Pathways for African American Success: Results of Three-Arm Randomized Trial to Test the Effects of Technology-Based Delivery for Rural African American Families

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Abstract

Objective The objective of this study was to test the effectiveness of a technology-based program to avert risky behaviors among rural African American youth. We hypothesized that the technology-based and group-based formats of the Pathways for African Americans Success (PAAS) program would lead to improvements in primary outcomes, and that the technology condition would perform at least as well as the group condition. **Methods** A three-arm Randomized Control Trial (RCT) ($N = 141$) technology-based delivery, ($N = 141$) small group delivery, and ($N = 136$) literature control) was conducted with 421 sixth graders and their caregivers, Summer 2009–Fall 2012. Families were recruited from five rural counties in Tennessee and completed baseline, posttest [$M = 14.5$ (4.4) months after pretest] and long-term follow-up [$M = 22.6$ (3.7) months after posttest]. Structural Equation Modeling (SEM) was used to test intervention-induced changes in both parents and youths' primary outcomes (pretest to posttest) and on secondary targeted outcome, youth sexual risk, and substance use patterns (pretest to follow-up). **Results** Parents in the technology condition reported significant increases in strategies to reduce risk. Youth in the technology condition experienced a significant decline in intent to engage in risk behaviors and reduction in substance use and sexual risk behavior. Youth in the group condition experienced a significant increase in affiliation with deviant peers. **Conclusions** This study provides evidence of the ability of eHealth to improve parenting and reduce adolescent engagement in substance use and sexual risk behavior. Suggestions for dissemination in schools and health-care systems are offered.

Key words: computer applications/eHealth; evidence-based practice; parenting; race/ethnicity; risk behavior.

Introduction

African Americans confront disproportionate rates of HIV and other sexually transmitted infections, teen pregnancy/parenthood, and unmet mental health and substance abuse needs (CDC, 2015; Flores, 2010). Risk for these negative outcomes originates in early

adolescence (Biddlecom, 2004; Brook, Brook, Rubenstone, Zhang, & Finch, 2010; Elkington, Bauermeister, & Zimmerman, 2010; Seth et al., 2011) and may be mitigated by intervening during this important developmental period, especially through the influence of positive parenting (Wyckoff et al., 2008).

For example, powerful factors that protect African American youth from high-risk behaviors originate in the family environment, particularly in parents' caregiving practices (Murry & Brody, 2004), which have been shown to buffer their children from engaging in behaviors associated with HIV risk vulnerability. Results from Murry's longitudinal studies conducted in rural African American communities have demonstrated that communication between parent and youth plays a critical role in the ability of parents to convey norms and establish expectations regarding risky behaviors (Murry et al., 2005). Additionally, supportive conversations between parents and youth have been shown to counteract negative peer influences related to risky behavior (Brody & Flor, 1998; Donenberg, Emerson, & Mackesy-Amity, 2011), promote resistance efficacy, and foster self-regulation (Brody, Murry, Kim, & Brown, 2002). The effectiveness of parent-child communication, however, depends on the quality and tone of conversations and youth perception of whether parents are warm and supportive (Berkel et al., 2009; Brody & Flor, 1998; Kotchick, Shaffer, Miller, & Forehand, 2001). These parenting approaches, taken together, increase youth's skills and abilities to avoid risky behaviors, by lowering intentions to perform the behavior even when there are no environmental constraints to prevent behavioral performance (Fishbein, 1996).

Extensive reviews and meta-analyses have highlighted the potential of family-based preventive interventions to address adolescent risk behavior (Allen et al., 2016; NRC/IOM, 2009; Sandler, Schoenfelder, Wolchik, & MacKinnon, 2011; Van Ryzin et al., 2016). The SAAF program, for one, resulted in long-term improvements in youth outcomes, including sexual risk behavior (Murry, Berkel, Brody, Gerrard, & Gibbons, 2007; Murry et al., 2011), substance use (Brody et al., 2009), and conduct problems (Brody, Kogan, Chen, & Murry, 2008) among African American families living in the rural South.

Despite these promising findings, family engagement in preventive interventions has been low (Kao, Gibbs, Clemen-Stone, & Duffy, 2013). Extensive research has been conducted to understand the reasons for low engagement, which span from logistical barriers such as the need for childcare, to demographic characteristics such as parent education, to parent mental health and child behavior problems, to elements of delivery and group process (Coatsworth, Duncan, Pantin, & Szapocznik, 2006; Haggerty et al., 2002). In the SAAF program, despite many strategies to support engagement (Murry & Brody, 2004), including delivering the program in community settings, scheduling around family preferences, providing childcare and transportation, offering meals catered by

local African American businesses, attendance remained a challenge for families, due primarily to inconsistent shift work schedules (Murry, Berkel, & Liu, 2018).

