Web-based cognitive–behavioral therapy for auditory hallucinations in persons with psychosis: A pilot study

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ABSTRACT

CBT for Psychosis (CBTp) is an empirically-supported intervention for schizophrenia, but few people have access to it in the U.S. "Coping with Voices" is an interactive, computerized self-directed web-based CBTp program developed to increase access to CBTp with the objective of reducing the severity, distress, and functional impairment caused by auditory hallucinations. This open pilot study tested the feasibility and effects of this new intervention. Twenty-one individuals with schizophrenia spectrum disorders and auditory hallucinations were enrolled in the individual-based 10-session Coping with Voices program at one of 4 community mental health centers. High levels of participant satisfaction with the program were found, with most reporting that the program was engaging and helped them manage their symptoms. Seventeen participants (81%) completed more than 50% of the scheduled program sessions (i.e., 6 or more sessions), and were defined as "exposed" to the program. Exposed participants showed statistically significant reductions from baseline to post-treatment in several measures of auditory hallucinations, including overall severity and the perception of voices as an "outside entity" and intensity of "negative commentary," as well as reductions in other psychotic symptoms, and overall psychopathology. This study supports the feasibility of the web-based Coping with Voices program and its potential clinical benefits, and suggests that more rigorous research is warranted to evaluate its effects.

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1. Introduction

Persons with schizophrenia often do not access mental health services, with as many as 50% of this population in the United States not receiving any treatment at all (SAMHSA, 2003; Drake et al., 2009; Mojtabai et al., 2009). For those who do participate in traditional mental health services, access to empirically-supported psychosocial treatments for this population is poor (Drake et al., 2009; Mojtabai et al., 2009). For example, cognitive–behavioral therapy for psychosis (CBTp) has been shown in over 30 randomized controlled trials to improve symptoms and functioning in persons with schizophrenia (Wykes et al., 2008). While there has been some recent debate regarding the efficacy of CBTp (i.e., Lynch et al., 2010; Jones et al., 2012), skeptics of research on CBTp have been criticized for imposing inappropriate or overly restrictive criteria for the inclusion of studies in their reviews, resulting in conclusions that are divergent from larger meta-analyses of controlled studies that have consistently found that CBT produces beneficial clinical effects (Kingdon, 2010). CBTp has been recommended in

the two most recent editions of both the PORT and NICE guidelines for the treatment of schizophrenia over the past 10 years (Lehman et al., 2004; Berry and Haddock, 2008; Dixon et al., 2010), indicating that there is a consensus among experts that this intervention does in fact have a sufficient and compelling evidence base. However, despite these recommendations, few individuals have access to CBTp, especially in the United States (Lehman et al., 2004). Obstacles to accessing CBTp include the limited number of clinicians trained in the approach, lack of patient resources to attend mental health clinics, and people choosing to not access mental health services due to stigma or lowered motivation (Tarrier, 2005; Spidel et al., 2006).

The poor access to CBTp has led to calls for innovative approaches to implementing this practice (Mueser and Noordsy, 2005). Self-guided CBTp is one potential solution to this problem. CBT bibliotherapy, used to either supplement standard psychiatric care or as an alternative to therapist-delivered CBT, has a strong evidence-base for improving depression, anxiety, sexual dysfunction, and sleep disturbance in the general population (Marrs, 1995). More recently, web-based CBT programs have been developed and empirically-validated for depression and anxiety disorders, with meta-analyses demonstrating large effect sizes (Barak et al., 2008; Cuijpers et al., 2009; Reger and Gahm, 2009; Titov, 2011), comparable to the effects of therapist-delivered CBT (Barak et al., 2008; Reger and Gahm, 2009). In addition, a recent study demonstrated the feasibility

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of using mobile phone text messages for participants with schizophrenia to assess and suggest CBT coping strategies for distressing hallucinations, prompt medication adherence, and facilitate socialization (Granholm et al., 2012). However, to our knowledge, computer-based internet CBT programs have not yet been developed that address persistent psychotic symptoms.

