ASSOCIATIONS BETWEEN ONLINE CIVIC ENGAGEMENT AND PERSONAL TECHNOLOGICAL CHARACTERISTICS AMONG COLLEGE STUDENTS

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Abstract

This thesis describes a cross-sectional study that looked at the level of online civic engagement among college students and its association with their technological experience and characteristics. In describing the use of technology in today's youth, Bers' (2005) Positive Technological Development (PTD) framework construes youth technological experiences and attitudes about technology in terms of the six Cs of PTD – technological competence, confidence, character, caring, connection, and contribution. Guided by this framework, this thesis examines a) how college students differ in their uses of the Internet for pro-social purposes, and b) how these differences might be associated with variations in their technological experiences and their attitudes about technology.

Eighty-five college freshmen from Tufts University participated in this study. To examine how participants responded to questions about the six Cs of PTD, exploratory factor analysis was conducted on data collected by using the *Positive Technological Development Questionnaire* (Bers, 2005). Results suggested that participants' responses could be described in terms of three constructs. The three constructs were interpreted as perceived technological efficacy, social uses of technology, and technological contribution.

A series of multiple regression analyses was conducted to assess the associations between these three constructs and participants' reported level of online civic engagement. Results indicated that participants' level of social uses of technology was significantly positively related to their level of online civic engagement, whereas participants' perceived technological competence was significantly negatively related to their online civic engagement. Results suggested that there indeed were variations in the way college students perceived their use of technology, and variations in these individual technological characteristics were associated with the extent to which these youth use Internet technologies for civic and pro-social purposes. This thesis concludes with a discussion of the implications of these results and suggestions for future research.

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Chapter I: Problem Statement

The purpose of this thesis is to examine the extent to which variations in the level of youth online civic engagement might be associated with differences in their technological competence and their attitudes about technology. To that end, this thesis reports results from a study that measured the frequency with which college students participated in social and civic activities by using Internet technologies as well as their experiences with and attitudes about using other computer-based technologies. This thesis describes the theoretical and historical bases as well as the methodological components and findings of a cross-sectional survey study about the level and correlates of civic-oriented technology use among first-year college students at Tufts University.

The study was initiated in response to growing concerns about the surging number of American youth Internet users and the implications of this surging number of youth users for the quality and the level of civic engagement and social development among American youth (Lenhart, Madden, & Hitlin, 2005; Putnam, 2000). In writing about the civic engagement and social responsibilities of today's American youth, Putnam (2000) contends that the Internet plays an important role in shaping, and in fact posing a problem to the future of the American civic landscape. Whether or not one agrees with Putnam in viewing the current civic landscape as a "problem" needing a solution, the Internet, without a doubt, plays a significant role in the way future generations identify themselves as active citizens (Blumler & Coleman, 2001). The Internet affords today's youth instantaneous means of communication, anonymity, and ways to connect to people from all around the world simply by logging onto the Internet from their bedrooms. The Internet, thus, provides youth an additional outlet aside from traditional means (such as school newspaper and school clubs, volunteering activities, and community service) to engage in meaningful exchange with peers concerning civic and pro-social issues.

Although we do not entirely understand the nature of the Internet's potential impact on the civic lives of American youth, these concerns are indeed warranted, if not by the sheer number of American youth Internet users (Lenhart, Madden, & Hitlin, 2005), then by the overwhelming numbers of activities and opportunities, civically oriented or otherwise, available on the Internet for youth in America and abroad (Center for Media Education, 2001). For example, the Pew Internet and American Life project (Lenhart, Madden, & Hitlin, 2005) reported that about 87% of American youth between the ages of twelve and seventeen use the Internet, and over half of these teens reported using the Internet on a daily basis. Furthermore, a survey by the Henry J. Kaiser Family Foundation (2002) reported that about three out of every four teen users log onto the Internet to get news and information about current events. About half of these teen users learn about politics and about presidential campaigns and elections primarily by going online, and approximately one in five youth users rely heavily on the Internet for their political news and election information. Although there is a large number of youth who use the Internet for civic matters, not all youth users do so. Then one might wonder, given the same Internet technology, what are the characteristics and differences between youth who use the Internet to learn about and participate in civic and social activities and youth who do not use the Internet for these particular purposes.

Insights into this issue are particularly important and timely in the fields of research on human development and on computer-mediated communication (CMC). On one level, such an inquiry could provide new perspectives about how the personal characteristics of youth might contribute to their online civic engagement. Furthermore, they could also help us examine the legitimacy and urgency of these growing concerns regarding the changing American civic landscape because of the Internet. As a result, insights into these issues could aid educators and technologists in developing Internet content that could potentially benefit youth civic development and encourage positive uses of the Internet.

In reflecting on these growing concerns and questions about the nature of the relationship between American youth and the Internet, the goal of this thesis is to describe results from a study that looked at how college students differed in their uses of the Internet for pro-social purposes and how these differences might be associated with variations in their technological experiences and their attitudes about technology.

To organize the present discussion, this thesis first describes the Positive Technological Development theoretical framework (Bers, 2005) as the guiding theoretical approach from which this thesis draws a conceptual foundation and generates a research goal. The Positive Technological Development (PTD) framework is particularly useful in this discussion because it provides a vocabulary and a lens through which to investigate systematically the personal characteristics of individuals as they relate to the way people use and think about technology. This particular framework grew out of a large body of literature in the fields of research on computer-mediated communication, educational technology, and applied developmental science. As will be further described in this thesis, these three fields of research provide unique yet complementary lenses through which to understand the impact of the Internet on the personal and social development of today's youth. Although these bodies of literature provide pertinent information about youth's activities online and about youth civic engagement, they are not sufficient for answering the particular question about how individuals' level of participation in online civic activities might be associated with their technological competence and attitudes. As a result, a study was designed to use ideas from the PTD framework and examine the potential relationships between online civic engagement and youth personal technological characteristics, such as their previous technological experiences and attitudes about computer technologies.

The second part of this thesis describes the cross-sectional study and its results. Finally, this thesis ends with a discussion of the significance and implications of this study's findings.

Chapter II: Literature Review

The study reported in this thesis drew on Bers' (2005) Positive Technological Development theoretical framework to investigate the extent to which differences in college students' level of online civic engagement is associated with their technological competence and their attitudes about technology. The Positive Technological Development framework describes six characteristics of technology use and attitudes about technology as pertinent to the positive development of youth in today's technology-rich society. This framework is particularly useful in providing a set of vocabulary to describe the various ways in which youth may positively develop while using technology. These six characteristics include technological competence, confidence, connection, caring, character, and contribution. Each of these is defined in detail in Table 1. When a young person exhibits these characteristics when using technology, Bers asserts, the young person is more likely to attain positive technological development, or an overall success in leveraging the potential of technology to promote positive development of the self.

Each of these six characteristics is considered a distinct but inter-related asset that dynamically interacts with other assets and with the context. These interactions thus provide a pathway through which youth would develop into successful technology users. Furthermore, Bers stipulates that youth who develop positively and successfully in these six Cs would be likely to contribute to their growth beyond simply their technological competence. As hypothesized, positive technological development could lead to the development of positive family and peer relationships and to the development of youth's identity as active contributors to their communities and to society (Chau & Bers, 2005).

Table 1
Working Definitions of the Six Cs of Positive Technological Development

Six Cs	*Definitions*
Competence	An ability to *use* technology, to *create* or *design* projects using the computer in order to accomplish a goal, and to *debug* projects and problem-solve.
Confidence	A sense of oneself as someone who can *act* and *learn to act successfully* in a technology-rich environment and *find help* when necessary.
Connection	Positive bonds and relationships *established* and *maintained* by the use of technology.
Character	An awareness and respect of *personal integrity and moral value, perseverance* over technical difficulty, and an ability *to express oneself* using technology.
Caring	A sense of *compassion* and *willingness* to respond to needs and concerns of other individuals, *to assist others* with technical difficulties, and to use technology as means to *help others in real life*.
Contribution	An orientation to *contribute* to society by *using and proposing* technologies to solve community and social problems

Bases for Positive Technological Development

The language and constructs that compose Bers' Positive Technological Development framework were derived from Lerner's work on Positive Youth Development (PYD, Lerner et al., 2005). Lerner et al. describe the "Five Cs" of positive youth development – competence, confidence, character, connection, and caring – as five developmental domains or assets that would propel a young person along a developmental trajectory toward an idealized adulthood, marked by successful contribution to the self, family, and community. The basis of PYD is framed by developmental contextualism (Lerner, 2002, 2004), an instance of developmental systems theory. Developmental systems theory posits that human development is plastic due to the dynamic connections between individuals and their contexts. As such, developmental contextualism posits that there exists a potential for systematic change across human development as a reflection of personal biological and psychological characteristics and of ecological, contextual, and historical influences. Furthermore, the relationships among these various levels of characteristics and influences are dynamically interactive, such that each of these levels bi-directionally interacts with other levels to create each individual's unique experiences and characteristics.

Plasticity in human development and the theory of developmental contextualism together propose that any particular individual might express different behaviors and embark on different developmental trajectory when given different ecological contexts; similarly, a particular ecological context might interact differently with different individuals' personal characteristics, and thus have varying impact across individuals. Lerner et al. (2005) hypothesize that positive human development can be promoted when there is an appropriate alignment between the unique assets of an individual and the assets that are afforded by the context or ecology in which the individual resides. The "Five Cs" of PYD, then, are instantiated to represent the various domains of these personal assets.

