



Feasibility and Acceptability of an Internet-Based Intervention for Young Adults with ADHD

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Received: 18 October 2021 / Revised: 29 March 2022 / Accepted: 8 April 2022 / Published online: 17 May 2022
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Abstract

Internet-based interventions (IBIs) to treat psychological disorders are available, but accessibility to these to treat attention-deficit/hyperactivity disorder (ADHD) in young adult populations is quite limited. The current study examined the feasibility of a proposed IBI for ADHD and participant perceptions regarding treatment *acceptability* and *credibility*, and outcome *expectancy*. Participants ($N = 235$; aged 18–35) with a prior ADHD diagnosis were recruited through Amazon’s Mechanical Turk (MTurk) and were provided with a proposed IBI and explanatory outlines of treatment module content. Participants in the cross-sectional study were randomly assigned to either a tailored (i.e., targeted content modules), minimal (i.e., presented overall fewer and non-targeted modules), or full (i.e., all possible modules) condition. Results demonstrated moderate IBI acceptability among participants in the tailored and full conditions. The majority of participants preferred IBI over face-to-face (F2F) treatment, and most individuals who preferred F2F treatment also considered an IBI to be an acceptable treatment modality. Lack of significant mean differences between the tailored and full conditions on several of the main outcomes of interest (e.g., perceptions of acceptability) suggests that implementation of either method of treatment could prove effective. Differences based on treatment length and relevance, and biological sex were also explored. Implications, limitations, and future directions are discussed.

Keywords ADHD · Young adults · Internet-based intervention · Digital mental health · Algorithmic content tailoring

Attention-deficit/hyperactivity disorder (ADHD) is characterized by elevated inattention, hyperactivity, and disinhibition (American Psychiatric Association, 2013). The prevalence rate of ADHD in adults is estimated to be 2.5% (American Psychiatric Association, 2013), and this population experiences significant functional impairment (Barkley, 2015; Holst & Thorell, 2020). Subpopulations of adults with ADHD, such as those in college, also face specific challenges across a range of domains (e.g., academic achievement, social adjustment, psychological distress; DuPaul et al., 2009; Shaw-Zirt et al., 2005). While both in-person, psychosocial interventions and pharmacological

treatment have been shown to ameliorate ADHD and its impairments, it is as yet not well-established whether internet-based psychosocial interventions are helpful, or even desirable from a client perspective.

Internet-Based Interventions (IBIs)

IBIs and other digital forms of health interventions (e.g., interventions completed on offline computers) have existed and have been studied for decades (Andersson, 2018). IBIs are described as “treatments that are mainly delivered via the Internet with at least some therapeutic tasks delegated to the computer” (Andersson & Titov, 2014, p. 4). An IBI can be either guided via clinician interaction (e.g., face-to-face [F2F] contact, phone, email, or through the IBI interface), or unguided, with no client–clinician interaction at all. Moreover, IBIs offer many advantages to help address barriers to mental health treatment, such as access to care (Torous et al., 2019).

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A range of IBIs currently exist to treat health concerns, such as alcohol or tobacco cessation, physical health, weight loss, chronic diseases, and mental health (Andersson, 2018; Hou et al., 2014). Across a wide range of psychological and non-psychological domains, IBIs have proven to be cost-effective (e.g., Hedman et al., 2014) as well as clinically efficacious and effective (Barak et al., 2008; Carlbring et al., 2018), and are so whether they are guided or unguided (Andersson & Titov, 2014). Further, in recent years, there has been an increase in consumer demand for digital interventions, stemming in part from the COVID-19 pandemic. Yet the increase in demand is not expected to completely dissipate post-pandemic (Ben-Zeev, 2020).

Tailored vs. Untailored IBIs

Mental health interventions are increasingly providing more personalized treatments to clients (Ng & Weisz, 2015) to increase acceptability and improve treatment outcome (Titov et al., 2010). IBIs can also be modified to best suit the needs of each individual client (for a review see Lustria et al., 2009). The ability to tailor an IBI to best suit the needs of each client would also help to reduce exclusionary criteria that would otherwise be typical within a traditional one size fits all approach to therapy (Nordgren et al., 2014). Moreover, research demonstrates that specific factors related to tailoring, such as *personal relevance*, *content novelty* (e.g., the degree to which the material is original and new to the client), and *information architecture* (e.g., giving clients a choice of treatment components), can positively affect acceptability, credibility, and use of an IBI (Danaher & Seeley, 2009; Oenema et al., 2001).

