Prepared by:
WGBH Educational Foundation and
the Association for Computing Machinery (ACM)

WGBH

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Advancing Computing as a Science & Profession

Executive Summary

New Image for Computing (NIC) is managed by WGBH, a leading producer of television and non-broadcast educational media, and the Association for Computing Machinery (ACM), the world's oldest and largest educational and scientific computing society. Supported by a grant from the National Science Foundation (Grant No. CNS-0753686), NIC is currently in the first stage of what is planned as a multi-phase project that aims to improve the image of computer science among high school students (with a special focus on gender and ethnic disparities) and encourage greater participation in computer science at the postsecondary level. Working with experienced marketing professionals, the NIC initiative seeks to:

1. understand the attitudes held by high school students toward the study of computing in college and potential computing careers;
2. create a set of market-tested messages that resonate with young people, accurately and positively represent the field, and reshape the way computer science is portrayed to and perceived by young people;
3. conduct a pilot campaign using the tested messages. This pilot will assess strategies for how the messages can be used in a variety of ways to reach young people in their communities;
4. build a coalition of partners (computing organizations, universities, high school educators, and others) to adopt the messages and spread the word about the rewards and benefits of a career in computer science in honest, positive, and unified ways; and
5. evaluate the results.

This report covers the first phase of the NIC initiative: market research and initial message testing, which was developed and implemented by Manhattan-based marketing and communications firms, BBMG and Global Strategy Group. In late 2008, we conducted a national online survey of college-bound high school students, ages 13–17, whose overall gender and ethnic representation mirrors that of all incoming U.S. freshmen.

National Online Survey

- College-bound youth
- Ages 13–17
- 1,406 total participants
- Ethnic oversampling
  - 300 African Americans (total = 454)
  - 300 Hispanics (total = 394)

Research Goals

- Assess the current attitudes toward computer science as a college major and career choice among college-bound high school students;
- Assess these same attitudes among Hispanic girls and African American boys, two of the groups most underrepresented in computer science;
- Develop messages that portray computer science in a variety of ways; and
- Gauge initial responses to those messages among teens.

Key Data

- Most college-bound males have a positive opinion of computing and computer science as a possible college major or career.
- College-bound African American and Hispanic teens are more likely than their white peers to be interested in computing.
- College-bound females, regardless of race and ethnicity, are significantly less interested than boys are in computing. More girls tend to associate computing with "typing," "math," and "boredom," while boys are more likely to associate computing with "video games," "design," "electronics," "solving problems," and "interesting."
- The three messages that tested best were:

Computing puts you in the driver's seat. *Why merely create a MySpace page when you can create the next MySpace? Computing gives you the power to imagine new languages, new worlds, and new ways of improving our lives by putting better ideas into actual practice in our communities.* Rated highest with African American and Hispanic boys.

Computing opens doors. *With eight billion computers in the world, just about everything depends on computing today. From transportation and energy to video games and space exploration, few careers enjoy so many real-world applications and few open as many doors as computing.* Rated highest with boys and those already interested in computing careers.

Computing empowers you to do good. *With computing, you will be able to connect technology to your community and make a world of difference—reducing energy consumption, improving health care, enhancing security, reducing pollution, and advancing learning and education.* Rated highest with girls and Hispanics.

Key Findings

Although the NIC initiative was originally designed to create messages that target college-bound high school students, especially African American males and Hispanic girls, our research shows little racial/ethnic differentiation in young people's attitudes toward computer science. It does show, however, a significant gender gap. Because of this, the NIC initiative is shifting its focus and will initially concentrate on girls as a special target audience.

It is also worth noting that computer science is clearly held in high regard by college-bound African American and Hispanic boys. Yet, these two groups remain underrepresented in both academia and the computer science workforce. If the issue isn't image, one needs to look at other factors that are turning off these young people. Why isn't a high school interest in computer science translating into enrollment in college computer science classes? WGBH and ACM will seek separate support to explore this issue further.

Introduction

The NIC initiative began in late 2007 with a review of the question, "Why is interest in computer science declining in U.S. colleges?" At that time, a recently published UCLA study found that the number of undergraduates choosing a computer science major was down a stunning 70% since 2000.[1] And according to a 2007 Computer Research Association (CRA) Taulbee Survey, there were double-digit declines in enrollments for graduate degrees in computer science.[2] Although it may be hard to believe, more than 80% of today's college freshmen—the very students that grew up with computers and are now called "digital natives"—said they had no idea what computer science majors actually do.[3]

While the most recent Taulbee Survey[4] reports improving numbers—undergraduate computer science majors are up 6.2% from last year—this good news must be tempered. The number of computer science majors is still not meeting projected workforce needs, and the Taulbee Survey points out that diversity in computer science programs continues to be poor. For example, just over 10% of the bachelor's degrees were awarded to women.

While there are likely many factors that contribute to the low interest in computer science, we believe that misperceptions and negative images play a significant role. Image is important. As long as teenagers believe that computer science is boring, difficult, antisocial, or doesn't have much impact on solving the world's problems, they're unlikely to choose it for their future.

To gauge current student attitudes toward computer science, we worked with BBMG, a professional marketing firm that specializes in branding and communication strategies for socially responsible companies, and the Global Strategy Group, a public opinion research and communications company, to conduct consumer research.

Methodology

A nationwide online survey of 1,406 college-bound teens was conducted from December 3–8, 2008. We worked with a private firm, e-Rewards, to professionally recruit high school students to participate in the survey. The total number of interviews includes 806 in a national sample, with an oversample of 300 additional interviews with African American teens (for a total of 454) and 300 with Hispanic teens (for a total of 394). Demographic and regional quotas were established based on a profile of current U.S. college students. Respondents were screened on the basis of age (13–17 years) and self-reported likelihood to attend college.

1 HERI/UCLA CIRP Freshman Survey, Feb. 06, 2007. http://www.heri.ucla.edu/

2 CRA's Taulbee Survey, *Computing Research News*, Vol. 19/No. 2, March 2007

3 Carter, Lori. *Why Students with an Apparent Aptitude for Computer Science Don't Choose to Major in Computer Science.* SIGCSE '06, March 1–5, 2006

4 Computing Degree and Enrollment Trends from the 2007–2008 CRA Taulbee Survey http://www.cra.org/govaffairs/blog/archives/CRATaulbeeReport-StudentEnrollment-07-08.pdf