Bers, influenced by Lerner's work on PYD, conceives of technology-rich environments, such as the world that surrounds American youth today, as one particular ecological context which affords unique assets that could interact with the personal assets of youth technology users. Positive Technological Development, thus, is one application of the PYD model that is particularly timely for today's American youth culture.

The vocabulary (i.e., the Cs of PTD) and the ideas behind Bers' Positive Technological Development (e.g., the inter-relatedness among these Cs) provide a framework through which one could understand how youth may relate to today's technology-rich environment in a positive way and how one could design technology-rich educational programs and applications. By drawing on these ideas to describe youth's experience with and relation to technology, this thesis examines how the level of youth online civic engagement might be associated with their technological characteristics, as described and measured in terms of Bers' six Cs of PTD.

Applications of Positive Technological Development

Bers has previously used the Positive Technological Development model to develop and assess technology used with children and early adolescents between the ages of nine and fourteen in a Lego robotic summer camp (Chau & Bers, 2005), as well as with young children working with their parents in the Project Inter-Actions robotics program (Bers, under review). To apply the PTD model in a research setting, Bers (2005) constructed a 36-item *Positive Technological Development* questionnaire to address a large set of variables that stems from the six constructs as defined in Table 1 (i.e., technological competence, confidence, character, caring, connection, and contribution). This questionnaire is included in Appendix B.

Using this questionnaire to assess how these various PTD characteristics or assets behave in young children, Chau and Bers found that early adolescents' technological competence is related to their confidence about their abilities as a technology user, $r(27) = .52$, $p < .01$. This correlation echoes similar findings in the field of educational technologies concerning the relationships among learning with technology, motivation and attitudes about using technology, and confidence about oneself as a successful technology user (e.g., Barab, Dodge, Thomas, & Tuzun, 2005; Clements & Gullo, 1984; Dede & Ketelhut, 2003; Papert, 2000). Chau and Bers also found a similar relationship between technological competence and character in technology use, $r(27) = .53$, $p <.01$. This relationship between technological competence and character is akin to findings from research on the ability of youth to establish meaningful community rules online, even without adult supervision (Cassell, 2002). The caring and connection constructs were found to be strongly related, $r(27) = .70$, $p<.01$, and such relationship aligns with results from other ethnographic studies in the field of computer-mediated communication (CMC) that propose to use computer technologies as a communication tool to help people stay socially connected (e.g., Smith & Kollock, 1998; Turkle, 1984, 1995; Wallace, 1999). Finally, the connection construct was found to be related to the tendency of youth to use and construe technology as a means to contribute to society, $r(27) = .62$, $p < .01$. This correlation corresponds to current discussions about the potential of computer mediated network technologies to provide public spheres for pro-social and civic-oriented interactions among youth (Hayhto, 2003).

Although these correlations reflect the findings reported in other studies in the field of educational technologies and computer-mediated communication, they should be interpreted cautiously. Because of the exploratory nature of the use of the *PTD* questionnaire in Chau and Bers' study, the validity and reliability of the questionnaire were not examined. Furthermore, the current literature about research on educational technologies and on computer-mediated communication, including the ones cited above, has relied on qualitative or anecdotal data from small sample workshops using newly devised computer technologies (e.g., Barab, Dodge, Thomas, & Tuzun, 2005; Clements & Gullo, 1984; Dede & Ketelhut, 2003), from ethnographic, exploratory interviews with youth (e.g., Smith & Kollock, 1998; Turkle, 1984), and from translating theories from other fields (e.g., Papert, 1980, adopting Constructionism from Piaget's Constructivism) to generate more research questions about the nature of youth's experience with technologies rather than testing and confirming ideas and questions. Therefore, the extent to which significant correlation results among the 6 Cs from Chau and Bers' study, and the similarities between these correlations and existing ideas in the literature, should be considered tentative. Thus, it is the intention of this thesis to draw on the principles of Bers' Positive Technological Development framework and examine the potential associations between differences in youth technological competence and attitudes towards online civic engagement.

Toward a Theory of Positive Technological Development for College Students

Although previous research on the Positive Technological Development model has focused on children and young adolescents, the goal of this study was to extend Bers' (2005) Positive Technological Development theoretical framework to a new population and assess the extent to which differences among college students' level of online civic engagement might be associated with variations in their individual technological characteristics (e.g., their competence in using technologies and their attitudes about technology).

College students are particularly interesting with respect to positive technological development for at least two reasons. First, as previously described, college-age youth are becoming heavy Internet users (Lenhart, Madden, & Hitlin, 2005); thus, they would be an appropriate population to examine how PTD might be manifested in youth Internet users. More importantly, however, researchers and technologists (i.e., Bridgman et al., 2004; Hayto, 2003) have begun to develop novel Internet-based applications to promote civic engagement among college students. By leveraging college students' natural interests in civic and social issues and in novel Internet technologies, these researchers believe that computer applications could provide meaningful tools that could either replace or extend on available real-life means (e.g., voting and volunteering) for college students to contribute to the society around them. Thus, college students comprise an appropriate sample to examine Bers' hypothesis regarding the outcome of positive technological development (i.e., positive technological development leads to positive contribution to the self and to society via technology).

For example, in examining the potential of online discussion boards to promote civic engagement and civic discussion among college students, Bridgman et al. (2004) developed a discussion board type program on the Internet that afforded students from three different colleges access to communicate with each other about civic issues that mattered to them. Over a period of one week during a school-sponsored *Civic Engagement Week* event, students from these three campuses posted over 1,000 messages on this discussion board, with topics including abortion, affirmative action, gay rights, gender issues, immigration, and others, and with content ranging from debates to suggestions for social change. Although Bridgman et al. did not conduct any follow up assessment to evaluate the effect of this activity, they hypothesized that this message board encouraged civic thoughts and discussion, a precursor to promoting civic mindedness among college students (McCoy & Scully, 2002).

While Bridgman et al.'s study along with others such as the report by Hayto (2003) illustrate the potential of the Internet to provide an arena for youth to participate in civic activities via technology, there has not been any systematic examination of the characteristics of youth who are likely to participate in social activities and the ways in which researchers could encourage youth, especially those who typically do not participate in civic activities, to participate in such pro-social online activities. For instance, although the sample in Bridgman et al.'s study included students from three college campuses, providing over 16,000 potential participants, only about 1,000 participated in any online conversations, even when given a wide range of topics. Although Bridgman et al. acknowledged this low participation rate, they did not systematically evaluate potential patterns among the students who chose to participate and among those who chose otherwise. Therefore, studies of this type could only tell us how an individual population may react to technological interventions, and such studies are limited in providing any information about how to leverage technology to promote civic engagement in youth who might not already be interested in participating.

Although there is a body of literature that describes how practitioners and researchers could develop Internet technologies to provide youth new avenues to participate in civic activities, there has not been a systematic investigation on how the level of participation in these activities among youth might be associated with differences in their personal technological characteristics and attitudes. The lack of this type of research prevents researchers from understanding how the reaction of an individual population to certain technology or intervention might be applicable or related to other populations. Furthermore, it prevents researchers from targeting their research effort on typically non-participating youth. Therefore, the goal of this thesis is to provide some insights, through analyzing data collected by a study on technology use and attitudes among college students, into how the personal technological characteristics of youth (e.g., competence and attitudes) might be associated with the level of their online civic engagement.

Chapter III: Method

The goal of this study was to understand the extent to which differences in the level of online civic engagement among college students might be associated with their personal technological characteristics, such as their perceived technological competence and their attitudes about technology. To that end, the study surveyed and analyzed data collected from college students at Tufts University using a battery of questionnaires described below regarding their previous technological experiences, the frequency with which they participate in online activities that were socially and civically meaningful, and their perceived competence and attitudes about Internet technology.

Sample

As part of a larger longitudinal study (Chau, Bers, & Mathur, 2006), the sample of this study was constructed to facilitate a longitudinal examination of the Positive Technological Development model and its relevance to social and civic contribution via Internet technology among college students. The participants were drawn from an entering class of first-year Tufts University students. First-year students were chosen for the larger study with the intention of conducting follow-up longitudinal data collection over the period of participants' education at Tufts University. Participants were recruited during their move-in day to the University, which was three days before their official matriculation as first-year students. Recruitment materials clearly indicated that the larger study was a four-year long longitudinal study and that participation in the study included future follow-up surveys and interviews throughout their four years at Tufts University.

Participants were recruited via two means. Many first-year students participated in on-campus orientation programs and these students were recruited by their orientation leaders to volunteer for this study. Residential advisors at first-year student housings were also asked to help recruit volunteers who did not participate in any orientation programs. Both orientation leaders and residential advisors were given a packet of information regarding the nature of the study with copies of the consent forms and surveys (as described in the Measures section). They were asked to distribute materials to any first-year students who agreed to participate in a longitudinal study about students at Tufts University and their interests and use of computer technologies.

The sample of this study initially included 86 first-year students. One participant completed only half of the survey and thus he was eliminated from the data sample. Data from eight-five participants were retained. Seventy-five of the participants were 18 years old, seven were 17, and three were 19 (mean age = 17.95 years, *SD* = 0.342). Forty-six (54%) of the participants were female. All but two of the participants were U.S. citizens representing at least 19 different states (three US residents did not specify a home state); one participant was from Bangladesh and one was from China. Although Tufts University has a 15% rate of international students in its undergraduate student body (Tufts University Office of Undergraduate Admissions, 2005), a larger proportion of local students was recruited than was anticipated. This could be because orientation programs began three days before students were required to attend the University and thus attracted more local students than students who needed to travel a far distance from home. Additional details about the demographic characteristics of these participants are summarized in Table 2.

