliberate and interact in an IT-facilitated deliberation environment with the communal display of the water scenario and single mouse control will tend to build stronger group identity toward each other,

than those in an IT-facilitated deliberation environment with individual laptop display of the problem scenario and multiple mouse controls.

Hypothesis 4: people who deliberate and interact in an IT-facilitated deliberation environment with the communal display of the policy scenario and single mouse control will tend to build more shared understandings of the water problem, than those in an IT-facilitated deliberation environment with individual laptop display of the problem scenario and multiple mouse controls.

Hypothesis 5: People who participate in a five-minute discussion on the features and slogan of the neighborhood tend to develop stronger group identity toward each other, than those who did not participate in the warm-up discussion.

Methods of Data Analyses

Given this is a two-by-two factorial experimental design, ANOVA and ANCOVA are used to analyze the survey data to answer the question of whether and to what extent the different information presentation environments and warm-up interactions affect people's social group identity and collaborative behavior. Significance tests, such as the F-test, are conducted to compare whether the differences in group identity and collaborative behavior between the four conditions are statistically significant. In addition, a reliability test is conducted to analyze the reliability of the four-item measurements for the group identity and the two-item perceived group norm variable.

In short, the two-by-two factorial experimental design and the statistical analysis allow me to explore the potential of a designed deliberation space for

facilitating deliberation activities and collective efforts to address common challenges and the influence of prior cooperative interactions on people's deliberation and collaborative behavior in a social dilemma scenario.

The following chapter four reports the findings from the experiment and provides detailed discussions on results.

Chapter 4: Results and Discussions

Results and findings from the experiment are presented in this chapter. This chapter first presents the descriptive statistics for the participants, including gender, race, and ethnicity. Then, it reports the summary statistics for the key dependent variables including social identity, shared understanding, and collaborative behavior. Last, results from the Kruskal-Wallis, Mann-Whitney tests, ANOVA, and ANCOVA tests are presented to discuss whether the research hypotheses are supported, followed by discussions.

During the experiment to study how different IT-facilitated deliberation environments and the warm-up discussion (a community-building activity) affect people's interactions, formation of social identity, and their collaborative behavior, participants were arranged to interact with one of two versions of Watersim, one with a large-screen communal display and the other with individual laptop display. A community-building activity was introduced to create prior cooperative interactions. At the conclusion of the experiment, groups engaged in a social goods game in which there was a dilemma between protecting individual resources and promoting a collective outcome. Participants were asked to decide whether to contribute water tokens to a neighborhood water recycling project. The outcome of the social goods game was directly tied to the money they were paid at the end of the experiment.

Descriptive Analysis: Composition of Participants

This section provides the demographic information of the participants in the study. As designed, only ASU students were invited to participate. During April 5th to May 6th, 2010, a total of 126 students (thirty four groups of three or four students) participated in the experiment at ASU Decision Theater. As Table 4 illustrates, 54.8% of the participants are female, 69% of the participants are white, 15.1% of the participants are Hispanic or Latino, of Spanish origin, and 96% of the participants are students. There are more female participants in the study and the majority of the participants are white and Asian.

It should be noted that even though it was stated clearly that ASU undergraduates at 18 years old and over were invited to participate in the experiment in the e-mails, flyers, and in-class announcements, students who just graduated from ASU and few graduate students still received information about the study because of lagged updates in ASU's database. In addition, the participation rate is extremely low so that the study cannot afford to exclude students when several graduate students showed up for the study. But, the undergraduate students remain the majority of the participants.

Table 4.

Demographic Information of the Participants

Demographic Variables		*N*	Percentage (%)
Gender	Female	69	54.8
	Male	57	45.2
Race*	White	87	69
	American Indian or Alaska Native	5	4
	Asian	24	19
	Black or African American	9	7.1
	Native Hawaiian or Other Pacific Islander	1	.8
	Prefer not to answer	8	6.3
Ethnicity	Hispanic or Latino, of Spanish Origin	19	15.1
	Not Hispanic or Latino	107	84.9
Student Type	Undergraduate Students	113	89.7
	Graduate students	8	6.3
	Students who already graduated	5	4.0

Note. *Six participants identified with more than one category of race

Comparing the race composition of the participants in this study with that of the general population, it shows in Figure 6 that the white population is well

represented, and the representation of other race groups such as Asian, African Americans, and American Indians, are somewhat off the race composition of the population.

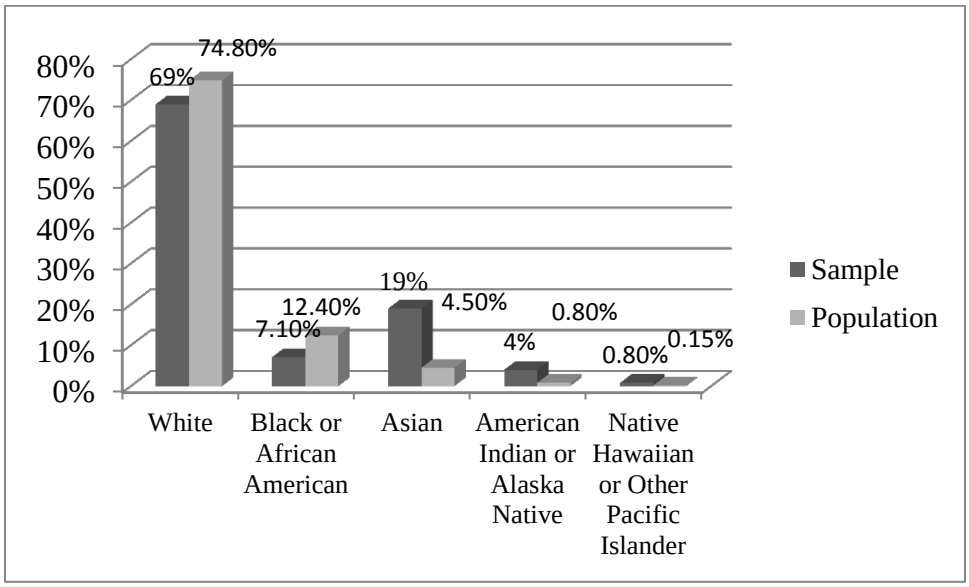

Figure 6. Race composition of participants: sample vs. population (source: 2009 American Community Survey 1-Year Estimates. United States Census Bureau.)

After breaking the participants into different experimental settings, it shows in Table 5 that experimental setting 4 has the most participants (n = 43), which are the reference groups. Although the percentages of female and white participants differ among experimental conditions, the mean comparisons in Table 6 show that there are no statistically significant differences in group identity, identity with Phoenix, and perceived group norm between female and male participants, white and non-white participants. Furthermore, the following ANCOVA analysis includes these demographic variables as covariates in the model. Hence, the differences in demographic composition are not a concern in later analyses.

Table 5.

Composition of the Participants across Four Experiment Conditions

Experimental settings	Gender (female)	Undergraduate Students	White	Total number of participants
Setting 1	16 (12.7%) 53.3%	27 (21.4%) 90%	15 (11.9%) 50%	30 (23.8 %)
Setting 2	15 (11.9%) 53.6%	26 (20.6 %) 92.9%	19 (15.1%) 67.9%	28 (22.2%)
Setting 3	13 (10.3%) 52%	22 (17.5%) 88%	20 (15.9 %) 80%	25 (19.8%)
Setting 4	25 (19.8%) 58.1.9%	38 (30.2%) 88.4.3%	33 (26.2%) 76.7%	43 (34.1%)
Total	69 (54.8%)	113 (89.7%)	87 (69 %)	126 (100%)

Note. The percent in the parenthesis indicates the proportion of the number of participants in this category relative to the total number of participants. The percent without the parenthesis indicates the proportion of the number of participants in this category relative to the total number of participants in the same experimental condition.