Findings

1 Existing attitudes about computer science: Word Use

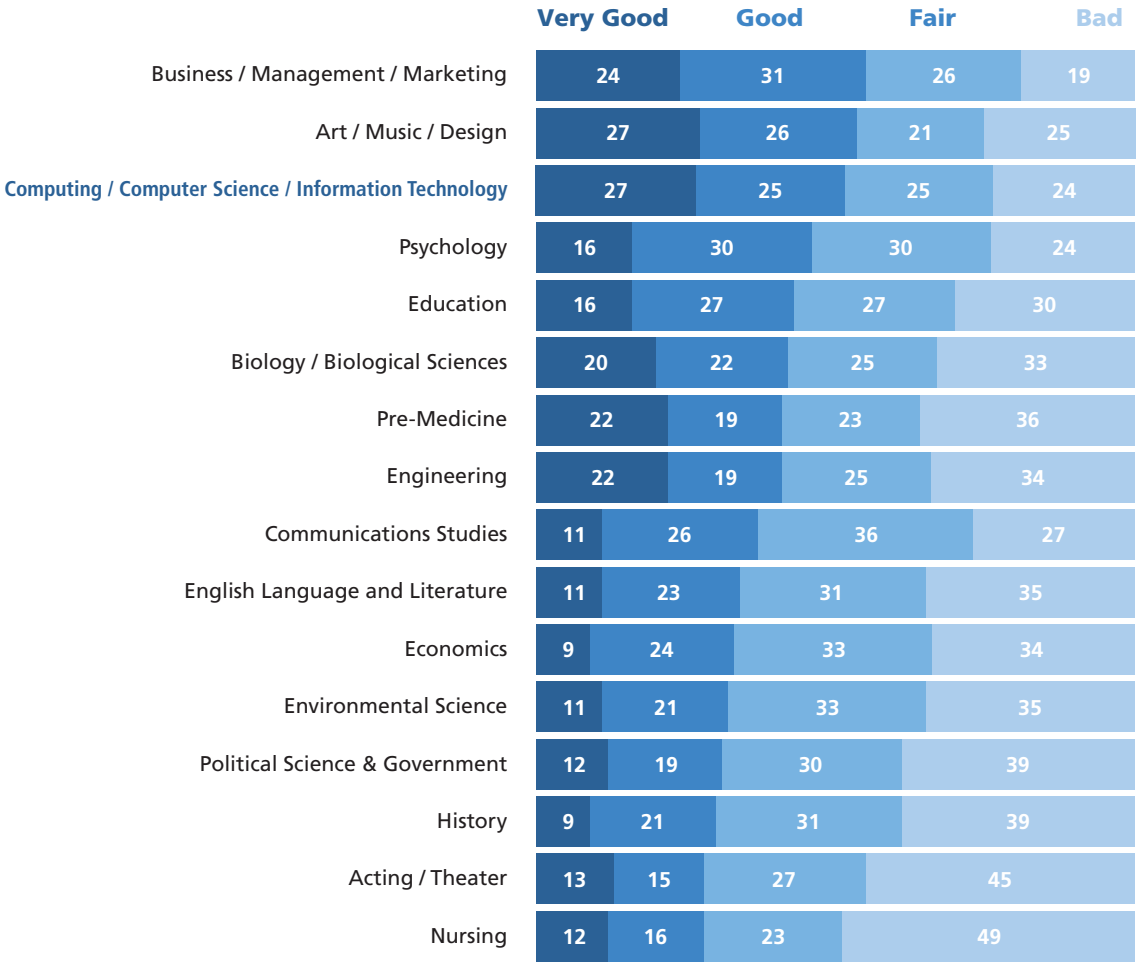
All survey respondents were asked, "What word comes to mind when you see or hear the word computing?" The most common words ("software," "programming," "technology," etc.) were similar between boys and girls. But gender differences emerged in the secondary words. For example, boys tended to use words such as "design," "games," "video," etc., with more frequency than girls. By contrast, the secondary words used by the girls tended to take on a more negative tone—with "boring," "hard," and "nerd" being used more frequently.

2 Computer science as a potential college major

When given a list of 16 possible college majors, all respondents were asked to rate each major as a "very good" choice, a "good" choice, a "fair" choice or a "bad" choice for them. Overall, computer science came in a close third, with 52% rating it as "very good" or "good." (*Fig. 1*)

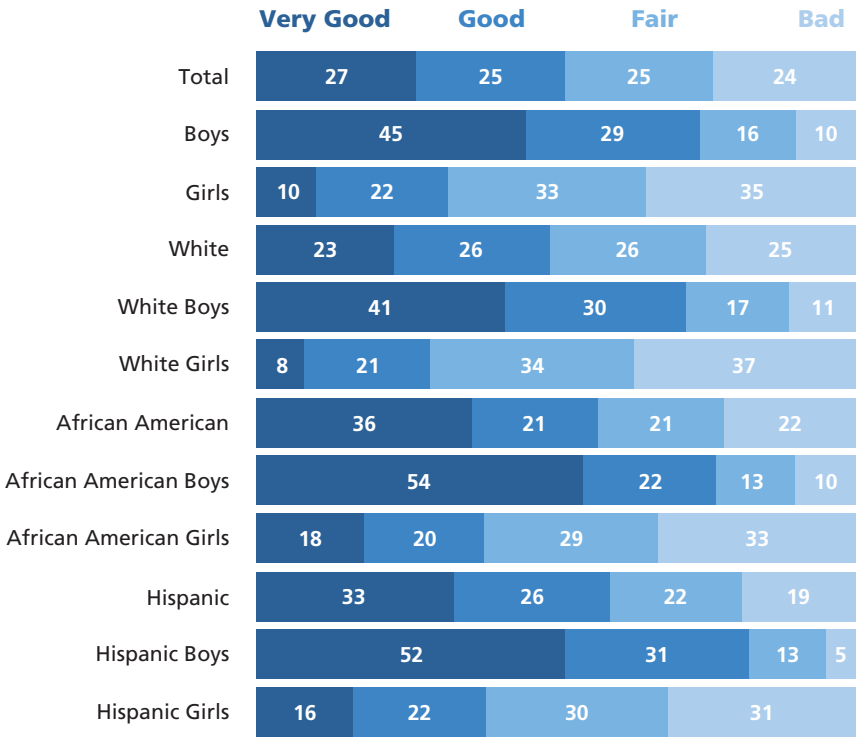
Figure 1. Interest in College Majors – Total Sample

Below is a list of college majors someone like you may choose. Please indicate how good a choice each would be as a college major for you or someone like you.



