Contextualizing the Gender Gap in African American Adolescents’ Technological Engagement: Effects of Parental Encouragement and Adolescent Technological Confidence

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Abstract
African Americans, especially African American women, are one of the most underrepresented groups in technology (e.g., College Board, 2017; McAlear, Scott, Scott, & Weiss, 2018; National Science Foundation, 2017). Despite this, there has been scarce research on whether these gender differences permeate African American adolescents’ engagement in technology in earlier development, such as in middle and high school, and further, what contextual factors affect their engagement. Drawing on an ecological (Bronfenbrenner & Morris, 1998) and intersectional framework (Collins & Bilge, 2016; Crenshaw, 1991), this study examined the contextual effects of parental encouragement (or lack thereof) on gender differences in African American adolescents’ technological engagement. Using survey data from a nationally representative and diverse sample of 1041 African American/Black parent-adolescent dyads, we investigated the mediational effects of adolescent technological confidence and the moderating effects of adolescent and parent gender on the parental encouragement – adolescents’ technological engagement association. Findings highlighted that African American/Black adolescents had less experience and interest with technical activities than creative activities, especially among girls. More African American/Black parents encouraged their adolescent sons but discouraged their adolescent daughters to use technology, yet girls reported greater technological confidence than boys. Moderated mediation analyses revealed that adolescent technological confidence mediated the positive association between parental encouragement and adolescents’ technological engagement across all parent-adolescent dyads with some nuances. Implications for prospective gender studies and educational programs that focus on African American adolescent boys’ and girls’ technological involvement and the influences of their parents are discussed.
Keywords: African American/Black adolescents, gender differences, technology engagement, parental encouragement, technological confidence, intersectionality
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Contextualizing the Gender Gap in African American Adolescents’ Technological Engagement: Effects of Parental Encouragement and Adolescent Technological Confidence

African Americans, in general, and African American women, in particular, remain one of the most underrepresented groups in technology (e.g., College Board, 2017; McAlear, Scott, Scott, & Weiss, 2018; National Science Foundation, 2017; The White House on Women and Girls, 2016). Recent evidence has demonstrated that in comparison to older generations, some African American millennials (ages 25-34) are obtaining greater educational achievements and closing the digital divide with more active technological engagement, especially in their mobile, innovative device, and social media use (Nielsen, 2016; Rideout, Lauricella, & Wartella, 2011; Tynes & Mitchell, 2014). As mobile technologies become ubiquitous, the digital divide has become less about the *access* to technology, but more the *use* of technology (Huang, Cotten, & Rikard, 2017; Paul, 2016). However, little is known about younger African Americans, specifically middle and high school adolescents’ technological use. It also remains unclear whether gender differences permeate African American adolescents’ experiences with diverse technological activities and further, what contextual factors motivate them to engage in technological creative efforts.

This study contextualized the gender gap in African American adolescents’ technological engagement. Notably, we are sensitive to the political issues related to using the terms “African American” and “Black” to represent a particular racial group. For the purposes of this article, we use these terms interchangeably to connote individuals of African descent, who reside in the U.S. This work was driven by both an ecological (Bronfenbrenner & Morris, 1998) and intersectional perspective (Collins & Bilge, 2016; Crenshaw, 1991) and draws upon literature on African American adolescents’ technological engagement and interests, the gender gap, parental
encouragement and adolescent technological engagement. It also examines the mediating effect of adolescent technological confidence and the moderating effects of adolescent and parent gender. Using self-reports from a nationally representative sample of African American parent-adolescent dyads, this study examined whether parental encouragement was associated with adolescents’ engagement specifically in creative and technical activities via the mediation of adolescent technological confidence. Furthermore, we examined whether the associations between parental encouragement and adolescents’ technological engagement, and between adolescent technological confidence and engagement were contingent upon the gender of both the adolescent and parent.

African American Adolescents’ Technological Engagement and Interests

African American adolescents do not take Advanced Placement (AP) computer science courses or enroll as computer science majors at a similar rate as their White peers (College Board, 2017). This, however, appears to be due to lack of access to these types of courses rather than lack of interest. Importantly, this lack of access does not correlate to engagement. Black junior high and high school students’ engagement in technology learning (e.g., app development, website creation) is nearly identical to White and Hispanic adolescents’ (Gallup, 2015). Moreover, younger African Americans (25-34 years old) are increasingly using mobile devices (e.g., smartphones) and social media to engage in social justice activities and connect to their communities (Nelson, 2016).

Notably, the frequency of African Americans’ engagement in technology can largely vary by specific activity types. Shank and Cott (2014) reported that African American elementary students more frequently engaged in multimedia entertainment (e.g., playing games, watching videos, and listening to music) or communication (e.g., emailing, social networking) rather than
content creation. Less is known about how older students engage with technology. However, what is clear is that level of access is not the same as the level of interest or engagement with technological activities. Notably, *creative activities* entail those that involve the proactive use of technology for “participation, production, and often collaboration in creating new media content” (Shank & Cotton, 2014, p. 186), such as making digital music (beats), making digital art, editing pictures or videos, writing blogs, stories, or articles for fun, and creating a presentation. *Technical activities* include those that involve the process of engaging in computing and creating advanced artifacts, such as coding (writing computer programs), creating an app, creating or modifying a video game, or creating a website (Gallup, 2015). There remain a scarcity of studies examining African American adolescents’ engagement in the aforementioned unique types of technological activities.