Table 2
Participants' Demographic Characteristics

Participant Characteristics	*n*	%	Participant Characteristics	*n*	%
Age			College enrolled		
17	7	8.2%	Arts and Sciences	69	81.2%
18	75	88.2%	Engineering	13	15.3%
19	3	3.5%	Undecided	3	3.5%
Gender			Top 5 Academic Interests		
Male	39	45.9%	International Relations	15	17.6%
Female	46	54.1%	Economics	13	15.3%
			Psychology	11	12.9%
Participation in orientation programs			English	10	11.8%
Yes	77	91.6%	Mathematics	8	9.4%
No	8	9.4%			
Ethnicity			Home state/ Country		
White/Caucasian	66	77.6%	MA	17	20.0%
African/African American	7	8.2%	NY	14	16.5%
Asian/Asian American	6	7.1%	NJ	10	11.8%
Latino American	5	5.9%	CT	7	8.2%
Other	1	1.2%	CA	6	7.1%
			PA	4	4.7%
Religion			FL	3	3.5%
Christian/Catholic	37	43.5%	IL	3	3.5%
Jewish	16	18.8%	TX	3	3.5%
Islamic	2	2.4%	VA	3	1.2%
Other	3	3.5%	OH	1	1.2%
None	27	31.8%	MN	1	1.2%
			MI	1	1.2%
English as first language			NC	1	1.2%
Yes	81	95.3%	ME	1	1.2%
No	4	4.7%	MD	1	1.2%
			OR	1	1.2%
Fluent in other languages			WA	1	1.2%
Yes	33	38.8%	SC	1	1.2%
No	51	60.0%	US-Not specified	3	3.5%
Not reported	1	1.2%	Bangladesh	1	1.2%
			China	1	1.2%
High School Type			Not reported	1	1.2%
Public	56	65.9%			
Private	29	34.1%			

Procedure

A survey was constructed to include a battery of five questionnaires. These questionnaires are described in detail in the Measures section and a sample copy of this survey is included in Appendix B. Copies of this survey along with copies of a consent form and a cover letter with a description of the nature of the longitudinal study were given to first-year housing residential advisors and orientation leaders. These were then distributed to incoming students who agreed to participate in a longitudinal study about technology use. Residential advisors and orientation leaders were instructed to distribute research materials upon students' move into their dormitory.

The survey instructions clearly stated that participants should take no more than 20 minutes to complete the survey. However, due to the volunteer nature of this survey study, participants were allowed to complete the survey at their leisure either during their orientation programs or during their initial move-in days. The only time requirement was that all survey materials needed to be returned before the academic year officially began in order to obtain a true baseline assessment for the purpose of the longitudinal study. All of the data reported in this thesis were collected before participants officially began their academic year at Tufts University.

Measures

The measures used in this study were chosen to address the research goal of this thesis as well as the objectives of the larger longitudinal study. Two of the questionnaires included in the survey battery were the *Positive Technological Development* questionnaire and the *On- and Off-line Civic Engagement Survey: Online Subscale*.

These two questionnaires were designed to measure, respectively, youth's technological attitudes and their level of online civic engagement. These surveys provided data to address the research goal described in this thesis. Because these two questionnaires are the only surveys relevant to the present discussion, they will be discussed in more detail in this chapter.

The survey also included other questionnaires that were designed to provide information that could be used for the larger study across subsequent waves to examine participants' development of technological competence, attitudes, and technology use across their college years. One of the foci of the longitudinal study was to understand the extent to which technology could contribute to college students' personal development, their social engagement, and their active contribution to the university campus and personal lives. However, because these questionnaires are not relevant to the current discussion, they will not be described below.

The *Positive Technological Development* questionnaire (Bers, 2005) is a 36-item self-report scale that measures different aspects of technological fluency, including both skills and attitudes about computers and technology, and their impact on youth development in terms of competence, confidence, caring, connection, character, and contribution to civic society. Concerning technological skills, the questionnaire addresses five domains of technological fluency. These include: 1) The ability to use the computer (e.g., operating systems, standard applications, and search for information on the Internet); 2) The ability to learn new ways of using the computer (e.g., new tools and programs, new features of a program, customizing applications, and integrating the use of multiple tools or applications in a project); 3) The ability to create or design computer projects from an initial idea to a finished work (e.g., projects involving text, images, animations, videos, and/or robotic constructions); 4) The ability to debug projects when something goes wrong (e.g., identifying the problem, testing different solutions, and finding help); and 5) The ability to use the computer to express ideas that are personally meaningful.

In regard to participants' attitudes about computers, the measure looks at different aspects of how youth perceive themselves as computer users, such as feeling comfortable and confident in learning new software features or programs, technical problem-solving and troubleshooting, and helping others with technical problems. It also assesses the extent to which youth can imagine the use of and propose new technologies to solve social problems (e.g., "I can imagine new ways to use technologies to make the world a better place."). Participants are asked to rate themselves on each of these items on a 5-point Likert-like scale. This instrument has been adapted from a previous version used with younger children (Bers, under review). No reliability and validity ratings have been reported in previous uses of this questionnaire. The Results section reports reliability analyses of the questionnaire as applied to the sample of this study.

Participants' engagement in online civic and pro-social activities was measured by using the *Online Subscale* from the *On- and Off-line Civic Engagement Survey*. This questionnaire was adapted from the *University College Civic and Political Activities and Attitudes Study* (Tufts University Office of Institutional Research, 2005). The revision was intended to extend questions about civic activities to situations in which these activities could be accomplished via the Internet.

The *Online Subscale* includes 19 questions that address the frequency to which participants engage in certain civic and pro-social activities on the Internet in the past year. These activities range from “Talk to your friends about social/political issues online” to “Volunteer in political campaigns/protests online.”

For this particular sample of college students, this 19-item *Online Subscale* achieved very high reliability, Cronbach’s a = .91. A mean score was generated of these 19 items as an average frequency of participants’ engagement in civically and pro-socially meaningful activities online. These 19 items are newly devised for this particular study. Although they achieved high reliability for this sample, no validity information has been previously provided about these items. Thus, validity issues were taken into consideration when using this questionnaire to assess students’ online civic engagement. Potential issues due to the validity and reliability of this questionnaire will be discussed in the Discussion chapter.

Chapter IV: Results

The goal of the study was to assess the extent to which differences in the level of online civic engagement among college students might be associated with variations in their personal technological characteristics, such as their technological competence and their attitudes about computer technology. To that end, several analyses were conducted on data collected from two questionnaires – the *Positive Technological Development* questionnaire (Bers, 2005) and the *On- and Off-line Civic Engagement Survey: Online Subscale* – that were designed to measure participants' personal technological characteristics in terms of Bers' six Cs of PTD and their level of online civic engagement. First, participants' responses to the 36-item *PTD* questionnaire were used in an exploratory factor analysis to explore potential patterns in the way different college students may perceive their technological competence and their attitudes about computer technology. Then, results from this exploratory factor analysis were further evaluated by assessing the relationships between these potential patterns or constructs and their level of online civic engagement, as measured by their responses to the *Online Subscale* of the *Civic Engagement Survey*.

The Positive Technological Development Questionnaire

Data obtained from the *Positive Technological Development* questionnaire dataset were screened by examining descriptive statistics for each of the 36 items, inter-item correlations among the items, and possible univariate assumption violations. Because listwise deletion for missing data is recommended for factor analysis (Meyers, Gamst, & Guarino, 2006), data from 81 of the 85 participants were used in this analysis after incomplete cases were removed. Descriptive statistics for individual items showed that participants' responses to five of the items (items 1, 10, 23, 27, and 32) deviated greatly from normality (i.e., both skewness and kurtosis statistics were outside of the ±1.0 range). Because individual item distributions that greatly depart from normality violate underlying assumptions of factor analysis (Meyers, Gamst, & Guarino, 2006), these items were removed from this factor analysis. Thirty-one items remained for factor analysis.

Inter-item correlations showed that most items were weakly to moderately correlated with each other (i.e., *r*s <.70), except in two cases in which item pairs (items 2 and 3, and items 17 and 18) were highly correlated (r = .722, p <.001 for both pairs). As a result, the Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity were conducted to estimate the adequacy of these 31 items' intercorrelations for factor analysis. The KMO statistics was .82, above the general heuristic of .70 or higher (Meyers, Gamst, & Guarino, 2006), indicating that the present data were suitable for exploratory factor analysis using the principal component extraction method. Similarly, the Bartlett's test was significant, $\chi^2(435) = 1448.83$, p <.001, indicating sufficient correlation between the item variables to proceed with factor analysis.

Data Reduction. After initial data screening, the remaining 31 questionnaire items were deemed adequate for exploratory data analysis using the principal component extraction method with a varimax rotation. An examination of each item's extracted communalities suggested that one particular variable, item 11, did not achieve an adequate level of communality with the factor solution, r = .08. As a result, item 11 was removed from the factor analysis. Exploratory factor analysis using the principal component extraction method and variamx rotation was recomputed with item 11 deleted.

Initially, factors were extracted using the Kaiser-Guttman retention criterion of eigenvalues greater than 1.0 as a heuristic, resulting in an eight-factor solution. However, some factors consisted of a small number of items. Specifically, Factor 4 consisted of three items, Factors 5 and 8 consisted of two items each, and Factors 6 and 7 consisted of one item each. It is generally recommended that at least four items are needed per factor for interpretation and sub-scale reliability (Meyers, Gamst, & Guarino, 2006); hence this solution was not acceptable.