There is growing evidence that people with schizophrenia and other serious mental illnesses are interested in and can use technologies such as computers, mobile phones, and the internet in mental health clinics, peer support centers, public libraries, and in their homes. In a 2007 survey, 28% of persons with serious mental illnesses reported that they owned a computer, and approximately one-third had accessed the internet (Borzekowski et al., 2009). In a recent survey among a large sample of respondents with serious mental illnesses, 63% with schizophrenia spectrum disorders reported using a mobile device (Ben-Zeev et al., 2012). In a National Alliance on Mental Illness survey of 1215 individuals with first episode psychosis, 54% reported they had sought information on the internet about their illness (Anonymous, 2011).

Furthermore, recent data suggest that people with schizophrenia are interested in participating in online forums and psychoeducation or therapy-based programs related to their symptoms or diagnosis. Haker et al. (2005) analyzed 1200 postings from 597 users of 12 different Internet schizophrenia forums. They found that the postings were primarily from individuals who identified as having a diagnosis of schizophrenia or a related illness, as opposed to caregivers or family members. Rotondi et al. (2005), in a comparison of an internet-based intervention for individuals with schizophrenia (and their caregivers) to usual care, reported over 17,000 hits on the home page alone and that the study's psychoeducation group and resources were well-used by the participants. These findings underscore the promise of computer-based technology for delivering CBT to individuals with schizophrenia.

To address the problem of low access to CBTp, a 10-lesson internet-based self-guided program for coping with auditory hallucinations was developed, "Coping with Voices." Auditory hallucinations were chosen as the treatment target for several reasons. Voices are a common symptom that cause substantial distress. People are often highly motivated to reduce distress related to voices, as opposed to paranoia or other delusional ideation where there may be ambivalence or other challenges. In addition, traditional CBTp has consistently been shown to improve the severity of auditory hallucinations (Wykes et al., 2008).

Coping with Voices was developed by the first author (JDG), a clinical psychologist with expertise in CBTp, with software development by the fifth author (BPC), founder of the website www.schizophrenia.com. This is a 10-"session" (lesson) interactive computerized game-based web-intervention, composed of multiple exercises and games to exemplify CBT principles (e.g., thoughts influence feelings and behaviors), as well as behavioral (use of humming and earphones to quiet auditory hallucinations) and cognitive (e.g., challenging beliefs that voices have power over the person) coping techniques (see Section 2.3 for more program detail). This paper reports on the first open pilot trial of this program conducted at community mental health clinics. The focus of the pilot was on evaluating the feasibility and acceptability of the program, and exploring its impact on hallucinations and related symptoms.

2. Methods

The study was conducted at 4 community mental health clinics with outpatients with serious mental illness. This research was approved by the Institutional Review Boards at both academic institutions where data was collected. All participants provided informed consent. Data collection occurred between October 2010 and April 2012.

2.1. Participants

Participants were 21 adults with a psychotic disorder who were receiving outpatient mental health services at one of four clinics located in a New England (n = 5) or Southeast U.S. metropolitan area (n = 16). Inclusion criteria were 1) diagnosis of schizophrenia, schizoaffective disorder, or psychosis, NOS; 2) at least "moderate" level of auditory hallucinations severity over the past week (BPRS Hallucinations item ≥ 4 or higher); 3) between the ages of 18–65; 4) no exposure to CBTp within the past 3 years; 5) no current suicidal ideation or hospitalization within the past month; 6) taking a stable dose of an antipsychotic medication for at least one month; 7) no active substance abuse/dependence; 8) English-speaking, with at least 8th grade reading level (measured by the WRAT); and, 9) no dementia (MMSE score ≥ 24). Diagnoses were determined by chart review for participants referred from schizophrenia specialty clinics (n = 14), and the Structured Clinical Interview for DSM-IV (First et al., 1996) for participants referred from the general outpatient clinics (n = 7).

Participants (62% male) ranged in age from 23 to 64 years (mean = 40.10; SD = 13.63), were primarily Caucasian (57%; African American: 38%; Asian 5%), currently unemployed (62%) and unmarried (86%), with diagnoses of schizophrenia (76%) or schizoaffective disorder (24%). All participants had completed high school or equivalency (47%) with some reporting post-baccalaureate work or graduate degrees (52%), and had an average estimated Full-Scale IQ level (based on the WASI) of 94.5 (SD = 15.73). This group experienced an average of 5.48 lifetime inpatient hospitalizations (range = 0–15; SD = 4.27), and had baseline mean scores on auditory hallucinations severity (as measured by the BPRS) in the "moderately severe" to "extremely severe" range (mean = 5.95; SD = .87; range = 5–7). Most participants were somewhat experienced internet users, with 50% reporting almost daily or daily use and 25% reporting use 3–4 times per week. Five percent used the internet once per week; 10% "a few times per month;" 5% a few times per year; and 5% reported no prior use. The 16 program completers attended an average of 11 visits (range 7–16; SD = 2.63) in order to complete the 10-lesson program. Participants spent an average of 58.7 min working on the program per visit (range = 48–71 min; SD = 5.9 min).