Since the digital divide rests upon both *access* to and *use* of technology (Huang et al., 2017; Paul, 2016), looking at technological engagement alone may be hampered by lack of access to technology. Interests in taking part in specific computing experiences (e.g., coding, programming) among those who lack access may add to a proximal estimate of engagement when opportunities arise. In fact, African American adolescents have shown substantial interests and motivation to learn technology and computer science-related fields, nearly identical to those of a similar age but different racial background (Benyo & White, 2009; Gallup, 2015), despite that some individuals lack access (College Board, 2017). If we examine type of use without exploration of features influencing the technological activity, we fail to get a complete picture of engagement. To account for the relations between lack of access and engagement in technology, this study considered both prior experiences with and interests in technological engagement as reflections of African American adolescents’ technological engagement.
The Gender Gap in African American Adolescents’ Technological Engagement

Women and girls of any race report less interests in investigative and engineering careers than their male counterparts, which might be associated with the gender gap in technology and computer science (Rottinghaus, Larson, & Borgen, 2003; Su & Rounds, 2015). More specifically, African Americans’ engagement in technology education and workforce has demonstrated a persistent gender gap. When compared to African American males, Black women earned their computer science degrees at a lower rate (e.g., National Science Foundation, 2017; The White House on Women and Girls, 2016). For the few Black women who did earn their computer science degrees, a lower percentage entered a technology-related career than individuals of another racial identity (Pew Research Center, 2018).

Despite these gender differences, there has been considerably less work conducted to understand African American adolescent girls’ relationship with technology (Robinson, Pérez-Quiñones, & Scales, 2016; Scott & White, 2013). African American girls reported similar, if not greater interests in technical activities such as creating a phone app or designing a computer/video game when compared with Hispanic or White girls (Girl Scout Research Institute, 2012) or African American boys (Alliman-Brissett & Turner, 2010). This work also demonstrates that African American girls struggle to have these interests valued. African American girls, but not White girls, perceive a lack of support from their teachers for their technological career interests (Girl Scout Research Institute, 2012). Thus, it is of importance to consider how race and gender as intersecting variables impact technology experiences of African American youth. Without examining the unique technology lives of Black girls and Black boys, generalities about race will persist.
Thus, the current study adopted an intersectional framework (e.g., Collins & Bilge, 2016; Crenshaw, 1991; Scott & Garcia, 2016) to conceptualize and examine African American adolescent boys’ and girls’ technology engagement. Such an approach recognized the intersections of multiple identities influenced by a host of factors (e.g., context, socioeconomic status, geographic region). These elements could shape girls’ and boys’ experiences that prevent generalized - also known as essentialist - assessments. In other words, a White girls’ experience in a middle-class family in the Northeast might not represent or resemble what occurs with an African American girls’ life in an elite Southwestern setting. Unfortunately, existing large-scale studies frequently examined adolescent race and gender as independent dimensions, such as comparing technological engagements and interests by race (i.e., among White, Asian, African American, and Hispanic Americans) or by gender (i.e., between male or female participants) (e.g., Alliman-Brissett & Turner, 2010; Girl Scout Research Institute, 2012). Such an essentialist approach does not account for intragroup differences, such as any distinctions among Black girls and boys (O’Brien, Blodorn, Adams, Garcia, & Hammer, 2015). Thus, this study took the intersectionality framework (Collins & Bilge, 2016) to address the need for a situated “and/both” rather than an “either/or” approach. As such, we did not assume that race or gender alone can encapsulate the totality of Black adolescent technological activities. Contextual factors influencing African American adolescents’ technological experiences and confidence as associated with their gender, parental gender, and socioeconomic status were also considered to tap into intragroup differences.

**Parental Encouragement and Adolescent Technological Engagement**

Parents have been considered one of the critical contextual factors in adolescents’ development, including shaping their interests and engagement in technology (e.g.,
Bronfenbrenner & Morris, 1998; Stipanovic & Woo, 2017). The messages that parents provide may reflect the larger sociocultural gender role expectations that in turn, socialize adolescents to internalize or conform to more gender typical activities or careers. Indeed, emerging evidence has suggested that parental attitudes and behaviors related to technological education may be contingent upon their child's gender. For example, girls are more likely to be discouraged than boys in science tasks by their parents in predominantly White families (Tenenbaum & Leaper, 2003). Similarly, whether parents encourage their children to try a new technological activity can be affected by gender stereotypes, which may further shape adolescents' engagement and interests in creative or technical activities. Interestingly, parents' rule-related behaviors have been found to increase tensions between parents' and adolescents' values in the use of digital media among European and African American mother-adolescent dyads (Fletcher & Blair, 2014), and as such, adolescents were more responsive to parenting when parents showed an understanding of their adolescents' actual use and values in digital media (Kim & Davis, 2017). On the other hand, parental encouragement has demonstrated a well-established positive relation with interests in math and science careers for predominantly White undergraduate students (Ferry, Fouad, & Smith, 2000) and African American eighth-grade boys and girls (Alliman-Brissett & Turner, 2010). However, this effect was not found among African American high school seniors on their career interests in environmental sciences (Quimby, Wolfson, & Seyala, 2007). These mixed findings call for a focused examination on African American adolescents’ technological encouragement as associated with parental encouragement, and whether it would be affected by adolescent and parent gender.

Few studies to date have provided information about technological socialization for African American families considering the intersection of contextualized features.
mathematical socialization research, African American high school adolescents received racial and mathematical socialization messages from their parents most frequently about how difficult, important, or useless mathematics was (English-Clarke, 2012). Moreover, the students reported hearing from their parents about the intersection of their racial and mathematical identities, such as the racial discrimination, mathematical stereotypes, and the lack of representation they may face as African Americans in mathematics (English-Clarke, 2012). While no specific gender differences were explored by English-Clarke, her findings provided preliminary evidence for the complexity of socialization processes in African American families (English-Clarke, 2012). The overarching messages appeared to convey the challenges of engaging in mathematics for African American parents, which could be internalized by the next generation of adolescents and generalized to other subjects like technology and computer science. Together, these findings suggest that parental encouragement may have significant implications on African American adolescents’ participation in creative and technical activities.