IBIs for Adults with ADHD

A review of the literature found one open-trial (Nordby et al., 2021) and two randomized controlled trials evaluating the effectiveness of two IBIs for adults with ADHD (Moëll et al., 2014; Pettersson et al., 2014). Moëll et al. (2014) examined the effectiveness of LivingSMART, a guided, CBT-based IBI (iCBT) for adults with ADHD (community sample; $N = 57$; M age = 36.3 years, $SD = 11.1$). LivingSMART directs individuals to use smartphones to increase their attention and organization, time management, and planning (OTMP) skills, and consists of seven modules (e.g., specific subsets of the treatment that each focuses on a particular topic), each associated with specific applications (e.g., Google Calendar, Stayfocused). As rated by blind assessors, only participants in the experimental condition demonstrated clinically significant change. When examining self-reported change, participants reported LivingSMART was more effective at reducing inattention symptoms

($d = 1.21$), hyperactivity/impulsivity symptoms ($d = 0.19$), and functional impairment ($d = 0.33$) in the ADHD group when compared to the waitlist control group. Moëll et al. (2014) concluded that the IBI should not be a stand-alone treatment—as symptom severity did not decrease below the clinical threshold for ADHD—but bears use in conjunction with F2F treatment.

The second IBI for adults with ADHD (M age = 38.92 years, $SD = 8.50$), who reported being on a stable medication regime, was also based on an iCBT framework (Pettersson et al., 2014). Two versions of this intervention were tested against a waitlist control: one that was unguided, and another that was guided (i.e., met weekly for F2F group meetings in addition to completing the IBI). In total, the IBI consisted of 10 modules, including: cognitive and behavioral strategies; OTMP, and problem solving; decreasing distractions; and mindfulness. Surprisingly, only the unguided condition resulted in significant reductions in self-reported ADHD symptoms compared with the waitlist control condition ($d = 1.07$). Moreover, when participants who changed medications mid-study (i.e., and thus were no longer on a stable medication regime) were removed from the analyses, this effect increased ($d = 1.40$). Those reductions were maintained at a 6-month follow-up. Pettersson et al. (2014) offered several hypotheses for why the guided condition seemed to have no substantive effects. One was that simply being in the group and talking with other participants, in particular about non-treatment-related issues, may have become a primary focus, resulting in less attention to the actual iCBT. They also suggested that guided participants may not have devoted enough time to skill practice outside of the group sessions, assuming that attendance was sufficient. Thus, unguided participation, for these adults, may have spurred more focused use of self-monitoring, self-assessing, and self-reinforcement. The authors do note the small sample size and encourage these results to be seen as preliminary evidence for the effectiveness of an Internet-based intervention for an ADHD population.

Although there are IBIs for a number of mental health problems, there are currently none published that target ADHD in young adults. An IBI for young adults with ADHD could help to fill an expanding gap between intervention needs and treatment availability in this population. Unfortunately, there is no direct evidence examining the association between acceptability, treatment credibility (i.e., logical, cognitive beliefs regarding treatment outcome), outcome expectancy (i.e., affective beliefs regarding treatment outcome), and the effectiveness of an algorithmically tailored IBI for young adults with ADHD. Acceptability should be considered essential because of the impact it likely has on both implementation and dissemination of IBI research (Danaher & Seeley, 2009; Gun et al., 2011). Therefore, as recommended by the Medical Research Council's framework for developing complex interventions (Craig

et al., 2008), prior to creating a full-scale IBI, researchers should first examine the acceptability and feasibility of this approach in young adults with ADHD. Following this, studies should test a number of the recommended components to examine what combination of components is most effective and acceptable with the target population. This all precedes large-scale open-label or experimental trials, steps that in implementation science ultimately establish any intervention's eventual efficacy and effectiveness.

The Current Study

The purpose of this study was to evaluate the *social validity* (e.g., acceptability), perceived *credibility*, *expectancy*, and *personalization* impact of a proposed IBI for young adults with ADHD. The proposed IBI used a personalized approach; treatment content was algorithmically tailored to each individual based on an Internet-based assessment of their ADHD symptoms and related impairment. Hypotheses include:

Hypothesis 1. A significant majority of participants will choose an IBI as the preferred treatment method rather than F2F treatment.

Hypothesis 2. Among participants who initially prefer F2F treatment, a significant majority will still consider IBI treatment acceptable.

Hypothesis 3. Among participants who initially prefer an IBI treatment, a significant majority will prefer unguided over guided.

Hypothesis 4. The tailored condition will be associated with more positive perceptions of the IBI (i.e., *treatment acceptability* and *credibility*, *outcome expectancy*, and *treatment relevance*) than the full condition.

Given that this research examined the feasibility of using an algorithm to tailor treatment content, exploratory analyses were conducted to test for possible treatment length effects that might explain any differences found between the tailored and full condition. Additionally, other exploratory analyses examined potential biological sex differences, and differences among a college specific population of young adults with ADHD.