Because the Kaiser-Guttman retention criterion was not sufficient in this analysis, the scree plot of this exploratory factor analysis was examined to determine the number of potential factors that could be extracted (see Figure 1). Cattell's scree test suggests dropping all further components after the one component that starts to "elbow" towards less steep declines. Figure 1 shows that the eigenvalue differences in this solution began to attenuate by the third factor after significant drops from Factor 1 to Factor 2 and from Factor 2 to Factor 3, visually suggesting that a three-factor solution might be one viable factor reduction for this dataset.

A three-factor solution was then computed using the principal component extraction method with a varimax rotation. With the rotation, these three factors accounted for 52.94% of the total variance. Table 3 presents the 30 items, the subscale to which these items belong in the original *Positive Technological Development* questionnaire, their factor correlations or component loadings, and communality estimates. Communalities among these items were moderate to high for most items, ranging from .20 to .74.

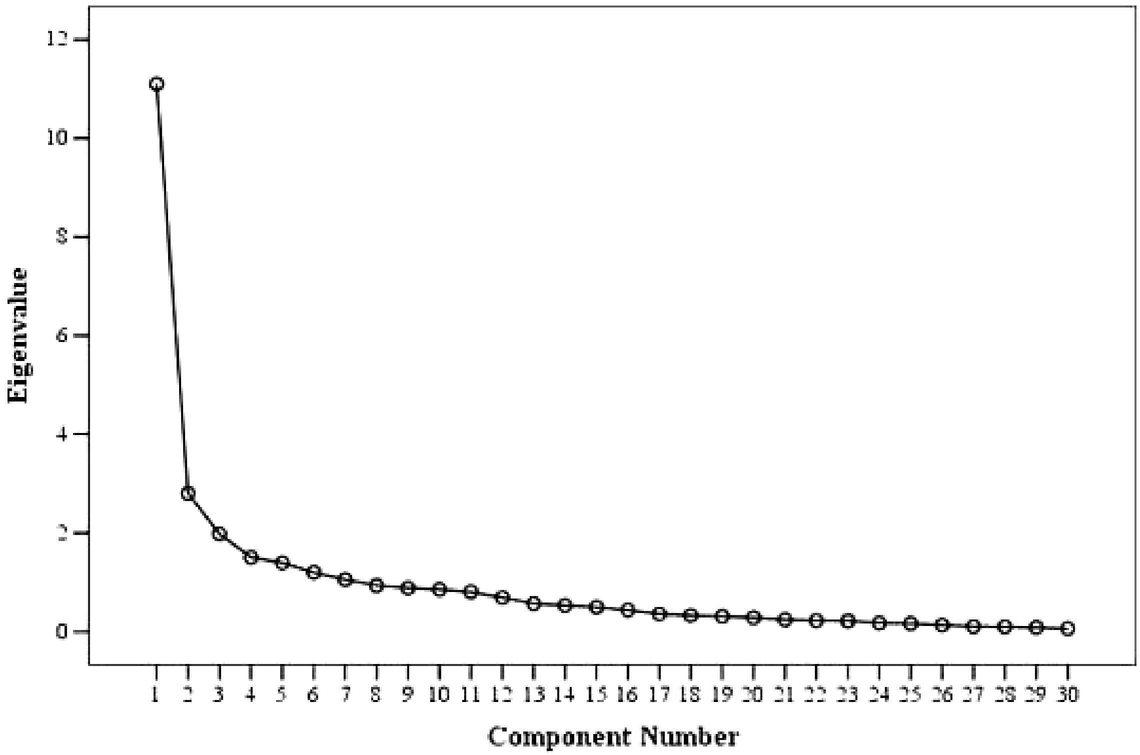

Figure 1. Scree plot from Exploratory Factor Analysis of the *PTD* Questionnaire.

Table 3

*Summary of Items and Factor Loadings from Exploratory Factor Analysis of 30 PTD Items with Varimax Rotation (N = 81)**

Variable	*Scale Origin*	*Item*	*Rotated Component Loading* 1	2	3	*Communality*	*Corrected Item-Total Correlation*
Q14	competence	I feel confident that I can figure out how to use new features of a program on my own.	**0.81**	-0.03	0.09	0.69	0.75
Q15	confidence	I know how to make computer projects that express things that are important to me.	**0.81**	0.17	-0.08	0.66	0.71
Q2	confidence	Learning a new technological skill is easy for me.	**0.80**	-0.05	0.13	0.66	0.73
Q7	competence	I know how to make or design my own projects with computers.	**0.78**	0.12	-0.13	0.64	0.69
Q13	competence	I have an advanced understanding of how a computer works.	**0.76**	0.17	0.15	0.63	0.77
Q20	confidence	I know that I can figure out how to create or design projects on the computer from an initial idea to a finished piece of work.	**0.74**	0.11	0.25	0.63	0.74
Q18	contribution	I can contribute to my community using my computer and/or my technical skills.	**0.73**	0.41	0.23	0.76	0.82
Q8	confidence	I feel confident that I can learn how to use a new computer application.	**0.70**	0.09	0.15	0.52	0.67
Q9	competence	I am able to create or design projects on the computer from an initial idea to a finished work that show who I am.	**0.69**	0.33	0.16	0.60	0.72
Q21	character	I feel good about myself when using the computer.	**0.67**	0.17	0.27	0.55	0.69
Q3	character	I can express myself by using the computer	**0.64**	0.21	0.39	0.61	0.71
Q31	competence	I can debug or fix computer projects or programs when something goes wrong.	**0.61**	0.23	0.18	0.45	0.59
Q26	confidence	I am confident that I can learn how to program the computer.	**0.58**	0.23	0.28	0.47	0.62
Q25	competence	I understand how a computer works.	**0.51**	0.20	0.20	0.67	0.70
Q22	caring	It is important for me to teach others the things that I already know about computers.	**0.46**	0.31	0.44	0.33	0.55
Q16	connection	I am part of a virtual community on the Internet where I give and receive advice.	0.24	**0.74**	-0.03	0.50	0.45
Q5	connection	I have met new people by using the computer.	0.02	**0.71**	0.09	0.60	0.53

Q35	connection	I actively use the computer to be part of different communities.	0.20	**0.68**	0.26	0.52	0.52
Q29	connection	I use the computer to connect with other people that think and feel the same way as I do.	-0.07	**0.68**	0.38	0.57	0.66
Q28	caring	I have found support groups on the Internet.	0.09	**0.56**	-0.18	0.61	0.54
Q17	connection	Because of my technical skills, I can connect with people in many different ways.	0.56	**0.56**	0.21	0.36	0.34
Q34	caring	Using the computer is a good way for me to understand better the people that I care about.	0.48	**0.50**	0.32	0.43	0.53
Q33	character	I am able to learn computer applications that help me express myself in different ways.	0.24	**0.50**	0.34	0.59	0.64
Q6	contribution	I can imagine new ways of using technology to make the world a better place.	0.23	**0.49**	0.36	0.42	0.52
Q19	competence	I know how to program a computer.	0.34	**0.41**	-0.18	0.32	0.29
Q24	contribution	The Internet opens new possibilities for becoming active participants in the communities we care about.	0.15	0.16	**0.72**	0.57	0.56
Q30	contribution	I can imagine positive ways to use computers for our society.	0.20	0.21	**0.67**	0.53	0.46
Q36	character	I can see how technology could be a negative influence or cause problems in our society.	-0.01	-0.09	**0.62**	0.39	0.41
Q12	contribution	I believe that by using new technologies people can find new ways to contribute more to their communities.	0.33	-0.12	**0.53**	0.41	0.50
Q4	caring	When working with someone on the computer I make sure that they understand everything I am doing.	0.11	0.16	**0.39**	0.20	0.31
Rotated Eigenvalues			8.26	4.34	3.28		
% of Variance			27.54	14.46	10.94		
Coefficient Alpha			.93	.84	.69		

Notes. Boldface indicates highest factor loadings. Component 1 = *Technological Efficacy*, Component 2 = Social Uses of Technology, and Component 3 = Technological Contribution. Corrected item-total correlation show the Pearson *r*s between the item and its subscale (the subscale score is "corrected" by excluding the particular item in computing the total score for the subscale).
*Listwise deletion method was used to manage missing any missing data.

To verify that this factor solution was not only statistically sound, but also made conceptual sense, each of these items were examined and compared to the items in the same factor group. Except item 22, all of the items in Factor 1 were about participants' level of technological competence and confidence. In contrast, item 22 was about technological caring, as defined by Bers (2005), and this item did not differentiate greatly between its loading to Factor 1 and its loading to Factor 3 (loading to Factor 1 = 0.46 and loading to Factor 3 = 0.44). Thus, this item was deemed ambiguous and was removed from Factor 1. Similarly, item 19 of Factor 2 was about technological competence and did not seem to fit conceptually with other items in this factor group, which were about caring, connection, and character. As a result, item 19 was removed from Factor 2 of the factor solution. Finally, whereas most items that composed Factor 3 were about technological contribution and character, item 4 was about technological caring. This item also loaded weakly onto this factor (factor loading = 0.39) and as a result was removed from Factor 3. After these three items were removed from their respective factor component due to weak and ambiguous loadings, either on statistical or conceptual grounds, 27 items remained in the factor solution. A second exploratory factor analysis was computed and it was verified that the removal of these items did not affect the way the remaining items loaded onto these factor components. Results from this second exploratory factor analysis are summarized in Table 4.

