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Engagement of adolescents with ADHD in a narrative-centered game-based behavior change environment to reduce alcohol use

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Abstract

Background: Attention deficit hyperactivity disorder (ADHD) affects about 13% of adolescents and is associated with substance use-related morbidity and mortality. While evidence on effective interventions to reduce alcohol use among adolescents with ADHD is limited, parent-teen communication about alcohol use has been found to be protective. Other approaches, such as educational interventions, hold promise to reduce alcohol-related harms in adolescents with ADHD. Digital technology offers an innovative approach to health behavior change, expanding

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access to services and may promote learning for neurodiverse youth, including teens with ADHD. INSPIRE, a narrative-centered game-based behavior change environment designed to promote self-regulation and self-efficacy to prevent risky alcohol use has been found to engage a general adolescent population. The goals of this pilot study are (1) to examine the engagement of youth with ADHD in INSPIRE; and (2) to examine if INSPIRE fosters parent-teen communication.

Method: Adolescents diagnosed with ADHD aged 14–16 were recruited from developmental medicine clinics and invited to a focus group offered via Zoom. Participants completed a pre-survey, interacted with the INSPIRE game, and answered a post-survey as well as open-ended questions about their gaming experience during the focus group. Engagement was measured through both self-report using subscales from the User Engagement Scale and computer data; survey and qualitative data collected information on parent-teen communication. Univariate statistics described adolescent characteristics, Rank-sum and Fisher's exact tests examined relationships among variables, and qualitative analysis identified themes in open-ended questions.

Results: Of adolescent participants ($N = 40$), 45% identified as female, 17.5% Black, 7.5%, Hispanic, and 62.5% White. Post-survey mean engagement subscales of Usability (on a 5-point scale) was 3.67 (SD = 0.74), and Satisfaction was 3.63 (SD = 0.75). Computer data indicated that participants played the game for a median of 24 min. Adolescents shared that playing the game strengthened refusal skills and their ability to navigate social gatherings with alcohol. Post-survey, 63% planned to share information from INSPIRE with a parent.

Conclusion: Findings suggest that INSPIRE may support facilitating youth with ADHD to learn the developmental competencies needed to mitigate risk and thrive. INSPIRE warrants further testing to explore its impact on alcohol use in youth with ADHD.

Introduction

Attention deficit hyperactivity disorder (ADHD) affects approximately 8–10% of school-age children (Barbaresi et al., 2004) and 13% of adolescents (Centers for Disease Control and Prevention., 2016; Bitsko et al., 2022), often persisting into adulthood (Barbaresi et al., 2018). Individuals with ADHD encounter challenges throughout the life course related to lower educational and occupational attainment, difficulties in relationships, substance abuse, and a five-fold increased risk of death by young adulthood (Dalsgaard et al., 2015). Substance use is highly prevalent in youth with ADHD (Ohlmeier et al., 2008). Adolescents with ADHD may struggle disproportionately with substance use across the life course due to barriers to quality healthcare (Wright et al., 2015), including insufficient resources, challenges in obtaining health information, as well as gaps in the receipt of diagnosis from providers and schools (Fridman et al., 2017). Co-occurring substance use is a significant risk factor for many challenging adult outcomes. Youth with ADHD who start using alcohol and other drugs earlier are more likely to have alcohol-related problems and to develop substance use disorders (Charach et al., 2011; Lee et al., 2011; Harstad et al., 2020). The maturing neural circuitry during adolescence heightens the impact of alcohol exposure on

regions of the brain sensitive to drugs and those regions involved in reward (Barkley, 1997; Sisk and Foster, 2004; Sibley et al., 2014). Thus, adolescence is an important sensitive period for alcohol and substance use in life course health development, and interventions to prevent or delay alcohol use in youth with ADHD have the potential to dramatically improve adult outcomes and to support thriving across the life course.

Research on alcohol prevention interventions in adolescents with ADHD and their caregivers/parents

The Society for Developmental-Behavioral Pediatrics ADHD practice guideline recommends clinicians engage in substance use prevention strategies with adolescents but notes an absence of evidence on effective interventions in this group. The guideline recommends that clinicians utilize interventions that were developed for adolescents in general (Barbaresi et al., 2020). Consistent with the Bright Futures Guidelines for screening and counseling for substance use for adolescents (American Academy of Pediatrics, 2017), behavior change interventions that show promise include brief interventions indicating a small to moderate effect for up to 1 year (Steele et al., 2020; Tanner-Smith and Lipsey, 2015; O'Connor et al., 2018).