Once again, small racial and/or ethnic differences were uncovered in the responses. For example, 83% of Hispanic boys and 76% of African American boys rated a college major in computer science as a "very good" or "good" choice for them. However, while computer science fared well among the boys, significant differences emerged when the data was broken down by gender. As *Figure 2* shows, 74% of boys (regardless of race or ethnicity) reported that a college major in computer science was a "very good" or "good" choice for them. Among the girls, however, computer science fared poorly—only 10% of the girls rated it as a "very good" choice and 22% rated it as "good." (*Fig. 2)*

Figure 2. Interest in Computer Science/Computing College Majors by Gender & Race/Ethnicity
Responses to "*how good a choice Computing / Computer Science / Information Technology would be as a college major for you or someone like you?"*

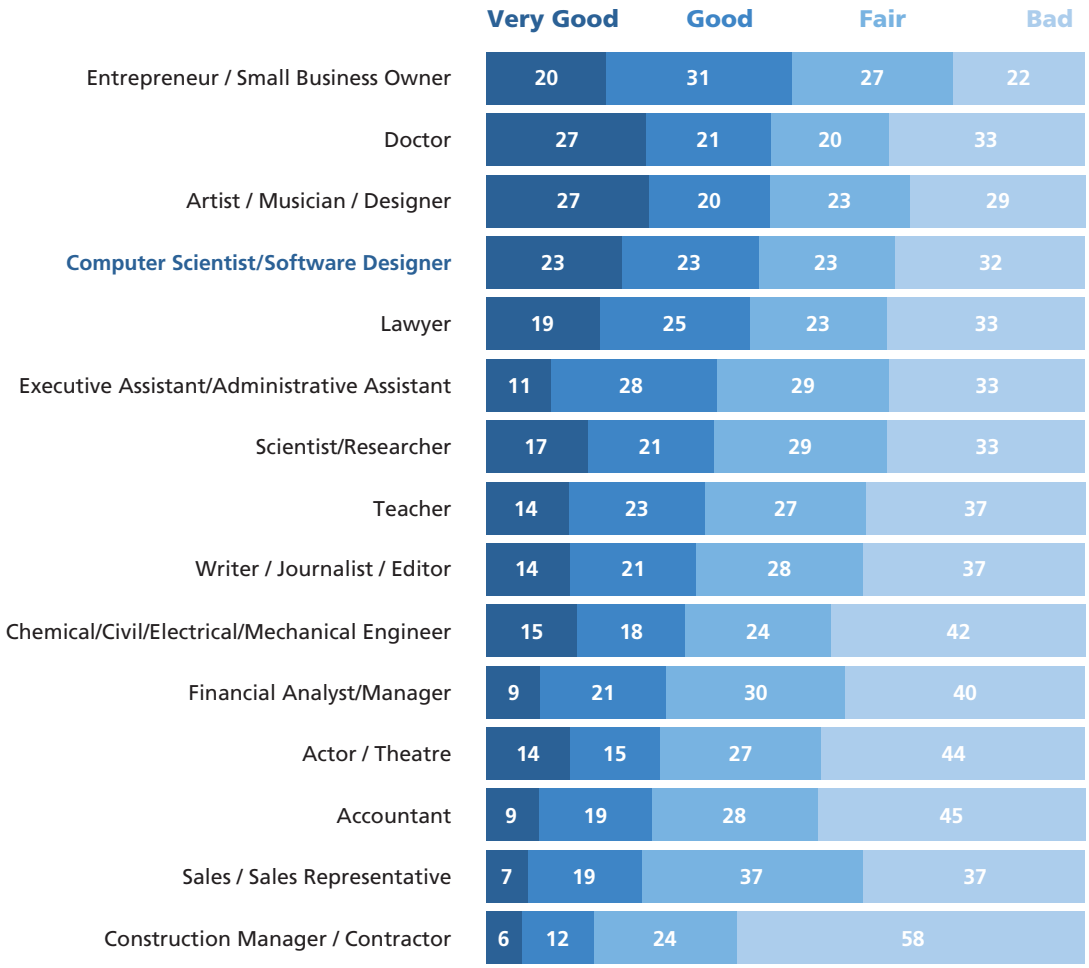


3 Computer science as a potential career choice

When given a selection of 15 possible careers, computer science came in fourth among our respondents with 46% rating it a "very good" or "good" career choice for them. (*Fig. 3*)

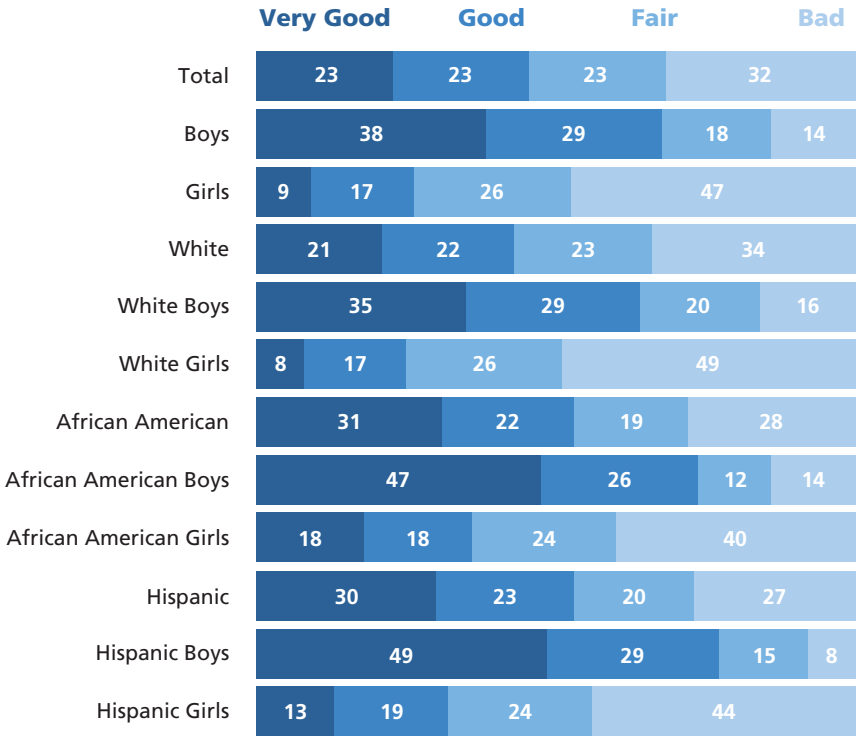
Figure 3. Career Interests – Total

Below is a list of careers or professions someone like you may choose. Please indicate how good a choice each would be as a career or profession for you or someone like you.



Again, we found relatively small differences in the responses of Hispanic, African American, and White boys, but the disparity between boys and girls is profound. While 67% of all boys rated computer science as a "very good" or "good" career choice, only 9% of girls rated it "very good" and 17% as "good." (*Fig. 4*)

Figure 4. Career in Computing
Responses to *"how good a choice Computer Scientist/Software Designer would be as a career or profession for you or someone like you?"*