Method

Participants

Participants were recruited through Amazon's Mechanical Turk (MTurk; <https://www.mturk.com>) and were all located

in the USA. Power analysis was conducted for a medium-sized effect, an alpha of 0.05, and 80% power; results indicated that a sample size of $N = 156$ or $n = 52$ per condition was needed. To account for possible data loss during screening as well as participant drop-out, which in MTurk populations may be close to 10% (Paolacci et al., 2010), recruitment targets were increased by 21% to $N = 189$ ($n = 63$ per condition).

To identify participants who met the inclusionary criteria, MTurk participants ($N = 8,678$), aged 18 to 80 ($M = 34.74$, $SD = 11.41$) and 61.8% biological female, completed a short pre-screen survey and were compensated \$0.15 for their time. MTurk participants who completed the actual study were compensated \$1.00 for their time.

The final non-clinical sample was composed of adults from our screener sample ($N = 235$), almost evenly split by sex (54.9% biological females), aged 18 to 35 ($M = 27.54$, $SD = 4.29$), with some diversity in racial identification (76.2% White, 6.8% Multiracial, 6.0% Black, 5.1% Asian, 3.4% Hispanic/Latino, 2.5% Other). Participants resided across all regions of the USA (West 16.7%, Midwest 22.6%, Southwest 10.7%, Northeast 23.1%, Southeast 26.9%). Almost two-thirds (62%) of the sample reported completion of a college degree, with the remainder reporting a high school degree. Participants also self-reported psychological symptoms and ADHD diagnosis and treatment history (see Table 1). Participants in the sample were randomly assigned to one of three possible IBI conditions, which differ in composition of modules to examine possible effects of tailoring and treatment length (see Procedure, below).

Measures

Demographics

This was a survey with 18 items tapping age, biological sex, race, education, and ADHD diagnostic history.

ADHD Diagnostic Screening Measures

BAARS-IV (Self-Report: Current Symptoms) The BAARS-IV (Barkley, 2011; 30 items) is a self-report measuring inattention (IA; 9 items) and hyperactivity/impulsivity (HI; 9 items) and related impairment in adults. It was included to help characterize the sample, validating that in general the participants are people who experience statistically elevated levels of ADHD symptoms. Items were based on ADHD symptom criteria in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; DSM-IV-TR; American Psychiatric Association, 2000) and were on a four-point Likert scale (1 = *Never or rarely*, 4 = *Very often*) indicating frequency in the past 6 months. An additional multi-part

Table 1 Descriptive statistics by condition for IVs, outcomes, clinical characteristics, and demographics

	Minimal (<i>n</i> = 68)	Full (<i>n</i> = 68)	Tailored (<i>n</i> = 99)
Independent variable			
Modules received [1.0.7]	1.29 (0.93)	7.00 (0.00)	4.65 (2.09)
Outcomes			
IBI acceptability [1.0.5]	3.18 (1.09)	3.46 (1.10)	3.63 (0.94)
Credibility [3.0.27]	16.63 (5.86)	17.01 (5.65)	18.17 (5.03)
Expectancy [3.0.27]	12.99 (5.63)	13.93 (4.76)	14.48 (4.98)
Treatment relevance [1.0.5]	3.13 (0.96)	3.43 (1.01)	3.72 (1.00)
Clinical/socio/demographics			
Age	26.72 (4.48)	27.75 (3.94)	27.97 (4.36)
ADHD HI symptoms [0.0.7]	4.32 (2.42)	4.60 (2.53)	4.95 (2.53)
ADHD IA symptoms [0.0.7]	5.56 (2.40)	5.88 (1.86)	6.05 (2.31)
ADHD impairment sum [0.0.4]	3.03 (1.01)	3.06 (1.06)	3.21 (1.02)
ADHD age of diagnosis	16.15 (7.22)	16.04 (7.75)	16.20 (7.90)
WFIRS total score [0.0.3]	1.26 (0.47)	1.16 (0.49)	1.27 (0.53)
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Male	31 (45.6)	33 (48.5)	42 (42.4)
ADHD diagnosis	68 (100)	68 (100)	99 (100)
Presentation type			
Inattentive presentation	19 (27.9)	23 (33.8)	31 (31.3)
Hyperactive-impulsive presentation	9 (13.2)	10 (14.7)	11 (11.1)
Combined presentation	9 (13.2)	17 (25.0)	18 (18.2)
Don't know	31 (45.6)	18 (26.5)	39 (39.4)
ADHD treatment history			
Current medication	20 (29.4)	22 (32.4)	38 (38.4)
Prior medication	50 (73.5)	50 (73.5)	79 (79.8)
Non-medication	22 (32.4)	17 (25.0)	25 (25.3)

Score ranges of each measure are included in the brackets next to the measure; *ADHD diagnosis* Endorsed a prior ADHD diagnosis, *ADHD Current, Prior, and Non-medication* Endorsed the respective treatment or treatment history, *ADHD Impairment sum* Number of impairment domains endorsed on the BAARS-IV

question assessed areas of impairment resulting from ADHD symptoms. Symptom counts for inattention and hyperactivity/impulsivity were determined by summing the items rated 3 (*Often*) or 4 (*Very often*). For reference, adults are likely to meet criteria for ADHD if they endorse five or more symptoms in either inattention or hyperactivity/impulsivity. In this study, the internal consistency of the BAARS-IV was satisfactory (i.e., $\alpha = 0.79$ for IA; $\alpha = 0.82$ for HI).