Research on alcohol and substance use prevention has identified the importance of parents[1] to support healthy behavior in adolescents. Several factors, including parental modeling, good parent-child relationship quality, parental involvement and support, and general communication, are associated with delaying early alcohol initiation and reduced levels of later drinking by adolescents (Ryan et al., 2010; Cox et al., 2018). Among adolescents with ADHD, a potentially important protective factor includes frequent alcohol-specific communication with parents, while a risk factor includes permissive parental messages regarding alcohol use (Booth-Butterfield and Sidelinger, 1998; Reimuller et al., 2011). Recent literature indicates that parents of adolescents with ADHD lack knowledge regarding the facilitation of alcohol-specific conversations (Harstad et al., 2020).

Research on innovative technologies for youth with ADHD to promote behavior change

With the goal of enhancing wellbeing across the life course, there has been a recent call to develop innovative technology interventions to promote health behavior change in adolescents and young adults (Harris et al., 2017; Ozer and Lester, 2020; Wong et al., 2020). In general adolescents engage in high rates of video game play and find digital technologies appealing (Anderson and Jiang, 2018), including in healthcare settings (Wozney et al., 2018). Pediatric digital health interventions to promote and maintain behavior change have been found to be impactful (Hieftje et al., 2013) and their effect is larger than that of educational interventions alone (Cushing and Steele, 2010). The growing interest in supporting the health and wellbeing of youth with ADHD by leveraging digital technologies that already captivate their attention (Fogler et al., 2017; Davis et al., 2018) provides a unique opportunity.

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[1].^ We define the term parent as a biological parent, guardian or caregiver who provides support and/or monitoring to an adolescent.

The few youth alcohol prevention digital technology interventions in the literature are primarily in design and development phases (Lyk et al., 2020; Prediger et al., 2021; Nicholas et al., 2022; Osilla et al., 2023). One innovative example of this technology in a general adolescent population is INSPIRE[2] (Ozer et al., 2020). INSPIRE is a narrative-centered behavior change environment designed to reduce risky alcohol use by promoting the acquisition of knowledge of alcohol risk, self-efficacy, and self-regulation skills. INSPIRE is grounded in social cognitive theory (Bandura, 1986) which has been applied across the life course to diverse populations (Ozer, 2022). According to Social Cognitive Theory, personal efficacy, beliefs in one's capabilities to organize and execute specific courses of action, plays a pivotal role in determining behavior (Bandura, 1982; Ozer and Bandura, 1990). Perceived self-efficacy is a strong predictor of behavior; people tend to avoid activities they believe they cannot carry out and engage in activities they judge themselves capable of handling. The INSPIRE game is designed to increase players' ability to set goals, adopt problem-solving strategies, reason about the consequences of their actions, and reflect on their observed outcomes to adjust their future behaviors. In INSPIRE, players enhance their self-efficacy through mastering a series of increasingly challenging scenarios and exploring alternative strategies for handling alcohol-related situations in the branching storyline. The interactive narrative has been designed to foster increased self-regulation, a key component of social cognitive theory, through setting and monitoring goals, gaining strategic knowledge (ways of refusing alcohol) and declarative knowledge (the risks and potential consequences of consuming alcohol), and reflecting upon prior decisions (Ozer et al., 2020). INSPIRE has several in-game tools to support enhancing self-regulation and players are encouraged to make decisions aligned with their stated goals by stopping and thinking about how their choices may support these goals.

In INSPIRE, players adopt the role of a teenage protagonist who "relives" the events and decisions of a high-school get-together involving alcohol. Players interact with a cast of virtual characters who model various health behaviors. The outcomes for the protagonist, his/her friends, and the storyline are actively shaped by the player's decisions. Once adolescents leave the game and return to their life, it is hypothesized that having acquired knowledge of alcohol and practiced behavioral competencies in a simulated environment with peer pressure, they are better prepared to translate their behavior to make healthy choices around alcohol use in their life.

An essential step to promote learning and behavior change through digital technology tools is to engage adolescents in the intervention (Couper et al., 2010; Giovanelli et al., 2023). The INSPIRE game was iteratively developed with input from over 200 adolescents, including obtaining their perspectives on characters, dialog, and usability of game techniques. INSPIRE has been shown to foster engagement in a general population of adolescents (Ozer et al., 2020), but it has not been studied in youth with ADHD. The primary aim of this research is to examine the engagement of youth with ADHD in the INSPIRE game using both quantitative and qualitative methods. A secondary aim of this

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[2]^ Interactive narrative system for patient-individualized reflective exploration.

pilot study is to examine if the intervention supports adolescent communication with parents regarding alcohol use after the INSPIRE game.