2.2. Measures

Outcome measures included severity of auditory hallucinations and related variables, such as distress and functional interference, as well as other psychiatric symptoms. Assessments evaluated the participants' symptom experience within the two weeks prior to the interview. Process measures included internet usage, CBTp knowledge acquisition, and program satisfaction. All measures were conducted at pre- and post-treatment intervals (unless otherwise specified) and were administered by trained raters with substantial experience in assessment with this population.

2.2.1. Primary outcomes

The Psychotic Symptom Rating Scales (PSYRATS; Haddock et al., 1999) is a fine-grained measure of psychotic symptoms that consists of 17 self-report items that evaluate dimensional symptom severity on a four-point scale. The PSYRATS provides a total score as well as two subscale scores (Auditory Hallucinations and Delusions). The primary outcome variables for the pilot were the Auditory Hallucinations subscale and the individual subscale items, including the frequency, intensity, loudness, associated distress, perceived degree of controllability of, and interference from auditory hallucinations.

2.2.2. Secondary outcomes

The Belief about Voices Questionnaire—Revised (BAVQ-R; (Chadwick et al., 2000) was used to evaluate beliefs about auditory hallucinations and the emotional and behavioral reactions to them. The Delusions subscale of the PSYRATS was used to measure severity of delusions. The total score and subscales of the Brief Psychiatric Rating Scale (BPRS; Overall and Gorham, 1962) were used to measure overall psychopathology. The BPRS is a 24 item semi-structured interview, with

ratings based on 7-point scales, widely used to assess symptoms in people with a serious mental illness. The following BPRS factor subscale scores were used in the statistical analyses: Psychosis, Depression, Activation, and Retardation (Velligan et al., 2005). The BAVQ-R is a 35-item self-report measure widely used in research on CBTp. The Beck Depression Inventory — II (Beck et al., 1996) was used to evaluate depression.

2.2.3. Cognitive measures

The Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) was used to obtain an estimate of IQ, using the Vocabulary and Matrix Reasoning subscales. As the Coping with Voices program was developed for an 8th grade reading level, the Wide Range Achievement Test (WRAT) Reading subscale (Wilkinson, 2003) was used to obtain a current estimate of reading level. The Mini-Mental Status Exam (MMSE; Folstein et al., 1975) was used rule out the presence of dementia. These cognitive measures were administered during the baseline visit only.

2.2.4. Client internet use and CBTp knowledge

The frequency and breadth of participants' prior experience using computers and internet in their daily lives were evaluated with a questionnaire developed for this study. Participants' knowledge of CBT and CBTp tenets, techniques, and skills were evaluated with a brief, multiple choice/true–false CBTp Knowledge questionnaire developed for the study, reflecting constructs illustrated in the program. Sample items include: "In the 'Cognitive Model' your thoughts affect your feelings which affect your _____ (actions);" and "Some things that may contribute to hearing voices include ____ (attention problems; drugs and alcohol; stress; all of the above)."

2.2.5. Program feasibility, acceptability, and client satisfaction

Program feasibility and acceptability were evaluated by calculating the number of participants who completed the program (i.e., those who completed all 10 computerized "lessons" — regardless of the number of in-person visits needed to achieve this), the number who were "exposed" to the intervention (defined as completion of more than half — 6- of the sessions), and the number of program dropouts (those with 1–5 sessions).

The "Coping with Voices" Program Client Satisfaction Survey is a feedback form designed for this study, consisting of 13 Likert scale items about the general program and 18 specific open-ended qualitative items, administered as an interview. Participants rated the helpfulness and difficulty of various aspects of the program and reported on their likes, dislikes, and suggested changes to the program.

