The Social Outcomes of Participating in the FIRST Robotics Competition Community

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Worcester Polytechnic Institute (WPI) and FIRST are partnering to investigate social networking within the FIRST community. FIRST aims to get young people interested in science, engineering and technology by providing young people with opportunities to develop and apply knowledge and skills in science, engineering, and technology. Moreover, FIRST provides a platform for young people to work with one another, work with mentors, and also cooperate and compete with one another. By providing this platform, FIRST encourages participants to develop communication and leadership skills, and may also boost self-esteem and self-confidence in participants. However, the social outcomes of participating in FIRST (e.g., boosts in self-esteem) has yet to be explored.

Why Are Social Outcomes Important?

According to Erik Erikson's (1959) psychosocial development theory, those between 13-19 are struggling with the question of who they are and what they want to do with their lives (1). Erikson argues that teenagers battle between role confusion (trying to figure out what role they should play) and identity (developing a sense of who they are and what they want to do with their lives). Moreover, Harris (1998) argues that youth are more likely to identify with their peers than their parents, and that peers are more likely to shape behaviors of individuals than parents (2). Thus, teenagers can be highly influenced by their surrounding peers, and it is possible that participating in FIRST may lead to positive benefits in terms of their psychosocial development as their participation may help teenagers find like-minded peers and help them develop an identity. Research also shows that youth who get involved in community programs and consequently interact with other youth and have adult mentors have more positive and advanced developmental outcomes (3, 4, 5, 6). And, self-esteem may be influenced by peers and activities (7).

Current Research

Thus, the specific goals of the current project are to (1) investigate social networking in FIRST, (2) investigate the social benefits of participating in FIRST (e.g., increased self-esteem, social awareness, social networking, social skills, etc.), (3) evaluate the usability and effectiveness of different networking and information repository websites that can by used by FIRST participants to better understand what resources FIRST participants are using and why.

Method

Participants

There were a total of 417 participants (255 male; 141 female; 21 Not specified) in this study, and came from all over the world, including the United States (Arizona, California, Connecticut, Colorado, Virginia, Florida, Georgia, Hawaii, Indiana, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nevada, New Jersey, New Hampshire, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Utah, Washington, Wisconsin), Canada, England, and Israel. The participants ranged from the ages of 13 to 49; and included FIRST Robotics participants (high-school aged) and mentors (college students and other adults). For most of the analyses, only the high-school aged FIRST participants were used and included 391 participants (247 male; 136 female; 8 Did Not Report). All participation was voluntary and all participants gave consent prior to participating.

Design

A 2 (Length of Time: Early in Season or End of Season) x 3 (Mindset Prime: Control, Academic Focus, or Social Focus) mixed-participants design was implemented. To investigate whether the length of time participating in FIRST influenced the social networks and social skills of participants, we assessed participants' attitudes early in the season and after the robotics season ended (within-participants variable). To examine whether awareness to different goals influenced social networking and social skills, participants were randomly assigned to one of three different versions of the survey: 1) instructions reminded participants of the importance of social networking while participating in FIRST (Social Focus Condition), 2) instructions reminded participants of the importance of learning about science and technology while participating in FIRST (Academic Focus Condition), and 3) instructions informed participants that the survey examined general experience in FIRST (Control Condition).

Materials

Mindset Prime Manipulation. We wanted to examine if having different goals, such as the goal to network socially or the goal strive academically, influenced social behaviors (e.g., networking, social skills). To examine this, we created a mindset prime (adapted from 8) to lead participants to believe that a) social networking was important in FIRST, b) learning about science and technology was important in FIRST, or c) a neutral prime condition where participants were informed we were interested in general experiences while participating in FIRST.

Length of Time Manipulation. To examine if length of time while participating in FIRST influenced participants' social networking skills, we administered the survey at the beginning of the FIRST robotics season and again at the end of the season. The season started in mid-January and ended in mid-April; thus there were approximately 3-4 months from the beginning of the season to the end of the season.

Self-Efficacy Measure. To see if participating in FIRST influenced self-efficacy, or the belief that one is capable of performing in a certain manner to attain certain goals, we measured their academic and social self-efficacy. To measure academic self-efficacy, we used the Academic Self-Efficacy Scale (9). It contained questions that measured how well participants believed they could handle different academic/learning situations. For instance, " How well can you get teachers to help you when you get stuck on your schoolwork?" We also measured their social self-efficacy with the social Self-Efficacy Scale (9). It contained questions that measured how well participants believed they could handle different social situations, such as "How well can you have a chat with an unfamiliar person?" Both scales used a 5-point Likert-Type Scale (1 = Not Very Well; 5= Very Well).

Social Connectedness Measure. To measure the how socially connected FIRST participants felt, we adapted the Mediated Social Connectedness Scale (adapted from 10). This scale measures the participants awareness of others and feelings of connection to others in FIRST, such as "When participating in FIRST, I have a sense that I am part of a larger community." This scale used a 7-point Likert-type scale (1 = Strongly Disagree; 7 = Strongly Agree).