Materials and methods

Study participants

This pilot study took place over 6 months (February to August 2022) with participants recruited from a large children's hospital in the Mid-Atlantic Region. The electronic health records for adolescents seen in the Division of Developmental and Behavioral Pediatrics and/or by physicians or psychologists in the Hospital's ADHD program were queried to identify patients who met the following eligibility criteria: (1) Age 14.5 to 16 years; and (2) visit diagnosis of ADHD (any subtype). As the study is focused on the engagement in INSPIRE of adolescents with ADHD, records were excluded if the child had a diagnosis of autism spectrum disorder, pervasive developmental disorder, or intellectual disability. Participants who were non-English speaking were also excluded. Parents were notified of the opportunity for youth to participate by email (if an email address was available) or regular mail. Recruitment occurred in 3 waves of emails/letters. Due to the under-recruitment of females in the first two waves, the third wave of recruitment only included females.

This study involving human participants was reviewed and approved by the Institutional Review Board (IRB) at the University of California San Francisco. The participants' parents provided their written informed consent, and participants provided assent to participate in this study.

Design

Families of eligible youth who received the recruitment letter or email were asked to contact the study team (MP) if the adolescent was interested in partnering with the study team to learn about developing an interactive computerized game for teenagers that focused on teenage health and wellbeing and particularly decreasing alcohol use. Parents and youth were informed that participation through Zoom would take approximately 1 hour and involved completing a pre-survey, interacting with the INSPIRE game, answering a post-survey, and then participating in a brief group discussion of four open-ended qualitative questions.[3] Two study team members (MP and SH) led participants in the Zoom focus group, guiding participants through the multiple methods of data collection, and utilizing PowerPoint slides to provide linkage to the pre-post surveys, the INSPIRE gaming platform, and qualitative questions. If during gameplay, an adolescent experienced a technical issue, the study research associate (SH) and the on-call study computer scientist and researcher (MB) would support the adolescent in troubleshooting and resolving the issue. Adolescents received a $25.00 gift card for their participation.

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[3].^ Three participants took the presurvey independent of gameplay due to technical issues and then played the game and completed the post-survey and brief discussion.

Intervention and data collection

INSPIRE enables youth to actively participate in unfolding storylines to enhance self-efficacy for navigating potentially risky social situations and self-regulation skills (Ozer et al., 2020). During the study, subjects played the INSPIRE game which also served as a data collection tool. As the participants play INSPIRE, detailed computer logs of in-game behaviors are time-stamped and recorded, called trace log data. Trace log data enable an understanding of how adolescents engaged with the game and enacted behavior change-related decisions (Ozer et al., 2020) by capturing the player's actions in the game. This granular view of in-game behaviors at the event level provides a window into participants' engagement.

Trace log data provides information on time spent playing the game, such as:

1.   Total time playing the game in minutes.

2.   Time spent choosing goals for the protagonist's behavior during the game. At the outset of the game, players select three goals for the evening (e.g., stay in control, have a chill night with friends, do not get in trouble) that apply to the events of the storyline and are intended to guide adolescent's decision making during problem-solving episodes in the unfolding storyline.

3.   Time spent engaging with "knowledge objects" in the game. There are three knowledge objects labeled: (1) "Cookies," which impart information about the comparative caloric value of cookies to alcohol; (2) "Guitar," which imparts information about the effects of alcohol on the teen brain; and (3) "Keys," which impart information about alcohol use and accidents.

Trace log data tracks the number of times a player clicks on knowledge objects and what goals the player chooses for the protagonist's goals for the evening. Trace log data also records whether the player decides to have the protagonist accept alcohol during the game.

Survey measures

The pre-game survey included: *How do you think your parents or caregivers feel about you drinking alcohol occasionally?* with three item options to choose from, 1. *Not disapprove*, 2. *Disapprove*, 3. *Strongly disapprove* (Miech et al., 2020). *How often do you have a discussion with your parent(s) or caregivers about alcohol use?* with five possible item answers, including *About once every few weeks*, *About once every few months*, *About once a year*, *Never have had a conversation with them about alcohol use*, and *Unsure* (Pugatch et al., 2021).