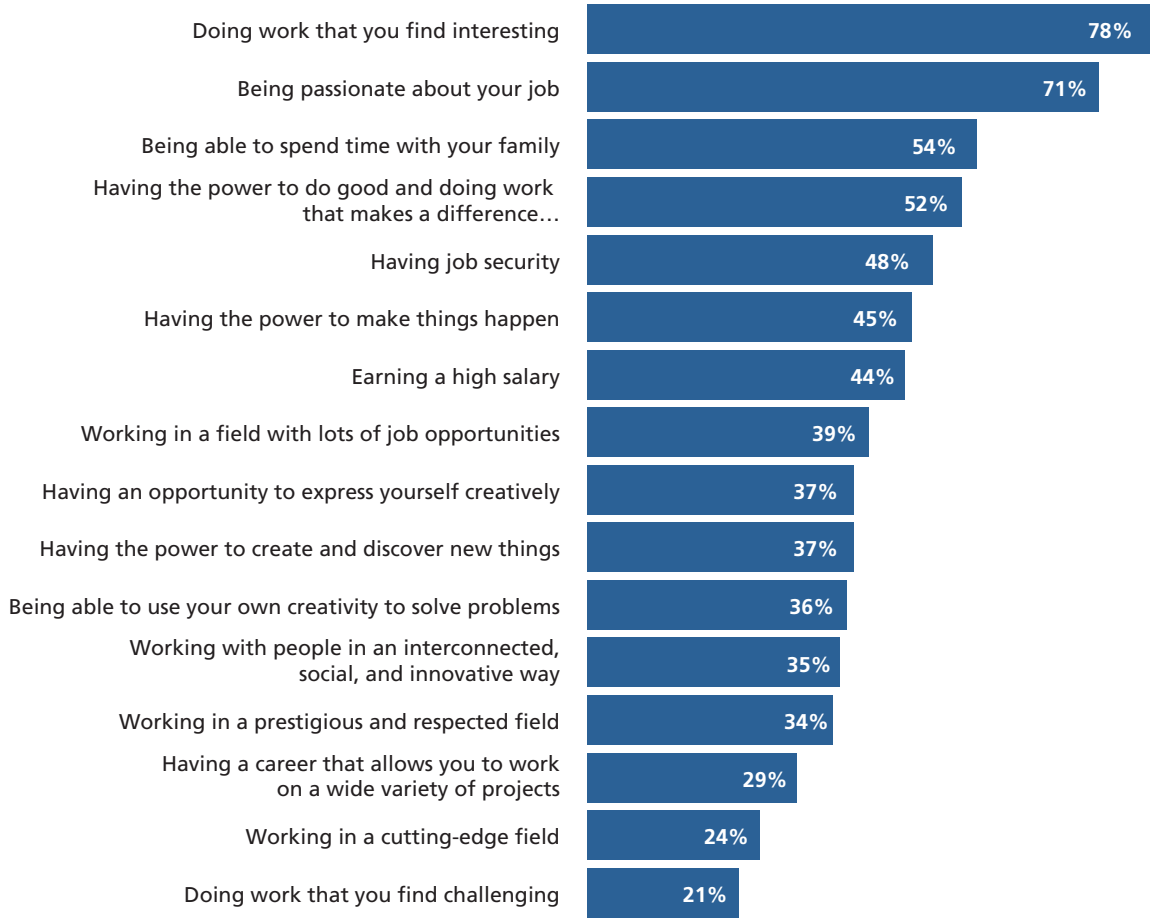


4 Important career characteristics

To gauge which career characteristics are important to young people, we asked them to rate 16 statements about careers (in general, not specific to computer science) as "extremely important," "very important," "somewhat important," "not very important," and "not important at all." The answers to these questions provide insight into what young people want in a career and inform the development of messages that resonate with this audience. Overall, the top four career elements, rated as "extremely important" were: doing work that you find interesting (78%); being passionate about your job (71%); being able to spend time with your family (54%); and having the power to do good and doing work that makes a difference (52%). (*Fig. 5*)

Figure 5. The Importance of Career Elements (Overall)

Please indicate how important each of the following is to you, personally, in considering which career to get into. (Percent rating at "extremely important")



When job characteristics were broken down by race and ethnicity, some significant differences appeared. One of these was "earning a high salary." While this attribute rated "extremely important" to 50% of the entire sample of boys, it was even more important to African American boys (61% rated it as "extremely important") and Hispanic boys (59% said "extremely important") than White boys. *(Fig. 6)*

Figure 6. Important Career Characteristics – All Boys/African American Boys/Hispanic Boys