Social Skills. To investigate the social skills of FIRST participants who are mainly in their teenage years, the Teenage Inventory of Social Skills Scale was adapted from (11). This scale measures different social behaviors teenagers engage in, such as "I listen when other people want to talk about a problem" on a 7-point Likert-type Scale (1 = Does not describe me at all; 7 = Describes me totally).

Collective Self-Esteem. To measure how positively participants feel about their social group, we measured their collective self-esteem using the Collective Self-Esteem Scale (12). An example question is "In general, I'm glad to be a member of the social groups I belong to", and the scaled uses a 7-point Likert-type scale (1 = Strongly Disagree; 7 = Strongly Agree).

Competition. To investigate attitudes towards competition, the Competition Scale was used (13). An example question is "I like competition because it teaches me a lot about myself " and the scale uses a 5-point Likert-type scale (1 = Strongly Disagree; 5 = Strongly Agree).

Personality Traits. To examine the personality types of those involved in first (e.g., competitive, independent, masculine, feminine), participants indicated the extent to which 32 traits described them on a 7-point Likert-type scale (1 = Not at All ; 7 = Very Much).

Other Social Networking Measures. As social networking may extend beyond FIRST and may even include online social networking sites (e.g., Facebook), we also measured participants' involvement with friends and certain activities. Participants indicated the number of friends they had in school, in FIRST, and on Facebook. Participants also indicated the amount of time they spent with their friends from school, friends from FIRST, and on Facebook.

Robotics and FIRST Websites. In addition to peer-to-peer social networking, we also investigated what online sources participants used to help with their Robotics competition. We assessed the extent to which participants were familiar with several different websites geared towards the FIRST Robotics competition (e.g., Chief Delphi, FIRST website, and WPI's ThinkTank website). We also assessed the usability and

preferred features of each website.

Demographics. Participants also provided demographic information including their age, gender, ethnicity, and FIRST team/location.

Procedure

To recruit participants for the study, announcements were sent via FIRSTs email system and posted on a popular blog for FIRST participants. Participants then logged onto a website and gave informed consent. Since FIRST has both academic and social goals, one aspect of the study investigated whether making people aware of the goals influenced their responses. To investigate this, participants saw one of three different instructions (the mindset prime manipulation). One-third of the participants were led to believe an important goal of FIRST was social networking, one-third were led to believe an important goal of FIRST was learning about science and technology, and the remaining one-third of participants were in the control (neutral prime) condition and were informed the survey measured general experiences in FIRST. After reading the instructions, participants completed the survey. The survey assessed Academic and Social Self Efficacy, Social Connectedness to FIRST, Social Skills, Collective Self-Esteem, Attitudes towards Competition, Personality Traits, Other Social Networking Experiences, and demographic information.

To understand whether participating in FIRST helped increase social skills, participants completed the survey early in build season (mid-January to mid-February), and completed the same survey again at the end of the national competition (mid-April to mid-May) approximately 4 months after the teams formed). The same participants from the Time 1 data collection (early in the build season) were recruited via email addresses provided on the survey and their responses were linked from Time 1 and Time 2 by a unique code each participant provided (e.g., favorite color and Mother's birthday). All participants were debriefed at the end of the FIRST Robotics season.

Results

At the current time, the FIRST Robotics season is still underway; therefore, the only data reported in this paper will be the data collected at Time 1 (early in the build season).

Academic and Social Self-Efficacy

The data were analyzed using a one-way analysis of variance (ANOVA) with the mindset prime and participant gender as factors. For academic self-efficacy, there was no main effect for gender ($p = .3$), for goals ($p = .5$), and no interaction between gender and instructions ($p = .7$). For social self-efficacy, there was no main effect for gender ($p = .8$), for goals ($p = .1$), nor was there an interaction ($p = .4$). Thus, contrary to predictions, early in the season, neither gender nor the goals participants were primed with influenced their self-efficacy.

Social Connectedness with FIRST

The data were analyzed using a one-way analysis of variance (ANOVA) with the mindset prime and participant gender as factors. There was no main effect for goals ($p = .6$). However, there was a main effect for gender, $F(1, 347) = 11.05$, $p = .00$. Females ($M = 5.8$, $SD = .74$) felt more socially connected to FIRST than males ($M = 5.5$, $SD = .80$). There was also an interaction between goals and gender, $F(2, 347) = 3.96$, $p = .02$. For those in the Neutral Focus Condition, Females ($M = 6.0$; $SD = .67$) felt more socially connected than males ($M = 5.5$; $SD = .82$), $F(2, 347) = 9.1$, $p = .00$. For those in the Social Focus Condition, Females ($M = 5.9$; $SD = .66$) felt more socially connected than males ($M = 5.4$; $SD = .83$), $F(2, 347) = 10.3$, $p = .00$. But, for those in the Academic Focus Condition, females and males felt equally connected, $p = .7$. But, Males in the Academic Focus Condition ($M = 5.7$; $SD = .75$) felt more connected than Males in the Social Focus Condition (M = 5.4; SD = .83), $t(2, 347) = 2.21$, $p = .03$.