The post-game survey included:

•   Questions from the validated and reliable User Engagement Scale (UES) (O'Brien and Toms, 2010; Wiebe et al., 2014; O'Brien et al., 2018), including the satisfaction subscale with items reflecting involvement and novelty (O'Brien and Toms, 2010; O'Brien et al., 2018). Items adolescents were asked on satisfaction included *Playing the game was worthwhile* and *The gaming experience was fun*, measured on a five-point Likert scale with a 3 indicating

the game was satisfying. Satisfaction (5 items; α = 0.89). Adolescents were also asked questions from the Perceived Usability subscale of the UES with items reflecting cognitive and affective dimensions about ease of game use. Items adolescents were asked on usability included *I felt frustrated while playing the game* and, *The gaming experience was demanding*, measured on a five-point Likert scale with a 3 indicating the game was easy to use. Usability (7 items; α = 0.85).

- The following questions on character relatedness (Ozer et al., 2020):

  1. *How much was Max (the protagonist) like you?* on a three-point scale ranging from *Not at all like me* to *Very much like me*.

  2. *Please choose the approach that best describes how you selected the dialog choices that Max made while exploring the narrative* with discreet choices, including:

     I chose dialog for myself if I were in Max's situation.

     I chose dialog that I thought Max would choose, based on what I know about him.

     I chose dialog options that seemed most interesting to watch unfold.

- One item about information the adolescent would share with parents is, *Is there information learned from this game that you will discuss with a parent or caregiver?* with three answers *No*, *Some*, and *A lot*.

Focus group qualitative measures—Following gameplay and completion of the post-survey, the study team (MP and SH) led participants in qualitative data collection consisting of a brief discussion of four open-ended questions developed by INSPIRE study team members. Adolescents were reminded that the information shared was confidential and would be anonymized. Questions were designed to elicit feedback and understand what adolescents learned in the game that might contribute to the further development of the game as well as to provide important information about the secondary aim of the research study—what adolescents might share with a parent post-game play. Questions included:

- Share one experience from the INSPIRE game that you might like to share with others.

- Name one thing from INSPIRE game that a teen participant playing the game might share with a parent.

- Name one thing from the INSPIRE game that a teen participant playing the game might share with a friend.

The two study team members (MP, SH) recorded notes by hand. Post focus group, the study team members compared and reached a consensus for qualitative notes. Anonymized focus group notes and summary documents were compiled (SH).

Data analysis

Trace log data capturing students' time-stamped interactions were downloaded from the INSPIRE software. The data was cleaned, and a set of descriptive variables were distilled from the logs to enable an analysis of participant engagement with the game. Data were coded through R and transferred to and analyzed in Stata statistical software (Baum, 2006). Descriptive statistics were run, and alcohol risk prevention was modeled by looking at the relationships between survey data (reported alcohol use in real life, parent disapproval of alcohol) and acceptance of in-game alcohol. *T*-tests, Rank-sum tests, Kruskal–Wallis tests and Fisher's exact tests were used to examine bivariate relationships.

Qualitative data analysis involved two coders analyzing responses to open-ended questions posed to adolescent participants. Coding was grounded in a content analysis that reflected research questions, including respective codes for (1) engagement and (2) conversations with parents about alcohol. Other codes were mapped to social cognitive theory (e.g., vicarious learning, mastery, self-regulation, and self-efficacy). Coders individually reviewed transcripts, met to compare, discuss, and reach a consensus on identified codes, and then developed themes (Beebe, 2001).

Results

Characteristics of the study participants

Of 1,929 families sent emails or letters, 73 (about 4%) responded with interest. Of those who responded, 49 (67%) consented to play the INSPIRE game. Forty-six youth participated in 10 focus groups between February 2022 and August 2022. Forty adolescents (55%) age 14–16 years were included in the final analysis (Figure 1).

Of the adolescent participants ($n = 40$), 35% self-identified as female, and 45% self-identified as female sex at birth. The race-ethnicity of the participants included 17.5% African American or Black, 7.5% Hispanic or Latino, 62.5% White, and 12.5% of multiple race-ethnicities. More than half (62.5%) of the adolescent participants reported taking a prescription medication given by a doctor for their ADHD; of the adolescent participants who took medication, 68% reported that they took prescription medications for ADHD that day (Table 1).

Of the teens who participated in the study, 25% reported having *ever used alcohol*. This use did not vary by gender, age, or race-ethnicity. About 90% of adolescents with ADHD reported that their parents disapproved of occasional drinking.

Character relatedness

In the post-game survey, 70% of the adolescents reported that Max, the main protagonist in the game, was somewhat or very much like them. Eighty percent of adolescents with ADHD reported playing the game as themselves (*I chose dialog options I would have selected for myself if I were in Max's situation*).

Parent-teen communication

Pre-game, 65% of adolescents reported never communicating with their parents about alcohol or only speaking about alcohol with parents once a year. Post-game, 62.5% reported that they would share at least some information from the INSPIRE game with their parents.