The Mediating Effect of Adolescent Technological Confidence

Growing numbers of researcher are examining the underlying mechanisms between parental encouragement and adolescents’ engagement in general computing activities. One such potential mechanism is technological confidence. It is well documented that if adolescents are more confident about their technological abilities, they are more willing to engage in and learn related activities (e.g., Huang et al., 2017; Shank & Cotton, 2014). However, the association between technological confidence and engagement may not hold true for White or Black girls. Adolescent girls of any race have been found to be generally less confident about their technological abilities than boys (Gallup, 2015). But girls’ performances in math and science were similar to boys’ and only reflected areas of weakness relative to their overall performances
across various domains of academic achievements (e.g., worse than reading; Steot & Geary, 2018). In other words, adolescent girls did not lack abilities in engaging and succeeding in math and science. However, as they performed better at other subjects, their confidence with technology might be lacking and deter them from continuing participation in technology. For example, African American undergraduate women have been found to be less confident in their learning outcomes in engineering than Black and White undergraduate men (Ro & Loya, 2015). These findings suggest that there may be gender differences in adolescent technological confidence with lower confidence among African American girls. Further, the association between adolescents’ confidence with technology and engagement in technological activities would be expected to be positive.

Outside school, adolescents spend a considerable amount of time at home. Much of their engagement in science and computing tasks may take the form of interactions and experiences with family members (e.g., their parents). Therefore, their relationship with parents can be a valuable catalyst to instigate adolescents’ interests and confidence in their science and technology-related abilities (Buck, Cook, Quigley, Eastwood, & Lucas, 2009). During this process, as parents encourage their adolescent children, adolescents might become more confident about their math and science abilities (e.g., Alliman-Brissett & Turner, 2010; Rice et al., 2013; Tenenbaum & Leaper, 2003), which could further facilitate greater future engagement. Turner and colleagues (2014) provided empirical evidence based on reports from a combined sample of predominantly White (73.6%) and African American (20.5%) sixth-grade students. Specifically, they found that support from both father and mother in an intact family household, and particularly parental encouragement of children’s pursuit of a math career, was associated with children’s greater self-efficacy, which in turn was positively linked to math and science
career interests. Similarly, parental support was linked to greater adolescent self-efficacy and interests in mathematics and science subjects for Latina/Latino, African American, Asian American, and multiracial high school adolescent boys and girls (Garriott et al., 2014). As such, parental encouragement may be positively related to adolescents’ technological engagement whereas potential differential treatment between African American adolescent boys and girls (e.g., more likely to encourage boys; Tenenbaum & Leaper, 2003) may affect their confidence in inverse ways. It is thus equally important to consider the role of parent and adolescent gender on these associations to contextualize the potential gender gap in African American adolescents’ technological engagement and experiences with parenting.

**Moderating Effects of Adolescent and Parent Gender**

Beyond the general positive effects of supportive parenting on adolescents’ academic performance and confidence (e.g., Alliman-Brissett & Turner, 2010; Prelow, Bowman, & Weaver, 2007; Rice et al., 2013; Tenenbaum & Leaper, 2003), researchers have found great heterogeneity in African American families’ parenting values and behaviors (Skinner, Perkins, Wood, & Kurtz-Costes, 2016; Smetana & Chuang, 2001). Such variations in parenting appeared to be contingent upon African American adolescent gender. In other words, Black fathers and mothers tend to adopt differential parenting practices for their sons and daughters (Mandara, Murray, & Joyner, 2005; Skinner et al., 2016). For example, Black mothers showed a tendency of monitoring behaviors for their daughters and encouraging autonomy in their sons, whereas Black fathers were more inclined to discipline their sons (Mandara et al., 2005; Skinner et al., 2016; Varner & Mandara, 2014). African American fathers of early adolescent boys (ages 11 to 14 years old) valued parenting firmness as in punishment whereas fathers of adolescent daughters tended to view firmness as in non-negotiation (Smetana & Chuang, 2001).
Black mothers have often considered as playing a critical role on their daughters’ psychosocial development (Townsend, 2008). Fathers’ roles, although less studied, also demonstrated nuanced patterns on their children’s development. McHale and colleagues (2006) found that African American mothers’, but not their fathers’, cultural socialization was positively associated with their children’s ethnic identity development. On the other hand, African American fathers’ cultural socialization, but not their mothers’, was linked to their children’s greater depressive symptoms. These findings suggested that paternal and maternal parenting might differ in their effects on adolescents’ socioemotional development in African American families. A recent study showed that mothers’ warmth, specifically their nurturing and accepting behaviors were associated with greater optimism, math grades, and language arts self-efficacy and grades at moderate effects for a sample of predominantly Mexican and African American low-income sixth-grade students (Suizzo et al., 2017).

Despite these promising findings, effects of parenting on technological socialization remain understudied. Existing literature on math socialization, however, also suggested that parenting influences may vary depending upon the adolescent child’s gender. For example, father’s warmth was associated with their daughters’ math grades but not their sons’ math grades; and father’s warmth was associated with their sons’ language arts grades but their daughters’ language arts grades. In other words, father’s warmth had differential effect on their daughters’ and sons’ academic performance (Suizzo et al., 2017). This implied that paternal support might be more crucial for adolescents’ confidence with less gender-conforming activities (math for girls and language arts for boys) when maternal support is accounted for. It is therefore possible that the association between parental encouragement and an adolescent’s confidence with technology may be moderated by the gender of both the parent and child. These
associations can be especially more positive in African American father-daughter dyads than between other parent-child dyads. However, this has not been empirically examined among middle and high school adolescents regarding their relationships with technological use.

**The Present Study**

Building upon the limited research on African American adolescents’ technological engagement, we used an ecological (Bronfenbrenner & Morris, 1998) and intersectional framework (Crenshaw, 1991; Scott & Garcia, 2016) to investigate the potential gender gap in African American adolescents’ technological engagement and its association with parental encouragement and adolescent technological confidence. The present study is a deeper examination of data collected in the context of a larger survey study about African American adolescents’ technology use (Rideout, Scott, & Clark, 2016). More specifically, we focused on items related to adolescents’ experience and confidence with technology as well their parents’ technology use. There were three main research questions.

The first overarching question examined the presence of gender gaps in African American adolescents’ technological experiences. Specific research questions and associated hypotheses are delineated below.

Research Question 1a (RQ1a): Do African American boys and girls differ in their *engagement* in creative and technical activities? Given the lack of prior research adopting an intersectional approach, we provided no a priori hypotheses on the gender differences in adolescents’ *engagement* in specific technological activities.