Table 6.

Mean Comparisons between Female and Male, White and Non-White

Variable	Gender		Race	
	Female (n = 69)	Male (n = 57)	White (n = 87)	Non-White (n = 39)
Identity with Group (Sense of the neighborhood community)	19.62 (5.12)	20.4 (4.92)	19.86 (4.97)	20.23 (5.19)
Identity with Phoenix	8.93 (3.36)	9.58 (2.85)	9.06 (3.26)	9.59 (2.89)
Perceived group norm	10.19 (2.1)	10.23 (2.0)	10.14 (2.09)	10.36 (1.97)
Token contribution	8.64 (2.14)	8.61 (2.55)	8.69 (2.28)	8.49 (2.44)

Note. *T*-tests were conducted to compare the mean differences. None of the mean differences are statistically significant. The value in the parenthesis is the standard deviation.

Summary Statistics for Dependent Variables: Group Identity, Shared Understanding, and Token Contributions

The primary dependent variables are the group identity variable and the token contribution variable. The group identity is measured by a summative index summing up the values of four questions that examine the participants' attitudes toward the group and other group members, which are shown in Table 7. The Cronbach's Alpha for the group identity index is .87. On average, the group identity is 19.98 (*SD* = 5.02) across four experimental settings on a scale of 4 to 28. The token contribution is measured by the number of tokens the participant is willing to contribute to the neighborhood water recycling project. On average, the participant contributes 8.63 tokens (*SD* = 2.32), which is quite high given that the

maximum tokens each participant has is 10. The variable of shared understanding is measured by three post-experiment questions asking participants whether they agree that Phoenix is facing a serious water problem and resident indoor and outdoor water use have great impacts on water sustainability in Phoenix. The average shared understanding is 18.67 (*SD* = 2.11) on a scale of 3 to 21. The Cronbach's Alpha for the shared understanding is .64. The perceived group norm is measured by a summative index composed of two questions asking how participants perceive other's token contributions in the social goods game. On average, the perceived group norm is 10.21 (*SD* = 2.04) on a scale of 2 to 14. And the Cronbach's Alpha for the perceived group norm is .41.

Table 7.

Summary Statistics for Group Identity, Group Norm, Identity with Phoenix and Token Contribution

Variables	Response Category (1=strongly disagree, 7=strongly agree)	*M*	*SD*	*N*
Confidence in using computers[+]	How confident are you in using computer to search for information?	6.26	.72	126
Identity with Group (Sense of the neighborhood community)	I think of the four of us as a group rather than as four distinct individuals.	4.89	1.55	126
	I feel like a group member rather than a distinct individual.	4.84	1.60	126
	I feel I belong to this group.	4.82	1.53	126
	I see myself as an important part of this group.	5.43	1.19	126
Identity with Phoenix	I feel strongly attached to the Phoenix area.	4.73	1.75	126
	I often talk about the Phoenix area as a great place to live.	4.49	1.67	126
Perceived group norm	The other people in the group were making choices to maximize the group interest.	5.58	1.11	126
	The other people in the group were making choices to maximize the group interest*.	3.37	1.45	126
Token contribution#	The number of tokens he or she would like to contribute to the neighborhood water recycling project.	8.63	2.32	126

Note. [+] This is measured on a 1-7 scale. 1 = not at all confident, 4 = neutral, 7 = extremely confident.
* This is reversely coded into the summative scale.
# This is measured by the actual number of token contributions by participants in a social goods game.

Hypothesis Testing

Both the Boxplots and the Shapiro-Wilk test indicate that the normality assumption for the token contribution does not hold ($W = .66$, $p < .001$). In addition, the Levene's test of equality of the error variance of token contributions shows that groups have unequal variance across four experimental settings ($F = 2.71$, $p = .048$). In general, the distribution of group identity is close to a normal distribution (see Figure 8). Given that distribution of tokens contributions is skewed to the right and is far off a normal distribution (see Figure 7), nonparametric tests (Kruskal-Wallis Test and Mann-Whitney Test) were conducted to compare token contributions across the four experimental conditions. Parametric tests (ANOVA and ANCOVA) were conducted to compare group identity across the four experimental conditions.

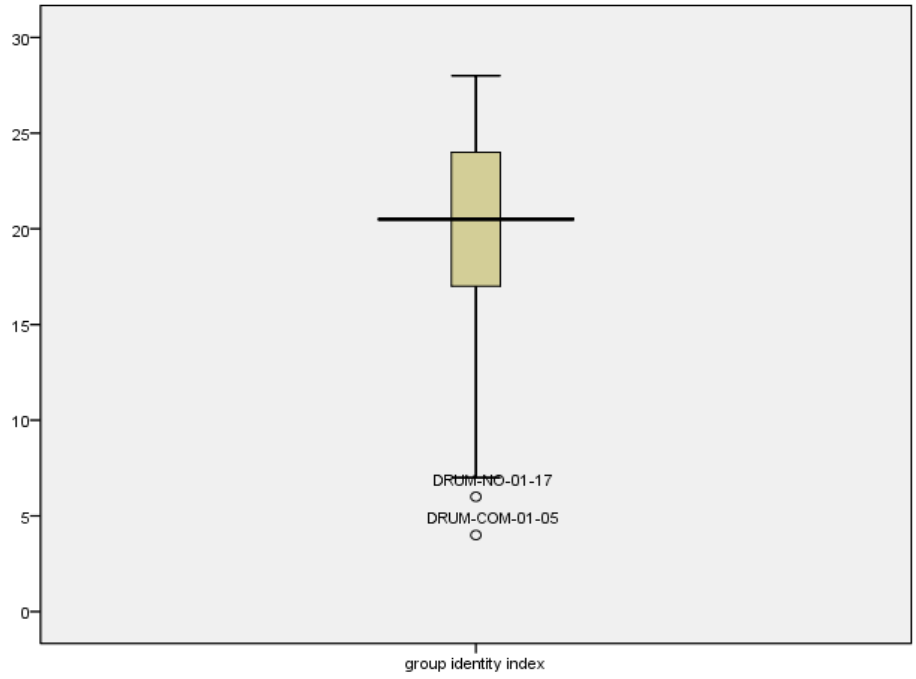

Figure 7. Boxplot of the group identity.

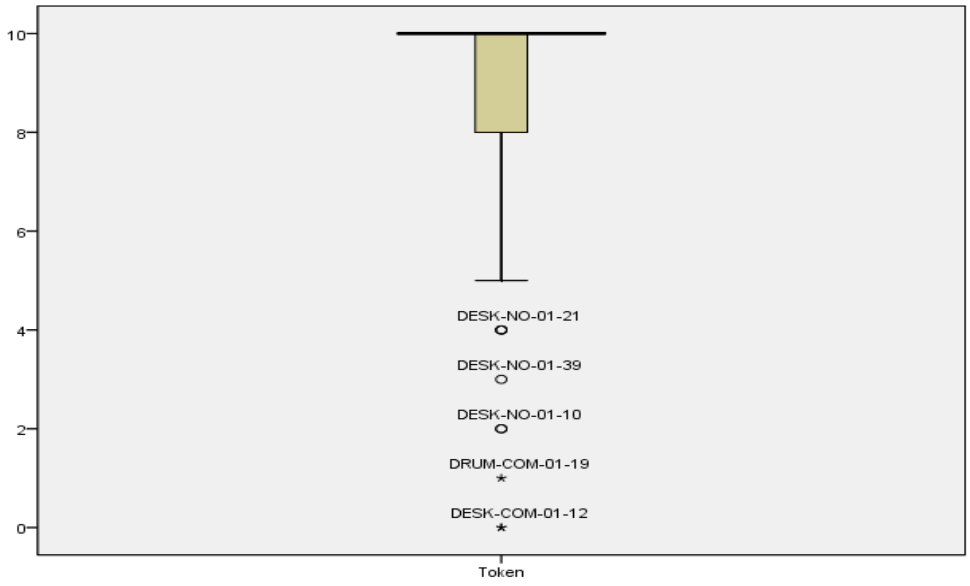

Figure 8. Boxplot of the token contributions.