Weiss Functional Impairment Rating Scale (WFIRS)

The WFIRS (Weiss, 2000) is a 70-item self-report designed for use with adults with ADHD, indexing functional impairment across family, work, school, life skills, self-concept, social, and risk domains. It was included to verify that the included sample experienced the kind of broad impairment that those with ADHD commonly experience. Items were answered on a four-point Likert scale ranging from 0 (*Never or Not at All*) to 3 (*Very Often* or *Very Much*), as well as an option of *Not Applicable*. Summary mean scores are reported (see Table 2); for reference, a score of 1 indicates

sometimes experiencing impairment across *all* domains and is considered a clinically elevated score. Internal consistency of WFIRS domains was good ($\alpha = 0.84$ to 0.96).

Treatment Feasibility Measures

The Treatment Credibility and Expectancy Scale (CEQ) The CEQ (Deville & Borkovec, 2000) is a widely used 6-item measure that assesses two areas related to treatment outcome beliefs: credibility and expected efficacy. Originally developed to measure credibility and expectancy based on treatment for trauma, the CEQ was adapted for this research by replacing references to “trauma” with “ADHD symptoms.”

Set I of the CEQ contained four treatment credibility items (e.g., “At this point, how successful do you think this treatment will be in reducing your ADHD symptoms?”). Set II measures outcome expectancy beliefs regarding the treatment outcome (e.g., “At this point, how much do you really *feel* that this treatment will help you to reduce your ADHD symptoms?”). The CEQ contains items that have two different Likert scales: an 11-point percentage scale

Table 2 Treatment modules shown to tailored and minimal conditions based on associated WFIRS item impairment

Treatment module	Module mean scores computed across the following WFIRS items	Module shown if module mean was:
Module 1: Psychoeducation	All conditions receive this module	All conditions receive this module
Module 2: Organization, time management, and planning skills	Based on 20 WFIR items Life: 3, 10–12 School: 2–3, 6–11 Work: 1–2, 5, 7–11	Tailored condition: $M \geq 0.91$ Minimal condition: $M \leq 0.27$
Module 3: Study skills and learning strategies	Based on 6 WFIR items School: 1–3, 6, 10–11	Tailored condition: $M \geq 1.45$ Minimal condition: $M \leq 0.43$
Module 4: Life skills	Based on 5 WFIR items Family: 6 Life: 2, 10–12	Tailored condition: $M \geq 1.11$ Minimal condition: $M \leq 0.31$
Module 5: Healthy lifestyles	Based on 15 WFIR items Life: 1, 4–9 Risk: 1, 2, 7–12	Tailored condition: $M \geq 1.14$ Minimal condition: $M \leq 0.42$
Module 6: Cognitive strategies	Based on 16 WFIR items Family: 4, 8 School: 10 Self-concept: 1–5 Social: 1, 8 Risk: 1, 3–4, 13–14	Tailored condition: $M \geq 1.24$ Minimal condition: $M \leq 0.44$
Module 7: Successful relationships	Based on 19 WFIR items Family: 1–5, 7–8 School: 4–5 Social: 1–4, 6–9 Work: 3, 6	Tailored condition: $M \geq 0.82$ Minimal condition: $M \leq 0.24$

Modules refer to specific subsets of the treatment program, each of which focuses on a particular topic or theme

(“0%” to “100%”) and a nine-point scale ranging from 1 (*not at all [logical, useful, or confident]*) to 9 (*very [logical, useful, confident, or much]*). The two 11-point percentage scale items were recoded to standardize the response format across the two subscales (Nock et al., 2007). Cronbach’s alpha values for credibility (0.87) and expectancy (0.85) in this study demonstrated good internal consistency.

Single-Item Measures Four single-item questions measured (a) treatment acceptability (b) treatment preference, and (c) perceived customization of the IBI treatment. Single-item measures can be used to gauge many factors reliably such as preferences, attitudes, satisfaction, and readiness to change (Bergkvist & Rossiter, 2007; Youngblut & Casper, 1993).