In addition to issues with engagement, there are also barriers to the delivery of programs in disadvantaged communities. The availability of trained staff, and technical assistance, and transportation (Mancini et al., 2009; Mihalic & Irwin, 2003) are factors that limit the availability of programs, especially in low-income, rural African American communities (Cené et al., 2013). Further, even within the tightly controlled context of research studies, program facilitators have struggled with fidelity (Albritton et al., 2014). Indeed, substantial variability was found in the delivery of the Strong African American Families Program (SAAF) program, despite close monitoring and feedback from the research team (Berkel, Murry, Roulston, & Brody, 2013).

Advances in technology may provide a solution to families' needs for flexible scheduling as well as the standardization of program delivery. Computer-based technology has been adopted as a format for delivering risk prevention programs to youth (Hansen, Bishop, & Bryant, 2009; Lightfoot, Comulada, & Stover, 2007; Schwinn, Schinke, & Di Noia, 2010; Van Voorhees et al., 2009; Vogl et al., 2009), and to a smaller extent, families (Fang & Schinke, 2013; Perrino et al., 2018; Schinke, Fang, Cole, & Cohen-Cutler, 2011). The SAAF program was adapted for computer-based delivery for rural African American families, informed by ethnographic research on the availability of computers in the local communities. While many homes did not have their own computers, all families had access via schools and libraries. A three-arm (technology, small in-person groups, or literature control) randomized trial was conducted to test the adapted version, named Promoting African American Success (PAAS). Potential concern for the acceptability of a computer-based intervention for rural African American families was allayed in a recent study comparing attendance in the technology and small group formats (Murry et al., 2018). More families attended the technology condition than the group condition, irrespective of parent age, education, or Socio-economic Status (SES).

Study Hypotheses

In the current study, we tested the hypotheses that the technology-based and group-based formats of PAAS would lead to improvements in outcomes, and that the technology condition would perform at least as well as the group condition. We used structural equation modeling to compare intent-to-treat improvements in parenting and youth risk factors from pretest to

posttest, and reductions in sexual risk behavior and substance use from pretest to long-term follow-up.

Methods

Recruitment and Randomization

To test the effectiveness of a technology-based prevention program for rural African American families, a three-arm (technology format, small group format, and literature control) randomized control trial was conducted with eligible participants, consisting of 421 sixth graders and their primary caregivers. The study took place in five rural counties in the western region of Tennessee (TN) between 2009 and 2012. Criteria for county selection were based on rurality, proportion of African American residents, evidence of high rates of teen pregnancy, and negative overall health indicators. Specifically, counties were selected based on the following characteristics: (1) rurality index scores >11 (scale of 0 = least rural to 16 or greater = most rural), (2) over 30% African American residents, (3) over 600 African American teens in the targeted age range, (4) teen pregnancy rates of 69%, which is 13% higher than the average for TN, and (5) state health indicators reflect poor health determinant outcomes in the state of TN, which include health care, health behaviors, socioeconomic factors related to health, and physical environment (U.S. Census Bureau, 2013). African American-targeted participants, both adult and youth, were excluded from the study if the primary caregiver or adolescent did not speak English.

Middle schools provided lists of 6th-grade African American students. Children were assigned a recruitment id, and their order was permuted randomly to contact families for eligibility screening and recruitment. A letter was mailed to all parents/guardians informing them about the study. A community liaison (well-known local community leader) either contacted families by phone or visited families' homes to provide information about the study. Active consent was obtained from primary caregivers and assent from youth. Randomization was carried out with computer-generated random numbers kept in opaque envelopes. After pretests, participants were randomized to one of three conditions based on the assignment found in the numbered envelop in the corresponding enrollment list. A total of 110 participants were enrolled, consisting of 110 for each of the five counties. Of the number of families contacted ($N = 550$), 78% consented to participate.

Interview Procedures

To enhance rapport and cultural understanding, trained African American community members served as interviewers. Study measures and procedures were developed and refined with feedback from 40 African

American community members (Murry & Brody, 2004). Self-report questionnaires were administered to parents and target youth via laptop computers. To maintain confidentiality and address potential literacy concerns, questions were read via computer using the audio computer-assisted self-interview program, and participants entered responses with a remote keypad. Each interview lasted approximately 2 hr. Participants were reinterviewed at posttest [$M = 14.5$ (4.4) months after pretest] and long-term follow-up [$M = 22.6$ (3.7) months after posttest]. To reimburse families for each data collection point, parents received \$100 and youth received \$50. Randomization to condition occurred after the pretest assessment to one of three conditions: group ($N = 141$), technology ($N = 141$), and literature control ($N = 136$) (see Figure 1).