As shown in Table 8, on average, people who deliberated and interacted in the IT-facilitated environment with the communal display and single mouse control and did not participate in the warm-up activity contributed the most water tokens in the social goods game, with the mean of 9.43. The addition of the five-minute warm-up activity appears to bring in mixed results with the token contributions, which will be discussed later in detail.

Table 8.

Token Contribution across Four Experimental Conditions

IT-facilitated deliberation environment	Prior cooperative interactions (a community-building activity)	
	Yes	No
Communal display, single mouse control	7.97 (*SD* = 2.5, *n* = 30)	9.43 (*SD* = 1.43, *n* = 28)
Individual laptop display, Multiple mouse control	8.76 (*SD* = 2.85, *n* = 25)	8.49 (*SD* = 2.24, *n* = 43)

Note. Token contribution could range from 0-10. Standard deviations and cell size care given in parentheses.

Kruskal-Wallis tests and Mann-Whitney tests: deliberation environment, warm-up activity, and collaborative behavior. The Kruskal-Wallis tests show that the participants in the four experimental conditions do not have an equal number of token contributions. The mean rank for the groups that interacted with the individual laptop display of WaterSim with multiple mouse controls and did not have the community-building activity is 60.8. The mean rank for the groups in experimental setting 1 (with the communal display and the community-building activity), experimental setting 2 (with the communal display and a single mouse control and without the community-building activity), and experimental setting 3 (with the individual laptop display and the community-building activity) are respectively 50.4, 75.66, 70.24. The Kruskal-Wallis chi-square test is significant beyond the .05 level, χ^2 (3) = 10.86, $p < .05$.

Given that the Krusakal-Wallis test result is statistically significant, pairwise comparisons among the experimental conditions 1, 2, 3 and the experiment 4 (the comparison condition) were conducted using the Wilcoxon-Mann-Whitney *U* test.

The Wilcoxon-Mannn-Whitney *U* tests show that participants who interacted with a communal display of WaterSim (Experimental Condition 2) showed more collaborative behavior in the social goods activity ($M = 9.43$, $SD = 1.43$) than participants who interacted with a laptop version (Experimental Condition 4) ($M = 8.49$, $SD = 2.24$). The Man-Whitney *U* test shows that the difference is statistically significant, Mann-Whitney $U = 462.5$, $z = -2.01$, $p = .021$ (one-tailed). The effect size is medium, $r = .24$. This result supports hypothesis 1 that people in the IT-facilitated deliberation environment with a communal display and single mouse control tend to make more token contributions in a social dilemma scenario. This is consistent with the findings in HCI research which suggests that a communal display and a single mouse control might not contribute to the efficiency of accomplishing certain tasks, but can encourage participation, facilitate discussions among participants, and cultivate possible cooperation (Koch, 2005; Liu & Kao, 2005).

The Mann-Whitney test was conducted to examine whether people in different group size make different token contributions. The result shows that there is no statistically significant difference in token contributions between individuals who are in groups with four participants and those who are in groups with three participants (Mann-Whitney $U = 1298.5$, $z = -.94$, $p = .35$). The Mann-Whitney tests were also conducted to examine whether female and male participants, white and non-white participants make different token contributions. The results show there are no significant differences in token contributions between female and male participants (Mann-Whitney $U = 1814.5$, $z = -.87$, p

= .39), and between white and non-white participants (Mann-Whitney U = 1608.5, z = -.54, p = .59).

A series of follow-up questions were also asked to measure the ease of interacting with a different deliberation environment for information retrieval and comparison, group discussions. Participants were also asked about their satisfaction with the way information was presented on the screen and the way their group communicated on a 1-7 scale (1=strongly unsatisfied, 7=strongly satisfied). The results show a mixed picture (see Table 9). The communal display appears to be more appealing for information comparison and increases people's positive attitudes toward the way they communicated. Participants interacting in the environment with a single display and a single mouse show a slightly higher level of satisfaction about the way their group members communicate (M = 5.64, SD = 1.06) than participants sitting in the environment with individual laptop display and multiple mouse control (M = 5.63, SD = 1.36). Yet the mean difference is not statistically significant. The experimental findings show that, overall, the IT-facilitated communication environment demonstrated its great potential in encouraging group discussions and cooperative behavior. Hence, more research needs to be done to figure out the favorable configurations of IT-facilitated environment for deliberation activities.

Table 9.

Mean Comparisons of Ease-of-Use and Satisfaction of Technology

Variables	Response Category: (1=strongly disagree, 7=strongly agree)	IT-facilitated communication environment	
		Communal display, single mouse control (n = 28)	Multiple laptops, Multiple mouse controls (n = 43)
Ease of information retrieval	It is easy to search for or retrieve information on the screen.	5.64 (SD = 1.34)	6.09 (SD = 1.1)
Ease of information comparison	It is easy to compare different information on multiple screens.	5.86 (SD = 1.27)	5.81 (SD = 1.16)
Facilitation of group discussion	The way information was presented on the screen facilitated my group's discussion.	6.07 (SD = .94)	6.28 (SD =.77)
Satisfaction with information presentation	I am satisfied with the way information was presented on the screen.	5.39 (SD = 1.32)	6.05 (SD = 1.09)
Satisfaction with group communication	I am satisfied with the way my group communicated.	5.64 (SD = 1.06)	5.63 (SD = 1.36)
Satisfaction with individual performance in the game	I am satisfied with my performance in the game exercise.	5.86 (SD = 1.08)	5.86 (SD = 1.17)

Mixed results have been found in groups that participated in the 5-minute community-building activity. In the environment with individual laptop display of Watersim, there are no statistically significant differences in token contributions between participants who participated in the community-building activity and those who did not. Participants who participated in the warm-up activity on average contributed fewer tokens (M = 8.76, SD = 2.85) than those who did not participate in the activity (M = 8.49, SD = 2.24). Yet the Mann-Whitney test shows that the difference is not statistically significant (Mann-Whitney U = 460, z = -1.17, p = .123, one-tailed). In the environment with the communal display of Watersim, participants who participated in the warm-up activity on average contributed fewer tokens (M = 7.97, SD = 2.5) than those who did not participate in the activity (M = 9.43, SD = 1.43) (Mann-Whitney U = 245, z = -3.09, p = .001, one-tailed). This is contrary to what is expected. Hypothesis 2 is not supported that argues that the warm-up activity can encourage participants to contribute more token contributions. This study does not support previous study conclusion (such as Chen et al., 2007) that argued warm-up activities, though not relevant to the following social dilemma activity, may encourage collaborative behavior. This finding will be further explained later with experiment results on the group identity outcome.