Engagement

Engagement, measured by the self-report subscales of the User Engagement Scale, indicated that participants' mean usability, which assesses ease of use of the game, was 3.67 (SD = 0.74), and satisfaction was 3.63 (SD = 0.75) on a 5-point Likert scale. Usability and satisfaction did not differ by the age, sex, or race-ethnicity of the participants (Prob > | Z| = 0.2) for all non-parametric Rank-sum tests (Table 2).

Engagement, as measured by trace log data, includes the users' total time spent playing the game, choosing goals, making dialog choices, and both the time and number of clicks by users on knowledge items. Trace log data indicated adolescents (n = 39) completed playing the game in 24.3 [6.6] minutes.[4] The time it took adolescents with ADHD to complete the INSPIRE game did not differ by age, sex, or race-ethnicity, (Prob > | Z| = 0.7) for all non-parametric Rank-sum tests (Table 3).

Participants engaged with three knowledge objects (cookies, guitar, and keys). The participants clicked on the knowledge objects between 0 and 9 times with a mean of 3.8 (1.9) clicks.

Goals for the evening

At the outset of the game, adolescents with ADHD chose their top three goals for the evening. The top two were "Do not get in trouble" (50%) and "Have a chill night with friends" (45%). "Look out for your friends" and "Stay in control" (42.5%) were tied for the third most chosen goals for the evening. Goal selection time took between 5.3 and 82.4 seconds.

In-game alcohol use

Among these adolescents with ADHD, 22.5% made dialog choices to accept in-game alcohol use. Further, 50% of those teens who *ever drank alcohol* in real life accepted alcohol in the game compared to only 13.3% of those who *never* reported drinking alcohol in the real world (Fisher's exact p = 0.029).

The focus group qualitative questions yielded information that deepened our understanding of what adolescents with ADHD learned from INSPIRE, querying about what they might share with others, including friends and parents. Enhancing the quantitative survey item on discussions with parents, the open-ended questions provided additional insight into the content of what they would share with parents and how collaborative parent-teen communication may further foster the acquisition of key developmental competencies

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[4].^ When we examined the mean time to complete the game of 27.3 min (SD 9.0), with a range of 16.2–56.6 min, this included three outliers who took over 35 min to play the game with one missing data point.

(Table 4). Four themes were identified in the qualitative data, displayed in Table 4. First, adolescents discussed how the game facilitates parent-teen communication, particularly with regard to navigating social situations. A second theme was the adolescents' engagement in the game through their relatedness to the virtual characters, as demonstrated by the strength of their emotional affinity to the INSPIRE characters. Third, adolescents discussed vicarious learning in a virtual environment, commenting on how "real" their emotions felt, including anxiety when responding to the main protagonist experiencing peer pressure to drink alcohol. Fourth, adolescents' discussed building mastery in a virtual environment through experiences involving alcohol-risk situations.

Discussion

This paper describes a novel approach to alcohol risk prevention intervention that shows promise to fill a gap in the literature to mitigate the alcohol risk trajectory for adolescents with ADHD. INSPIRE was engaging for adolescents with ADHD, and their results were similar to those found in a general group of adolescents. Specifically, most teens with ADHD played the game and explored knowledge objects for a similar amount of time to adolescents in a general population. Further, as in a general population, most youth with ADHD chose to play the game as themselves (Ozer et al., 2020). User Engagement Scale results in youth with ADHD were similar to previous general adolescent study populations (mean usability 3.59: and mean satisfaction 3.55 and 3.57) (Ozer et al., 2020; Pugatch et al., 2022). Adolescents with ADHD selected similar goals for the evening as adolescents in the general population (e.g., were most likely to choose "Stay in control" and "Not get in trouble").

Post-INSPIRE gameplay, adolescents with ADHD were eager to talk with their parents about alcohol risk scenarios, a known protective factor for youth with ADHD (Harstad et al., 2020). Specifically, they expressed wanting to share knowledge and problem-solve about how to deal with peer pressure effectively and to develop skills in personal efficacy and regulation. Consistent with this qualitative data, survey data reinforced adolescents' desire to communicate with parents about alcohol risks post-game, as a majority of youth reported that they wanted to share information they learned in the game with their parents. Adolescents' inclination to discuss with parents what they observed in the game, as well as talk through strategies to refuse alcohol and watch out for friends, may facilitate and bolster known alcohol prevention protective factors (e.g., parental support, frequent communication regarding alcohol use, parental modeling) (Ryan et al., 2010; Reimuller et al., 2011; Cox et al., 2018).