2.3. CBT for auditory hallucinations intervention: "Coping with Voices"

Coping with Voices consists of ten lessons that are each designed to take 45 to 80 min to complete, depending on client speed. Lesson 1 starts with a detailed self-assessment of the client's experience with auditory hallucinations. At the beginning of each subsequent lesson, clients are prompted to enter their "daily voices log" where they recount their experiences with auditory hallucinations each week, rate level of associated distress and disruption, and identify which specific program-taught strategies they used to cope with the hallucinations. Various video tutorials are used throughout the program to orient the individual to topics such as psychosis and (dysfunctional) thinking styles. Interactive games, quizzes, content review and outside practice opportunities are structured around these tutorials and are used to assist individuals in applying concepts and practicing skills. The skills learned in the intervention are cumulative, with session complexity gradually increasing.

Participants work at their own pace, based on their computer ability, reading level, and attention span. The program utilizes many of the guidelines developed by Rotondi et al. (2007) regarding effective website design for individuals with schizophrenia and accompanying

cognitive difficulties and is multi-modal, including video tutorials, readings and audio, interactive games, symptom tracking, homework review, printable session summaries and worksheets, and quizzes. The program also provides an opportunity to participate in the "social feed," an (anonymous) social networking piece that allows clients to learn about how other program users are progressing and which particular program-taught strategies they find most helpful in their day-to-day experience. Program curriculum is summarized in Table 1.

2.4. Procedures

Participants were recruited at the four mental health agencies by clinic staff and referred to the trained study raters for eligibility screening and baseline assessment. Once participants met inclusion criteria and were enrolled in the study, they were re-assessed following completion of the intervention (or in the case of dropouts, following their final program visit), and all subjects were paid for their participation in the assessments. Eligible participants began the intervention within two weeks of their baseline assessment. Study staff served as "proctors" who helped set the participant up on the computer for each program visit, occasionally checked in on their progress, and were available throughout each session to answer questions as needed. Proctors were situated in rooms adjacent to the participants, to allow for privacy, as well as close support as needed.

The majority of the program visits took place in individual offices at the mental health centers. In some cases, participants worked individually on computers in a shared office space in small groups of 3–5 persons at a time, with each person working at their own pace and wearing headphones in order to hear the auditory portions of the program and minimize distraction from the other participants.

2.5. Analyses

Descriptive statistics were computed to evaluate client characteristics, demographic, baseline cognitive functioning, and program satisfaction data. Paired-sample t-tests were conducted to evaluate changes from baseline to post treatment for all primary and secondary outcomes. The SPSS-Version 19 statistical package was used to conduct all study analyses.

3. Results

Of the 21 participants who completed baseline assessments, 17 (81%) were exposed to the program (i.e., completed at least 6 lessons), with an average of 9.76 lessons completed (SD = .97). Of the four remaining participants, two completed only one lesson and two completed four lessons. Two participants dropped out due to a long, burdensome commute; one changed his mind about participation; and one experienced a death of a close relative during the course of the study and decided to not continue. Post-assessments were completed on all but one of the 21 participants. Analyses were conducted on both the treatment exposed (n = 17) and intent-to-treat (n = 20) subgroups, and yielded similar findings, with only slight differences. Given that the results from the treatment exposed group have the greatest relevance in terms of understanding the clinical impact of the program, we present the results from this group.

3.1. Primary outcomes: auditory hallucinations severity

As summarized in Table 2, paired t-tests for the PSYRATS Auditory Hallucinations subscale and subscale items showed statistically significant improvements in overall severity, perception of voices as an outside entity ("Location"), negative commentary from voices ("Negative Statements"), and trends for reduced frequency and duration of auditory hallucinations, reduced perception that voices emanated from an external source, and increased perceived control over voices. Intent-to-treat

Table 1

Curriculum for "Coping with Voices" computerized CBT for auditory hallucinations program.