ANOVA tests: group identity, group norm, and collaborative behavior. The aforementioned Boxplot (Figure 8) of group identity shows that the group identity is approximately normally distributed. Additionally, group identity has a relatively large variance (s^2 = 25.19). The Levene's test of equality of the error

variance of group identity shows that groups have equal variance across four experimental settings ($F = .86$, $p = .47$). Hence, the parametric tests (ANOVA and ANCOVA) were conducted to test whether participants in groups that deliberated and interacted in different IT-facilitated deliberation environments and took part in the community-building activity develop higher level of group identity.

On average, participants' group identity is 19.98 ($SD = 5.02$) on a 4-28 scale. As shown in Table 10, participants who interacted with the individual laptop displays of WaterSim and participated the community-building activity on average have the highest group identity ($M = 21$, $SD = 3.95$). Yet, participants who interacted with the communal display of WaterSim and did not participate in the community-building activity have the lowest group identity ($M = 18.5$, $SD = 4.91$). It is surprising that participants who interacted in the more collaborative IT-facilitated deliberation environment and took part in the community-building activity have lower social identity ($M = 19.13$, $SD = 5.35$) than those in the less collaborative environment and without the warm-up activity ($M = 20.93$, $SD = 5.23$).

Table 10.

Descriptive Statistics on Group Identity across Four Experimental Settings

IT-facilitated deliberation environment	Prior cooperative interactions (Community-building activity)	
	Yes	No
Communal display, single mouse control	19.13 (*SD* = 5.35, *n* = 30)	18.5 (*SD* = 4.91, *n* = 28)
Individual laptop display, Multiple mouse control	21.0 (*SD* = 3.95, *n* = 25)	20.93 (*SD* = 5.23, *n* = 43)

Note. Social Identity index could range from 4-28. Standard deviations and cell size care given in parentheses.

The two-way ANOVA tests in Table 11 show that neither the communication environment nor the community-building activity has a large effect on participants' group identity, given the very low effect size (η^2 = .04 for the deliberation environment, and η^2 =.00 for the community-building activity). It seems that there is statistically significant effects of the IT-facilitated deliberation environment on participants' group identity at the .05 level, F (1,122) = 5.67, p = .019. Yet, a *t*-test for group means shows that the relationship between the deliberation environment and group identity is different from expected. People who were in the individual laptop display environment and did not participate in the warm-up activity on average formed higher social identity (M = 20.93, SD = 5.23) than those who were in the communal display environment and did not participate in the activity (M = 18.5, SD = 4.91) (t = -1.96, p = .054). This provides an unclear explanation about the role of a collaborative IT-facilitated communication environment in developing participants' group identity. Hypothesis 3 is not supported that assumes that there is positive relationship

between a more collaborative IT-facilitated deliberation environment and group identity. This finding does not support previous findings on a communal display and group identity by Swaab et al. (2002). Swaab et al. (2002) found that a communal display of information about the negotiation task (a spatial planning issue) can support negotiators' "convergence of perceptions of reality," increase "cohesiveness and entitativity," and "stimulates consensus formation" (p. 143). They found that people with the communal display of information on the spatial planning developed a higher level of cohesion than those without a communal display. The measures of cohesion in their study test whether group members can develop their identity with groups and sense of unity (Swaab et al., 2002).

Table 11.

Two-way ANOVA Summary Table

Source	*Df*	*SS*	*MS*	*F*	*P*	η^2
Main Effects						
Collaborative IT-facilitated deliberation Environment (E)	1	139.55	139.55	5.67	.02*	.04
Prior cooperative interactions (Community building activity) (C)	1	3.74	3.74	.15	.68	00
Interaction						
E*C	1	2.4	2.40	.098	.76	.00
Error						
Within groups (Error)	122	3001.26	24.6			
Total	125	3148.93				

*$p < .05$

The IT-facilitated deliberation environment seems to have very little impact on the formation or enhancement of group identity. This result might be attributed to the technological configurations of the two experimental settings. The post-experiment questionnaires show that participants actually feel that it is slightly easier to retrieve and compare information within the environment with the individual laptop display and multiple mouse control than in the environment with the shared display and single mouse control. However, overall, they are more satisfied with the group communication in the latter environment. In future study, more work needs to be done to isolate the impacts of information displays from other input devices, such as the control mouse. In this way, future study can focus on how people deliberate and interact with each other in an environment with the communal display.

To understand whether the participants develop a shared understanding of the water challenges facing Phoenix, three questions were also included in the post-experiment survey asking participants whether they agree that Phoenix is facing a serious water problem and resident indoor and outdoor water use have great impacts on water sustainability in Phoenix. The shared understanding variable is measured by the summative value of three questions on a scale of 1-7 (Min = 3, Max = 21, α =.64), seen in Table 12. The average shared understanding is 18.67 (SD = 2.11). Since the shared understanding variable is also skewed to the right, a Mann-Whitney test instead of the two sample t-test has been conducted. Hypothesis 4 is not supported since the Mann-Whitney test shows that people who interacted with a communal display of WaterSim showed slightly

lower level of shared understanding (M = 18.28, SD = 2.23) than people who interacted with a laptop version (M = 19.12, SD = 1.79) (Mann-Whitney U = 465, z = -1.64, p = .051, one-tailed). This finding is different from what Swaab et al. (2002) found in their study. They noted that the communal display of information on the spatial planning can help develop a share understanding, which is measured by the extent the negotiators agree on the benefits of building a harbor area and pipelines for the environment and the organization (Swaab et al., 2002).

Table 12.

Shared Understanding of Water Sustainability

Variable	Response Category (1=strongly disagree, 7=strongly agree)	IT-Facilitated Communication Environment	
		Communal display, Single mouse control (*n* = 28)	Multiple laptops, multiple mouse controls (*n* = 43)
Shared understanding of water sustainability	Phoenix is facing a serious sustainable water supply problem.	5.93 (*SD* = 1.15)	6.37 (*SD* = .85)
	Residential outdoor water use has great impacts on the water sustainability in Phoenix (such as, pools, landscape watering).	6.43 (*SD* = .92)	6.56 (*SD* = .63)
	Residential indoor water use has great impacts on the water sustainability in phoenix (such as shower, toilets, laundry, etc.).	5.93 (*SD* = 1.08)	6.19 (*SD* = .85)

The five-minute community building activity does not have significant influence on the individual participants' group identity. This finding does not support hypothesis 5 that the warm-up activity contributes to developing stronger group identity. In addition, the previous Mann-Whitney *U* test shows that the warm-up activity does not bring about differences in participants' later token contributions.

Previous research findings are inconclusive on the interactions among warm-up discussions, social identity, social norm, and collaborative behavior.

Chen et al. (2007) argued that the warm-up activity may increase group identity and subsequently influence the cooperative behavior. De Cremer and van Dijk (2002) proposed that social identity can transform individual goals of maximizing personal interests into collective goals rather than amplify existing trust. Yet other scholars noted that the warm-up activity influences people's cooperative behavior not through its influences on social identity, but through its impacts on commitment and perceived social norms (such as Bouas & Komorita, 1996; Kerr & Kaufman-Gilliland, 1994). Chen & Komrita (1994) found that the cooperation rates do not differ between nonbinding pledge conditions and no-pledge conditions, whereas before-task pledges with binding components or commitment can influence participants' cooperation rates. Bouas and Komrita (1996) suggested that common fate does not suffice to increase group identity. They also found that group identity is not correlated with cooperation rates, whereas the perceived consensus is highly correlated with the cooperation outcomes (Bouas & Komrita, 1996). Kerr (1996) also assumed that it is through the commitment rather than the group identity derived from the face-to-face communication that encourages cooperative behavior. In short, these scholars argued that the discussions, no matter if the activity occurs before the task or in the middle of the task, only matters when the activity can create or enhance people's perceived group norm or commitment to cooperate.