Adolescent discussions in the focus groups post-game play suggest that adolescents were incorporating the central points of the intervention. Adolescents with ADHD may learn from the INSPIRE game how to navigate peer pressure with alcohol at a house party, including strengthening refusal skills and practicing setting goals and aligning behavioral choices with these goals.

Of interest, we found significantly different frequencies in game-based drinking behavior depending on past reported alcohol use. Specifically, adolescent participants with ADHD

who had *ever drunk* alcohol in real life were significantly more likely to choose to drink in-game alcohol than those adolescent participants with ADHD who never had drunk alcohol previously outside of the game. This pattern has not yet been examined in a general group of youth playing INSPIRE and would be useful to look at this population as well. In future work, with larger numbers of adolescents with ADHD, analyzing the in-game alcohol use choices of adolescents in real-time with computer log data and examining this subgroup's alcohol use behavior longitudinally in real life could be instructive. INSPIRE may provide a particularly high-risk group of teens the opportunity to learn to make different choices once they return to their lives.

In this pilot study, it was feasible to recruit the target population of youth with ADHD and technical challenges were mitigated. The youth found the intervention acceptable to play. Triangulation of the engagement subscales, trace log data, and qualitative data demonstrate a strong multidimensional measure of engagement. Another strength of this study is that almost half of the participants were female, an understudied group with ADHD (Hinshaw et al., 2022). We found no differences in engagement across youth characteristics, although due to the small sample size, we could not determine differences across all categories of race and ethnicity. In future work, it will be important to test INSPIRE with a larger, more diverse sample of youth across race, ethnicity, sex, gender, and socioeconomic status to establish equitable access to the most vulnerable adolescents with ADHD. There are many potential advantages to the INSPIRE approach regarding equitable dissemination through the digital online platform. Scalability in clinical preventive services has a broad reach with the potential to reach adolescents with public and private insurance and achieve population-level impact, as well as the flexibility to use across settings with diverse populations. Future research is needed to test if the INSPIRE game impacts adolescents' self-efficacy and real-life alcohol risk in adolescents with ADHD.

The present study has limitations, including that it is a pilot study examining the engagement of youth with ADHD using descriptive statistics and did not examine the impact of the intervention on alcohol use in real life. Further, it is comprised of a small sample focused on youth with ADHD in developmental medicine clinics in one children's hospital in the mid-Atlantic US region. Therefore, our findings may not apply to other types of settings or be representative of US youth with ADHD. The low response rate may reflect the broad email and mail recruitment method, suggesting that a more targeted personal approach might yield improved results. We did not receive any responses explicitly declining study participation. While the study encourages youth to share information about alcohol use with parents, specific parent-youth conversations about alcohol, including the frequency of these conversations over time, were not tracked. To further study if INSPIRE facilitates parent-youth conversations about alcohol use, it would be important to quantify and qualify conversations with parents post-game and explore parents' perceptions of parent-youth conversations about alcohol use pre and post-INSPIRE gameplay.

Conclusion

This pilot study of a strategically timed narrative-centered behavior change environment targets a key developmental period to reduce alcohol use among adolescents with ADHD.

The aims of this pilot are primarily to examine the engagement of adolescents with ADHD in INSPIRE and to examine the holistic eco-system of the adolescent. Findings demonstrate that adolescents with ADHD engaged with the game and were motivated to share information with their parents about alcohol-related risks. INSPIRE may provide a digital technology innovation to foster the critical developmental competencies and supportive ecosystems needed to mitigate risk across the life course for neurodivergent adolescents with ADHD. The application of INSPIRE presents a significant opportunity for researchers and providers to partner with adolescents with ADHD and their parents for health. INSPIRE warrants further testing with adolescents with ADHD to explore this narrative-centered game-based behavior change environment's effectiveness in both preventing and reducing alcohol use.

Acknowledgments

Data availability statement

The datasets presented in this article are not readily available because due to the nature of the study questions and age of the participants, data from this study will not be shared. Requests to access the datasets should be directed to MP mpugatch@luriechildrens.org.