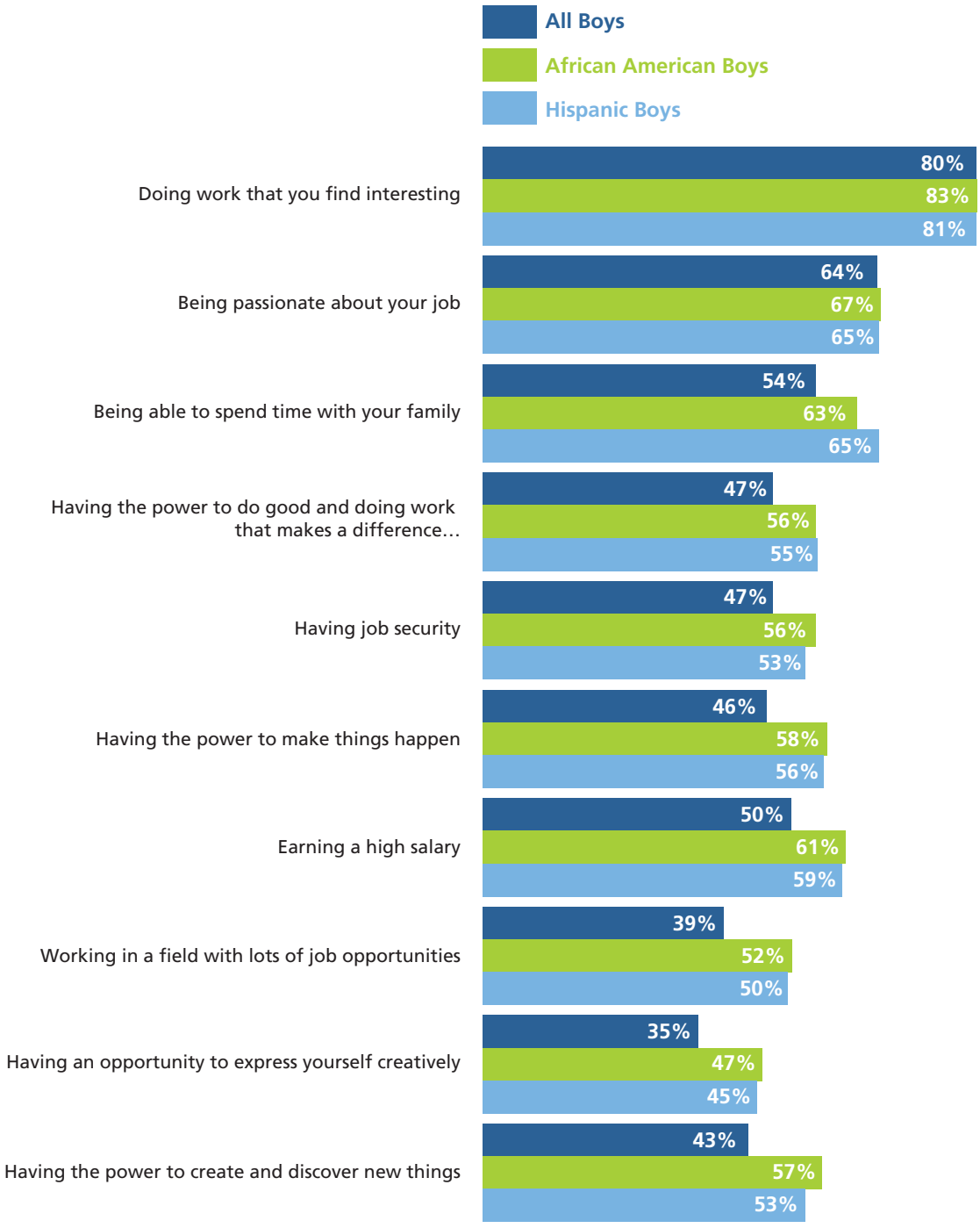
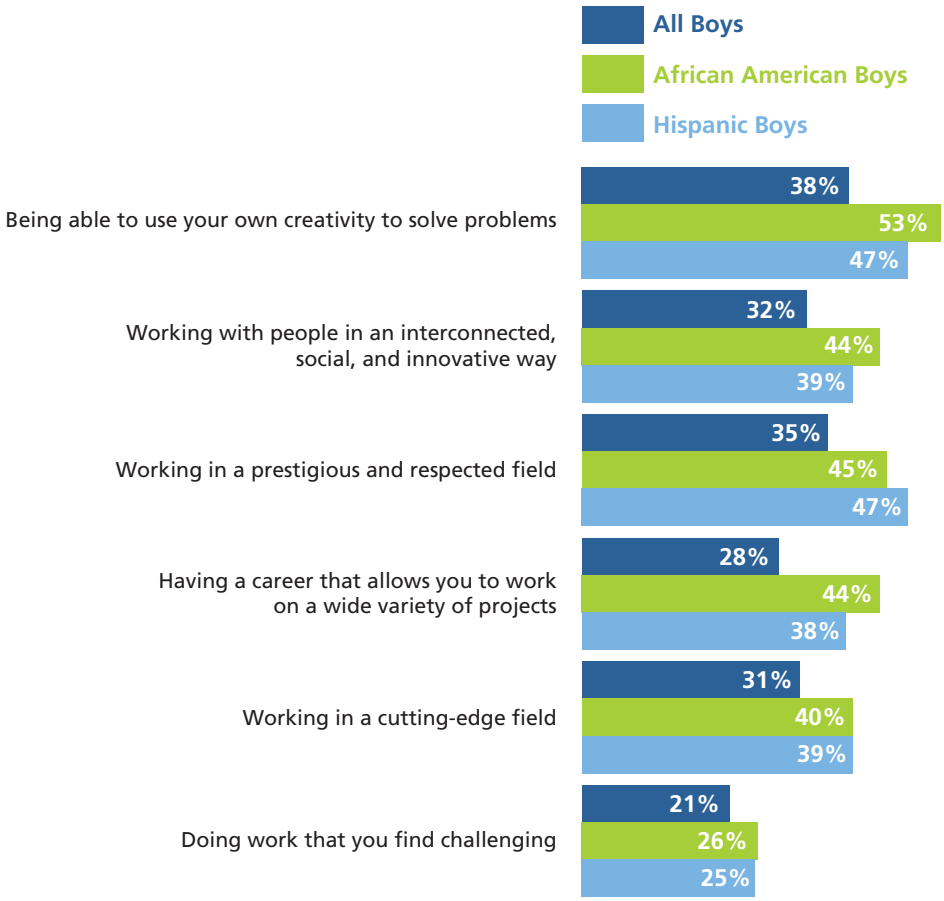


Figure 6. Important Career Characteristics – All Boys/African American Boys/Hispanic Boys *(continued)*

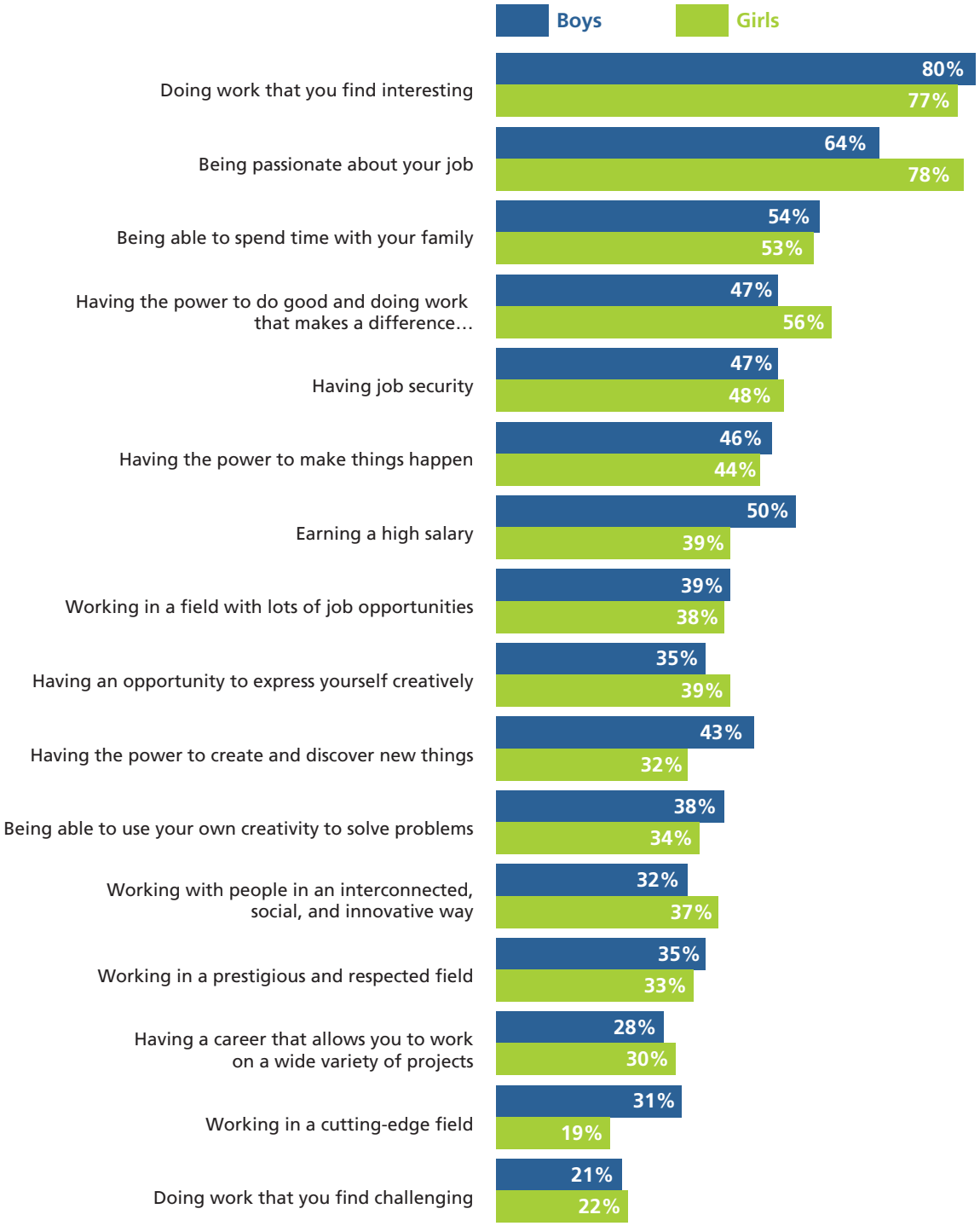


However, the most noteworthy differences showed up between boys and girls.
In *Figure 7*, our attention was drawn to three career elements:

- While 64% of boys rated "being passionate about your job" as "extremely important," 78% of the girls felt the same.
- Earning a high salary rated "extremely important" to 50% of all boys, but only 39% of all girls.
- And "having the power to do good and doing work that makes a difference" rated "extremely important" to 56% of the girls in comparison to 47% to the boys.