Factor Interpretation. Although there are six constructs in Bers' (2005) original Positive Technological Development model (i.e., technological competence, confidence, character, caring, connection, and contribution), the exploratory factor analysis described

Table 4

*Summary of Items and Factor Loadings from the Second Exploratory Factory Analysis of 27 PTD Items with Varimax Rotation (N = 81)**

Variable	*Scale Origin*	*Item*	*Rotated Component Loading* 1	2	3	*Communality*	*Corrected Item-Total Correlation*
Q2	confidence	Learning a new technological skill is easy for me.	**0.81**	-0.02	0.09	0.67	0.72
Q14	competence	I feel confident that I can figure out how to use new features of a program on my own.	**0.81**	-0.04	0.09	0.67	0.74
Q15	confidence	I know how to make computer projects that express things that are important to me.	**0.81**	0.16	-0.09	0.69	0.73
Q7	competence	I know how to make or design my own projects with computers.	**0.78**	0.12	-0.17	0.66	0.69
Q13	competence	I have an advanced understanding of how a computer works.	**0.78**	0.18	0.06	0.64	0.77
Q20	confidence	I know that I can figure out how to create or design projects on the computer from an initial idea to a finished piece of work.	**0.74**	0.13	0.24	0.63	0.74
Q18	contribution	I can contribute to my community using my computer and/or my technical skills.	**0.73**	0.44	0.19	0.76	0.80
Q8	confidence	I feel confident that I can learn how to use a new computer application.	**0.71**	0.09	0.15	0.53	0.66
Q21	character	I feel good about myself when using the computer.	**0.66**	0.15	0.28	0.54	0.71
Q9	competence	I am able to create or design projects on the computer from an initial idea to a finished work that show who I am.	**0.66**	0.37	0.11	0.59	0.68
Q3	character	I can express myself by using the computer	**0.66**	0.27	0.33	0.61	0.70
Q31	competence	I can debug or fix computer projects or programs when something goes wrong.	**0.59**	0.20	0.27	0.46	0.59
Q26	confidence	I am confident that I can learn how to program the computer.	**0.57**	0.22	0.33	0.48	0.61
Q25	competence	I understand how a computer works.	**0.51**	0.19	0.17	0.33	0.55

Q5	connection	I have met new people by using the computer.	0.03	**0.74**	-0.03	0.55	0.55
Q16	connection	I am part of a virtual community on the Internet where I give and receive advice.	0.26	**0.73**	-0.13	0.61	0.59
Q29	connection	I use the computer to connect with other people that think and feel the same way as I do.	-0.06	**0.71**	0.30	0.60	0.58
Q35	connection	I actively use the computer to be part of different communities.	0.17	**0.69**	0.26	0.57	0.63
Q17	connection	Because of my technical skills, I can connect with people in many different ways.	0.57	**0.57**	0.14	0.67	0.67
Q6	contribution	I can imagine new ways of using technology to make the world a better place.	0.23	**0.55**	0.28	0.43	0.53
Q28	caring	I have found support groups on the Internet.	0.12	**0.53**	-0.25	0.35	0.38
Q33	character	I am able to learn computer applications that help me express myself in different ways.	0.47	**0.52**	0.34	0.61	0.63
Q34	caring	Using the computer is a good way for me to understand better the people that I care about.	0.21	**0.51**	0.39	0.45	0.51
Q24	contribution	The Internet opens new possibilities for becoming active participants in the communities we care about.	0.16	0.19	**0.76**	0.63	0.57
Q30	contribution	I can imagine positive ways to use computers for our society.	0.19	0.26	**0.65**	0.53	0.41
Q36	character	I can see how technology could be a negative influence or cause problems in our society.	0.01	-0.05	**0.61**	0.37	0.44
Q12	contribution	I believe that by using new technologies people can find new ways to contribute more to their communities.	0.36	-0.06	**0.46**	0.35	0.48
Rotated Eigenvalues			7.95	4.25	2.74		
% of Variance			29.44	15.76	10.16		
Coefficient Alpha			.93	.85	.69		

Notes. Boldface indicates highest factor loadings. Component 1 = *Technological Efficacy*, Component 2 = Social Uses of Technology, and Component 3 = Technological Contribution. Corrected item-total correlation show the Pearson *r*s between the item and its subscale (the subscale score is "corrected" by excluding the particular item in computing the total score for the subscale).

*Listwise deletion method was used to manage missing any missing data.

above found that Bers' original six-construct model was not the best model to describe the way these college students responded to the questionnaire. Results from the above exploratory factor analysis suggested that a three-construct model would be more appropriate for this particular sample.

The constructs that resulted from the second and final exploratory factor analysis were named and interpreted according to the items that made up the various factors. Factor 1 (rotated eigenvalue = 7.95) accounted for 29.44% of the variance and consisted of 14 items. This factor included variables that pertained to participants' self-perceived technological competence and their sense of confidence in using and learning new technologies; hence, the construct resulting from this factor was named Perceived Technological Efficacy. Factor 2 (rotated eigenvalue = 4.25) accounted for 15.76% of the variance and consisted of 9 items. This factor included question items that related to whether and to what extent participants used technology to express caring and connection behaviors to others; as a result, the construct resulting from this factor was named Social Uses of Technology. Factor 3 (eigenvalue = 2.74) accounted for 10.16% of the variance and consisted of 4 items. This factor included variables that could be characterized as reflecting an orientation and an ability to imagine positive ways to use the Internet and other technologies to contribute to society and to the community; thus, the construct resulting from this factor was named Technological Contribution.

Internal Consistency of Resulting Constructs. Alpha coefficient reliability analysis was conducted on the three constructs extracted from the exploratory factor analysis process. Table 4 presents the alpha coefficients for each of these three constructs and each item's corrected item-total correlation. The final solution resulted in high alphas

– construct 1: *a* = .93, construct 2: *a* = .85, and construct 3: *a* = .69, indicating good overall subscale reliabilities for all three constructs.

Predicting Online Civic Engagement

The three constructs derived from the previous exploratory factor analyses were used as predictor variables in a linear regression analysis to examine their association with participants' level of online civic engagement. Before proceeding to linear regression analysis, the three predictor variables (perceived technological efficacy, social uses of technology, and technological contribution) and the outcome variable (online civic engagement) were screened for possible violations to statistical multiple regression assumptions, as well as for missing values and outliers.

Data were screened for missing values and none was detected for the three predictor constructs, but three missing cases were discovered for the outcome variable and they were eliminated through listwise deletion.

Potential univariate outliers were determined by using Tukey's hinges. Hartwig and Dearing (1979) suggest that any cases lying beyond 1.5 times the interquartile range of the hinges should be considered a univariate outlier. Using this rule of thumb, it was found that the distributions of the three predictor variables did not contain any outliers, while three outliers were detected for the outcome variable, online civic engagement. The online civic engagement values of these three outliers were all above the 1.5 times the interquartile range of the hinges rule of thumb. Thus, these outliers were removed from the dataset for later regression analysis.

Multivariate outliers were screened by computing Mahalanobis distance for each case on the four variables. Using the χ^2 (4) critical value of 18.467 (p >.001) as a cutoff, no multivariate outliers were detected once univariate outliers were removed listwise.

After removing all outliers, the four variables were scanned for univariate normality and bivariate linearity. For testing of normality, Meyer et al. (2006) suggest using the criterion that skewness and kurtosis statistics beyond ±1 should be considered departure from normality. These four variables were deemed normally distributed using this criterion. Bivariate linearity of these four variables was examined by visually evaluating all permutations of pairwise scatterplots of these four variables and all four variables were deemed linear.

As a result, a total of six cases were deleted listwise from the dataset for later regression analysis. Three were deleted because of missing values and the other three were deleted because of univariate outliers. The remaining dataset of 79 cases satisfied the underlying statistical assumptions of multiple regression analysis. Descriptive statistics, including means, standard deviations, range, and inter-correlations of these 79 cases of the four variables are presented in Table 5.

Table 5
Means, Standard Deviation, and Inter-correlations for Online Civic Engagement (Outcome) and Predictor Variables Perceived Technological Efficacy, Social Uses of Technology, and Technological Contribution. (N=79)

Variables	M	SD	Min-Max	1	2	3
Outcome Variable						
Online civic engagement	2.24	0.62	1.00-3.42	.09	.52**	.25*
Predictor Variables						
1. Perceived technological efficacy	3.37	0.84	1.57-5.00	1	.63**	.46**
2. Social uses of technology	2.88	0.85	1.00-4.67		1	.43**
3. Technological contribution.	3.84	0.75	1.50-5.00			1

**p*<.05, ***p*<.01, ****p*<.001; all scales ranged from 1 to 5

Multiple Regression Analysis. Ordinary least squares regression was conducted with online civic engagement as the outcome variable and perceived technological efficacy, social uses of technology, and technological contribution as predictor variables.

A taxonomy of multiple regression model is presented in Table 6. Predictor variables were entered in four steps. First, to evaluate whether an orientation to civically oriented uses of technology was enough of a predictor for online civic engagement outcomes, the technological contribution construct was entered in step 1. Results showed that technological contribution was a significant predictor for online civic engagement, but this predictor variable alone only accounted for 6% of the variance in the outcome variable.