Lesson#	Lesson plan	CBT strategies/key points	Practice exercises
1	Program orientation/ self-assessment; "What is CBT" tutorial; thoughts and feelings exercise; social feed	Self-monitoring of AH; Psychoeducation; Thought–feeling model	CBT/AH Knowledge Quiz; thought–feeling model
2	Homework review; daily voices log; "Inaccurate Thinking Styles" tutorial; Inaccurate Thinking Styles Game I; social feed	AH symptom tracking; psychoeducation; Thought–feeling–behavior model; cognitive distortions	Cognitive Distortions Quiz; daily voices log; Inaccurate Thinking Styles game
3	HW review; daily voices log; Inaccurate Thinking Styles Game I & II; social feed	AH symptom tracking; thought–feeling–behavior model; cognitive distortions	Daily voices log; Inaccurate Thinking Styles games
4	HW review; daily voices log; "Coping with Voices" tutorial; voices and feeling exercise; social feed	AH symptom tracking; psychoeducation thought–feeling-behavior model	Coping with Voices Quiz; daily voices log
5	HW review; daily voices log; Behavioral Coping Strategies Game I; social feed	AH symptom tracking; Coping strategy enhancement	Daily voices log; Beh Coping Strategies Game
6	HW review; daily voices log; Behavioral Coping Strategies Game II; Challenging What Your Voices Say: I; social feed	AH symptom tracking; Coping strategy enhancement; Cog restructuring (AH content)	Daily Voices Log; Beh Coping Strategies Game; Cognitive restructuring practice
7	HW review; daily voices log; Challenging What Your Voices Say: II; social feed	AH symptom tracking; Cog restructuring (AH content)	Daily voices log; cognitive restructuring practice
8 and 9	HW review; daily voices log; Challenging Beliefs About Your Voices; social feed	AH symptom tracking; Cog restructuring (Beliefs about AH)	Daily voices log; cognitive restructuring practice
10	HW review; daily voices log; post self-assessment and results; session summaries; program review; progress letter to self; maintaining gains	AH symptom tracking; Self–monitoring AH; progress review/ attributions of change; relapse prevention	Daily voices log; post self-assessment; relapse prevention planning

analyses were similar for overall auditory hallucinations severity changes, although the changes in associated perceptions related to voices location and negative commentary were not significant.

3.2. Secondary outcomes: other symptoms and CBTp knowledge

There were significant reductions in overall psychopathology on the BPRS, as well as the BPRS Psychosis, Depression, and Activation subscales. There were trends towards a significant reduction in the PSYRATS Delusions subscale, and in depression severity on the BDI-II. There were no significant changes in maladaptive beliefs related to voices (BAVQ-R). Participants improved significantly on knowledge about auditory hallucinations and CBTp skills from pre- to post-assessment. Intent-to-treat analyses yielded similar results for Total BPRS score with similar trends in PSYRATS Delusions and

BDI-II; however the changes in the BPRS Depression and Activation subscales were no longer significant, nor were the improvements in CBTp knowledge.

3.3. Program usage and user satisfaction

As summarized in Table 3, there were high levels of satisfaction with and perceived helpfulness of the program as a whole.

4. Discussion

The results of this open pilot study support the feasibility and potential efficacy of the web-based Coping with Voices program for persons with psychotic disorders. Despite the severe symptoms of the study sample, the rate of program completion rate was high, as were participant satisfaction levels. Analyses suggest that the program was effective at reducing the severity of voices, other psychotic symptoms, and overall psychopathology.

Interestingly, participants improved in depression and delusion severity, although these symptoms were not directly targeted in the program. There is a well-established relationship between severity of hallucinations and delusions in schizophrenia (e.g., persecutory beliefs), as well as between the severity of psychotic symptoms and depression (Mueser et al., 1991; Freeman and Garety, 2003; Smith et al., 2006). The results of this pilot suggest that improved coping with auditory hallucinations may reduce associated delusional conviction as well as depression. It is also possible that some of the CBT skills taught in the Coping with Voices program, such as behavioral coping strategies (e.g., reducing avoidance and safety behaviors) and cognitive restructuring to challenge inaccurate distressing thoughts (e.g., upsetting beliefs about the content or origin of the voices), could have contributed to reducing the severity of delusions and depression.

There are several components of the Coping with Voices program that may have contributed to these positive findings. First, clients

Table 2

Pre- and post-treatment differences on symptom outcomes for participants exposed[a] to the "Coping with Voices" intervention (n = 17).

