Evaluating the Outcomes of Fashion FUNdamentals:
A STEM Education Program for Middle School Girls

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Concerns about the potential loss of female human capital in the science, technology, engineering, and math (STEM) disciplines have prompted the development of educational programs to build girls' interest in math and science. The educational program described here, Fashion FUNdamentals (FF), represents a departure from other STEM programs designed for middle school girls insomuch as it introduces girls to the application of STEM within *fashion*, a discipline that is grounded in STEM principles but that is not traditionally associated with STEM learning. Furthermore, because fashion often captures the imagination of adolescent girls (Drake-Bridges & Burgess, 2010), it may foster girls' interest in the STEM disciplines. Interest in STEM disciplines during adolescence, as well as self-esteem, may play a role in shaping sustained positive attitudes toward the STEM disciplines (Aschbacher, Li, & Roth, 2010). Thus, the purpose of this work was to evaluate the capacity of FF to engender interest in the STEM disciplines and to build self-esteem among middle school girls, demonstrating the effectiveness of this program in providing benefits to the participants and offering an educational model to academics in the field who may wish to implement a similar program at their home institutions.

Funded by the American Honda Foundation, FF is a two-week, no-cost, summer program (M-F, 9 am-5 pm) that targets underserved middle school girls (aged 11-14). The program was developed by faculty in the Department of Design and Merchandising at Colorado State University and addresses the multifaceted educational and developmental needs of middle school girls through both technical and social programming. Offering STEM education to underserved girls on a university campus can inspire them to attain a college degree and may open their minds to diverse career possibilities. Technical programming utilizes the university's technology-rich computer, science, and design labs to provide hands-on, STEM-based education in fiber/textile science; digital textile printing; apparel engineering; apparel costing and pricing; apparel advertising, costing, and efficiency; and store layout and design. The culminating product of the technical programming is a sewn garment constructed from digitally-printed fabric designed by each girl. Social programming is intended to enhance self-esteem and comprises content units addressing body image/media literacy, nutrition, physical activity, anti-bullying, and Internet safety. The program was piloted in 2015 with 72 middle school girls.

Quantitative and qualitative data were collected to evaluate program outcomes. Participants completed pre- and post-test measures of self-esteem and interest in math and science. Fifty-two girls completed both the pre- and the post-test measures. Focus group

interviews were conducted with 16 participants. Analyses of data were conducted to address three questions related to the aims of the program:

1. Did participation in FF increase girls' interest in math and science?
2. Did participation in FF increase girls' self-esteem?
3. How did girls' initial interest in math and science and initial self-esteem influence their interest in math and science at the culmination of FF?

We conducted paired sample t-tests to examine whether participation in FF influenced girls' interest in math and science and their self-esteem. Analysis revealed no differences in pre- and post-test measures of girls' interest in math and science ($M_{pre} = 4.89$, $SD_{pre} = 1.46$, $M_{post} = 4.75$, $SD_{post} = 1.38$, $t = -.99$, $df = 51$, $p = .32$). Qualitative analyses, however, did suggest a possible increase in interest in math and science owing to girls' involvement in the program: "…in school, I don't really like science. But, I felt like this [program] really engaged me…because they made it really fun—like, the different experiments we did." Paired sample t-tests indicated differences in pre-test and post-test measures of girls' self-esteem ($M_{pre} = 3.02$, $SD_{pre} = 0.42$, $M_{post} = 3.16$, $SD_{post} = 0.42$, $t = 2.72$, $df = 51$, $p = .009$). Again, qualitative data supported these results: "I kinda felt, um, more confident in myself…this program kinda made me believe more in myself... and think about…how I want to be."

Regression analysis was used to examine whether girls' initial interest in math and science and initial self-esteem influenced their interest in math and science at the culmination of FF. Specifically, we regressed post interest on initial interest, initial self-esteem (linear term), and initial self-esteem squared (quadratic term). By including the quadratic term, we were able to model potential non-linear relationships between self-esteem and interest. After controlling for initial interest, the linear term ($b = -0.40$, $\beta = -0.12$, $SE = 0.31$, $p = .20$) was not statistically significant, but the quadratic term ($b = 2.09$, $\beta = 0.28$, $SE = 0.65$, $p = .02$) was statistically significant. In keeping with best practice, the non-statistically significant linear effect was retained because the quadratic term was statistically significant. The addition of self-esteem to the model explained approximately 9% more of the variance in interest than initial interest alone ($\Delta R^2 = .10$). Girls with the lowest initial self-esteem expressed the highest interest in mathematics and science, followed closely by girls with the highest initial self-esteem.

Findings provide evidence that FF has the potential to build girls' interest in math and science as well as their self-esteem. Girls who enter the program with either low or high self-esteem may benefit from participation relative to increased interest as an outcome. In the summer 2016 offering of the program, we will revise components of the technical and social programming to better meet the goals of the program (e.g., to further ensure that the programming fosters girls' interest in math and science). A long-term goal is to disseminate the curriculum to educators at other institutions with textiles and apparel programs.

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