Several steps were undertaken to ensure that research activities did not cause harm or adverse events for participants. First, community research staff administered all questionnaires to each participant individually in a private area where no other household members could hear. For questions with sensitive content, respondents keyed their own responses into a remote keypad. In addition, data obtained from participants were monitored carefully, and community research staff were instructed to report any adverse incidents to the research project coordinator. Further, after each data collection in families' homes, community research staff were required to record on comment cards any unusual or adverse events that occur during an interview. Comment cards were reviewed daily by project coordinator and if any seriously adverse event occurred, the project coordinator informed the Principal Investigator (PI). Fortunately, no adverse events occurred during the course of the study. All study procedures were approved by Vanderbilt University's Institutional Review Board (IRB).

Participants

Primary caregivers were, on average, 40 years old and predominantly female (84%). The majority (87%) had completed high school. Half were single parents, 37% were married, and the remaining were grandparent-headed households. On average, there were 2.7 children in the household (54% female). Most primary caregivers (63%) were employed and worked approximately 40 hr per week; 50% owned their own home; 56% reported that their income was adequate income to meet their needs; and 14% received public assistance.

Measures

Intervention-Targeted Parenting Behaviors

Four indicators of primary caregivers' intervention-targeted behaviors were included: supportive parent-youth relationship, adaptive racial socialization,

Figure 1. Consort flow diagram.

communication about sex, and clear communication of rules and expectations about substance use.

At pre- and posttest, parents reported on the *supportiveness of their relationship* with children using the four-item Carver Caregiver Support scale (Carver, Scheier, & Weintraub, 1989), rated on a 5-point scale from 1 (*not at all true*) to 5 (*very true*). An example item is “[child name] gets emotional support from me.” Items were coded such that higher scores indicate greater support. Cronbach’s alphas were .81 at pretest and posttest.

At pre- and posttest, parents reported on *open, supportive, family communication* using the Discussion Quality Scale, an instrument that we have used in previous research with rural African American families (Murry et al., 2005). Three subscales were created from this 12-item scale. The first subscale, *Frequency of Conversation*, consisted of four items asking youth and parents how often they engage in conversations with each other about school, friend choices, drugs, alcohol, and sex. Possible scores ranged from 0 to 12, with higher scores indicating more frequent conversation between caregivers and youth. For caregiver reports, Cronbach’s alphas for the Frequency of

Conversation subscale were .64 at pretest and .63 at posttest. The second subscale, *Parent–Youth Discussion Quality*, also included four-items and assessed the extent to which the tone, frequency, and quality of conversations between caregiver and youth about choice of friends, school, alcohol/drugs, and sex were “open, supportive, allowing each to share [their] side of the issue.” Possible scores ranged from 0 to 16 with higher scores indicating higher levels of open conversation. For caregiver reports, Cronbach’s alphas for the Discussion Quality subscale were .73 at pretest and .77 at posttest. The third subscale measured *conflicted and ineffective communication* to assess the relative contributions of caregivers and youth to discussions about friends, school, alcohol/drugs, and sex, as well as how often discussions become arguments. Possible scores ranged from 0 to 16, with higher scores indicating lower occurrences of arguments. For caregiver reports, Cronbach’s alphas for this subscale were .73 at pretest and .68 at posttest.

At pre- and posttest, parents reported on their *establishment of clear rules about substance use and sexual risk behavior* using an expanded nine-item version of the Substance Use Rules Communication Scale

from Strengthening Families (Spoth, Redmond, & Shin, 1998), rated on a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Example items are “I have explained my rules concerning drug use to my child” and “I have explained the consequences of not following my rules concerning drug use to my child.” Items were coded such that higher scores indicate more endorsement of clear rules. Cronbach’s alphas were .91 at pretest and .95 at posttest.

At pre- and posttest, parents reported on their *communication with children about sex* using the eight-item Frequency of Sexual Communication scale (Miller, Kotchick, Dorsey, Forehand, & Ham, 1998), rated on a 4-point scale from 1 (*never*) to 4 (*often*). Example items are, “how often have you and your child talked about pressures in his/her life to have sex?” and “how often have you and your child talked about the importance of young people using condoms when they are sexually active?” Items were coded such that higher scores indicate more frequent sexual communication. Cronbach’s alphas were .96 at pretest and posttest.

At pre- and posttest, parents reported on their *positive racial socialization practices* using the five-item celebration of racial heritage subscale of the Racial Socialization Scale (Hughes & Johnson, 2001), rated on a 3-point scale from 1 (*never*) to 3 (*three to five times*). Example items are, “done or said things to encourage your child to do other things to learn about the history or traditions of your racial group” and “celebrated cultural holidays of your racial group?” Items were coded such that higher scores indicate higher levels of positive racial socialization. Cronbach’s alphas were .85 at pretest and .88 at posttest.