Outcome Variable	Baseline	Post-treatment	t (DF)	p-value
PSYRATS[b] auditory hallucinations subscale total	26.76 (6.75)	22.94 (6.44)	3.11 (16)	.007
Voices frequency	3.12 (.99)	2.59 (.87)	1.94 (16)	.070
Voices duration	2.59 (1.18)	2.06 (1.20)	2.05 (16)	.058
Voices location	2.24 (1.20)	1.53 (0.62)	2.40 (16)	.029
Voices loudness	1.82 (0.95)	1.76 (0.75)	0.29 (16)	.773
Voices source	2.18 (1.29)	1.71 (1.11)	2.06 (16)	.056
Voices frequency of negative statements	2.59 (1.37)	2.47 (1.13)	.44 (16)	.668
Voices intensity of negative statements	2.65 (1.41)	2.24 (1.39)	2.14 (16)	.049
Voices frequency of distress	2.71 (1.05)	2.59 (1.00)	.42 (16)	.683
Voices intensity of distress	2.41 (1.00)	2.41 (1.00)	.000 (16)	1.000
Voices extent disrupting	1.82 (0.81)	1.47 (0.62)	1.69 (16)	.111
Control over voices	2.65 (1.41)	2.12 (1.36)	2.05 (16)	.058
PSYRATS delusions subscale total	12.71 (4.74)	10.88 (4.40)	1.74 (16)	.101
BPRS[c] total score	50.47 (10.15)	41.77 (9.43)	4.29 (16)	.001
Psychosis factor subscale	3.00 (0.77)	2.35 (0.64)	3.79 (16)	.002
Depression factor subscale	2.70 (0.91)	2.09 (0.79)	3.33 (16)	.004
Activation factor subscale	1.42 (0.26)	1.18 (0.23)	3.95 (16)	.001
Retardation factor subscale	1.53 (0.49)	1.25 (0.49)	1.69 (16)	.110
BAVQ-R[d] total score	39.88 (14.20)	39.47 (13.74)	.125 (16)	.902
BDI-II[e] total score	19.24 (8.53)	15.24 (11.13)	1.84 (16)	.085
CBTp knowledge	24.65 (2.87)	26.59 (2.81)	3.19 (16)	.006

[a] Treatment Exposed = 6 or more program modules completed.
[b] PSYRATS = Psychiatric Symptom Rating Scale.
[c] BPRS = Brief Psychiatric Rating Scale.
[d] BAVQ-R = Beliefs About Voices Questionnaire, Revised.
[e] BDI-II = Beck Depression Inventory-II.

Table 3
Program satisfaction data for completers (n = 16) from the "Coping with Voices" client satisfaction survey.

Satisfaction category	Questionnaire item	Response	Percentage of responses
Amount of information	"Does the program cover the right amount of information?"	Just right	88.2%
		Not enough information	11.8%
		Too much information	0%
Ease of understanding	"Are the skills and material in the computer program easy to understand?"	Very easy to understand	23.5%
		Easy to understand	70.6%
		Not easy to understand	5.9%
Program flow and structure	"Does the information/skills presented in the program flow well together and fit together?"	Very good flow	76.5%
		Somewhat good flow	23.5%
		Not good flow	0%
Usefulness	"How useful was the program?"	Very useful	58.8%
		Useful	29.4%
		Not useful	11.8%
Self-management of symptoms	"How much did the program help you manage your symptoms?"	Helped very much	58.8%
		Helped	29.4%
		Did not help	11.8%
Program interest level	"How interesting did you find the program?"	Very interesting and engaging	52.9%
		Somewhat interesting	47.1%
		Not at all interesting	0%
Level of program interaction	"Was the program interactive enough?"	Just right	82.4%
		Too much	11.8%
		Not enough	5.9%
Outside practice and homework	"To what extent did you follow through on the Outside Practice assignments?"	A good deal	25%
		Somewhat	50%
		Not at all or hardly	25%
Program recommendation	"Would you recommend the computerized CBT program?"	Very willing to recommend	76.5%
		Somewhat willing to recommend	23.5%
		Not at all willing	0%
Overall helpfulness of program	"Overall, how would you rate the Coping with Voices program?"	Very good/helpful	82.4%
		Medium/some helpful and some not helpful parts	17.6%
		Poor/unhelpful	0%