Figure 7. Important Career Characteristics – Boys/Girls

Please indicate how important each of the following is to you, personally, in considering which career to get into. (Percent rating at "extremely important")



5 Characteristics that drive young people toward, and away from, computer science

An analysis of our data has revealed that some of the career characteristics in our survey correlate with an interest (or lack of interest) in computer science. For example, the top positive *drivers* towards computer science are:

- having the power to create and discover new things; and
- working in a cutting-edge field.

This means that there is a correlation between young people who think that "working in a cutting-edge field," for example, is an important career characteristic, and those who rate computer science highly as a possible career. From that, we can extrapolate that characteristics such as "working in a cutting-edge field" or "having the power to create and discover new things" are important to our respondents AND do not, in their opinion, appear to be incompatible with a career in computer science.

The strongest negative drivers away from computer science as a career choice are:

- working with people in an interconnected, social, and innovative way; and
- having the power to do good and doing work that makes a difference in other people's lives.

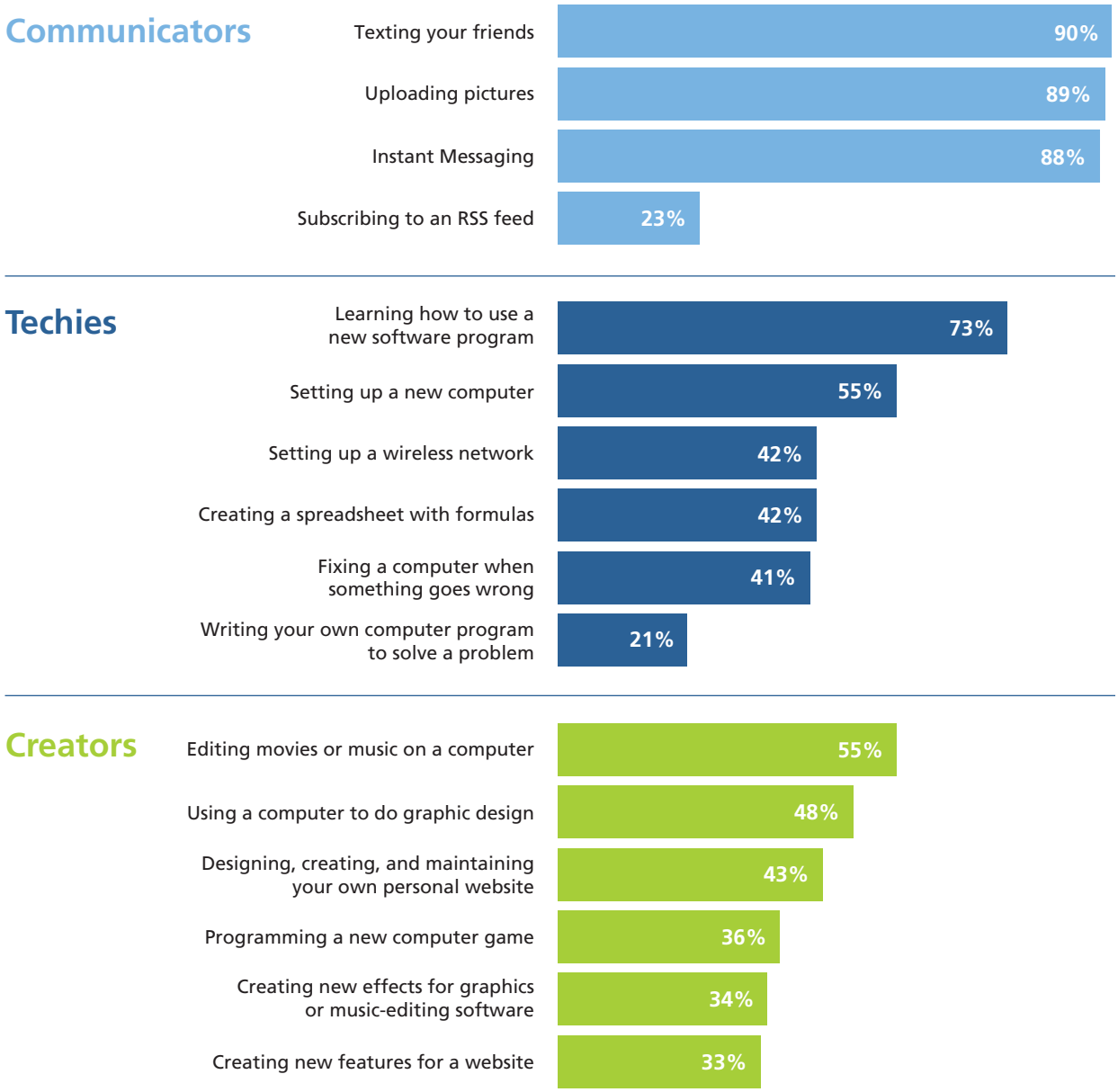
Based on our survey this means that young people who want to "make a difference in other people's lives," for example, are less likely to rank a career in computer science highly. Again, this suggests that characteristics such as "social interaction" and "making a difference in people's lives" are important to our respondents but may not be viewed by them as compatible with computing careers.

6 Technology comfort index

To explore the psychosocial characteristics of our respondents, we created three non-exclusive personality categories (Communicators, Techies, and Creators) based on their comfort with various technologies. *Figure 8* shows the overall comfort with each computer-related activity from all respondents.

Figure 8. Comfort with Technology

How comfortable are you doing each of the following? (Percent responding "extremely" or "very" comfortable)



When broken down by gender, some differences emerge. (*Fig. 9*) It is, perhaps, no surprise that there is little gender difference among the "Communicators." Most kids are comfortable with texting, instant messaging, and picture sharing, and, regardless of gender, fall into the category of "Communicators." Unfortunately, as the computer-related activities become more technical (including setting up a new computer or wireless network, fixing a computer, and writing software), the gap between girls and boys widens significantly.