Intervention-Targeted Youth Behaviors

At pre- and posttest, adolescents reported on their *intent to engage in risk* using the eight-item Substance Intention Questions scale (Gibbons, Gerrard, Blanton, & Russell, 1998). Example items are, “do you plan to use marijuana in the next year?” and “how likely is it that you will use marijuana in the next year?” Responses to the “plan” items ranged from 1 (*definitely no*) to 4 (*definitely yes*), and responses to “likely” items ranged from 1 (*not at all likely*) to 4 (*very likely*). Items were coded such that higher scores indicate greater intent to engage in risk. Cronbach’s alphas were .89 at pretest and .87 at posttest.

At pre- and posttest, adolescents reported on their *affiliation with peers* engaging in externalizing behaviors, using substances, and engaging in sexual risk behavior using the Affiliation with Deviant Peers scale (Elliot, Huizinga, & Ageton, 1985), rated on a 4-point scale from 0 (*none of them*) to 3 (*all of them*). With the stem, “In the past 3 months, how many of your

close friends have,” example items are, “gotten high using drugs of some kind?” and “had sex with someone they did not know well?” Items were coded such that higher scores indicate greater affiliation with risk-engaging peers. Cronbach’s alphas were .89 at pretest and .91 at posttest.

Youth Risk Behavior Outcomes

At pretest and long-term follow-up, adolescents reported on their vaginal, anal, and oral sexual behaviors using the 37-item *Sexual Risk Survey* (Jemmott, Jemmott, Fong, & McCaffree, 1999). Response scales were dichotomous for items like, “the last time you had vaginal sex, was a condom used?” or counts for items like, “how many times have you had anal sex?” Items were coded such that higher scores indicate greater engagement in risky behaviors.

At pretest and long-term follow-up, adolescents reported on their *substance use* across a range of substances (i.e., cigarettes, alcohol, marijuana, cocaine, hallucinogens, methamphetamines, heroin, huffing, ecstasy, or prescription drugs) using the 28-item Monitoring the Future scale (Johnston, Bachman, & O’Malley, 1993). An example item is, “have you ever used marijuana?” Items were coded such that higher scores indicate greater engagement in risky behaviors. A youth risk behavior summary score was created combining all forms of substance use and sexual risk behavior.

Program Description

Similar content was included for both active conditions, regardless of delivery format (Murry et al., 2018). Both formats include concurrent parent and youth sessions, followed by a conjoint family session. A “highway to success” organizes the session topics in the technology version of the program with off ramps and side streets to illustrate associations between choices and consequences. The program includes characters that look and sound like members of the local community, and participants can customize avatars to represent themselves. These avatars can interact with the characters in the program via a menu of preprogrammed responses. There are also discussion activities for the family sessions in which questions appear for 3 min, while the parents and children discuss the topic. If participants get stuck, they can request to observe characters in the program model the discussion for them.

The delivery of the group format includes organized role-playing activities, guided discussions among group members, and allotted time during each session for participants to ask questions. Parent sessions were designed to target universally adaptive parenting practices, including communication, the establishment of rules about risk behaviors, and monitoring and

consistent discipline to ensure rules are followed. PAAS also includes a primary focus on racial socialization, which teaches children to cope with racism through fostering a sense of pride in their history and community (Murry et al., 2011; Murry et al., 2007). Youth sessions also included both universal (e.g., risk resistance skills and future orientation) and culturally specific content (dealing with racism). Additional details about program content are presented in (Murry et al., 2018). Families assigned to the noninteractive literature control group received home-mailed educational materials containing the same topical content information as the weekly technology-delivered and traditional small group conditions. In essence, this three-arm trial assessed the comparative effectiveness of two interactive delivery modalities and a noninteractive content-only comparison modality.

Program Delivery

The program was delivered in community settings over 6 weekly sessions for both the group and technology conditions. Families attended weekly sessions, and a member of the research staff sent a schedule to families informing them of the dates and times over the course of 6 weeks, when the program would be available in their community. Each family received a follow-up call by the research team to confirm attendance. On completion of each session, each family received a \$25 financial incentive. Monetary incentives yield high compliance in assessment completion, retention, and program engagement (Guyl, Spoth, & Redmond, 2003; Murry & Brody, 2004), which was necessary for establishing the effects of the program with a relatively small sample. Incentives are used in numerous community agencies that deliver programs to low-income families. Because both conditions received the same incentives, it is unlikely that these incentives had differential effects on attendance by condition.

For the technology condition, teams of two trained to serve as on-site technology intervention assistants (TIAs). TIAs received 6 hr of training on program content, procedures for setting up and managing weekly computer interactive sessions, and instructions on how to identify and solve on-site computer-related issues. The child and parent worked individually on separate computers, and then a TIA escorted youth to the parent's computer to complete the family session. Each concurrent parent/youth individual session and family session lasted 45 min on average, resulting in 1.5 hr per session, and 9 hr of total dosage. For the group condition, each parent/youth concurrent session and family session lasted 1 hr on average, resulting in 2 hr per session, and 12 hr of total dosage. Program facilitators for the traditional group-based condition, working in teams of three (one for parent and two for youth sessions). Facilitators received a total of 36 hr of

training over the course of 6 days. In both conditions, the majority of program implementers (i.e., TIAs or program facilitators) were African American community members who were high school graduates and actively engaged in community leadership positions, including church-related roles and instructors for youth recreational programs.