Learning in FIRST

The data were analyzed using a one-way analysis of variance (ANOVA) with the mindset prime and participant gender as factors. There was no main effect for goals ($p = .4$). However, there was a main effect for gender, $F(1, 365) = 11.07$, $p = .00$. Females ($M = 5.7$, $SD = 1.24$) felt more socially connected to FIRST than males ($M = 6.1$, $SD = .92$). There was also a marginal interaction between goals and gender, $F(2, 365) = 2.48$, $p = .09$. For those in the Academic Focus Condition, Males ($M = 6.2$; $SD = .11$) reported learning more in FIRST than Females ($M = 5.4$; $SD = .16$), $F(1, 365) = 14.2$, $p = .00$. However, there were no differences in the Social Focus Condition ($p = .3$) or the Neutral Focus Condition ($p = .4$).

Collective Self-Esteem

The data were analyzed using a one-way analysis of variance (ANOVA) with the mindset prime and participant gender as factors. For collective self-esteem, there was no main effect for gender ($p = .3$), for goals ($p = .3$), and no interaction between gender and instructions ($p = .5$).

Attitudes Towards Competition

The data were analyzed using a one-way analysis of variance (ANOVA) with the mindset prime and participant gender as factors. For attitudes towards competition, there was no main effect for gender ($p = .6$), for goals ($p = .2$), and no interaction between gender and instructions ($p = .2$).

Website Use

Eighty-nine percent of the participants reported using the FIRST website and 74 percent reported using Chief Delphi, and the percentage of people using both sites does not significantly differ, $\chi^2 = 1.4$, $p = .2$. However, only 9 percent of the participants

reported using ThinkTank.

Discussion

In conclusion, the overall goal of this project is to better understand the potential social benefits that may result from participating in FIRST (or similar programs). The results, thus far, suggest that both the mindset goals and participant's gender influence how socially connected participants feel, as females feel more connected than males; but males who have the Academic Focus goal feel more connected than males who have the Social Focus Goal. Moreover, participant's gender and possibly their mindset goal influence the amount that participants believe they learn about science and technology by participating in FIRST. Males report more learning than females, and this effect is even more robust when males and females are given the Academic Focus goal. Thus, participating in first seems to influence how socially connected participants feel and how much they believe they learn.

However, this research has not yet explored whether participating in FIRST influences other social outcomes. The data so far were collected early in the season, and more data will be collected when the season ends to examine the long-term social benefits. It is possible that while there were no differences in Time 1 for self-efficacy, social behaviors and other social outcome variables that after participating in FIRST for 3 months, there will be significant differences in these variables.

Thus, this study will lead to a better understanding of the social outcomes of participating in programs like FIRST. The results of this research can lead to methods of recruiting participants, maintaining participants, and organizing other aspects of FIRST. In addition, this research will begin to provide an understanding of how participating in programs that bring students together to work on academic problems may also have benefits that extend beyond the classroom.

References

1. Erikson, E. (1959). Identity and the life cycle. *Psychological Issues, 1*, 171.
2. Harris, J. R. (1998). The *nurture assumption: Why children turn out the way they do.* Free Press.
3. Eccles, J. & Gootman, J. (2002). *Community programs to promote youth development.* Washington, D.C.: National Academy Press.
4. Greenberg, M.T., Weissberg, R.P., O'Brien, M.U., Zins, J.E., Fredericks, L., Resnik, H., & Elias, M.J. (2003). Enhancing school-based prevention and youth development through coordinated social, emotional, and academic learning. *American Psychologist, 58,* 466- 474.
5. Larson, R. W., (2000). Toward a psychology of positive youth development. *American Psychologist*, *55*, 170-18.
6. Small, S., & Memmo, M. (2004). Contemporary models of youth development and problem prevention: Toward an integration of terms, concepts, and models. *Family Relations*, *53*, 3-11.

7. Harter, S. (1990). Self and identity development. At the threshold: The developing adolescent. In S. Shirley Feldman & Glen R. Elliott (Eds). *At the threshold: The developing adolescent. (pp. 352-387).* Cambridge, MA, US: Harvard University Press.

8. Chartrand, T. L. & Bargh, J. A. (1996). Automatic activation of impression formation and memorization goals: nonconscious goal priming reproduces effects of explicit task instructions. *Journal of Personality and Social Psychology, 71, 3*, 464-478.

9. Muris, P. (2001) A brief questionnaire for measuring self-efficacy in youth (s). *Journal of Psychopathology and Behavioral Assessment, (23)*, 145-149.

10. Gonzales, A.L. & Gay, G.K. (under review) Constructing and Validating the Mediated Social Connectedness (MSC) Scale. http://www.amygonzales.org/MSC

11. Inderbitzen, H. M., & Foster, S. L. (1992). The teenage inventory of social skills: Development, reliability, and validity. *Psychological Assessment, 4*, 451-459.

12. Luhtanen, R., & Crocker, J. (1992). A collective self-esteem scale: Self-evaluation of one's social identity. *Personality and Social Psychology Bulletin*, 18, 302-318.

13. Ryckman, Hammer, Kaczor, and Gold (1996). Construction of a personal development competitive attitude scale. *Journal of Personality Assessment, 66*, 374-385.

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