To evaluate whether other predictor constructs would provide more information about the outcome, the other two constructs, perceived technological efficacy and social uses of technology, were entered into Model 2. As described in Table 6, when all three constructs were included in the model, the technological contribution variable became non-significant while the perceived technological efficacy and social uses of technology constructs significantly accounted for a large portion of the variance in the outcome. These three constructs together accounted for 38% of the variance in participants' online civic engagement.

Two-way interactions among these three variables were tested in step 3 of the regression taxonomy, and subsequently the three-way interaction among these three predictor variables was tested in step 4. Results indicated that there were no interactions among these predictor variables in relation to the outcome variable.

As a result, a final Model 5 was computed using only significant predictor constructs – perceived technological efficacy and social uses of technology – to predict the outcome of interest, online civic engagement. This model accounted for a significant portion of the variance in the outcome, $R^2 = .36$, $F\ (2, 76) = 21.753$, $p<.001$. Statistics and coefficients for these five models are described in Table 6.

Table 6
Parameter Estimate [a], Approximate p Values, and Goodness-of-Fit Test for a Taxonomy of Regression Models that Describes Factors that Relate to Online Civic Engagement with Predictor Variables Including Perceived Technological Efficacy, Social Uses of Technology, and Technological Contribution. (N = 79[b])

	Models				
	M1	M2	M3	M4	M5 (Final)
Intercept	1.45***	1.35***	-.08	3.38	1.60***
Technological Contribution	.21*	.11	.46	-.52	
Perceived Technological Efficacy		-.31**	-.18	-1.42	-.28**
Social Uses of Technology		.53***	.94*	-.51	.56***
Contribution*Efficacy			.00	.44	
Contribution*Social			-.03	.28	
Efficacy*Social			-.11	.25	
Contribution*Efficacy*Social				-.11	
R^2	.06*	.38***	.39***	.40***	.36***
dfE	77	75	72	71	76
ΔR2		.31***	.02	.01	
df(ΔR^2)		2	3	1	

[a]Regression Bs are presented in this table.
[b]6 participants were deleted from this analysis because of outliers and missing data
Key: *p<.05; **p<.01; ***p<.001

The perceived technological efficacy construct negatively related to the outcome variable ($B = -.28$, $p<.01$), suggesting that the higher one's perceived technological competence and confidence, the less likely one would participate in pro-social activities online, when controlling for social uses of technology. In contrast, the social uses of technology construct positively related to the outcome ($B = .56$, $p<.001$), suggesting that the higher one's ability to use technology and the Internet to connect to and care for others, the more likely one would participate in pro-social and civically meaningful online activities, when controlling for perceived technological efficacy. These relationships are illustrated in a prototypical plot in Figure 2.

Furthermore, although the technological contribution construct was a significant predictor when it was the sole predictor in Model 1, the contribution of this construct to the outcome variance became non-significant when other variables were accounted for, suggesting that the variance in the outcome accounted for by this variable would be better explained by the other two predictor constructs in the final Model 5.

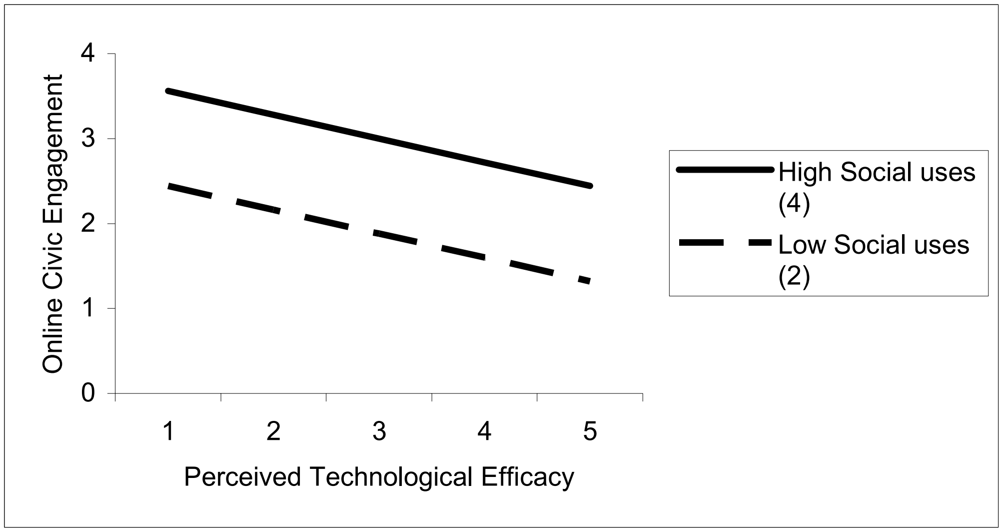

Figure 2. Prototypical Plot Illustrating Relationships among Perceived Technological Efficacy, Social Uses of Technology, and Online Civic Engagement.

Chapter V: Discussion

The goal of this thesis was to describe and examine the potential associations between the level of college students' online civic engagement and their personal technological characteristics as described in terms of Bers' (2005) six Cs of Positive Technological Development. Data were collected about participants' frequency of using the Internet as a means to participate in various civic activities using the *Online Subscale* of the *On- and Off-line Civic Engagement Survey*, and about their perceived level of technological competence, confidence, caring, character, connection, and technological contribution (i.e., six Cs of PTD) using Bers' (2005) *Positive Technological Development* questionnaire.

Exploratory factor analysis was conducted to examine patterns in the way participants responded to the thirty-six items in the *Positive Technological Development* questionnaire. Results suggested that there were three constructs, subsequently interpreted as perceived technological efficacy, social uses of technology, and technological contribution, that represented distinct and independent dimensions (i.e., statistically orthogonal) that together represented one possible way in which college students might use or perceive computer technologies in their lives.

Ordinary least squares multiple regression analysis was conducted to examine the associations between the above three constructs and participants' level of online civic engagement as measured by the *Online Subscale* of the *Civic Engagement Survey*. Results indicated that participants' reported level of perceived technological efficacy and social uses of technology significantly related to the variance in participants' level of online civic engagement. On the other hand, when these two constructs were accounted for, participants' level of technological contribution was not a significant predictor construct in the regression model. The final regression model, accounting for 36% of the variance in participants' online civic engagement, suggested that participants with higher level of perceived technological competence and confidence (as measured by perceived technological efficacy) were less likely to participate in online civic and social activities, when compared to other students of the same level of social uses of technology. In contrast, participants with higher level of social uses of technology were more likely to participate in pro-social and civically meaningful online activities when compared to other participants of the same technological efficacy level. The implications of these results will be discussed in a later section.

Limitations

Although this thesis reported several significant findings, several limitations must be kept in mind when considering the implications of these findings. First is regarding the population from which the sample was drawn. All of the participants in this study enrolled at the same University, and all of them volunteered to participate in this study. Thus, these participants might be more likely to participate in community or voluntary activities in general and thus might not be representative of all college students. As a result, possible sampling errors and self-selection effect could threaten the external validity of the results reported in this thesis.

The small sample size (N=85) was also another limitation, particularly with respect to the statistical requirements of exploratory factor analysis. Meyer et al.'s (2006) general guideline of about 10 participants per variable item (i.e., 360 participants would be required for factor analysis of the *Positive Technological Development* questionnaire) was not met, thus threatening the reliability and validity of the results from the exploratory factor analysis procedures. In light of this limitation, cautions must also be taken when considering the results reported in the multiple regression analysis that drew its predictor variables from the exploratory factor analysis procedures.

Aside from sample consideration, another limitation related to the methodology of this study must be kept in mind. Participants were told that they were participating in a research study in which the primary aims were to understand the frequency with which students on campus participate in civic-related activities and the extent to which computer technologies mediated these activities. Thus, participants' responses to the questionnaires could have been over-exaggerated or biased due to experimental effects. Furthermore, participation in civic activities is generally a highly desirable behavior among college students. As a result, a social desirability effect could have also biased participants' report of the frequencies to which they participate in online civic activities. This potential effect could particularly threaten the validity of the conclusions made in respect to the results from the multiple regression analysis.

Finally, all data collected were self-report ratings. Research studies based on self-report data of adults' civic activities have suggested that people tend to mis-estimate the frequency with which they participate in civic activities (Pattie, Seyd, & Whiteley, 2003). Researchers have suggested that participants who do not participate in civic activities tend to under-report no activities while those who frequently participate in civic activities tend to over-report engagement. If such is the case of this particular sample of college student, then the variability in participants' online civic engagement (and to some extent their social uses of technology) might be less varied than reported in this thesis, and thus the relationship among perceived technological efficacy, social uses of technology, and online civic engagement might be exaggerated. As a result, these positive technological development constructs might not be related to the level of engagement in online civic and pro-social activities among these college students as reported in this thesis; but rather, they described the way in which these college students perceived the level and quality of their engagement in relation to their peers.

Implications and Directions for Future Research

Given that some cautionary notes must be kept in mind concerning the limitations of the analyses presented in this thesis, the results described in this thesis hold several important implications regarding youth development and technology, and thus warrant future research in this particular line of study.