In programs delivered via traditional, in-person program formats, implementation can vary widely and depends on both facilitator delivery and the participant responsiveness (Murry et al., 2011). In the group condition, sessions were videotaped to assess fidelity. For each group, two parents, two youths, and two family sessions were selected randomly and scored for fidelity to the prevention curriculum. Reliability checks were conducted on 23% of the fidelity assessments, and interrater reliability exceeded 80% for parent, youth, and conjoint family sessions. Fidelity to the curriculum exceeded 80%. An advantage of technology is the ability to standardize facilitator delivery, thus removing the costs of behavioral observations. Nonetheless, it is still important to examine how participants engage with the program, as well as participant's satisfaction. After each technology session, a brief questionnaire was administered to parents and youths to evaluate their perception of ease of completing and understanding the core elements of each session, including interactive activities. Average parent and youth satisfaction ratings exceeded 90%.

Analytic Strategy

Study hypotheses were tested in Mplus 7.11 (Muthén & Muthén, 2012), using Full Information Maximum Likelihood to address missing data (Enders & Bandalos, 2001). Little's (1988) Missing Completely at Random (MCAR) test demonstrated that data were likely missing completely at random, $\chi^2(30) = 26.16$, $p = .67$. Two latent constructs were used to assess two dimensions of parenting, one that related to general supportive parenting (i.e., support, open communication, and frequency of communication) and one that related to sensitive topics (i.e., racial socialization, communication about sex, and setting up clear rules about substance use). Youth intent to engage in risk and affiliation with deviant peers were included as observed indicators. A measurement model was first run to test the adequacy of the latent constructs. Correlations between parent and adolescent variables were freely estimated, and errors for indicators were allowed to correlate from pretest to follow-up. To assess improvements in program outcomes over time, we included baseline scores for all variables. To assess the influence of group condition, we used two dummy coded intervention variables (Hayes & Preacher, 2014). Intraclass Correlations (ICCs) were all under .05, indicating that no need for a clustering variable

(Kreft & de Leeuw, 1998). We determined good model fit as indicated by a nonsignificant χ^2 or a combination of Standardized Root Mean Square Residual (SRMR) close to .08, Root Mean Square Error of Approximation (RMSEA) close to .06, and Comparative Fit Index (CFI) close to .95 based on simulation studies that revealed using this combination rule resulted in low Type I and Type II error rates (Hu & Bentler, 1999). Finally, because of a smaller sample size for the long-term follow-up, we examined the effect of delivery format on reductions in youth engagement in risk behavior using a composite of the sexual risk behavior and substance use indicators from baseline to long-term follow-up in a separate model. Robust standard errors were used to address nonnormality of the risk behavior outcomes (Satorra & Bentler, 1994).

Results

Table I summarizes baseline characteristics by condition and indicates that they did not significantly differ from each other on these variables. Correlations, *Ms*, and *SDs* are presented in Table II. In general, parenting variables were intercorrelated with one another, as were adolescent risk variables. Correlations were typically stronger between adolescent risk factors (i.e., behavioral intention and affiliation with deviant peers) and risk outcomes (i.e., sexual behaviors and substance use) than parenting and risk outcomes. Some interesting patterns were discovered among correlations with long-term follow-up variables. For example, behavioral intention and affiliation with deviant peers were correlated with vaginal sex at pretest, but not at long-term follow-up and parenting appeared to be more predictive of substance use than sexual risk behavior at long-term follow-up. However, because of the small sample sizes in the long-term follow-up, caution is warranted in making interpretations about these differences.

Effects of PAAS Delivery Format on Improvements in Parenting

A measurement model indicated the validity of the latent variables, with adequate fit, $\chi^2(96) = 246.36$, $p \leq .05$; RMSEA = .06 (90% confidence interval, CI = .05, .07); CFI = .91; SRMR = .08, all loadings $\geq .30$, $p \leq .001$ and no modification indices suggesting alternative latent constructs. Results of the structural model testing the effect of delivery format on improvements in parenting are presented in Figure 2. The loadings for all indicators of the latent constructs $\geq .30$, $p \leq .001$. The structural model demonstrated good fit, $\chi^2(111) = 192.21$, $p \leq .05$; RMSEA = .04 (90% CI = .03, .05); CFI = .95; SRMR = .05. The standardized β s demonstrated that the group condition led to