The experimental findings appear to be more aligned with the groups of scholars who emphasized the importance of social norms and commitments. The variable of perceived group norm was added to the model and another ANCOVA

test was conducted. As seen in Table 13, compared with the warm-up activity, the perceived group norm has more explanatory power (η^2 = .18).

Table 13.

Two-way ANCOVA summary table

Source	*Df*	*SS*	*MS*	*F*	*P*	η^2
Main Effects						
Collaborative IT-facilitated Environment (E)	1	94.03	94.03	4.6	.03*	.04
Prior cooperative interactions (Community building activity) (C)	1	2.97	2.97	.15	.70	.00
Interaction						
E*C	1	.557	.557	.27	.87	.00
Covariate						
Perceived group norm	1	526.6	526.6	25.75	.00***	.18
Error						
Within groups (Error)	121	2474.66	20.45			
Total	125	3148.93				

* p<.05, ** p<.01, *** p<.001

To remove the effects of other possible covariates on the group identity, another ANCOVA test was conducted. A set of variables were included as covariates, including race, gender, group size, identity with Phoenix, confidence in using computers, and perceived group norm. As seen in Table 14, there are no big changes to the relationships between the environments, the prior cooperative activity, and the group identity.

Table 14.

Two-way ANCOVA summary table with all covariates

Source	*Df*	*SS*	*MS*	*F*	*P*	η^2
Main Effects						
Collaborative IT-facilitated Environment (E)	1	136.79	136.79	6.67	.01*	.05
Prior cooperative interactions (Community building activity) (C)	1	.69	.69	.034	.85	.00
Interaction						
E*C	1	5.54	5.54	.27	.60	.00
Covariate						
Race (Nonwhite)	1	14.43	14.43	.70	.40	.01
Gender (Male)	1	6.46	6.46	.32	.58	.00
Group size (3 or 4)	1	.39	.39	.02	.89	.00
Confidence in using computers	1	36.74	36.74	1.79	.18	.02
Identity with Phoenix	1	37.79	37.79	1.84	.18	.02
Perceived group norms	1	405.14	405.14	19.76	.00***	.15
Error						
Within groups (Error)	116	2378.25	20/50			
Total	125	3148.93				

* $p<.05$, ** $p<.01$, *** $p<.001$

Since the five-minute warm-up activity asked the participants to discuss the desired features and the entrance for the imagined neighborhood in Phoenix they hypothetically live in, the discussion is not relevant to the later social dilemma game. Hence, this warm-up discussion activity does not influence how the

participants perceive how the other groups will do in the game, or develop any commitments to the neighborhood water recycling project in the social dilemma activity. This might also explain why the before-task discussions do not bring statistically significant differences to the token contributions.

Overall, our experimental results show that when people deliberated and interacted in an IT-facilitated communication environment with a communal display and single mouse control, they demonstrated a higher contribution toward the social outcome, which suggests a more collective orientation with regard to the problem. This could be because that when people look at the communal display of the problem scenario at the same time, they are more likely to acknowledge others' concerns, perspectives, and questions rather than focusing on their own viewpoints. In other words, the social presentation of the problem broke down perceptions of individual positions and created a communal challenge people were facing.

Additionally, the single mouse control may not contribute to the efficiency of solving the problems, but it may encourage more participation and interactions between participants since they need to discuss with each other to decide what factors to change or what policies to implement. Or, this could simply be because people in the more communal deliberation environment may just enjoy the novel way of presenting information compared with individual laptop display of information. More research in the future is needed to understand the mechanisms by which the IT-facilitated communication environment affects individuals' social orientation and cooperative behavior.

In the following chapter five, policy implications, limitations of the study, and future research work are discussed in detail.

Chapter 5: Conclusions, Policy Implications and Future Work

The increasing complexity of management challenges makes it necessary to seek collaboration from all stakeholders, organizations, communities, and individual citizens to ensure successful public administration practice. Public administrators face a great task encouraging and sustaining collaboration from multiple parties to achieve collective goals. This dissertation investigates whether different IT-facilitated deliberation environments and prior cooperative interactions influence people's deliberation, and if so, to what extent they affect people's group identity and their collaborative behavior when facing a social dilemma scenario.

This last chapter situates the research findings in a broader context brought by a new generation of information technology, which in turn can help generalize this small-scale study to a bigger picture. Then, this chapter provides practical suggestions for public managers and community leaders on how to design and develop the desired features of IT-facilitated interaction environments for face-to-face and computer-mediated online public deliberation activities. This chapter also discusses lessons and strategies on how to build a stronger sense of community for community development and community-based efforts to achieve collective goals. Last, this chapter concludes with the limitations of the study design and experiment implementation, and future research.

Promises of a New Generation of IT for Citizen Engagement and Collective Action

The contemporary e-government development in the United States has neither reached the highly interactive stage (Coursey & Norris, 2008) nor lived up to the expectations of transforming the hierarchical structure of power and authority (Kraemer & King, 2006; Rethemeyer, 2007). It still lacks the features encouraging civic engagement in public services (Brainard & McNutt, 2010; Coursey & Norris, 2008; Dawes, 2008; Norris, 2010). Yet the recent years have witnessed the rapid advances and great potential of web 2.0 and social media technology, characterized by "peer production," "open source and open context," "user-centered innovation," "crowdsourcing," and "task granularity" (Mergel, Schweik, & Fountain, 2009, pp. 9-16). As Mergel and her colleagues argued, the fundamental changes and potential transformative of web 2.0 technology lie in "the ease in which interactive collaboration can occur between organizations or between individuals with very limited technical know-how" (Mergel, et al., 2009, p. 30). Recent studies further differentiate the general Internet use and other types of IT, such as social network websites and physically-based virtual communities. Facebook, a very popular social networking website, has been found to be positively correlated with all three types of social capital: bridging, bonding, and maintaining social capital, though the general Internet use does not significantly correlate with the growth of social capital (Ellison, Steinfield, & Lampe, 2007). Scholars also began to analyze the emerging "e-neighborhood" to explore its potential for initiating contacts in "rather contact-resistant communities of new

estates" and to mobilize resources in a neighborhood (Kotus & Hlawka, 2010, p. 204). Yet these studies of emerging IT tools remain at the early stage and lack systematic theoretical frameworks.

The argument about the transformative power of IT continues. There is no clear and comprehensive answer what exactly the new generation of IT can bring to civic engagement, public deliberation, and collaboration between individuals and between organizations. As DiMaggio and his colleagues argued, the Internet or other new emerging web 2.0 technology themselves may have "no intrinsic effects on social interaction and civic participation," and what is needed is to study "the institutional conditions that encourage or discourage successful exploitation of this technology for collective ends" (DiMaggio, Hargittai, Neuman, & Robinson, 2001, p. 319). Fountain (2001) in her seminal book, *Building the Virtual State*, also took an institutional perspective and proposed the "technology enactment" framework to study "the relationship between information technology, organizations, embeddedness, and institutions" (p. 83). In contemporary theory and practice of public administration, it is important to go beyond the "ICT-driven view of e-government" that emphasizes the role of IT for improving efficiency of internal government operations and enhancing the service delivery (Dawes, 2009). It is crucial to take a holistic approach and take into account the complexity of economic, political, and social contexts and to draw perspectives on "such matters as governance, trust, multi-culturalism, and human, organizational, and institutional capabilities" (Dawes, 2009, p. 260). Dawes (2009) argued that e-government research should go beyond examining the applications of IT to

improving services and administration. She suggested that e-government research needs to adopt a more "encompassing perspective" to examine the interaction between government and society within a changing technological environment, (Dawes, 2009). She noted that compared with e-government, "e-governance" can better capture the broader focus.