Treatment Acceptability To gauge the acceptability among participants for participating in either F2F treatment or IBIs, two single-item measures were created for this research: “How acceptable is an (in-person treatment [OR] Internet-based treatment) for ADHD for you personally?” Participants provided responses on a five-point Likert scale ranging from *Not at all acceptable* to *Extremely acceptable*. For the current analyses, the treatment acceptability scale was recoded into a dichotomized variable (*Acceptable* [i.e., moderately acceptable or higher; responses 3 thru 5] and *Not Acceptable* [i.e., not at all acceptable; response 1]).

Treatment Preference Treatment preference was assessed through either one or two forced choice questions. The first was “If you were to seek treatment for ADHD, would you prefer an in-person based treatment or an Internet-based treatment?” If participants chose an Internet-based treatment they were also asked, “Which type of Internet-based treatment would you prefer?” with two response options (a) *Guided (some contact with a therapist through either face-to-face contact, phone, email, or through the Internet-based treatment program)* or (b) *Unguided (no contact with a therapist)*.

Treatment Relevance To examine whether tailored content modules were personally relevant to participants, a single-item measure was created for this research: “How relevant were the customized treatment modules to your experienced difficulties in life?” Responses were provided on a five-point Likert scale ranging from *Not at all relevant* to *Extremely relevant*.

Procedure

This study was reviewed and approved by the institutional review board at the second author’s institution. Participants provided informed consent via MTurk for the initial survey,

a broad-based screener for the follow-up (main) study; the screener included a measure to assess for ADHD symptomatology (i.e., BAARS-IV) and seven demographic questions. Inclusion criteria for participation in this study included: (a) aged 18 to 35, (b) endorsed a prior ADHD diagnosis, (c) endorsed five or more current symptoms of either inattention or hyperactivity/impulsivity, (d) endorsed one or more areas of current impairment related to ADHD, and (e) not in any current, non-medication-based treatment for ADHD.

Following informed consent for the main study, eligible participants completed a measure of functional impairment (i.e., WFIRS) and answered several additional demographic questions. Next, participants were randomly assigned by Qualtrics to one of three conditions (i.e., tailored, minimal, or full). Participants were provided information regarding ADHD and an informational paragraph describing their assigned proposed IBI for ADHD. The descriptive module material was designed to help ensure that participants had a clear understanding of what constituted an IBI and how an IBI is different from a static website. This included an informational video with closed captioning and detailed outlines of the content of each treatment module (please see the supplemental text and video resources provided online).

Participants were also shown module outlines that differed across conditions. The modules were drawn from a treatment program designed for young adults with ADHD (Canu et al., 2021). The algorithm used to assign specific IBI modules to participants in the tailored and minimal conditions was based on a nuanced analysis of participant item-level responses to the WFIRS. We consulted with colleagues in the field of ADHD (i.e., doctoral level psychologists with a research focus on ADHD and extensive experience in leading related investigations) to determine, based on expert consensus, which items on the WFIRS related best to the content covered in specific modules of the IBI. As a result, the algorithm only analyzed participant responses to individual items that were unambiguously relevant to specific modules of the IBI, based on agreement between at least 5 of the 7 experts in the field.

Participants in the tailored condition were shown a proposed treatment consisting of Module 1 (i.e., psychoeducation) and any other treatment modules that corresponded to areas of self-reported impairment (assessed via WFIRS items; see Table 2). Participants in the minimal condition were shown modules that corresponded to areas of non-impairment, as assessed using means across the same items in each module as participants in the tailored condition (see Table 2).

Subsequent to providing participants with the proposed IBI, all participants completed a measure assessing anticipated treatment credibility and outcome expectancy (i.e., CEQ). Finally, participants were asked about treatment acceptability and preference, as well as treatment relevance,

related to the possible treatment they were assigned to. Finally, a debriefing statement informed participants more about the research and provided links to lists of ADHD treatment centers and clinical practitioners in the USA (<http://www.help4adhd.org/treatment/prof/centers>; <http://locator.apa.org/>).

Analytic Approach

Initial screening found no cases of missing data on outcomes of interest, incorrect attention check responses, nor duplicate data or participants were identified. However, three participants were removed from the dataset after assessing for univariate outliers and multivariate outliers. The final dataset ($N=235$) approached normality across all composite and outcome of interest variables (e.g., skew ≤ 1.03 ; kurtosis ≤ 1.98 ; Levene's test $ps > 0.05$).

A series of analyses were performed on demographic and experimental variables to determine if there were any differences across conditions (see Table 1). The results of a one-way analysis of variance (ANOVA) revealed significant differences in the level of anxiety across conditions $F(2,232)=4.19$, $p=0.016$. Tukey's post hoc analyses indicated that individuals in the tailored condition ($M=5.63$, $SD=1.76$) endorsed higher levels of anxiety than those in the full condition ($M=4.82$, $SD=1.74$). There were no other significant differences across conditions ($ps > 0.05$).