Table I. Baseline Characteristics by Condition

	Technology	Group	Control
Demographics			
Parent age (years)	39.2 (7.7)	39.1 (8.3)	40.3 (9.9)
Parent education (% with college diploma or higher)	16	12	14
Parent employment	71%	65%	67%
Receipt of public assistance	12%	18%	11%
Child gender (% female)	53	55	53
Study variables			
Established rules about substance use	4.4 (0.8)	4.5 (0.7)	4.4 (0.7)
Sexual communication	2.7 (0.9)	2.6 (0.9)	2.6 (0.9)
Racial socialization	2.0 (0.6)	1.9 (0.5)	2.0 (0.6)
Support	4.3 (0.8)	4.1 (0.8)	4.1 (0.8)
Open communication	2.9 (0.8)	2.9 (0.8)	2.9 (0.8)
Frequent communication	2.4 (0.7)	2.4 (0.7)	2.3 (0.7)
Intent to engage in risk	1.0 (0.1)	1.1 (0.3)	1.1 (0.3)
Affiliation with deviant peers	0.3 (0.3)	0.3 (0.4)	0.3 (0.3)
Vaginal sex	0.5 (2.7)	0.1 (0.4)	0.3 (1.5)
Anal sex	0.1 (1.2)	0.0 (0.2)	0.2 (.16)
Oral sex	0.1 (0.6)	0.1 (0.2)	0.1 (0.2)
Substance use	0.3 (0.7)	0.4 (0.8)	0.5 (1.3)

Note. No group differences were significant at $p \leq .05$.

improvements in supportive parenting ($\beta = .12$; 95% CI = .02, .20; $p = .02$). In contrast, the technology condition led to improvements in parenting with respect to sensitive topics ($\beta = .30$; 95% CI = .09, .54; $p = .03$).

Effects of PAAS Delivery Format on Reductions in Youth Risk Factors

Figure 2 also presents the results of delivery format on youth risk factors, specifically their behavioral intent to engage in risk behaviors and their affiliation with deviant peers. Youth assigned to the technology condition experienced a significant decline in behavioral intent to engage in risk behaviors from baseline to posttest ($\beta = -.12$; 95% CI = $-.20, -.01$; $p = .04$). Youth in the group condition experienced a significant increase in affiliation with deviant peers ($\beta = .16$; 95% CI = .06, .27; $p = .002$). To ensure there were no suppression effects based on the correlation between affiliation with deviant peers and intent to engage in risk, we ran the models examining effects on affiliation and intent separately. In each of the individual models, fit remained good, and the pattern of program effects was nearly identical.

Effects of PAAS Delivery Format on Reductions in Youth Risk Behavior

In examining the influence of condition on sexual risk behavior and substance use from pretest to long-term follow-up, random assignment to the technology condition was associated with a significant decrease in

Table II. Correlations, Ms, and SDs for All Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. Rules	—																							
2. Sexual communication	.14**	—																						
3. Racial socialization	.16***	.10*	—																					
4. Support	.21***	.23***	.13**	—																				
5. Open communication	.36***	.24***	.24***	.36***	—																			
6. Frequency communication	.33***	.27***	.24***	.33***	.67***	—																		
7. Intent	.01	-.00	.11*	-.03	.06	.05	—																	
8. Deviant peers	-.09+	.02	.09+	-.11*	.07	.10*	.37***	—																
9. Vaginal sex	-.03	-.07	.01	-.11*	-.02	.04	.29***	.35***	—															
10. Anal sex	-.00	-.05	.03	-.02	.02	.08	.07	.23***	.77***	—														
11. Oral sex	-.09+	-.09+	-.05	-.14**	-.04	-.02	.30***	.26***	.53***	.22***	—													
12. Substance use	-.05	-.04	.04	-.03	-.02	-.01	.52***	.37***	.20***	.04	.28***	—												
Posttest (N = 337)																								
13. Rules	.41***	.13*	.14**	.22***	.17**	.19***	-.05	-.00	-.04	.08	-.04	-.16**	—											
14. Sexual communication	.16**	.28***	.01	.22***	.24***	.20***	-.00	.05	.00	-.01	-.06	-.03	.19***	—										
15. Racial socialization	.21***	.10+	.42***	.11*	.26***	.23***	.02	.06	-.02	-.01	-.06	.09+	.13*	.02	—									
16. Support	.20***	.17**	.13*	.64***	.39***	.35***	-.10+	-.06	-.06	-.10+	-.04	-.08	.20***	.24***	.17**	—								
17. Open communication	.33***	.27***	.28***	.30***	.56***	.62***	.04	.12*	-.03	.06	-.05	.00	.25***	.21***	.24***	.43***	—							
18. Frequency communication	.34***	.27***	.25***	.42***	.59***	.55***	-.03	.09	-.05	.04	-.06	-.02	.25***	.29***	.25***	.56***	.70***	—						
19. Intent	.02	.03	.08	-.05	.05	.04	.57***	.36***	.07	.03	.10+	.46***	-.14**	-.01	.07	-.13*	-.01	.04	—					
20. Deviant peers	-.05	.06	.07	-.06	.05	.09	.31***	.50***	.03	-.00	.11*	.25***	-.05	.18***	.03	-.02	.04	.15**	.54***	—				
Long-term follow-up (LTFU) (N = 165)																								
21. Vaginal sex	.07	.01	-.06	-.07	.07	.02	.11	.14+	.19**	.07	.29***	.05	.12	-.12	.02	-.02	.03	.05	.07	.07	—			
22. Anal sex	-.04	-.02	.20**	-.09	.06	.10	.22**	.33***	.13+	.03	.14+	.29***	-.07	.05	.15+	.04	.06	.12	.16*	.27***	.40***	—		
23. Oral sex	-.09	-.03	.05	-.03	-.01	.00	.11	.24**	.15+	.11	.24**	.18*	-.01	-.13+	.00	-.07	.00	-.03	.18*	.19*	.58***	.32***	—	
24. Substance use	-.01	.05	-.04	-.20**	-.01	-.03	.28***	.10	.01	-.03	.12	.21**	-.13	-.09	-.02	.20**	-.17*	-.10	.36***	.26***	.33***	.21**	.38***	—
Ms	4.4	2.6	2.0	4.2	2.9	2.4	1.1	0.3	0.3	0.1	0.1	0.4	4.5	2.7	1.9	4.2	3.1	2.5	1.1	0.3	0.7	0.1	0.4	0.8
SD	0.7	0.9	0.5	0.8	0.8	0.7	0.2	0.3	1.8	0.7	0.4	0.9	0.8	0.8	0.6	0.7	0.8	0.6	0.3	0.4	1.3	0.3	0.9	1.1