Unlike studies in e-government or e-governance, Johnston (2010) went further and proposed to build "smart governance infrastructure," arguing that "the interaction of technology and society can be leveraged" to help design "interaction-defined, participation-based" future "governance infrastructures" (s122). He provided a very inspiring definition of governance infrastructures:

> A government infrastructure is the collection of technologies and systems, people, politics, practices, and relationships that interact to support governing activities (Johnston, 2010, p. 122).

In other words, when thinking about the potential of IT development, we should embed the discussions in the governance infrastructure and focus on how the intersection of technology and society can mobilize and "augment society's ability to organize, interact, and govern" (Johnston, 2010, p. 122). We need to think of information technology as the new avenue through which citizens can contribute to identifying and framing policy concerns, and proposing ideas, thoughts, and solutions to collective challenges. We need to consider information technology as the channels to encourage public deliberation, to enhance citizens' trust in government, and to initiate and sustain cooperative behavior between policy makers, stakeholders, and citizens to address collective challenges.

This dissertation explores a designed IT-facilitated deliberation space in which people come together to interact with a computer-simulated scenario of water supply and demand, and deliberate on the policy challenges and possible solutions. This results show that the setting for deliberations, especially those that are dependent on high levels of trust between participants, influences the choices of the participants and ultimately the success of the collaboration. The experimental findings show that, overall, the IT-facilitated deliberation environment demonstrated great potential in encouraging group discussions and collaborative behavior.

Facing the increasingly complex policy challenges and the great opportunities provided by IT revolution, public administrators need to redefine their roles. It is time to think about what a digital age means for public administrators to better serve people. Public administrators need to provide effective pathways for citizens to contribute their ideas, thoughts, and other resources, offer support for online communities to involve citizens in local community activities, and provide mechanisms to cultivate mutual responsibility of both citizens and government (Johnston, 2010).

Now, a growing number of examples exist in which citizens make use of social media to contribute to the rebuilding of communities after natural disasters, to provide support to people suffering from severe diseases, and to make government more responsible and effective. When envisioning the future generation of IT for citizen participation and collaborative governance, we need to think beyond any particular type of information technology, and explore the

potential of information infrastructures in a broader sense. To support public deliberation and foster collaboration, features of IT that can encourage collective contributions and help build a shared understanding of public concerns need to be considered seriously. More research needs to be done to study the diverse types of information technology, not just the Internet in general or government web sites. More systematic studies are needed to examine how civic organizations and associations utilize the emerging information technology to mobilize resources and coordinate to address common challenges, and to examine the role of public administrators, the organizational contexts, and the institutional conditions (DiMaggio, et al., 2001).

Sense of Community, Community development and Community Governance

The importance of community has historically been a part of American democracy and pubic administration. The consequences of underdeveloped community life and the declining social capital have been described in depth in Putnam's ground-breaking book, *Bowling Alone: The Collapse and Revival of American Democracy*. Putnam (2000) used nationwide survey data to show that the total associational group membership has dropped by about 25 percent since 1974, and that informal social connectedness had also dropped within the same time period. Scholars have proposed diverse ways to help community building and development, including institutional designs, empowering communities with resources and power, enhancing collaboration, etc. (Chaskin, 2001; Warren, 2001). Among these strategies, one crucial aspect is to encourage collaboration "to find

solutions to local problems, and to work toward shared objectives that contribute to the well-being of the local community as a whole" (Simpson, 2005, p. 108).

The experiment in this dissertation was designed to enhance a sense of community (group identity) among the participants through a five-minute warm-up discussion about the desired features and entrance slogan for the hypothetical common neighborhood. The experiment results revealed no significant differences in the participants' attitudes toward the group between the group that participated in the warm-up activity and the group that did not participate in the activity. This finding could be attributed to the insufficiency of a five-minute non-task related interactions as a strategy to cultivate a stronger sense of community. The experiment also indicates that the warm-up discussion cannot explain adequately either participant's formation of group identity or their collaborative behavior in the social dilemma scenario, whereas the perceived group norm plays a relatively more important role in explaining people's group identity. Participants in the groups that took part in the pre-task interaction activity do show a slightly higher level of identity with Phoenix.

The five-minute warm-up group activity did not foster trust, reciprocity, and commitments to collaboration, which have collectively conceived as crucial factors for successful collaboration and collective action (Ansell & Gash, 2007; Ostrom, 1990). Despite the number of diverse angles and frameworks used to study collaborative governance, shared understanding, trust, and commitments recur as common themes necessary to foster collaboration (Ansell & Gash, 2007; Bryer, 2009; Johnston, et al., 2010; Yang, 2005). Yang (2005) proposed that

"public administrators' trust in citizens" is "a missing link in citizen involvement efforts" (p. 273). According to the survey data, Yang found that public administrators generally hold a "neutral view of citizens" and called for efforts from administrators to "serve as trust initiators, to initiate the process to restore and maintain the mutual trust between government and citizens" (pp. 273, 283). Bryer (2009) analyzed two cases of collaboration between neighborhood councils and government departments in a Collaborative Learning Project in Los Angeles, CA. He proposed that trust in citizens, long-term relational commitments, and shared goals affect the responsiveness of administrators in collaboration (Bryer, 2009). Building on field observations of successful cases in community health programs in Colorado, Johnston and his colleagues developed multi-agent models and conducted simulated experiments to explore how institutional designs in the inclusion process affect the outcomes of collaborative governance (Johnston, et al., 2010). They found that the "deliberative planning" (allowing enough time to deliberate before progression) and "thoughtful inclusion of new participants" (building interdependency) interventions can affect the interactions of participants, foster trust, strengthen understanding and commitment, and ultimately contribute to building collaborative relationships (Johnston, et al., 2010, p. 14).

Thus, in future efforts to cultivate a stronger sense of community, it is more worthwhile to explore activities that directly concern the residents' daily lives (issues such as residential safety, and physical revitalization of community), and engage community members in local public affairs to foster their trust with each other and their commitment to social norms.

Studies of IT use at the community level remain very limited. In addition to examining the impact of the Internet use on social capital and economic development in communities, future studies need to explore whether and how IT development can help foster "spirit of community". Community informatics has recently emerged as an independent research field that studies how to apply information and communication technologies in order to "enable and empower the community processes," to support community development, and to achieve community objectives (Gurstein, 2007; Stoecker, 2005, p. 11). More studies are needed to explore the potential of IT advances for developing social capital, strengthening social ties among community members and outside the community, and fostering collaboration to address shared challenges.

Limitations of the Study

There are several limitations of the study that need to be further discussed, including the strengths and weaknesses of the experimental design itself and the technological constraints and implementation problems.

The experiment methodology. As explained in chapter three, the experimental design has its strength in making causal inferences, whereas it has its own limitations. The experimental design can help exclude or control possible impacts of the confounding factors and focus on the variables of research interests. In this dissertation, experiments were conducted to explore the impacts of two types of IT-facilitated communication environments and a community-building activity on people's interactions, social identity, and collaborative behavior. On

one hand, the research is focused on the aforementioned key variables. It asks the participants to participate in a deliberation activity and focuses on their 30-minute interactions between three to four participants situated in different experimental settings at the Decision Theater. Through randomization, except the two treatments in the experiment, all variables are expected not to be systematically different except the two experiment treatments, which lends support to the validity of the observed impacts of the treatments. On the other hand, it has less strength in providing a more comprehensive explanation for the complex relationships between social identity, social norms, and collaborative behavior. By contrast, using other non-experiment studies such as surveys, scholars may include a variety of variables in their survey questionnaires (such as Barr, 2008). For instance, Barr (2008) proposed in a survey study that people's environmental behavior and actions are influenced by a wide range of factors, including "environmental values," "situational characteristics," (access to resources and necessary infrastructure) and "psychological variables (awareness and acceptance of subjective social norms)" and included measurements for all of these factors (p. 227). In short, the experimental design allows the study to focus on the variables of interest in this dissertation but leaves out some other policy-relevant variables.

