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Visual Causal Models Enhance Clinical Explanations of Treatments for Generalized Anxiety Disorder

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A daily challenge in clinical practice is to adequately explain disorders and treatments to patients of varying levels of literacy in a time-limited situation. Drawing jointly upon research on causal reasoning and multimodal theory, the authors asked whether adding visual causal models to clinical explanations promotes patient learning. Participants were 86 people currently or formerly diagnosed with a mood disorder and 104 lay people in Boston, Massachusetts, USA, who were randomly assigned to receive either a visual causal model (dual-mode) presentation or auditory-only presentation of an explanation about generalized anxiety disorder and its treatment. Participants' knowledge was tested before, immediately after, and 4 weeks after the presentation. Patients and lay people learned significantly more from visual causal model presentations than from auditory-only presentations, and visual causal models were perceived to be helpful. Participants retained some information 4 weeks after the presentation, although the advantage of visual causal models did not persist in the long term. In conclusion, dual-mode presentations featuring visual causal models yield significant relative gains in patient comprehension immediately after the clinical session, at a time when the authors suggest that patients may be most willing to begin the recommended treatment plan.

As many as 90 million American adults find it difficult to understand complex health information (Berkman et al., 2004; Institute of Medicine, 2004), and 14% of English-speaking American adults have not achieved a basic level of health literacy, unable to

do more than follow written instructions on simple forms, or find prominently placed information in health-related text (Kutner, Greenberg, Jin, & Paulsen, 2006). Surveys across several countries have indicated that health literacy for mental disorders may be even worse than for other medical conditions (Jorm, 2012), given people's low awareness of mental health interventions. Yet, people's understanding of disorders and diseases, whether accurate or not, can strongly influence their health-related behaviors and decision making (Furnham & Buck, 2003; Furnham, Pereira, & Rawles, 2001; Jahng, Martin, Golin, & DiMatteo, 2005; Pistrang & Barker, 1992; Wong, 1994), and the inability to understand explanations given by one's clinician is associated with poorer health outcomes (American Medical Association, 1999; Baker et al., 2007; Institute of Medicine, 2004; Williams, Davis, Parker, & Weiss, 2002). The purpose of the present work is to test a new way to help clinicians effectively transmit critical information about disorders and treatments to their patients.

The Importance of Having a Causal and Conceptual Understanding of Disorders

Clinicians not only learn what *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013) symptoms and characteristics are associated with a mental disorder, but also formulate hypotheses and beliefs about why and how those symptoms and characteristics go together (Medin, 1989). For example, in forming a concept of *anorexia nervosa*, a clinician might hypothesize that a person with this disorder "refuses to maintain body weight at or above minimal levels" because of a "disturbance in the way one's body weight or shape is experienced." Such beliefs comprise the *causal structure* of the disorder and may be gathered over time from outside sources (e.g., books, articles, colleagues) and from direct experience (Murphy, 2002).

Learning clinicians' causal structures is an important part of patients' health literacy for a number of reasons. First, it is important for patients to understand the basic reasoning behind their clinicians' diagnoses and recommendations. If a patient, for example, rejects a treatment after understanding the clinician's reasons for recommending it, we would argue that this is better than if the patient rejects the treatment due to miscommunication.

Second, learning the causal structure of a disorder from the clinician reveals to the patient what the clinician thinks is important. Clinicians and lay people give causal symptoms more weight in diagnosis than their effects, and causal symptoms are better remembered (N. S. Kim & Ahn, 2002a, 2002b). Because these findings hold true even if a clinician's causal structures are idiosyncratic, it is critical for patients to know what their own clinicians consider to be the causes of their disorders.