Results

Hypothesis 1 (i.e., a significant majority of participants will choose an IBI as the preferred treatment method rather than F2F treatment). The results of a single proportion z -test examining IBI preference revealed that 59% of participants preferred IBI over F2F treatment (95% CIs [0.52, 0.65], $z=2.61$, $p=0.009$).

Hypothesis 2 (i.e., among participants who initially prefer F2F treatment, a significant majority will still consider IBI treatment acceptable). The results of a single proportion z -test using the treatment acceptability item demonstrated that among those who initially preferred F2F treatment, 91% participants endorsed that an IBI would be Acceptable rather than Not Acceptable (95% CIs [0.84, 0.97], $z=6.86$, $p < 0.001$).

Hypothesis 3 (i.e., among participants who initially prefer an IBI treatment, a significant majority will prefer unguided over guided). Next, among participants who initially chose an IBI over F2F treatment for ADHD, the result of a single proportion z -test examining type of IBI revealed that 73%

(95% CIs [0.66, 0.81]) preferred a guided over unguided IBI for the treatment of ADHD, $z = 5.36$, $p < 0.001$.

Hypothesis 4 (i.e., the tailored condition will be associated with more positive perceptions of the IBI [i.e., *treatment acceptability* and *credibility*, *outcome expectancy*, and *treatment relevance*] than the full condition). A series of independent sample *t* tests were run to examine mean differences between the tailored and full conditions on the outcomes of interest (i.e., IBI acceptability, treatment credibility, outcome expectancy, and perceived treatment relevance). None of the comparisons were significant at an alpha level < 0.05 , though two of the comparisons evidenced small effects: treatment credibility ($g = 0.22$, $p = 0.167$) and treatment relevance ($g = 0.29$, $p = 0.068$; see Table 3 for test statistics and effect sizes).

Exploratory Analyses

Treatment Length and Relevance

To determine whether shorter proposed treatment length (i.e., number of modules shown to participants) was associated with significant increases in outcome scores in the tailored condition, a series of independent sample *t* tests examined mean group differences between the tailored and minimal conditions on the outcomes of interest. Participants in the tailored condition reported significantly higher IBI acceptability than participants in the minimal condition, $t(165) = 2.84$, $p = 0.005$, Hedges' $g = 0.45$, 95% CIs [0.29, 0.60], difference of means = 0.45, 95% CIs [0.14, 0.76], a small to medium effect size (approaching 0.50). In addition, there was a significant difference in treatment relevance, such that participants in the tailored condition reported the proposed IBI was significantly more relevant to their individual needs than participants in the minimal condition,

Table 4 Bivariate correlations among outcome variables, treatment relevance, and length ($N = 235$)

Bivariate associations	1	2	3	4	5
1. IBI acceptability	–				
2. Credibility	0.542**	–			
3. Expectancy	0.450**	0.723**	–		
4. Treatment relevance	0.495**	0.538**	0.513**	–	
5. Treatment length	0.125	0.043	0.138**	0.154*	–

Treatment length = the number of modules shown to participants; *r*s of 0.1, 0.3, and 0.5 represent small, medium, and large effect sizes, respectively (Cohen, 1992)

* $p < 0.05$; ** $p < 0.01$

$t(165) = 3.77$, $p < 0.001$, Hedges' $g = 0.60$, 95% CIs [0.45, 0.75], difference of means = 0.59, 95% CIs [0.28, 0.89]. None of the remaining comparisons were significantly different ($ps > 0.05$), but each evidenced a small effect size in the expected directions ($gs > 0.2$; Cohen, 1992).

Bivariate correlations (Table 4) were computed to examine the association of treatment length and relevance with outcome variables. Treatment length demonstrated statistically significant but small associations with both treatment expectancy ($r = 0.138$, $p < 0.05$) and treatment relevance ($r = 0.154$, $p < 0.01$). There was no significant relation between treatment length and either IBI acceptability or credibility. Treatment relevance demonstrated significant and large, positive associations with all of the outcome variables (IBI acceptability, credibility, expectancy; *r*s ranging from 0.50 to 0.54, $ps < 0.01$).