First, there indeed exists diversity in the ways college students relate to and use technologies for personal and interpersonal matters. The three constructs described in this thesis suggest that there are at least three dimensions by which college students may differ in the way they use and think about computer technologies. These dimensions include perceived technological efficacy (a sense of technological competence and confidence), social uses of technology (using technology for connecting to and caring for others), and technological contribution (to society and community). Furthermore, results in relation to the associations between positive technological development constructs and online civic engagement support the idea that individual differences in college students' personal technological characteristics could affect the way they use computer technologies. Similar to other findings in the literature (e.g., Mather, 1995), the results presented in this thesis suggest that youth are indeed active agents in their uses of technology. For example, college students who possess a high level of social uses of technology may use Internet technology in manners that are more conducive to building connection and caring relationships with peers than would students with a lower level of social uses of technology, given the same degree of perceived technological efficacy. Although these results are indeed illuminating in terms of technology design and development, the results presented in this thesis should be considered preliminary given the limitations as mentioned in the previous section (e.g., small sample size). Future research and replications are needed to further explore the three constructs proposed in this thesis in other samples to examine whether these constructs hold true in other populations with different contextual and technological characteristics. Such populations might be non-educational settings where computer technologies play a less important role or in non-traditional educational settings such as professional schools.

Second, the implication of these results suggests the importance for researchers to take into consideration individual youth technological characteristics (as described in terms of perceived technological efficacy, social uses of technology, and technological contribution) when designing technology or technology-rich environments to augment the lives of today's youth. Furthermore, although technologists and researchers have been successful in developing technologies that could afford youth different experiences (e.g., Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005; Bers, 2003; Papert, 1980), results from this thesis illustrate the importance of understanding how youth might be receiving and using these technologies. Doing so, researchers and educators can develop specifically designed technologies to address the various characteristics of youth. For example, youth who are low on perceived technological efficacy may benefit most if given technologies that could provide meaningful experiences that help them develop their technological competence and a sense of technological confidence. On the other hand, similar technologies might not benefit youth who are already high on perceived technological efficacy, even though such technologies might naturally attract this population. As a reflection of these results, future research could focus on exploring how different technologies may benefit youth of specific technological profiles (e.g., low perceived efficacy and high social use; or high perceived efficacy and low social use). Doing so, educators and researchers in the field who are interested in youth development can identify the technological needs of each individual youth and match appropriate technological tools to their needs in order to promote positive technological development.

Third, the three positive technological development constructs relate to online civic engagement in different ways. Results from multiple regression analysis indicated that, at least for these college students, perceived technological efficacy relates negatively to participants' frequency of online civic engagement while social uses of technology relates positively to participants' frequency of online civic engagement. These results reveal that although technology could be used to promote civic engagement, not all youth are leveraging technologies to participate in socially meaningful or civic activities. If we hope to promote college students' use of Internet technologies as a mean to participate in civic life on campus and in surrounding communities, then technology developers and educators need to develop technologies that would encourage interpersonal uses of Internet technology (such as Internet-based communication), while being careful not to over emphasize technological experiences that would accentuate or require a high level of technological competency. Future research are needed to examine the proposed relationships for generalization purposes and also to extend the research in populations beyond college students populations to examine whether these relationships between technological characteristics and civic engagement exist in populations where civic engagement might not be so intertwined with daily activities and educational curricula.

In sum, the preliminary results of this thesis underscore the diversity in youth's personal technological characteristics and the importance of aligning appropriate technological experiences with these individual characteristics to help youth develop in a pathway toward positive technological development and become positive technology users.

Conclusions

This thesis provided preliminary results that suggested the importance of understanding individual youth technological characteristics when conducting research related to the use of technology in today's youth. There are indeed variations in the use of technologies among today's youth to learn about civic and political matters, to share and communicate their ideas, and to exchange opinions and take action online in hope to contribute to the social and civic development of their communities. These variations among youth need to be acknowledged when trying to design appropriate technologies or technology-rich learning environments to promote positive youth development.

Understanding that individual and personal differences among youth technology users are important elements in the way technologies impact the lives of youth, and as a result, impact the social and civic worlds around them, this thesis builds on recent discussions in the literature that describe youth's experience with technology as a dynamically interactive process (e.g., Hansen & Froelich, 1994; Jones, 1997; Mather,

1995) and further illustrates the importance of looking at individual differences among youth's online civic contribution, rather than making generalization and simply deeming technology or the Internet as tools appropriate, or not, for promoting positive youth development. Youth bring into their experiences with technology a host of unique personal and contextual characteristics; thus, it is imperative that we keep in mind the diversity of these experiences and individual characteristics when conducting research on youth development and technology and when developing new technologies in the service of positive youth development.

As demonstrated in this thesis, the extent to which youth may perceive their technological competence, their experiences with interpersonal technology uses, and their attitudes about technological contributions influence their technology use. It is hoped that this thesis can become a springboard to promote further research and technology development that acknowledge the pertinence of understanding the diversity in the personal characteristics among today's youth in the context of computer technology, as well as the diversity of computer technologies and technological affordances that may attract or steer away youth of particular profiles. Only by doing so can we truly develop new technologies conscientiously to further our digital culture and to address the complexity in the personal, cognitive, and social developmental characteristics of today's youth.

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Appendix A: IRB Materials

Appendix A includes a copy of the IRB letter approving the protocol of this study and a copy of the original consent form given to participants.

SIGILLUM UNIVERSITATIS TUFTENSIS PAX ET LUX

TUFTS UNIVERSITY

May 25, 2005

Dear Student:

My name is Marina Bers and I am a Professor in the Eliot-Pearson Department of Child Development at Tufts University. I am conducting a research project aimed at understanding the potential benefit of integrating face to face and virtual experiences for building community at Tufts and for helping freshman have a successful and enjoyable personal and academic experience at Tufts.

The purpose of this letter is to ask your consent to participate in this pilot research project. At the beginning of each semester and at the end of the academic year you will be asked to complete an anonymous questionnaire. You will also be asked to provide information about your grades, curricular and extra-curricular activities and awarded honors. All this information will be kept confidential.

If you have any questions, please do not hesitate to contact Prof. Marina Bers at 617-627-4490 or via e-mail at marina.bers@tufts.edu.

Sincerely,

Marina Bers, PhD
Assistant Professor
Tufts University

Consent

______ ***I give my consent*** to participate in the research project.

______ **I do not give my consent** to participate research project.

Signature/date ________________________

APPROVED IRB
JAN 11 2005

EXPIRES
JAN 10 2006
TUFTS UNIVERSITY
MEDFORD IRB

TUFTS UNIVERSITY

Office of the Vice Provost

Re: IRB Study # 72302B
Title: Communities of Learning and Care: Virtual Environments to Foster Positive Youth Development
Date: 1/12/2005
Dear: Marina Bers
IRB Review Date: 1/11/2005

The Institutional Review Board (IRB) has reviewed the above referenced study.

This protocol now meets the requirements set forth by the IRB and is hereby approved. Approval is valid for a period of one year from the IRB Review Date.

Enclosed you will find a consent form which shows the date through which the consent is valid. Use this stamped consent form for the purpose of reproduction. Please remember that all translated consent documents must be submitted to the Office of the IRB for review and approval before they can be used. In addition, all subject recruitment materials, including flyers, advertisements, and brochures must be reviewed and by the IRB stamped with the IRB's approval before using.

Investigators with full approval will be required to submit continuing review reports on their research activities on a continuing basis not to exceed one year. All adverse reactions, protocol deviations, modifications to the protocol and consent forms, and/or termination of your study must be reported to the Office of the IRB in a timely manner.

According to federal regulations a protocol may be audited at any time.

If you have any questions regarding this protocol, please contact the Office of the Institutional Review Board at (617) 627-3417. In addition, *if* you submitted your Human Subject Review Form electronically or if you neglected to sign your hard copy, you are required to submit the first page of the form with your signature. Please forward the signed copy to my attention at the address below.

Sincerely,

Helen A. Page, Ed.D.
IRB Administrator

Ballou Hall
Medford, Massachusetts 02155
617 627-3417
Fax: 617 627-3673

Appendix B: Questionnaires and Summary of Results

This appendix includes questionnaire materials distributed to participants with data collected summarized. Number items represent the number of participants who selected each response.

ID Number _____******____

Thank you for your participation in our study. Please complete this questionnaire. It should take you no more than 20 minutes. All information is kept confidential and will be used exclusively for research purposes. Please make sure you complete all the questions, and read both sides of every page.

BACKGROUND INFORMATION

1. Age: _____ [17 years, n=7; 18 years, n=75; 19 years, n=3]
2. Gender: F __46__ M __39__
3. Race/Ethnicity: White/Caucasian=66; African/African American=7; Latino American=5; Asian/Asian American=6; Other=1
4. Religion: Christian/Catholic=36; Jewish=16; Islam=2; Other=3; None=27
5. Is English your first language? Yes __33__ No __51_ [Missing: n=1]
6. Do you speak languages other than English? Yes 33 No 51 [Missing: n=1]

   If yes, please list them: ___N/A____
7. Home State/Country: ____N/A____
8. Personal education (check one):

   Public high-school 56 private high-school 29

   Public elementary school 33 private elementary school 13 [Missing: n=39]
9. Please circle the highest degree achieved by your mother [Missing: n=1]

   High school 9 College 29 Graduate level degree 43 Other 3
10. Please circle the highest degree achieved by your father [Missing: n=1]

    High school 9 College 24 Graduate level degree 49 Other 2

Academic experience

11. Please describe yourself as a high school student (check one): [Missing: n=1]

    High achiever 71 Average student 12 Low achiever 1
12. Are you interested in getting involved in research projects while at Tufts?

    Yes 44 No 2 Maybe 39
13. Are you interested in getting involved in extra-curricular activities while at Tufts?

    Yes 83 No 0 Maybe 2
14. Are you interested in getting involved in volunteer work or community service activities while at Tufts?