Hypothesis 1b (H1b): Regarding whether African American boys and girls differ in their *confidence* in creative and technical activities, we predicted that African American
adolescent girls will report lower technological confidence than adolescent boys based on Gallup findings (2015).

H1c: Consistent with the findings of Tenenbaum and Leaper (2003), we predicted a gender difference in African American parents’ encouragement toward their children’s engagement in technology such that that parents, regardless of their gender, will report encouraging their African American sons more than daughters.

The second overarching question explored if parental encouragement is associated with adolescent technological confidence, and adolescents’ technological engagement in both creative activities and technical activities. There were two hypotheses regarding the relations between parental encouragement and adolescent outcomes.

H2a: Parental encouragement will be positively associated with adolescents’ engagement in both creative and technical activities. This hypothesis was based on work by Ferry et al. (2000) and Fletcher and Blair (2014).

H2b: Parental encouragement will be positively related to greater adolescent technological confidence, which in turn, will be positively associated with adolescents’ technological engagement (e.g., Huang et al., 2017; Shank & Cotton, 2014).

The third overarching question examined whether the associations between parental encouragement and adolescent technological confidence, and the associations between parental encouragement and adolescents’ technological engagement, differ depending upon adolescent and parent gender. These questions were influenced by the Suizzo and colleagues’ study (2017) yet were considered exploratory due to lack of robust evidence. A conceptual moderated mediational model is depicted in Figure 1.
RQ3a: Do the associations between parental encouragement and adolescent technological confidence differ by adolescent gender, parent gender, or the intersection of both?

RQ3b: Do the associations between parental encouragement and adolescents’ technological engagement differ by adolescent gender, parent gender, or their interplay?

Method

Procedure

Data for this study were part of a national study on African American adolescents’ and their parents’ digital lives conducted in the fall of 2015. The purpose of this project was to “understand to what degree and in what ways African American families are using and learning with technology outside of formal learning environments such as school” (Rideout, Scott, & Clark, 2016, p. 5). To achieve this goal, we adopted a sequential exploratory design with two phases. In the first phase, ten focus groups (including four parent groups and six adolescent groups) were conducted in Atlanta, Georgia; Oakland, California; Chicago, Illinois; New York City, New York; and Shaw, Mississippi. Findings from the focus groups informed the development of a phone survey for the second phase that assessed a wide range of African American families’ technological use and learning. An expert advisory group was consulted for the face validity of items developed in this phase. In the current study, we examined data from the from the second phase of research.

Institutional Review Board approval was obtained at a large Southwest public university. For each parent-adolescent dyad, the parent first provided consent for their own and one of their adolescent children’s participation. Subsequently, parents responded with their demographic information, technology use, parenting behaviors specific to encouragement or limiting for their children’s use of technology. Following parents’ completion of the phone survey, adolescents
responded with their experiences with and interests in technological activities, confidence with technology. Upon completion, parents and adolescents were compensated for their time. The median length of participation time among all respondents was 23 minutes.

Participants

The sample included 1041 dyads ($n = 2082$ individuals) of African American adolescents ($M_{\text{age}} = 14.06$, $SD = 1.98$, ranging from 11 to 17 years) and their parents ($M_{\text{age}} = 41.49$, $SD = 8.60$, ranging from 18 to 72 years) that completed the survey. Only one parent from each family took part in the survey. The sample was composed of 146 father-son dyads (14.02%), 142 father-daughter dyads (13.64%), 376 mother-son dyads (36.12%), and 377 mother-daughter dyads (36.22%). Recruitment efforts included a combination of probability and convenience approaches to approximate a nationally representative sample. More information on recruitment strategies can be found in Rideout and colleagues (2016).

Measures

**Technological engagement.** Adolescents reported their experience and interest in two different types of technological activities. They responded whether they had engaged in each activity. If they answered “no,” they were then prompted to respond whether they were “interested” or “not interested” in doing the activity. From these responses we calculated a composite of either having relevant experience or interests in two categories of activities: a *creative activities* score reflecting five activities including making digital music (beats), making digital art, editing pictures or videos, writing blogs, stories, or articles for fun, and creating a presentation, and a *technical activities* score reflecting four activities including coding (writing computer programs), creating an app, creating or modifying a video game, or creating a website (Gallup, 2015).
Parental encouragement. Parental encouragement was assessed by parents’ agreement with which statement was closer to their view: “I limit my child’s online activities because of my concerns about the negative content or experiences they may encounter” or “I encourage my child to experiment with computers and the Internet, even though I know I can’t protect them from everything they might see online.” This item was created to assess general parental engagement for their adolescents’ use of technology. Responses were effect coded such that the limiting response = -0.5 and the encouraging response = 0.5.

Adolescent technological confidence. Adolescents responded on a four-point Likert scale ranging from 1 = not at all confident to 4 = very confident. to four items regarding their confidence in performing technological activities (e.g., using a keyboard, search engines, or word processing programs) and learning how to use new technologies. A sum score was computed from the individual responses on each item. The four items demonstrated acceptable internal consistency, Cronbach’s $\alpha = .72$.

Demographics. Parents reported their gender, household income, marital status, region of residence, metro status and adolescents reported their age and gender. Detailed demographic information appears in Table 1. Parental education, household income, and adolescent age were entered as covariates to control for their effects on adolescents’ technological engagement.

Data Analytical Strategies

To investigate RQ1a, H1b, and H1c, we first conducted preliminary analyses to address data missingness as well as to calculate descriptive statistics of the main variables of interests. Regarding RQ1a, we examined whether technological engagement differs by activity type (i.e., creative activities vs. technical activities) and gender (i.e., male vs. female) using repeated-measures analysis of variance (ANOVA). Proportion scores were computed so that both creative
and technical activity scores ranged from 0 to 1, reflecting adolescents’ levels of engagement and interests amongst all five creative and four technical activities, respectively. Regarding H1b, to examine gender differences in parental encouragement versus limiting behaviors, we performed a binary logistic regression with adolescent and parent gender each entered in the first step and the interaction term between adolescent and parent gender entered in the second step. Regarding H1c, we performed an independent-samples t test to examine gender differences in adolescent technological confidence.