Biological Sex

A series of chi-square tests of independence were conducted to examine the role of biological sex on dichotomous outcome variables (i.e., preference for IBI or F2F treatment for

Table 3 Comparison of outcomes by condition

Analysis of group difference	<i>t</i>	<i>p</i>	Mean difference 95% CIs	<i>g</i> 95% CIs
Tailored and full conditions				
IBI acceptability	1.07	0.285	0.17 [−0.14, 0.48]	0.17 [0.02, 0.32]
Credibility	1.39	0.167	1.16 [−0.49, 2.80]	0.22 [−0.59, 1.02]
Expectancy	0.73	0.470	0.56 [−0.96, 2.08]	0.11 [−0.63, 0.86]
Treatment relevance	1.84	0.068	0.29 [−0.02, 0.60]	0.29 [0.14, 0.44]
Tailored and minimal conditions				
IBI acceptability	2.84	0.005	0.45 [0.14, 0.76]	0.45 [0.29, 0.60]
Credibility	1.82	0.071	1.54 [−0.13, 3.21]	0.29 [−0.53, 1.10]
Expectancy	1.81	0.072	1.50 [−0.13, 3.13]	0.28 [−0.51, 1.08]
Treatment relevance	3.77	< 0.001	0.59 [0.28, 0.89]	0.60 [0.45, 0.75]

Hedges' unbiased *g* (Hedges, 1981) were calculated as a means of providing effect sizes (*g*s of 0.2, 0.5, and 0.8 represent small, medium, and large effect sizes, respectively; Cohen, 1992)

ADHD, IBI acceptability, and preference for a guided or unguided IBI) collapsed across the tailored and full conditions. The results revealed a significant relation between biological sex and treatment preference (i.e., IBI or F2F), $\chi^2(1, N = 167) = 7.81, p = 0.005, r = 0.22$, a small effect. Women were thereby somewhat more likely to prefer an IBI, whereas men were more likely to prefer a F2F treatment. There were no significant effects for any of the other dichotomous outcome variables ($p > 0.05$).

Similarly, a series of independent sample t tests were conducted to examine the role of biological sex on continuous outcome variables (i.e., IBI acceptability and credibility, outcome expectancy, and treatment relevance), collapsed across the tailored and full conditions. The results demonstrated only one significant difference, for credibility, $t(165) = -3.02, p = 0.003$, Hedges' $g = 0.47$, 95% CIs $[-0.32, 1.25]$, difference of means $= -2.43$, 95% CIs $[-4.02, -0.84]$, a small-to-medium effect. Specifically, women reported higher levels of credibility. None of the remaining outcome variables demonstrated significant differences by biological sex.

College Students

Treatment preferences (i.e., IBI or F2F) among a subsample, composed exclusively of college students were evaluated. The results of a single proportion z -test revealed no statistically significant difference between preference for either an IBI or F2F ADHD treatment among college students, $z = 0.32, p > 0.05$. Measures of central tendency regarding IBI acceptability demonstrated that a majority of this subsample considered an IBI to be at least *moderately acceptable* ($M = 3.42, SD = 1.00, Mdn = 3.00$).

Discussion

This study evaluated whether an IBI is feasible and acceptable for the treatment of ADHD in young adults and whether personalizing or tailoring is warranted in this population. The results of the study confirmed several hypotheses. First, the results suggest that overall, these young adult participants were slightly more likely to choose an IBI than a F2F treatment for ADHD. Second, IBI acceptability among those who initially preferred F2F treatment was still high. In fact, means of IBI acceptability across all conditions were above moderate acceptability. It is possible that ratings of IBI acceptability could increase further as future studies continue to develop, define, and clarify to participants what an IBI is and what components it entails. Contrary to expectations, participants were significantly more likely to prefer a guided over an unguided IBI. These findings suggest that young adults find an IBI that includes some component with

an actual clinician to be more appealing than an unguided IBI.

Next, significant differences were unexpectedly not found between tailored and full IBI conditions. However, treatment relevance had a p value approaching significance and both treatment relevance and credibility evidenced small effect sizes. Therefore, it is plausible that small-but-real differences exist but were not found due to the size of the sample. It is also possible that analyses for these differences were hampered by the hypothetical nature of the research. One way to test this in the future would be to examine for potential differences, due to tailoring, within a pilot study of an actual IBI. For instance, perhaps participants' perceived outcomes on a hypothetical treatment are not equivalent to perceived outcomes of an implemented treatment. Consequently, it is possible that the perceived outcomes would be different after participants have personal experience using an IBI—tailored vs. untailored—in a real-world setting.

In addition, the results of exploratory analyses demonstrated that participants in the tailored condition reported higher acceptability and treatment relevance than participants in the minimal condition, which was included to control for potential treatment length effects. These findings suggest that treatment length was not a primary factor for differences between the tailored and full conditions. In addition, the mean group comparisons on treatment credibility and outcome expectancy both approached significance and demonstrated small effect sizes. Given that the current sample was powered for medium effects, future samples should be powered for small effects. Further, the results of bivariate correlations demonstrated that treatment relevance accounted for a significant amount of the variance in all anticipated treatment outcome scores, whereas treatment length only accounted for a small amount of the variance in expectancy.