But it's in the category "Creators," where girls' comfort level in activities such as creating websites, doing graphic design, and to a lesser extent, making movies, is nearly equal to the boys. Female "creators," who are already comfortable with computers in these significant ways, may comprise a very reachable target audience for NIC messaging.

Figure 9. Comfort with Technology – Gender
How comfortable are you doing each of the following? (Percent responding "extremely" or "very" comfortable)

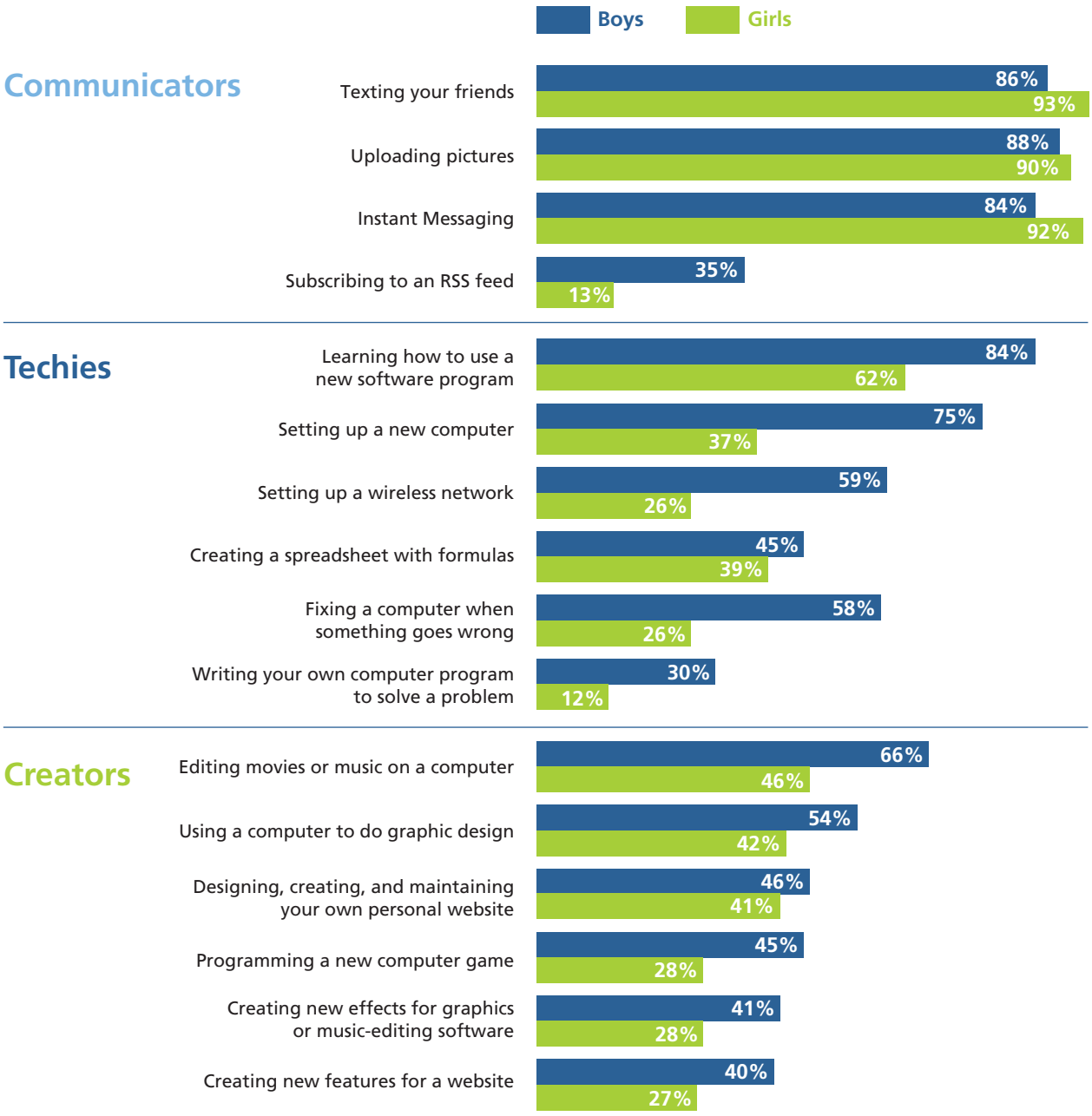
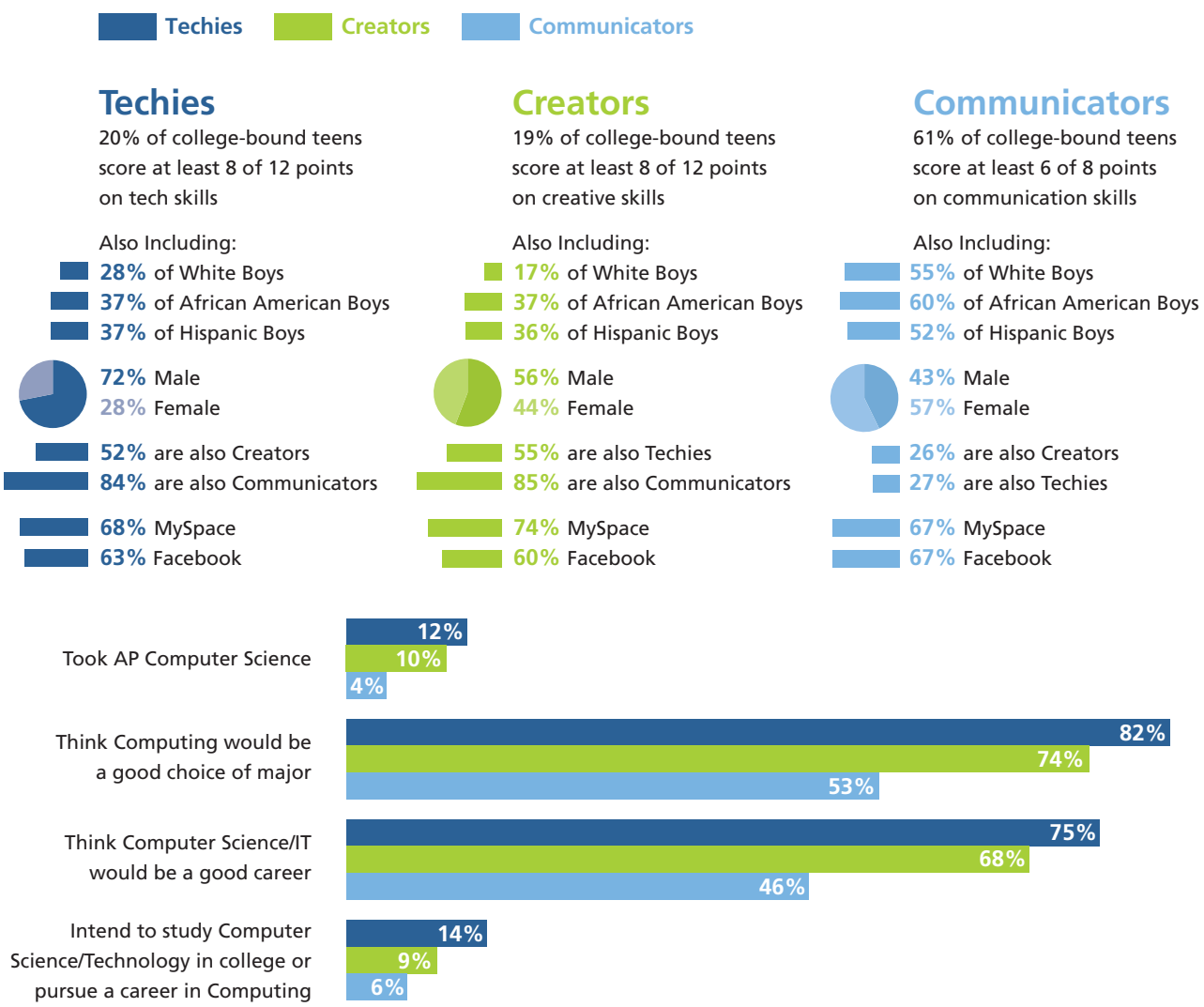