The random sampling issues and technological constraints. The initial method of recruiting students was through sending out e-mails to undergraduate students randomly selected from the ASU student registration database. Due to the extremely low e-mail response rate (around 1%), mixed sampling methods were used to recruit participants, including in-class announcements in large

classes, on-site recruitment, and snowballing. Strictly speaking, the participants cannot be considered a totally random sample. Fortunately, the mixed sampling methods do create a very diverse sample of participants across different races and ethnicities.

The ideal experimental design was to separate the design of single display from the configurations of input control so that only different types of information display are examined. However, only one control panel can be allowed in the Drum version of WaterSim. Therefore, the IT-facilitated deliberation environments includes two components, one seven-screen shared display and one mouse control versus multiple regular laptop displays and multiple mouse controls, which fortunately can also find support from HCI literature. In fact, some scholars called for more research comparing the "sharable interfaces" in its entirety, instead of focusing on "the single factor" investigating one single technological feature (Rogers, Lim, Hazlewood, & Marshall, 2009, p. 79).

The experimental design also presented time constraints for fostering trust and commitment. Constrained by the timeline and other factors, this experiment utilized a one-time measure to test participants' collective orientation in a social dilemma game. A five-minute pre-task interaction was introduced to cultivate good feelings about the group (a hypothesized neighborhood) and each other. Yet, as studies show, it may take time for participants to initiate a conversation and know each other enough to develop a certain level of trust (Lewicki, 2006). In the social dilemma game, participants choose to keep tokens to themselves, or to contribute to a neighborhood water recycling project which will benefit the entire

group by earning double tokens, and participants only make a one-time contribution. Previous studies suggested that it takes longer time to build a reciprocal relationship and trust (Lewicki, 2006). It would be worthwhile to explore how participants change their strategies as they play multiple times.

Future Research

Current e-governance research has focused much attention on computer-mediated communication in the virtual community and on the impacts of the Internet and social media. This dissertation instead examined peoples' face-to-face interactions under IT-facilitated communication environments. The experiment results suggest that when participants deliberate on the local policy issues through interacting in a designed deliberation space with a communal display and a single mouse control, they show more collaborative behavior in a social dilemma scenario than those in an environment with individual laptops and multiple mouse controls. This type of IT-facilitated deliberation environment can provide not only the deliberation context for peoples' interactions, but also an important public deliberation platform for fostering collaborative behavior on community problems. This study calls for more attention and future research to studying emerging information technologies enabling or strengthening the community development. The deliberation space for a social presentation of community challenges may contribute to building shared understandings and a stronger sense of community, and facilitate coordinating collective action to pursue the collaborative goals. More systematic studies are needed to further

understand both contributing factors and hurdles to the successful collective action among diverse stakeholders. More systematic studies are needed to reflect on effective institutional designs that can encourage use of IT to enhance citizen engagement and community involvement in tackling collective challenges.

Future work will further extend this dissertation. This dissertation examined a particular type of IT-facilitated deliberation environment which used an interactive computer simulation of water demand and supply as the deliberation context and different information display interfaces to facilitate people's deliberation activities. Future studies will go beyond studying this particular deliberation environment and study a variety of IT tools, including but not limited to social media, dynamic computer simulations, and virtual communities, which demonstrate potential in changing the way people work, promoting collaborative behavior, and encouraging citizens to engage more actively in public affairs.

This dissertation has limitations that can be addressed in future studies. The participants in this dissertation were primarily undergraduate students, which might limit its external validity. With support from a grant at the ASU College of Public Programs, plans are made to run another round of experiments with participants composed of a combination of water management professionals, Masters of Business Administration (MBA), and Masters of Public Administration (MPA) students. Besides the computer simulations of water supply and demand, other simulations of community problems can also be utilized as the policy scenario to test how people deliberate on a diverse range of common challenges.

Opportunities will be explored to work with the ASU Decision Center for a Desert City (DCDC) to create a more effective platform for experimentation, policy deliberation, and collaborative learning. This can be done by increasing interactivity of the interface and integrating experimental conditions directly into WaterSim. The role of participants may be embedded in WaterSim so that participants can take different roles to examine the water issue. Additionally, the IT-facilitated online deliberation environment can be included as the third deliberation environment for the public deliberation activity to help further identify the desired features of IT-facilitated deliberation platforms.

Another challenging task of studying computer-mediated deliberation activity is to understand the deliberation quality both in terms of the process and outcomes. Enormous conversation data exist on online forums and in face-to-face communication. Drawing on the coding schemes and methods developed in the field of political science, computer-mediated deliberation can be coded along six dimensions, including "reasoned opinion expression," "sourcing" (reference to information), "disagreement," "equality" to participate, "topic," and "engagement" (Stromer-Galley, 2007, pp. 4-7). It would be particularly interesting to examine whether a designed IT-facilitated communication environment can improve the equality of participation and encourage participation, and to study what features would be more friendly to encourage idea expressions or other types of contributions from the segment of population that are traditionally perceived as incompetent for participating in policy making. Experiments will be designed and implemented to not only examine how people communicate and interact with

each other on public environmental issues, but also to explore the effective features of the IT-enhanced scenaric device that can encourage more interactions and discussions, and promote equability in deliberation.

To conclude, the rapidly advancing IT—from the Internet to the latest social media—provides great opportunities for people to interact with each other, to access and retrieve the most up-to-date information, to gather attention and mobilize resources for collective action, and to engage in community life and public affairs. Yet supportive institutional designs and organizational structure are needed to make good use of IT for cultivating a sense of community, developing trust, and fostering commitments to collective action. More studies are needed that examine the IT-facilitated communication process and its outcomes and explore how IT can be better utilized to facilitate collaboration and to enhance social connections. This dissertation mainly focuses on the influence of IT tools on the collaboration process. Given the complexity of collaborative governance, future research needs to look at a more comprehensive picture and address the dynamic relationships between the use of IT tools and the other dimensions of collaborative governance, such as the institutional design, facilitative leadership, and diverse initial collaboration conditions. In addition, besides the IT-facilitated deliberation environment that was studied in this dissertation, there are various promising IT tools that need to be systematically studied to fully exploit their potential for better collaborative governance.

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APPENDIX A

PRE-EXPERIMENT SURVEY QUESTIONNAIRE

Thank you for participating in the study. Please follow the instruction to fill out the survey questions. Your answer to the questionnaires will be anonymous.

Question 1:
Please enter your participant code _____

Question 2:
How confident are you in using computer to search for information?
(1 = not at all confident, 4 = neutral, 7 = extremely confident)

___ 1 ___ 2 ___ 3 ___ 4 ___ 5___ 6 ___ 7

Question 3:
Do you know anyone in your group?
☐ Yes
☐ No

Question 4:
Many things influence water supply and demand in Phoenix. What do you think some of those things are, and how do they interact?

_____

_____

_____

_____

Question 5:
Please indicate whether you think the following statements are true or false.

(1) Phoenix gets water from the Salt and Verde Watersheds.