Third, learning clinicians' causal structures might help patients understand why a particular treatment regimen was prescribed. Adherence to treatment is reliably predicted by whether people's beliefs about the illness are compatible with their beliefs about what the treatment does (Cameron & Leventhal, 2003; Leventhal, Leventhal, & Breland, 2011). People who believe that the root cause of a disorder is biological in nature feel strongly that medications would treat the disorder more effectively than psychotherapy, and vice versa for those who believe the root cause is psychological (Ahn, Proctor, & Flanagan, 2009; Yopchick & Kim, 2009). Moreover, the degree to which patients and clinicians agree about the causes of the disorder predicts their level of engagement in therapy (Addis, Truax, & Jacobson, 1995).

We thereby argue that learning one's clinician's view of the causal structure of a disorder is an important part of health literacy. The widespread use of cognitive-behavioral therapy techniques designed to make patients more aware of the root causes of their cognitions suggests that it is reasonable to expect lay people to learn causal structures, even for complex concepts such as mental disorders. For example, one common approach is to ask patients to fill out homework sheets to increase their awareness of some causes of their symptoms (e.g., thinking patterns; Burns, 1999a, 1999b), and understanding the theoretical model underlying therapy is a key step of many cognitive-behavioral techniques (Hazlett-Stevens, 2008). In the present work, we considered how to aid clinicians in communicating their beliefs about the causal structures of disorders to their patients.

The Potential for Visual Causal Models to Facilitate Learning of Causal Structures

More generally, patients often find it difficult to understand the explanations clinicians are trying to convey (Aspegren, 1999); even if clinicians avoid using technical termi-nology (Institute of Medicine, 2004), patient comprehension may still remain inade-quate. In busy health care settings, the clinician simply may not be allotted enough time to ensure that the patient has correctly understood the information (Dugdale, Epstein, & Pantilat, 1999). Moreover, clinicians may not always detect patient mis-understanding (Lukoschek, Fazzari, & Marantz, 2003), particularly when patients do not admit to a lack of understanding in front of clinicians or are unaware of their lack of understanding.

The conceptual tools that classroom instructors use to improve understanding and retention of explanations can be used to do the same in clinical settings. Dual-mode instruction is one example; in a classroom setting, instruction can be delivered via visual modalities (e.g., diagrams, slides), auditory modalities (e.g., an oral lecture), or both simultaneously. Multimodal theory (Mayer, 2006) suggests that dual-mode explanations (i.e., auditory and visual combined) can ease the burden on working memory while facilitating learning (Reed, 2006; Tversky, 2011). In keeping with the working memory model (Baddeley, 2001; Baddeley & Hitch, 1974), Sweller (1988, 1994, 2003) similarly posited that material should be presented in a manner that simul-taneously engages the visual and auditory components of working memory. Cognitive processing is thereby distributed between the two limited-capacity channels—visual and auditory—such that neither channel is under excessive cognitive load (Mayer & Moreno, 2003; Nakanishi, Taguchi, & Okada, 2010). Across numerous studies in classroom settings, students learned better when material was presented with a com-bination of auditory (spoken) words and visual models, compared with single-mode presentations containing equivalent content (Ginns, 2005; Mayer, 2001; Tindall-Ford, Chandler, & Sweller, 1997).

It is generally more difficult to learn a causal structure than a noncausal structure (Hmelo-Silver & Pfeffer, 2004). To help convey information about causal structure, visual causal models, primarily characterized by the inclusion of arrows to indicate causal relationships between features, may be most effective (Heiser & Tversky, 2006). Heiser and Tversky (2006) showed that the presence of arrows primes people to pay particular attention to detecting functional or causal relationships when approach-ing new information. Such models support long-term memory, facilitate information processing, organize thoughts, and promote inference and discovery (Tversky, 2011).

Yet, a recent, comprehensive review of interventions to combat low health literacy did not uncover any attempts to test the efficacy of using visual causal models to enhance patient understanding (Sheridan et al., 2011).