    Yes 52 No 1 Maybe 32
15. In which school are you enrolling? (check one)

    Arts and Science 69 Engineering School 13 Undecided 3 Other 0
16. Please describe your academic interests (possible major and minor). ___N/A____

Read carefully and circle the option that best applies to you on a rating scale of 1 (strongly disagree) to 5 (strongly agree)							
	1 Strongly Disagree	2	3	4	5 Strongly Agree	Missing	M (SD)
1. I know how to use a computer (operating system, standard applications, and searching for information on the Internet).	0	1	2	18	64	0	4.71 (.57)
2. Learning a new technological skill is easy for me.	0	4	17	39	25	0	4.00 (.83)
3. I can express myself (my ideas and my values) by using the computer.	1	10	21	24	29	0	3.82 (1.07)
4. When working with someone on the computer, I make sure that they understand everything I am doing.	2	20	30	17	14	2	3.25 (1.08)
5. I have met new people through the use of computers.	15	15	10	25	20	0	3.24 (1.45)
6. I can imagine new ways of using technology to make the world a better place.	9	8	27	23	18	0	3.39 (1.23)
7. I know how to make or design my own projects with computers (i.e., text, images, animations, songs, robotic constructions, etc.).	16	18	19	17	15	0	2.96 (1.38)
8. I feel confident that I can learn how to use a new computer application.	1	5	17	31	31	0	4.01 (.96)
9. I am able to create or design projects on the computer from an initial idea to a finished work that show who I am.	8	17	27	17	14	2	3.14 (1.21)
10. I think that everyone should have a computer.	4	6	8	24	43	0	4.13 (1.14)
11. My social life would be the same without a computer. (R)	23	19	21	9	13	0	2.65 (1.39)
12. I believe that by using new technologies people can find new ways to contribute more to their communities.	2	5	19	36	23	0	3.86 (0.99)
13. I have an advanced understanding of how a computer works.	14	16	24	19	12	0	2.99 (1.29)

Read carefully and circle the option that best applies to you on a rating scale of 1 (strongly disagree) to 5 (strongly agree)	1 Strongly Disagree	2	3	4	5 Strongly Agree	Missing	M (SD)
14. I feel confident that I can figure out how to use new features of a program on my own.	1	11	21	30	22	0	3.72 (1.03)
15. I know how to make computer projects (i.e., text, images, animations, songs, videos, robotic constructions, etc.) that express things that are important to me.	12	18	17	24	14	0	3.12 (1.31)
16. I am part of a virtual community on the Internet where I give and receive advice.	38	15	9	17	6	0	2.27 (1.39)
17. Because of my technical skills, I can connect with people in many different ways.	12	13	30	17	11	2	3.02 (1.22)
18. I can contribute to my community using my computer and/or my technical skills.	13	24	19	18	10	1	2.86 (1.26)
19. I do not know how to use a computer. (R)	19	12	8	15	31	0	3.32 (1.61)
20. I know that I can figure out how to create or design projects on the computer from an initial idea to a finished piece of work.	7	22	20	21	13	0	3.13 (1.22)
21. I feel good about myself when using the computer.	3	10	33	26	13	2	3.42 (1.00)
22. It is important for me to teach others the things that I already know about computers.	15	21	25	19	5	0	2.74 (1.17)
23. I use email and other online tools (IM, weblogs, etc.) to stay in touch with those who I really care about.	0	2	6	19	57	0	4.56 (.73)
24. The Internet opens new possibilities for becoming active participants in the communities we care about.	2	3	23	29	27	1	3.90 (.98)
25. I do not understand how a computer works.	39	22	12	8	4	1	2.01 (1.19)
26. I am confident that I can learn how to program the computer.	9	15	19	22	19	0	3.32 (1.30)

Read carefully and circle the option that best applies to you on a rating scale of 1 (strongly disagree) to 5 (strongly agree)							
	1 Strongly Disagree	2	3	4	5 Strongly Agree	Missing	M (SD)
27. I know what is good and bad behaviors regarding uses of the Internet and computer packages.	2	1	12	32	37	1	4.20 (.90)
28. I have found support groups on the Internet.	42	20	13	5	2	2	1.83 (1.06)
29. I use the computer to connect with other people who think and feel the same way as I do.	15	12	25	20	11	2	3.00 (1.29)
30. I can imagine positive ways to use computers for our society.	6	7	17	33	20	2	3.65 (1.15)
31. I can debug or fix computer projects or programs when something goes wrong (identify problems, test solutions, etc).	18	21	18	19	7	2	2.71 (1.27)
32. I <u>do not</u> know how to find help when using the computer. (R)	33	34	9	4	2	3	1.88 (.96)
33. I am able to learn computer applications that help me express myself in different ways.	7	12	29	11	24	1	3.25 (1.12)
34. Using the computer is a good way for me to understand better the people who I care about.	12	18	22	21	10	2	2.99 (1.24)
35. I actively use the computer to be part of different communities.	13	26	14	22	9	1	2.86 (1.27)
36. I can see how technology could be a negative influence or cause problems in our society.	1	9	15	25	34	1	3.98 (1.06)

Civic Activities On- and Off-line Survey

Please indicate how frequently you do the following activities: a) offline/in-person and b) via the Internet

		a) offline/in-person							b) via the Internet						
	Activities	Never	Seldom	Sometimes	Often	Always	Missing	M (SD)	Never	Seldom	Sometimes	Often	Always	Missing	M (SD)
1	Talk to your friends about social/political issues	2	5	24	25	26	3	3.83 (1.03)	20	22	20	12	7	4	2.56 (1.26)
2	Talk to your family about social/political issues	1	6	24	23	28	3	3.87 (1.02)	56	13	7	2	3	4	1.56 (1.01)
3	Talk to people you don't know about social/political issues	20	28	20	8	5	4	2.38 (1.15)	44	17	8	7	2	7	1.79 (1.11)
4	Read opinion columns/editorials	5	12	24	27	10	7	3.32 (.93)	14	10	21	26	7	7	3.03 (1.25)
5	Write opinion columns/editorials	45	18	6	6	4	6	1.18 (1.18)	52	9	7	7	4	6	1.76 (1.23)
6	Engage in a conversation with people who don't share your opinion	2	4	22	36	17	4	3.77 (.93)	17	15	25	17	7	4	2.78 (1.25)
7	Help mediate a heated debate	13	22	26	19	10	5	3.01 (1.25)	51	16	8	2	3	5	1.63 (1.02)
8	Discuss ways to improve your local community or school	5	12	30	18	13	7	3.28 (1.12)	38	21	13	3	3	7	1.87 (1.07)
9	Help propose changes in policies in your school and/or local community	16	11	29	14	11	4	2.91 (1.29)	46	19	10	4	1	5	1.69 (.96)
10	Discuss contrasting views about culture andor values with other people	3	10	20	28	19	5	3.63 (1.10)	26	14	19	14	6	6	2.49 (1.32)
11	Come to an agreement about social/political issues with someone with different opinions	9	15	31	17	10	3	3.05 (1.15)	40	21	12	5	2	5	1.85 (1.06)
12	Give your honest opinion even when someone else may disagree with you	2	6	11	32	30	4	4.01 (1.02)	17	6	14	24	19	5	3.28 (1.46)
13	Participate in community service projects	4	5	21	29	22	4	3.74 (1.08)	55	12	6	3	2	7	1.53 (.98)
14	Volunteer in political campaigns/protests	34	17	12	6	10	6	2.25 (1.41)	55	7	9	4	3	7	1.63 (1.12)
15	Post on website or online blogs (e.g., *LiveJournal*) about community, school, or social issues								36	13	13	11	9	3	2.32 (1.43)
16	Keep/update online personal profiles (e.g., *Facebook*, *MySpace)*								20	9	10	16	27	3	3.26 (1.60)
17	Use online personal profiles to find others who share similar opinions about civic issues								38	13	14	11	5	4	2.16 (1.32)
18	Visit other people's websites to read about their opinions regardin civic/school issues								22	12	17	16	14	4	2.85 (1.46)
19	Read other people's personal profiles online								5	9	16	24	27	4	3.73 (1.22)

Civic Activities On- and Off-line Survey

	Social Activities (in- or out-of-school)	Level of involvement: 1 Not Involved	2	3	4	5 Very Involved	Missing	M (SD)	Leadership role: Yes	No	Missing
1	Academic or Pre-professional society	27	8	13	19	14	4	2.81 (1.53)	18	64	3
2	Community service organization	9	10	25	16	23	2	3.41 (1.31)	34	49	2
3	volunteer vacation	57	6	9	3	6	4	1.70 (1.25)	6	76	3
4	cultural, religious, or gender-based organization	41	11	9	12	9	3	2.23 (1.47)	13	68	4
5	Political organization (other than student government)	53	7	7	8	7	3	1.89 (1.38)	13	67	5
6	Media (student newspaper, radio, etc.)	48	9	8	8	9	3	2.04 (1.44)	14	67	4
7	Performing Arts (theatre, music, etc.)	28	9	12	9	24	3	2.90 (1.67)	24	57	4
8	Programming or social programming board	59	8	6	4	4	4	1.59 (1.14)	5	76	4
9	Sports (collegiate or intra-mural) or recreation	12	5	11	16	38	3	3.77 (1.46)	39	42	4
10	Student Government	51	5	5	8	11	5	2.04 (1.54)	16	62	7

	Voting	Yes	No	Not of age	Not American	Missing
11	Are you are registered voter?	35	38	10	1	5
12	Did you ever vote?	23	48	12	1	1