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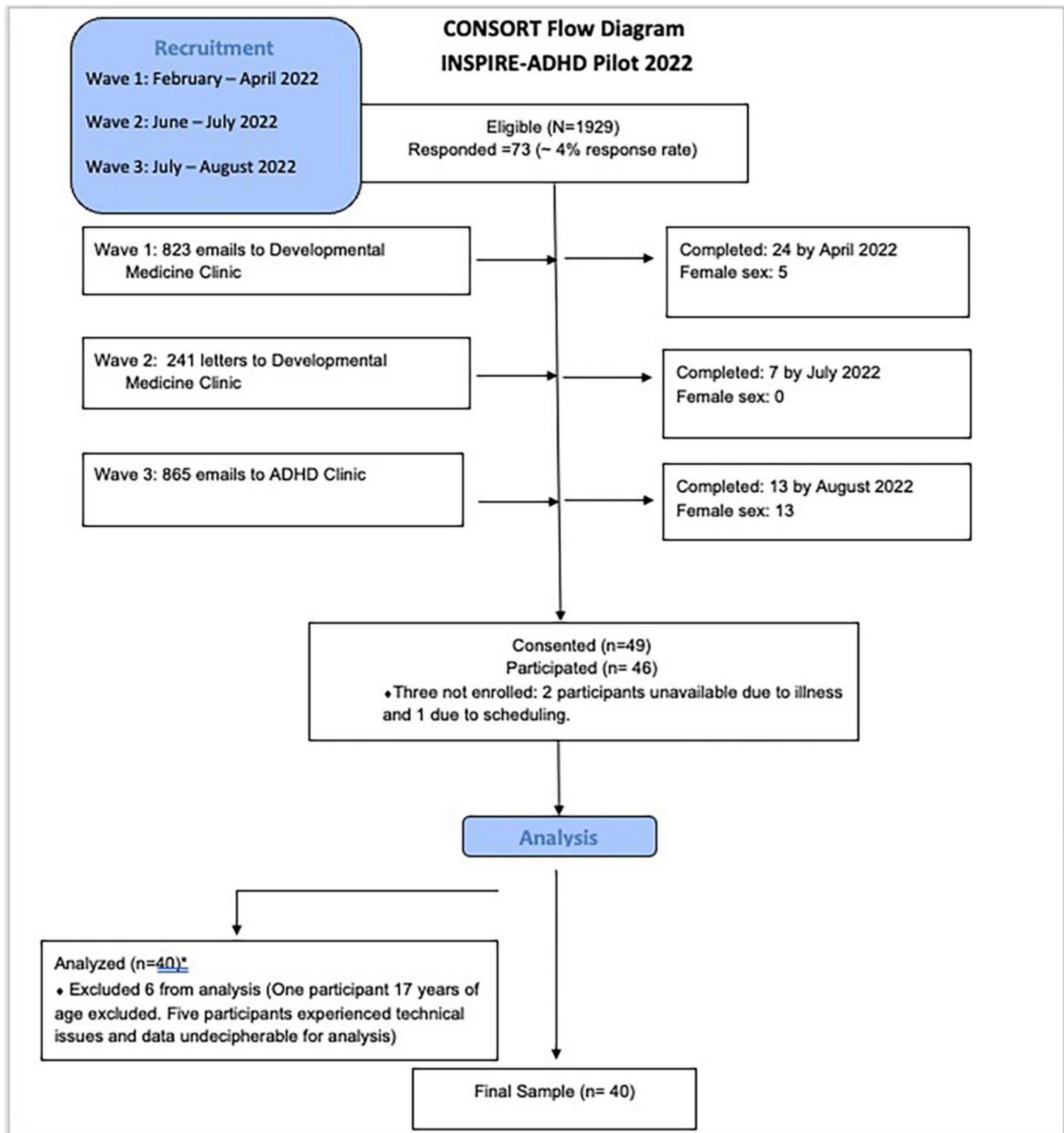
FIGURE 1.
Consort flow diagram for pilot study of INSPIRE in adolescents diagnosed with ADHD.

TABLE 1

Characteristics of adolescents with ADHD ($N = 40$).

Adolescent characteristics	Mean (SD) or %
Age	15.4 (0.59)
Gender	
Female	35.0
Male	52.5
Gender queer/gender non-conforming	12.5
Sex assigned at birth	
Female	45.0
Race or ethnicity	
Black or African American	17.5
Hispanic or Latino	7.50
White	62.5
Black or African American, White	2.5
Asian, White	5.0
Other	5.0
Education level	
At least completed college–Mother	77.5
At least completed college–Father	82.5
Medication use	
Participants taking ADHD prescriptions	62.5
Of those taking ADHD prescriptions, took that day	68.0
Alcohol use	
Ever used alcohol (yes)	25.0
Past 30 day alcohol use (yes)	15.0
Parent disapproval of occasional use	
Disapprove/strongly disapprove	90.0
Frequency of parent-teen communication	
Never or once a year	65.0

Means, standard deviations, or percentages for demographic characteristics and alcohol use for adolescents with ADHD participating across pilot tests.

TABLE 2

Survey results of engagement $N = 40$.