Patient and Disorder Selection

We propose that combining a visual causal model with clinicians' orally delivered explanations will yield an increase in patients' knowledge of the causal structure of disorders relative to an auditory explanation alone, all else held equal. We aimed to test this hypothesis for the first time in mental health patients of a range of ages and educational backgrounds and from a racially diverse population. Mental health patients might differ in significant ways from lay people in terms of multiple factors affecting learning, including general attentiveness and a priori interest in disorders. For this initial investigation, we focused on the learning of patients diagnosed with mood disorders. It was necessary to present patients with information about a disorder that was not a mood disorder to minimize the amount of knowledge patients had before the study, reducing potential ceiling effects. We chose to teach them about generalized anxiety disorder (GAD) for several key reasons.

First, GAD is one of the most common disorders seen in primary care (Davidson, Feltner, & Dugar, 2010) and is associated with increased use of health care resources (Wittchen, 2002). Second, lay people are particularly uninformed about GAD; in one study, only 51.8% of participants recommended a vignette depicting GAD for treatment compared with 82.9% for depression (Coles & Coleman, 2010). Third, patients with mood disorders are, in some respects, similar to patients with GAD; although they are separable, both are centrally characterized by the experience of negative affective states, and they share to some extent a potential capacity for insight (Watson, 2005). There are also some similarities between them regarding approaches to treatment (e.g., antidepressants and cognitive-behavioral therapy are common to both), and some overlap in symptoms (e.g., sleep disturbances; American Psychiatric Association, 2000; Mennin, Heimberg, Fresco, & Ritter, 2008). Although this overlap is well documented, and has been intensively reviewed (First, 2007), the relationship between GAD and mood disorders is complex. GAD has been shown to have a number of core, unique features (e.g., worry and fear of uncertainty) validating its separate diagnosis as an anxiety disorder (Mennin et al., 2008).

We recruited lay people as a comparison sample to determine whether the proposed visual causal model presentation was as effective for mental health patients as for lay people. Finding ways to effectively teach lay people about disorders is itself also important, as 1 in 4 U.S. adults are diagnosed with a disorder in any given year (National Institute of Mental Health, 2006), directly and indirectly affecting a sizable portion of that population.

Method

Participants

We recruited 193 adults (87 mental health patients and 106 lay people who had never been diagnosed with any disorders) from the Boston metropolitan area via newspaper ads, online ads, and flyers. Datasets from two participants were unusable because of a technical error, and one participant admitted to giving responses at random. Thus, only the data from the remaining 190 participants (86 patients and 104 lay people)

Table 1. Study participant demographic information

Demographic information	Lay people		Patients	
	n	%	*n*	%
Gender				
Male	58	55.8	49	57.0
Female	46	44.2	36	41.9
Declined to report	0	0	1	1.1
Race				
White	46	44.2	41	47.7
African American	28	26.9	37	43.0
American Indian	7	6.6	1	1.2
Asian	13	12.5	1	1.2
More than one race	6	5.8	4	4.7
Declined to report	4	3.8	2	2.3
Ethnicity				
Hispanic or Latino/a	13	12.5	5	5.8
Not Hispanic or Latino/a	82	78.8	60	69.8
Declined to report	9	8.7	21	24.4
Other				
Age, *M* (*SD*)*	41.7	16.9	48.2	12.6
Years of education, *M* (*SD*)**	14.3	2.3	13.5	2.5
Need for Cognition Scale, *M* (*SD*)*	20.7	22.6	12.1	24.9

*$p = .01$; **$p = .02$.

were analyzed. Participants received US$10–$15 for an initial in-person session, and an additional US$10 for completing a follow-up phone session. All participants spoke English and could read and understand written English. All participants were at least 18 years of age ($M = 44.7$, $SD = 15.4$). Overall, 44.2% of lay people and 41.9% of patients self-identified as female. Reflecting the demographics of the greater Boston area, our sample was diverse; 57.7% of lay people and 53.5% of patients self-identified as belonging to one or more racial and/or ethnic minority groups (some were members of both racial and ethnic minority groups and others were not). See Table 1 for more detailed participant demographic information.