Next, we regressed parental encouragement on adolescents’ engagement in creative and technical activities in two separate models to examine the associations between parental encouragement and adolescents’ technological engagement (H2a). Parental education, household income, and adolescent age were entered as covariates. To further examine the mediational effect of adolescent technological confidence and the moderating effect of parent and adolescent gender on these associations, we conducted two multi-categorical moderated mediation regression analyses, with creative and technical activities each as the criterion, using the PROCESS macro for SPSS (Hayes, 2013). In Step 1 of both models, parental encouragement, adolescent gender, parent gender, and interaction terms between the three variables were regressed on adolescent technological confidence to examine the main effect of parental encouragement on adolescent technological confidence and whether it is contingent upon adolescent, parent gender or the interaction of both (RQ3a). In step 2 of each model, parental encouragement, adolescent gender, parent gender, and interaction terms between the three variables, as well as adolescent technological confidence were regressed on creative and technical activities. Findings of these analyses were designed to unpack the mediational effect of adolescent technological confidence (H2b) and the potential conditional effect of parental
encouragement on adolescents’ technological engagement depending upon adolescent, parent
gender or the interaction of both (RQ3b). Post-hoc comparisons with Bonferroni corrections
were performed to decompose any significant interactions.

**Results**

**Preliminary Analyses**

An examination of pattern of data missingness revealed that all variables of interest had
less than 2% of missing data. Little’s MCAR Test demonstrated that data were missing
completely at random, $\chi^2(8) = 204.73, p = .96$. Subsequent analyses were proceeded with
regression analyses.

Distributions of African American adolescents’ engagement in technology, specifically
with creative and technical activities, by adolescent gender are depicted in Figure 2. Distribution
of parental encouragement versus limiting behaviors by adolescent and parent gender are
depicted in Figure 3. Descriptive statistics and correlations among African American
adolescents’ technological engagement and confidence by gender can be found in Table 2.

**Gender differences in African American adolescents’ technological engagement.** In
regard to RQ1a, repeated-measures ANOVA revealed a main effect of activity type such that
African American adolescents have engaged in a higher proportion of creative activities ($M$
= .76, $SD = .27$) than technical activities ($M = .62, SD = .36$), $F(1, 1000) = 232.48, p < .001, \eta_p^2$
= .20. There was a marginally significant main effect of gender, $F(1, 962) = 3.15, p = .076, \eta_p^2 <$
0.01. However, this was qualified by a significant activity type by gender interaction, $F(1, 1000)$
= 86.18, $p < .001, \eta_p^2 = .081$. Post-hoc comparisons with Bonferroni correction at a significant
level of 0.008 demonstrated that African American adolescent boys engaged and showed less
interests in creative activities ($M = .73, SD = .28$) than girls ($M = .78, SD = .25$), $t(1039) = -3.00,$
p = .003. However, boys engaged and showed greater interest in technical activities ($M = .68, SD = .34$) as compared to girls ($M = .58, SD = .38$), $t(1038) = 5.44, p < .001$.

**Gender differences in adolescent technological confidence.** Inconsistent with previous work, an independent-samples $t$ test showed that African American adolescent boys ($M = 14.27, SD = 12.04$) reported lower technological confidence than their female counterparts ($M = 14.60, SD = 1.79$), $t(1038) = -2.75, p = .006$.

**Gender differences in parental encouragement.** Binary logistic regression analysis with adolescent and parent gender in the first step and the interaction term in the second step revealed that the overall model was significant ($R^2 = .03, \chi^2 = 25.01, p < .001$), but only adolescent gender had a significant main effect. Consistent with H1b, the probability of parental encouragement was lower for African American adolescent girls than boys, $\beta = .63, p < .001$, which held true for both fathers and mothers. In other words, African American girls are less encouraged to engage with technology by their parents, regardless of the parents’ gender.

**Effects of parental engagement on adolescents’ technological engagement.** Partially in support of H2a, when parent education, household income, and adolescent age were held constant, parental encouragement was not associated with adolescents’ engagement in creative activities ($b = .06, t(1022) = 3.93, p < .001$), but was positively associated with adolescents’ engagement in technical activities ($b = .21, t(1028) = 2.25, p = .024$). Regression coefficients for the two moderated mediational models with engagement in creative and technical activities each as the criterion variable can be found in Table 3.

**Effects of parental engagement on adolescent technological confidence.** Results from step 1 of both models demonstrated an overall significant model, $R^2 = .06, F(10, 1021) = 6.22, p < .001$. Parental engagement was positively associated with adolescent technological
confidence, $b = .06$, $t(1022) = 3.93$, $p < .001$, after controlling for the positive effects of adolescent age and parental educational levels. Regarding RQ3a, this association did not vary depending on adolescent gender, parent gender, or the interaction of adolescent and parent gender or adolescent-parent dyad type (e.g., father-son, father-daughter, mother-son, mother-daughter).

**Moderated mediational effects on engagement in creative activities.** Findings from step 2 of the moderated mediational model with engagement in creative activities showed an overall significant model, $R^2 = .08$, $F(11, 1020) = 8.50$, $p < .001$. We did not observe a direct effect between parental encouragement and adolescents’ engagement in creative activities, $b = 0.01$, $t(1021) = 0.10$, $p = .92$, which did not vary upon adolescent gender, parent gender, or the interaction of adolescent and parent gender (RQ3b). However, as expected, we observed a positive association between adolescent technological confidence and engagement in creative activities, $b = 0.18$, $t(1021) = 8.26$, $p < .001$. Together with findings on the positive association between parental engagement and adolescent technological confidence from step 1, H2b is supported such that the association between parent encouragement and African American adolescents’ engagement in creative activities was fully mediated by adolescent technological confidence.