Figure 10 below provides an overall demographic summary of the respondents broken down by the three psychosocial groups: "Techies," "Creators," and "Communicators." This table also shows how many respondents fit into the other two groups, and it details their responses to specific questions such as: have you taken AP computer science and would computer science be a good college major or career choice for you?

Figure 10. Technology Comfort Scale – 3 Groups



7 Initial message testing

As part of the market survey, the respondents were given seven messages that could be used for a campaign to encourage young people to consider careers in computing. The message development was an iterative and collaborative process that included a review of relevant background literature on the participation of high school, college, and graduate students in computer science. We also drew upon our recent experience with a similar messaging campaign for engineering and the wealth of experience that BBMG brought to the table. A long list of messages was presented to the NIC Board of Advisors (see list of Advisors at the end of this report), revised, and returned again to the Board until a final short list was agreed upon for testing.

In the survey, the respondents were asked to rate each statement, regardless of their future plans, as "very appealing," "somewhat appealing," "not that appealing," and "not appealing at all." *Figure 11* represents how all seven messages rated across the entire sample with each number representing the percentage of respondents rating that particular message as "very appealing."

Figure 11. Overall Results of Message Testing

	Total	Boys	Girls	White	African American	Hispanic
Computing puts you in the driver's seat. Why merely create a MySpace page when you can create the next MySpace? Computing gives you the power to imagine new languages, new worlds, and new ways of improving our lives by putting better ideas into actual practice in our communities.	42	48	35	39	50	48
Computing opens doors. With eight billion computers in the world, just about everything depends on computing today. From transportation and energy to video games and space exploration, few careers enjoy so many real-world applications and few open as many doors as computing.	39	50	29	37	40	38
Computing empowers you to do good. With computing, you will be able to connect technology to your community and make a world of difference–reducing energy consumption, improving health care, enhancing security, reducing pollution, and advancing learning and education	37	36	38	34	42	46
Computing brings people together. Computing connects you to a world of smart, creative people who share a passion for new ideas, new inventions, and new solutions that impact our lives, our nation, and our world.	31	36	27	28	42	36
Computing is achievable. You don't need to love math and science to be a computing leader. But you do need to have a passion for solving problems and for working with others to figure out how to make all this computer stuff work better.	26	32	21	33	33	32
Computing puts you on the cutting edge. When you choose computing, you are plugged into the latest innovations, and you understand like few others how connected we are as businesses and people in today's digitally driven economy.	26	36	17	33	33	32
Computing calls for creative problem solvers. Computing requires you to know what you want to solve and how you want to solve it. That takes creative thinking, a powerful imagination, and real collaboration.	24	30	18	30	31	28

8 Unexpected findings

The market research to date has yielded some interesting results. Although the NIC initiative was originally designed to create messages that target college-bound high school students, especially African American boys and Hispanic girls, our research shows little racial/ethnic differentiation in young people's attitudes toward computer science. It does show, however, a significant gender gap. Because of this, the NIC initiative will initially concentrate on girls as a special focus audience.

It is also worth noting that computer science is clearly held in high regard by college-bound African American and Hispanic boys. Yet, these two groups remain underrepresented in both academia and the computer science workforce. If the issue isn't image, one needs to look at other factors that are turning off these young people. Why isn't a high school interest in computer science translating into enrollment in college computer science classes? WGBH and ACM will seek separate support to explore this important issue further.

9 Summary of key findings

- Most college-bound males, regardless of race/ethnicity, have a positive opinion of computing and computer science as a career or a possible major.
- College-bound females are significantly less interested than boys are in computing; girls associate computing with typing, math, and boredom.
- College-bound African American and Hispanic teens, regardless of gender, are more likely than their white peers to be interested in computing, although for girls the overall interest is extremely low.
- Teens interested in studying computer science associate computing with words like "video games," "design," "electronics," "solving problems," and "interesting."
- The strongest positive driver towards computer science or an openness to a career in computing is "having the power to create and discover new things."
- Three of the seven messages we tested are appealing to teens, particularly to key groups. These include:

Computing puts you in the driver's seat. *Why merely create a MySpace page when you can create the next MySpace? Computing gives you the power to imagine new languages, new worlds, and new ways of improving our lives by putting better ideas into actual practice in our communities.* Rated highest with African American and Hispanic boys.

Computing opens doors. *With eight billion computers in the world, just about everything depends on computing today. From transportation and energy to video games and space exploration, few careers enjoy so many real-world applications and few open as many doors as computing.* Rated highest with boys and those already interested in computing careers.

Computing empowers you to do good. *With computing, you will be able to connect technology to your community and make a world of difference—reducing energy consumption, improving health care, enhancing security, reducing pollution, and advancing learning and education.* Rated highest with girls and Hispanic boys.

Next steps

While we are pleased with the strong positive responses we got from our initial messages, much work remains to be done. Focusing in on a target audience of high school girls, our next steps include:

1. Continue concept development that includes the creation of names, slogans, tag lines, and preliminary rollout of activation strategies.
2. Develop an array of tactics for reaching the target audience.
3. Select 3–5 preliminary creative studies for market testing.
4. Create survey instruments and carry out nationwide online testing with college-bound high school girls, including oversamples of African Americans and Hispanics.
5. Review survey results and launch messaging initiative in a pilot community.
6. Evaluate results.

In addition, we will also seek support to pursue a deeper understanding of our findings in regard to boys and computer science. Specifically we want to understand why more boys are not choosing to major in computer science in college when they often express high interest in the field in high school. We hope to include both in-person focus group studies and online surveys of high school and college undergraduates that will uncover one or more factors that can be addressed in a systematic and coordinated way.

New Image for Computing Leadership

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