expressed high levels of satisfaction with the program, and reported that it was interesting and engaging, and easy to use. Second, the program is skills-based, and involves systematically teaching a range of CBTp techniques for coping more effectively with auditory hallucinations through the use of engaging, interactive exercises, and games. Third, participants were able to complete the program at their own pace, including reviewing some previously taught material, which may have facilitated their ability to compensate for any cognitive challenges they experienced in learning the skills. Fourth, different components of the program "normalized" the experience of hearing voices (Dudley and Turkington, 2011). The psychoeducational tutorials explained that hearing voices exists on a continuum of normal experience in order to correct the belief that having hallucinations means the person is "crazy" or "abnormal." The "social feed" part of the program, whereby participants could (anonymously) share and examine the struggles and effective coping strategies of other users, may have made participants more willing to disclose potentially upsetting or embarrassing content or experiences related to their hallucinations, which could have reduced feelings of self-stigma related to this symptom. Finally, although a live, human, face-to-face therapeutic relationship may be an important component of CBTp in order to facilitate trust and to develop a shared case conceptualization, it is possible that in the absence of such a relationship, the other CBTp components delivered in this interactive computer-based program provided the critical skills for participants to experience some relief from their symptoms, and an increased feeling of mastery over their lives. In addition, some people with psychosis may not be interested in receiving other traditional mental health services and/or starting a new relationship with a therapist, making the Coping with Voices program a good alternative.

Although participants worked independently and in a self-paced manner, they did have ready access to a proctor for technical and other assistance (e.g., reminder appointment calls, program log-in and log-out, troubleshooting if stuck in an exercise or game). Thus, the impact of this program when used in a different environment and with less or no proctor support (e.g., at home) remains an open question. A related issue is the time required by clinical staff (e.g., a therapist or case manager) in a non-research community mental health setting to support clients' use of this program. In the current study, proctors were available to help for the entirety of the participant's visit. However, several participants were often able to work on the program at the same time, on different computers, allowing proctors to maximize their support time. Additionally, while the participants' needs for assistance and individual attention varied, proctors were able to attend to some other non-program work tasks when the clients were using the program independently. This model could potentially translate well to traditional mental health settings, in which case managers or clinicians could provide similar supports to clients independently using the program, while also attending to work tasks such as recording progress notes, reviewing charts, etc. If more rigorous research supports the efficacy of the Coping with Voices program, future research will be needed to compare the overall costs and cost-effectiveness of implementing and sustaining this approach compared to traditional individual or group CBTp interventions. Conversely, future research is also needed to evaluate the feasibility of providing the Coping with Voices program with fewer supports.

Several limitations of the study should be noted. Given that this was an open pilot study without a control group, improvements in auditory hallucinations and other outcomes following participation in the Coping with Voices program cannot directly be attributed to the intervention. The lack of follow-up assessments after the post-treatment evaluation raises the question of whether the improvements in symptoms following completion of the program will be sustained over time, as has been found in other CBTp studies (Sensky et al., 2000; Wykes et al., 2008). The small sample size also limited statistical power to detect changes in the outcome measures. In addition, despite recent data showing increased use of technology and internet among people with schizophrenia, it is possible that this sample was more internet savvy than the

broader schizophrenia population. More research is needed to evaluate effects of the program in people with schizophrenia who have less experience with the internet.

The results of this study suggest that the Coping with Voices program has significant promise for increasing access to CBTp and reducing psychotic and other symptoms in people with psychotic disorders. There is a need for more rigorous evaluation of this program via controlled research. A small randomized controlled trial, comparing the Coping with Voices program to usual care within a publically funded urban community mental health center, is currently underway. In addition, the feasibility and effectiveness of implementing the program outside of the lab or clinic (e.g., at home) is also being studied, in a large multi-site investigation, using Coping with Voices and other technology-based interventions for persons with schizophrenia who have had a recent relapse and hospitalization. Last, the development of a companion program to address paranoid ideation (created by the first author and other colleagues), is also underway. While future research is needed to address the generalizability and necessary supports to implement this program, this study strengthens the premise that web-based treatments, such as the Coping with Voices program, have the potential to increase access to empirically-supported interventions for people with schizophrenia and other serious mental illnesses.

Contributors

Dr. Gottlieb developed the web program used in this study, designed the study, wrote the protocol, conducted the statistical analyses, and wrote the first draft of the manuscript. Dr. Harper Romeo managed the literature review and supervised subject recruitment and data collection. Dr. Penn supervised the subject recruitment and data collection and contributed to the drafts of this manuscript. Dr. Mueser contributed to the literature review and contributed to drafts of this manuscript. Mr. Chiko developed the software for this web program and contributed to the development of the manuscript. All authors have contributed to and approve the final manuscript.

Conflict of interest

Mr. Chiko is now the CEO of Cognitive Health Innovations, a newly developed company that creates and markets online psychotherapeutic tools. The remaining authors have no interests to disclose.

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