User Engagement Scale	Mean (SD) or %
Satisfaction subscale (least satisfied = 1, most satisfied = 5)	**3.63 (0.75)**
The content of the game incited my curiosity.	3.63 (1.00)
I continued to play this game out of curiosity.	3.70 (0.85)
Playing the game was worthwhile.	3.50 (0.85)
I felt interested in the game.[*]	3.69 (0.92)
This gaming experience was fun.	3.63 (0.87)
Perceived usability subscale (least user-friendly = 1, most user-friendly = 5)	**3.67 (0.74)**
I felt discouraged while playing the game.[*]	3.84 (0.93)
I felt annoyed while playing the game.[*]	3.66 (1.00)
Playing the game was mentally taxing.	3.83 (1.00)
I found the game confusing to use.[*]	3.13 (1.03)
I felt frustrated while playing the game.	3.80 (0.99)
I could not do some of the things I needed to do in the game.[*]	3.66 (1.22)
The gaming experience was demanding.[*]	3.87 (0.98)
Character relatedness	
Please indicate how much do you think Max is like you?	
Not at all like me	30.0%
Somewhat/very much like me	70.0%
Choose the approach that best describes how you selected choices that Max made	
I chose as if I were in Max's situation	80.0%

[*]
$n = 39$.

Percentages, means and standard deviations for INSPIRE engagement questions for adolescents with ADHD participating across pilot tests.

TABLE 3

Trace log data results of engagement ($N = 40$).

Dialog choices and time spent	Mean (SD) or %
Goals for the evening	
Resist peer pressure	25.0
Have a good party	32.5
Not get into trouble	50.0
Stay in control	42.5
Have a kickback with friends	25.0
Avoid alcohol	37.5
Look out for your friends	42.5
Have a chill night with friends	45.0
Total time played INSPIRE (minutes) [*]	24.0 [6.6]
Goals selection time (seconds)	28.5 (13.4)
Knowledge objects (seconds)	
Cookies	8.4 (9.6)
Guitar	8.0 (10.6)
Keys	3.8 (19.6)

[*] Median [IQR].

Percentages, means, and standard deviations for Adolescents with ADHD goal choice and knowledge object interactions across pilot tests.

TABLE 4

Qualitative results: engagement with inspire and information shared with a parent.

Theme	Illustrative quotes from adolescents
Having a conversation with a parents about navigating social situations with alcohol	"[I would ask my parent] if they can relate to it in any way. Whether any of the experiences in the game happened to them and how they would react to it..."
	"I might share [with a parent] like the different choices I could make and what I did and maybe what the outcomes were. So, like the goals for the night and the dialog options that supported what that goal was and like the different options."
	"I would probably talk to my mom... about... the safest way to navigate...this kinda situation and what she thinks about it in general."
Engagement in game–character relatedness	"I think it's a really great game. . . If you're going to teach it to the young generation it would be a good way to teach about how to not give into peer pressure. I can tell this is mainly about alcohol and alcoholism and how to stay strong with your friends and stuff. If this is what it's for I think it's so far so good. Pretty good."
	"I would share with my friend like my emotional connection with some of the characters. Like I was just always pissed at Nicki because every time she came up I knew she wasn't going to be up to something good."
Vicarious learning–navigating social situations with alcohol	"If my friend talked to me about being peer pressured... I would use the little stuff I learned from the game to influence my decision on how to comfort them..."
	"It was interesting like how real it felt with peer pressure because usually in games there isn't really pushback when you tell them you don't want to do that but in this game the girl was like really trying to get you to do something you didn't want to do and it was interesting."
	"In one of the scenes between the main character and his friends when they were trying to pressure [Max] into drinking alcohol, even though it's a very textbook peer pressure type of scene, it felt like different to be playing it in a game where you could answer the questions how I would answer them and so I felt very attached. . . so it kind of felt like I was in it and I did actually feel some anxiety from it and after the things was done I felt more confident about you know peer pressuring"
Building mastery–building self-efficacy and practicing self-regulation in social situations with alcohol	"I might share [with a parent] like the different choices I could make and what I did and maybe what the outcomes were. So like the goals for the night and the dialog options that supported what that goal was and like the different options."
	"I felt like the game kinda taught me that there's always more than one option. Like it's not just 'no I don't want alcohol' or 'yeah I want the alcohol' and you can say 'eh I'll pass' or 'I don't think we should be doing that'. . . But it kind of gave different words. There's more than just the no option"
	"I like how you could choose your goals for the night and what you wanted the character to do because it kinda showed how when you were making decisions throughout the night you could still pick things and you could still like have a fun time while staying in control of yourself and making smart and safe decisions."