Figure 2. The influence of delivery format on Intent to Treat (ITT) improvements in parenting and youth risk factors.

risk behavior over time ($\beta = -.17$; 95% CI = $-.31, -.04$; $p = .04$). The decrease for participants assigned to the group condition was not significant ($\beta = -.05$; 95% CI = $-.20, .11$; $p = .58$).

Discussion

The current study tested the effects of the PAAS program using two delivery modalities: traditional in-person group format and a technology-based version delivered to individual families via computer. This work was undertaken to address two challenges in the dissemination and implementation of evidence-based programs: family attendance in group-based preventive interventions and provider fidelity to program curriculum (Berkel et al., 2013). A recent study demonstrated that the technology condition was associated with higher levels of program attendance. The current study took the next step to determine relative effectiveness. Evidence supported the ability of the technology platform to improve parenting and reduce adolescent engagement in substance use and sexual risk behavior. In the paragraphs that follow, we will summarize the implications of the findings of the study for future research and practice, discuss limitations, and highlight future directions.

In previous studies, we have distinguished between two categories of parenting to support youth development: universally positive parenting that is beneficial for all developing adolescents (e.g., supportive parenting and communication) and racially specific parenting (e.g., racial/ethnic socialization), which is critical for adolescents who are members of marginalized groups (Murry et al., 2007). In the current study, we found evidence for a related, but somewhat more refined way of characterizing aspects of parenting—which may have particular implications for the delivery of parenting programs using different delivery

formats. In this case, data indicated a differentiation between general supportive, communicative parenting and parenting with respect to potentially challenging or sensitive topics, including rules about substance use, communication about sex, and racial socialization. We found differential effects by condition for these two aspects of parenting. Specifically, the group-based format of PAAS experienced greater improvements in supportive, communicative parenting than the technology condition, whereas the technology condition experienced greater improvements in addressing the more challenging topics. It may be the case that the group environment provides parents the opportunity to practice positive relationship skills with others and that the space feels safe for this type of conversation. On the other hand, privacy concerns may inhibit open conversations about the more sensitive topics in a group setting. Previous research on barriers to participation has demonstrated that privacy is a salient topic for both parents and adolescents (Heinrichs, Bertram, Kuschel, & Hahlweg, 2005; Stanford et al., 2003). These findings have implications for the possibility of a hybrid approach to delivering programs with families, delivering content that deals with “safe” topics in a group setting and delivering more sensitive content via a more private technology-based format.

In previous studies of the SAAF program, on which PAAS was based, program effects on youth outcomes were mediated through parenting (Murry et al., 2007, 2011). This finding is consistent with some other programs, such as the New Beginnings Program for divorcing families, which dropped its child component when a three-arm trial demonstrated no additive effect of the child component (Wolchik et al., 2000). In contrast, the current study demonstrated direct effects of the PAAS technology condition on adolescents’ intent to engage in risk behavior, above and beyond the effects of the program on improvements in parenting.