☐ True ☐ False ☐ Do not know

(2) Phoenix gets water from the Colorado River.

☐ True ☐ False ☐ Do not know

(3) Phoenix pumps groundwater from the aquifer to meet its water demand.

☐ True ☐ False ☐ Do not know

(4) Climate Change does not influence the availability of water in Phoenix.

☐ True ☐ False ☐ Do not know

(5) Phoenix receives about the same amount of surface water flow (e.g., river runoff) each year.

☐ True ☐ False ☐ Do not know

Question 6:

On a 1-7 scale (1 = strongly disagree, 4 = neutral, 7 = strongly agree), please indicate to what extent you agree or disagree with the following statements:

(1) Phoenix is facing a serious sustainable water supply problem.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___6 ___7

(2) Residential outdoor water use (e.g., pools, landscaping) has great impacts on water sustainability in Phoenix.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5___6___7

(3) Residential indoor water use (e.g., toilets, laundry) has great impacts on water sustainability in Phoenix.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

Question 7:

On a 1-7 scale (1=not at all a threat, 4=neutral, 7= a great threat), please rate the following possible threats to water sustainability:

(1) The amount of agricultural use of water

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(2) The amount of residential use of water (e.g., showers)

___ 1 ___ 2 ___ 3 ___ 4 ___ 5___ 6 ___7

(3) Drought

___ 1 ___ 2 ___ 3 ___ 4 ___ 5___ 6 ___7

(4) Climate change and global warming

___ 1 ___ 2 ___ 3 ___ 4 ___ 5___ 6 ___7

(5) Population growth

___ 1 ___ 2 ___ 3 ___ 4 ___ 5___ 6 ___7

Question 7: On 1-5 scale (1 = strongly disagree, 2 = disagree, 3 = neutral/unsure, 4 = agree, 5 = strongly agree), please indicate to what extent you agree or disagree with the following statements:

(1) I worry about conserving energy only when it helps to lower my utility bills.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(2) Contributions to community organizations can greatly improve the lives of others.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(3) The individual alone is responsible for his or her satisfaction in life.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(4) It is my duty to help other people when they are unable to help themselves.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(5) Many of society's problems result from selfish behavior.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(6) Households like mine should NOT be blamed for environmental problems caused by energy production and use.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(7) My responsibility is to provide only for my family and myself.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(8) Use of renewable energy is the best way to combat global warming.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(9) My personal actions can greatly improve the well beings of people I don't know.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

APPENDIX B

POST-EXPERIMENT SURVEY QUESTIONNAIRE

Thank you for participating in the study. Please follow the instruction to fill out the survey questions. Your answer to the questionnaires will be anonymous.

Question 1:
Please enter your participant code _____

Question 2:
Many things influence water supply and demand in Phoenix. What do you think some of those things are and how do they interact?

_____

_____

_____

_____

Question 3:
Please indicate whether you think the following statements are true or false.

(1) Phoenix gets water from the Salt and Verde Watersheds.

☐ True ☐ False ☐ Do not know

(2) Phoenix gets water from the Colorado River.

☐ True ☐ False ☐ Do not know

(3) Phoenix pumps groundwater from the aquifer to meet its water demand.

☐ True ☐ False ☐ Do not know

(4) Climate Change does not influence the availability of water in Phoenix.

☐ True ☐ False ☐ Do not know

(5) Phoenix receives about the same amount of surface water flow (e.g., river runoff) each year.

☐ True ☐ False ☐ Do not know

Question 4:
On a 1-7 scale (1 = strongly disagree, 4 = neutral, 7 = strongly agree), please indicate to what extent you agree or disagree with the following statements:

(1) Phoenix is facing a serious sustainable water supply problem.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___6 ___7

(2) Residential outdoor water use (e.g., pools, landscaping) has great impacts on water sustainability in Phoenix.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5___6___7

(3) Residential indoor water use (e.g., toilets, laundry) has great impacts on water sustainability in Phoenix.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

Question 5:

On a 1-7 scale (1=not at all a threat, 4=neutral, 7= a great threat), please rate the following possible threats to water sustainability:

(1) The amount of agricultural use of water

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(2) The amount of residential use of water

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(3) Drought

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(4) Climate change and global warming

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(5) Population growth

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

Question 6:

On 1-7scale (1 = strongly disagree, 4 = neutral, 7 = strongly agree), please indicate to what extent you agree or disagree with the following statements:

(1) I think of the four of us as a group rather than as four distinct individuals

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(2) I feel like a group member rather than a distinct individual.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(3) I feel I belong to this group.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(4) I see myself as an important part of this group.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(5) The other people in the group were making choices to maximize the group interest.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(6) The other people in the group were making choices to maximize their own payoffs.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

Question 7:

On a 1-7 scale (1 = strongly disagree, 4 = neutral, 7 = strongly agree), Please indicate to what extent you agree or disagree with the following statements:

(1) I feel strongly attached to the Phoenix area.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(2) I often talk about the Phoenix area as a great place to live.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

Question 8:

On a 1-7 scale (1 = strongly disagree, 4 = neutral, 7 = strongly agree), please indicate to what extent you agree or disagree with the following statements:

(1) Water sustainability in Phoenix should be maintained or achieved through policies or programs that increase household water costs.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(2) Water sustainability in Phoenix should be maintained or achieved through regulations. (e.g. require the use of gray water for toilets in buildings)

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(3) Water sustainability in Phoenix should be maintained or achieved through policies or programs that emphasize social responsibility and social commitments to the society (e.g., community education programs).

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

Question 9:
On a 1-7 scale (1 = strongly disagree, 4 = neutral, 7 = strongly agree), Please indicate to what extent you agree or disagree with the following statements:

(1) It is easy to search or retrieve information on the screen.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(2) It is easy to compare different information on multiple screens.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(3) The way information is presented on the screen facilitates my group discussion.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(4) I am satisfied with the way information is presented on the desktop/decision theater screen.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5___ 6 ___7

(5) I am satisfied with the way my group communicated.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

(6) I am satisfied with my performance in the game exercise.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___7

Question 10:
What is your gender?
☐Man
☐Woman
☐Transgender
☐Prefer not to answer

Question 11:
Which of the following best describes your ethnic background? (you may select more than one)
☐ Hispanic or Latino, of Spanish origin
☐ Not Hispanic or Latino

Question 12:
Which of the following best describes your racial background? (You may select more than one)
☐ American Indian or Alaska Native
☐ Asian
☐ Black or African American
☐ Native Hawaiian or Other
☐ White
☐ Prefer not to answer

Question 13:
Are you currently a student?
☐ Yes, undergraduate student
☐ Yes, graduate student
☐ No

Question 14:
On 1-7 scale (1 = not at all like me, 2 = not much like me, 3 = somewhat like me, 4 = quite a lot like me, 5 = just like me), please indicate how well each of the following statements describes you:

(1) I can always manage to solve difficult problems if I try hard enough.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(2) If someone opposes me, I can find the means and ways to get what I want.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(3) It is easy for me to stick to my aims and accomplish my goals.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(4) I am confident that I could deal efficiently with unexpected events.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(5) Thanks to my resourcefulness, I know how to handle unforeseen situations.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(6) I can solve most problems if I invest the necessary effort.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(7) I can remain calm when facing difficulties because I can rely on my coping abilities.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(8) When I am confronted with a problem, I can usually find several solutions.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(9) If I am in trouble, I can usually think of a solution.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5

(10) I can usually handle whatever comes my way.

___ 1 ___ 2 ___ 3 ___ 4 ___ 5