Lastly, exploratory examination of potential biological sex differences demonstrated that women were more likely to prefer an IBI and endorsed higher perceived treatment credibility for an IBI, as compared to men. However, the other perceived outcome variables did not significantly differ based across sex. These results suggest that biological sex likely influences some factors important to the success of an IBI for treating ADHD in young adult populations, but not overwhelmingly so.

Overall, the study yields initial evidence demonstrating that either tailored or untailored IBI for ADHD could be perceived as acceptable, credible, and effective by young adults with ADHD. While the current research was unable to conclusively demonstrate a relation between tailoring and more positive perceptions, the potential exists that future revisions could increase tailored condition responses even further.

It is important to note that the perceived outcomes may prove different from actual outcomes of a clinical trial. Based on the Medical Research Council's framework for developing complex interventions (Craig et al., 2008), following feasibility and acceptability testing, research should begin to assess actual components of a new treatment. Therefore, it is paramount to clinically assess the efficacy of a full-scale IBI, such as the one proposed in this manuscript. Moving forward, research should address factors related to implementation science, such as whether multiple versions of an IBI would be needed to provide treatment to multiple populations (e.g., different versions to address different phases of adulthood; different versions for college versus non-college attending adults). For instance, it is plausible that an IBI developed to treat individuals in middle or late adulthood would not have as strong of a therapeutic effect within college populations. However, it is conceivable that one IBI might offer a range of different modules, all within the same program and each specifically geared towards different populations (e.g., modules specific to college students, not in college, adults with a childhood ADHD diagnosis, those diagnosed with ADHD in adulthood, or even modules specific to parents of students about to enter college).

Future studies should also evaluate other factors related to implementation science, such as various dimensions of clinician guidance (e.g., frequency of clinician contact; Andersson & Titov, 2014) to determine if specific factors have more utility than others, both in terms of clinical resources needed and desirability to patients. Finally, future research evaluating potential dissemination and implementation issues are warranted. Beyond identifying if patients find an IBI acceptable, it is also important to identify whether providers who receive requests for ADHD treatment or requests for referrals to such treatment, across a range of settings (e.g., *college*: student health service centers, university disability support, university counseling centers, or psychology clinics; or in the *community*: psychologists, psychiatrists, counselors, physicians, social workers, or nurses) would be willing to refer clients to IBIs.

Several limitations of this research are important to note. First, these data were collected from a non-clinical sample, who self-reported prior ADHD diagnostic history, current symptomatology, and impairment. There was no independent verification of clinical diagnostic history. Future studies should include participants with verified diagnoses or include collateral reports of ADHD symptomatology. As there is debate about diagnostic thresholds for ADHD in adolescents and adults (Hartung et al., 2016), it would be prudent to evaluate for potential differences between those with and without formal diagnoses, too. An IBI, such as the

one described, could prove beneficial even to individuals without a formal ADHD diagnosis, as has been shown in IBIs for other disorders (e.g., depression and anxiety; Mason & Andrews, 2014).

Second, it seems likely that the sample herein was too small to detect some differences that may have relevance. Future research should use a priori power analyses to determine optimal sample sizes for (a) inclusion of both condition and biological sex as predictor variables, and (b) to detect small effects. Third, this research focused on young adults (aged 18–35) in the general population. As a result, the findings should be generalized beyond that scope with caution. Fourth, single-item measures were used for several of the variables (e.g., acceptability, preference), and future research should consider using more robust measures of these factors.

Despite the limitations noted, there are several strengths to the research reported. First, this is the first study to examine the use of an algorithmically tailored approach for an ADHD IBI within young adult populations. Therefore, the results offer unique insight into a variety of factors regarding the perceptions and use of IBIs for ADHD treatment within these populations. Further, the samples were drawn from a diverse population of participants across the USA. For instance, there was a near equal split across biological sex. There was also considerable diversity across other factors such as race, geographic location, and education attainment. This diversity helps to bolster the potential generalizability of these results.

In summary, the current study suggests that an IBI for ADHD would be perceived as useful and acceptable by young adults with ADHD. The experiment established that it is feasible to algorithmically tailor treatment material, based on self-reported ADHD impairment. However, it is still unclear whether tailoring the content of an IBI for ADHD leads to clinically significant differences in participant perceptions of the treatment or actual treatment outcomes. Overall, these results can help guide a wide range of future research to better understand factors that might be important for IBIs for ADHD, including development of full-scale interventions.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s41347-022-00256-4>.

Acknowledgements The authors wish to thank Tara W. Clapp, Adam R. Conner, Patrick A. LaCount, Judah W. Serrano, and Anne E. Stevens for the assistance and expertise they provided on this project.

Declarations

Conflict of Interest The authors declare no competing interests.

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