The group condition of PAAS was associated with an increase in affiliation with deviant peers. Previous studies have found iatrogenic effects of group-based programs for delinquent youth (Dishion, McCord, & Poulin, 1999). However, this is an unexpected finding in the current study given that it would be considered a selective (i.e., based on membership in a marginalized racial group), rather than indicated (i.e., based on some initial indicators of risk behavior) intervention (Mrazek & Haggerty, 1994). Further, because these findings did not occur in the PAAS effectiveness trial, further investigation is warranted.

Limitations and Future Directions

Results must be interpreted in light of a number of study limitations, and these will be presented with future directions. First, it must be acknowledged that we relied on self-report data to assess program effects. Second, for a three-arm effectiveness trial, the sample size was relatively small. This was true to some extent for the pre- and posttest data, but especially so for the long-term follow-up, where because of funding limitations, we were only able to interview the first cohort. The fact that we found positive effects on adolescent substance use and sexual risk behavior 3 years following the intervention speaks to the power of PAAS program's technology version to protect youth.

Third, because of the trial's goal to test the effectiveness of the technology-based format, the curriculum was delivered in community settings at set time frames. This design has two potentially counteracting consequences. On the one hand, it removes the requirement to have access to a computer to participate in the program, which may have enhanced program engagement. However, ethnographic work conducted a decade ago, before the creation of the program, indicated that rural African American families do have access to computers, even if not in their own homes. Technology access has only grown since then (Smith, 2014). On the other hand, the design removes the whenever–wherever benefit, which is thought to be a primary mechanism for improving participant engagement through technology; hence, results presented are thought to be a conservative estimate of the potential effects when delivered in more “real world” conditions, which should be assessed in future research. These studies should also include additional measures of engagement, which can be captured automatically through the technology (e.g., participant responses and click patterns).

A related concern for technology-based interventions is reaching the intended audience. The market for eHealth products is increasingly competitive and saturated with products that are not “evidence-based.” Relying on families to seek out interventions on their own, and being able to distinguish those that are effective, is unlikely to improve reach. A referral

from a trusted individual is likely to be more effective. As schools were the location of recruitment for the trial, teachers could also be a referral source for the program on an ongoing basis. However, there is also growing interest in embedding prevention programs in primary care (Leslie et al., 2016), which has the benefit of longitudinal contact with families, trust and perceived expertise, health focus, and sustainable billing mechanisms (Murry et al., 2018). As many pediatricians are concerned with parenting and the development of substance use or sexual risk behaviors (Berkel et al., 2019), referrals may be given from adolescents' primary care provider. An important consideration of this context is the pressure pediatricians experience to cover a wide variety of content (e.g., sexual risk behavior, romantic relationships, substance use, puberty, gender identity, mental health, obesity, sleep, physical activity, nutrition, water intake, food insecurity, housing, community engagement, family, peers, school, violence, rape/consent, internet safety, dental health, hearing, vision, anemia, tuberculosis, sun screen, hearing protection, safety equipment including seat belts and helmets, riding with a drunk driver, and gun safety) in a 20-min appointment (Hagan, Shaw, & Duncan, 2008). Pediatricians also struggle to remember to make a referral when eligibility requirements come into play. Technology could address this concern as well: patient characteristics established in the electronic health record could trigger a referral to be e-mailed directly to all families with African American early adolescent children.

On the other hand, technology is easily customized. As it currently stands, families in PAAS can customize avatars to reflect their family composition. It may also be that the program could be customizable to reflect needs of diverse family backgrounds represented in the clinic. This approach has been taken for parenting programs in other settings. For example, because divorce knows no racial/ethnic boundaries, the New Beginnings Program for divorcing families went through a multicultural adaptation process to ensure that it fits with the cultural needs and values all groups that seek services through the family court system (Sandler et al., 2016; Wolchik et al., 2009). Finally, as the U.S. population becomes more diverse, there is unprecedented need to test the effectiveness of existing Evidence-Based Program (EBP) cultural relevance for African Immigrant families, with specific consideration given to what is universal, applicable to all families regardless of ethnic, cultural, and geographic setting, and what aspects of EBP need to be tailored to fit the cultural niche and nuances of targeted populations. Further, it remains unknown for whom and under what circumstances technology is a viable platform for delivery family-based programs, as some families may be more receptive to one of the three

modalities tested in the current study. This is an area that warrant further investigation.

In summary, rural African Americans face extreme and persistent disparities that can in part be reduced through the implementation of evidence-based programs. Based on an extensive body of research demonstrating the barriers to attendance in group-based preventive interventions, and the difficulty in ensuring adherent delivery of evidence-based programs, we created the PAAS program. A three-arm trial demonstrated the effectiveness of the technology version on parenting and reducing adolescent substance use. These promising findings lay the foundation for the widescale study of the implementation of technology-based delivery of EBP to address disparities in underserved areas.

Conflicts of interest: Murry is the developer of PAAS. Berkel, Inniss-Thompson, and Debreux, declare they have no conflict of interest.

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