**Moderated mediational effects on engagement in technical activities.** A similar moderated mediational model was conducted with engagement in technical activities as the criterion variable. The overall model was significant, $R^2 = .10$, $F(11, 1019) = 10.73$, $p < .001$. The direct effect of parental encouragement on engagement in technical activities was insignificant, $b = .01$, $t(1020) = 0.10$, $p = .92$. However, this association was qualified by an interaction by adolescent and parent gender, $b = -1.04$, $t(1020) = -2.49$, $p = .01$ (RQ3b).
Specifically, post-doc comparisons using Bonferroni corrections at a significance level of 0.008 indicated that after controlling for the effect of covariates and adolescent technological confidence, the association between parental encouragement and adolescents’ engagement in technical activities was more positive for mother-son dyads ($b = .52$), father-daughter dyads ($b = .29$), and father-son dyads ($b = -.04$), than for mother-daughter dyads ($b = -.17$), $t(751) = 45.38$, $t(517) = 34.50$, and $t(521) = 7.89$, $ps < .001$, respectively. Moreover, the association between adolescent technological confidence and engagement in technical activities was positive, $b = .16$, $t(1020) = 6.72$, $p < .001$. In other words, consistent with H2b, we found support for a full mediation such that parental encouragement is linked with greater adolescent technological confidence, which in turn, is associated with greater engagement in technical activities.

Discussion

The current study used a large-scale survey data to examine the complex relations between parent and teen as well as gender and race when evaluating African American teens’ use of technology.

The Gender Gap in African American Adolescents’ Technological Engagement and Confidence

Our findings painted a nuanced picture of African American adolescents’ engagement and confidence in technology. Importantly, the well-documented underrepresentation in African American women in technological education and workforce compared to African American men (e.g., McAlear et al., 2018; National Science Foundation, 2017; The White House on Women and Girls, 2016) showed a complex pattern in middle and high school adolescence. We found that African American adolescent girls were more engaged and showed greater interests in technological activities that involved content creation than their male counterparts. However,
they appeared to endorse lower engagement and interests than African American adolescent boys in technical activities that involved more advanced computing skills such as coding and creating apps and websites (Gallup, 2015). This nuanced result appeared to be partially consistent with prior studies on gender differences in investigative and engineering careers with girls demonstrating less interest (Rottinghaus et al., 2003; Su & Rounds, 2015).

On the other hand, the greater engagement in creative activities suggested that African American girls did not lack the abilities to access and use technology. In fact, to our surprise, we found overarchingly greater confidence in technological abilities among African American adolescent girls than boys. This affirmed prior findings from a few studies (Alliman-Brissett & Turner, 2010; Girl Scout Research Institute, 2012) that African American girls did not lack technological confidence. Recognizing the nuances in these gender gaps in technological engagement, interests, and confidence are critical to understand the underexamined African American adolescents’ experiences with technology. More importantly and even less understood were the factors that affect their use of technology, such as the parental socialization process (Bronfenbrenner & Morris, 1998).

**Parental Encouragement and Adolescent Technological Engagement, and the Mediating Effect of Adolescent Technological Confidence**

Consistent with our hypothesis (H1b) based on prior research in White families (Tenenbaum & Leaper, 2003), African American parents tended to encourage their sons to experiment and explore computers and Internet and were more inclined to limit their daughters to do so with concerns about potential negative experiences from online engagement, which held true for both fathers and mothers. For both adolescent boys and girls, being encouraged by their parents to explore technology was directly associated with engagement in technical activities.
Moreover, parental encouragement was indirectly linked to greater engagement in both creative and technical activities via greater confidence in their own technological abilities. In other words, having parents limit adolescents’ technological engagement could be associated with lower technological confidence among African American adolescents, which in turn, might deter them from engaging or developing interests in technological activities, especially for those involving advanced technical abilities such as coding and programming. While this was true for both adolescent boys and girls, African American girls demonstrated less experience with and interests in technical activities, possibly due to their greater likelihood of being limited rather than encouraged by their parents to engage in technology.

**Moderating Effects of Adolescent and Parent Gender**

Similar to existing research on the parent-adolescent intergenerational effects (e.g., McHale et al., 2016; Suizzo et al., 2017), our findings revealed a complex pattern of the associations among parental encouragement, adolescent technological confidence and engagement. This was especially true for the association between parental encouragement and adolescents’ engagement in technical activities. Although this relation was overall significantly positive for all parent-adolescent dyads, it showed an inverse pattern for mother-daughter dyads when the effects of adolescent technological confidence was considered: African American girls’ engagement in technical activities were at lower levels for those whose mothers encouraged them to explore computers and the Internet than those whose mothers limited such explorations. In contrast, encouragement by fathers was more positive for both daughters’ and son’s engagement in technical activities, over and beyond the indirect effect via adolescent technological confidence. Although such conditional effects of parental encouragement were only present for engagement in technical but not creative activities, they might be of particular
interests to inform prospective research and educational programs to address the gender gap in African American adolescents’ engagement in technical activities. That is, we found it imperative to recognize the contextual influences of parents and parental socialization on technological engagement among African American adolescents. The messages parents sent to adolescents regarding their abilities to experiment with computers and the Internet while coping with potential negative content online could also be critical to foster their self-confidence, interests, and engagement specific to technology.

Limitations and Future Directions

Notably, findings from this study should be interpreted within the context of a few limitations. First, we assessed African American adolescents’ interests in creative and technical activities only among those who have not had experiences in the respective activity. Thus, we had limited information on whether adolescents’ current or prior experience (or lack thereof) with each activity could be attributed to external (e.g., access to resources at school and at home) or internal (e.g., interests, motivation) factors. For example, some adolescents might have sought out these experiences on their own, while others were required to do so as part of a class or after-school program. We computed a composite engagement score from both prior experience and current interests to account for the potential influence of external factors such as access, offering a broader picture of African American adolescents’ engagement and interests in a wide range of technological activities. However, despite that household income was not a significant predictor of adolescents’ engagement scores as assessed in this study, adolescent age and parental educational levels were still positively associated with engagement. Future research may benefit from teasing technological experiences apart from interests and expanding the
assessment from a dichotomous response of having the experience or not to the level of engagement and competence adolescents may have with each activity.

Second, parental encouragement or limiting behaviors was measured using a dichotomous single item. Parents were asked which of the two statements best described their parenting approaches. Nonetheless, we found convincing evidence for the role of parental encouragement on African American adolescents’ technological engagement. Prospective studies may expand the measurements to involve more diverse parenting behaviors related to technology in response to the prior findings on heterogeneity in African American families’ parenting (Smetana & Chuang, 2001). Researchers may consider transforming the current dichotomous response to a continuous scale to allow for more variances in responses. Moreover, we only assessed parenting specific to technological access and use. Considerable literature has suggested that Black parents play a significant role on the socialization of adolescents’ gender and racial identity (Mandara et al., 2005; Skinner et al., 2016; Varner & Mandara, 2014), which in turn, are associated with adolescents' self-esteem (Buckley & Carter, 2005). Future investigations can explore the effects of Black adolescents’ gender and racial identity as well as associated parental socialization on adolescents’ technological confidence and engagement.

Third, the effects of parental encouragement on adolescent technological confidence and engagement in technology were conceptual, and our findings could not infer directionality among these factors due to the cross-sectional nature of data collection. It is possible that technological confidence and engagement are bi-directional such that more experience yields greater confidence, which in turn, increases adolescents’ interest in trying new technological activities. Prospective research can replicate and extend our current findings by adopting
longitudinal designs to investigate the temporal relationships between parental encouragement, adolescent technological confidence and engagement over time.

Implications

Despite these limitations, this study supplemented the extant literature in several important ways. This study examined specific activities that involved technological innovation beyond general computing skills. As a result, a broader landscape of African American adolescents’ technological engagement by gender appeared. The well-documented underrepresentation of African Americans, in general, and African American girls, in particular, going into computing-related fields might be grounded in the split of engagement in different types of activities. Specifically, African American girls did not lack technological confidence in their adolescence or engagement and interests in creative activities. However, their engagement and interests in technical activities were lacking in comparison to their male counterparts. Program developers of computing education for African American girls, in particular, are encouraged to consider incorporating both technical and creative activities in their offerings.

Additionally, this study collected responses from African American families that represent the U.S. population across different geographic locations and of various socioeconomic status. This intragroup variance added to existing findings by expanding beyond the typical small sample sizes of African Americans used for non-Black comparisons (e.g., Madden, Lenhart, Duggan, Cortesi, & Gasser, 2013; Yardi & Bruckman, 2012). The inclusion of African American families from different social strata also expanded results with a sheer focus on one social class group (e.g., Smetana et al., 2000). More work needs to be done attending to the intersecting features constituting the multitude of Black experiences with technology.
Finally, this study explored the unique intergenerational mechanisms of technological socialization from African American parental encouragement to middle and high school adolescents. The vast majority of studies on this topic examined White families (e.g., Tenenbaum & Leaper, 2003). This current project offered important insights into the parent-adolescent dynamics related to technology in African American families. Given that adolescents can be frequently exposed to familial environment that perpetuate the differential messages between sons and daughters, educational programs that aim to instigate girls’ interests ought to consider the familial environment and the presence of encouragement from parental figures, especially considering the positive effects of paternal encouragement over and beyond the effects of adolescents’ own technological confidence on technological engagement.

Therefore, educational programs that aim to enhance African American boys’ and girls’ engagement in technical activities may benefit from including components to promote girls’ technological confidence in general and involve their parents, especially fathers. In doing so, this may further empower girls to experiment and engage in challenging computing activities. African American parents may have experienced personal challenges with math and technology or have been exposed to gendered racial stereotypes about their abilities (English-Clarke, 2012). Therefore, it may be beneficial to normalize their experiences and also promote the strengths and resilience within themselves and their adolescent children. Independent sessions or programs as part of a larger educational program can be developed to target African American parents, especially fathers, to address the larger gender stereotypes against women in computer science or technological fields and to promote their encouragement of adolescents’ exploration of technological advances. More practical approaches may be brief education via pamphlets and flyers on the positive effects of encouragement on adolescent development in general, and
technological engagement, in particular. Additional information on possible ways to support adolescents in coping with potential negative experiences with technology during recruitment efforts and consent processes.

In summary, findings from this study call for an ecological (Bronfenbrenner & Morris, 1998) and intersectional perspective (Crenshaw, 1991; Scott & Garcia, 2016) in prospective research and design of educational programs. Assuming these perspective as conceptual and analytical tools may promote a nuanced understanding of African American adolescents’ engagement in technology and the associated cross-generational efforts, specifically encouragement from parents. These theoretical models may offer critical support for the inclusion of African Americans and African American adolescent girls in a technology-driven society.
References


English-Clarke, T. (2012). *Things my family told me about math: African American youths' perception and use of racial and mathematical socialization messages* (Order No.)


Table 1

Demographic information by adolescent gender

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Total</th>
<th>Male Adolescents</th>
<th>Female Adolescents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL N</strong></td>
<td>1041</td>
<td>522</td>
<td>519</td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M(SD)</td>
<td>-</td>
<td>14.08(2.00)</td>
<td>14.04(1.96)</td>
<td></td>
</tr>
<tr>
<td><strong>Region</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td></td>
<td>185</td>
<td>117</td>
<td>63.2%</td>
</tr>
<tr>
<td>Midwest</td>
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<td>179</td>
<td>81</td>
<td>45.3%</td>
</tr>
<tr>
<td>South</td>
<td></td>
<td>585</td>
<td>284</td>
<td>48.5%</td>
</tr>
<tr>
<td>West</td>
<td></td>
<td>92</td>
<td>40</td>
<td>43.5%</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Urban</td>
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<td>471</td>
<td>247</td>
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</tr>
<tr>
<td>Suburban</td>
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<td>455</td>
<td>225</td>
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<td>Rural</td>
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<td>114</td>
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<tr>
<td><strong>Household Income</strong></td>
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<td></td>
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<tr>
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<td>285</td>
<td>163</td>
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<tr>
<td>$25-75,000</td>
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<td>458</td>
<td>215</td>
<td>46.9%</td>
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<tr>
<td>&gt;$75,000</td>
<td></td>
<td>299</td>
<td>145</td>
<td>48.5%</td>
</tr>
<tr>
<td><strong>Parent Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farther</td>
<td></td>
<td>288</td>
<td>146</td>
<td>50.7%</td>
</tr>
<tr>
<td>Mother</td>
<td></td>
<td>753</td>
<td>376</td>
<td>49.9%</td>
</tr>
<tr>
<td><strong>Parent Education</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some high school or HS Diploma</td>
<td>357</td>
<td>210</td>
<td>58.8%</td>
<td>147</td>
</tr>
<tr>
<td>Some college to Bachelor's Degree</td>
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<td>264</td>
<td>45.1%</td>
<td>322</td>
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<tr>
<td>Post-Secondary Degree</td>
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<td>99</td>
<td>49</td>
<td>49.5%</td>
</tr>
<tr>
<td><strong>Parent Marital Status</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or Living with Partner</td>
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<td>288</td>
<td>47.0%</td>
<td>325</td>
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<tr>
<td>Widowed</td>
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<td>6</td>
<td>2</td>
<td>33.3%</td>
</tr>
<tr>
<td>Divorced or Separated</td>
<td></td>
<td>185</td>
<td>104</td>
<td>56.2%</td>
</tr>
<tr>
<td>Never Married</td>
<td></td>
<td>237</td>
<td>128</td>
<td>54.0%</td>
</tr>
</tbody>
</table>
Table 2

Descriptive statistics and correlations of adolescents’ engagement in creative and technical activities and technological confidence by adolescent gender

<table>
<thead>
<tr>
<th>Variable</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creative Activities Engagement</td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>.61***</td>
<td>.30***</td>
<td>3.80</td>
</tr>
<tr>
<td>Technical Activities Engagement</td>
<td></td>
<td>.63***</td>
<td></td>
<td>-</td>
<td>.25***</td>
<td></td>
<td>2.48</td>
</tr>
<tr>
<td>Adolescent Technological Confidence</td>
<td>.29***</td>
<td></td>
<td>.29***</td>
<td></td>
<td></td>
<td></td>
<td>14.44</td>
</tr>
</tbody>
</table>

Note. Correlations for male adolescents are below the diagonal and correlations for female adolescents are above the diagonal. *** = p<.001.
Table 3

*Regression coefficients for the effects of parental encouragement and adolescent technological confidence on adolescents’ engagement in creative and technical activities*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Model 1</th>
<th></th>
<th>Model 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Step 1</td>
<td>Step 2</td>
<td>Step 1</td>
<td>Step 2</td>
</tr>
<tr>
<td></td>
<td>Tech Confidence</td>
<td>Creative Activities</td>
<td>Tech Confidence</td>
<td>Technical Activities</td>
</tr>
<tr>
<td>Intercept</td>
<td>11.41***</td>
<td>.58</td>
<td>1.95***</td>
<td>.46</td>
</tr>
<tr>
<td>Adolescent Age</td>
<td>0.12***</td>
<td>.03</td>
<td>-0.06**</td>
<td>.02</td>
</tr>
<tr>
<td>Parent Education</td>
<td>0.14***</td>
<td>.04</td>
<td>0.02</td>
<td>.03</td>
</tr>
<tr>
<td>Household Income</td>
<td>0.001</td>
<td>.01</td>
<td>0.01</td>
<td>.01</td>
</tr>
<tr>
<td>ENCRG</td>
<td>0.54***</td>
<td>.14</td>
<td>0.01</td>
<td>.09</td>
</tr>
<tr>
<td>Gender (A)</td>
<td>-0.17</td>
<td>.14</td>
<td>-0.15</td>
<td>.09</td>
</tr>
<tr>
<td>Gender (P)</td>
<td>-0.10</td>
<td>.14</td>
<td>0.17</td>
<td>.09</td>
</tr>
<tr>
<td>ENCRG x Gender (A)</td>
<td>0.05</td>
<td>.27</td>
<td>-0.14</td>
<td>.18</td>
</tr>
<tr>
<td>ENCRG x Gender (P)</td>
<td>0.44</td>
<td>.27</td>
<td>0.24</td>
<td>.18</td>
</tr>
<tr>
<td>Gender (A) x Gender (P)</td>
<td>-0.001</td>
<td>.27</td>
<td>-0.14</td>
<td>.18</td>
</tr>
<tr>
<td>ENCRG x Gender (A) x Gender (P)</td>
<td>0.78</td>
<td>.55</td>
<td>-0.25</td>
<td>.37</td>
</tr>
<tr>
<td>Tech Confidence</td>
<td></td>
<td></td>
<td>0.18***</td>
<td>.02</td>
</tr>
</tbody>
</table>

Note. ENCRG = parental encouragement; Gender (A) = adolescent gender; Gender (P) = parent gender; Tech confidence = adolescent technological adolescence. Gender are effect coded as male = 0.5 and female = -0.5. For model 1 on creative activities, N = 1032 and for model 2 on technical activities, N = 1031. \( ^1 p < .10. \) \( ^* p < .05. \) \( ^{**} p < .01. \) \( ^{***} p < .001. \)
Figure 1. Conceptual Model. Black solid lines denote hypothesized paths and grey dashed lines denote effects of control variables.
Figure 2. Distribution of African American adolescents’ technological engagement as a function of activity type and adolescent gender.

Note. Numbers indicated in each segment of the bars reflected the number of adolescent boys and girls that reported engagement and interests in each respective number of activities. Creative activities compose of a total of five activities and technical activities compose of a total of four activities.
Figure 3. Distribution of parental encouragement (versus limiting behaviors) as a function of parent-adolescent dyad type depending on adolescent and parent gender.

Note. Numbers indicated in each segment of the bars reflected the number of parents that reported encouragement or limiting behaviors toward adolescents’ technological engagement in each respective parent-adolescent dyad.
Figure 4. Adolescents’ engagement in technical activities as a function of parent-adolescent dyad type.

Note. * = p < .05.