Patient participants were either current patients with a mood disorder who had already undergone at least 3 months of professional treatment (to substantially reduce the likelihood that patients would confuse the information learned in this study with information about their own treatment), or former patients with a mood disorder not currently in treatment. Because we wanted participants to have minimal previous knowledge about GAD to reduce potential ceiling effects, people who had taken a psychology course at any level or who had ever been diagnosed with an anxiety disorder were ineligible to participate.

Fifty-three patients indicated that major depression was their primary mood disorder and 32 indicated bipolar disorder (1 declined to specify). On average, patients were diagnosed at 32.3 years of age ($SD = 12.5$). In addition, 62 were currently in treatment, and 23 had received past treatment (1 declined to specify). Fifteen patients participated in psychotherapy only, 18 received medication only, and 52 were treated

with a combination of both (1 declined to specify). Seventy-two patients estimated an average treatment length of 72.3 months ($SD = 83.9$; 14 patients declined to specify).

Materials

Realistic auditory explanations of GAD were acquired by asking two experienced, board-certified psychiatrists what they would tell a patient just diagnosed with GAD about the disorder and the treatments they would typically prescribe. Clinicians were asked to mimic speaking to an actual patient and to confine their comments to what they would typically have time to say in an actual session. We audio-recorded these explanations, transcribed them, and then met again with each clinician. We asked them to identify from the transcript the most important points they would want their patients to take away from a real clinical session. On the basis of their feedback, we then created a visual causal model of each clinician's explanation using the Concept Builder software (Kim & Park, 2009; see Figure 1). Each clinician also generated eight questions to test participants' comprehension of the most important take-home information.

Procedure

The Northeastern University Institutional Review Board approved this project. All participants gave voluntary consent to participate and be audio-recorded (all patients also passed a pretest that assessed their capacity to consent). Patients were explicitly informed that they were participating in a research study and that they would not be receiving treatment or information about their own condition in this study. Participants in each group, lay person and patient, were randomly assigned to either the auditory-only or the visual causal model (dual-mode) condition for the duration of the experiment, and each was randomly assigned to learn information by Clinician I
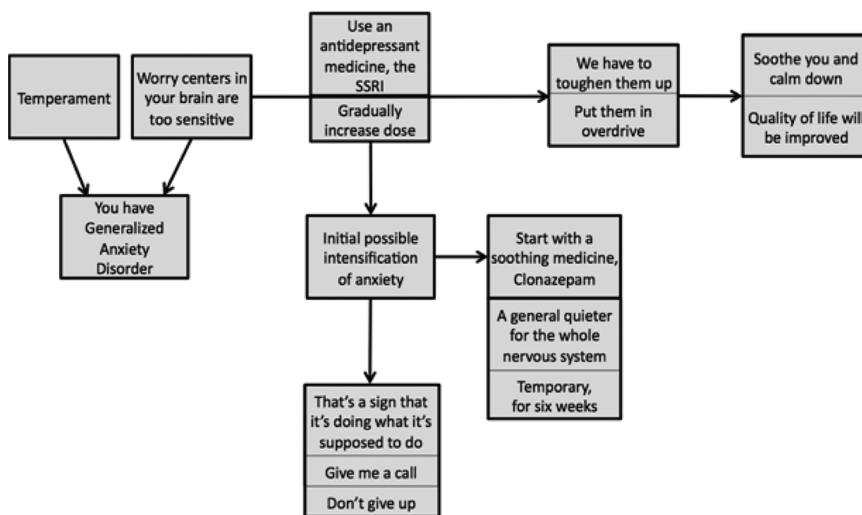

Figure 1. Sample visual causal model illustrating Clinician I's verbal explanation of generalized anxiety disorder and the treatment that Clinician I most typically prescribes. The wording of each phrase was taken verbatim from the clinician's explanation to correspond to the clinician's audio recording in the dual-mode condition.

or Clinician II. They took part in an initial in-person session, and a second session 4 weeks later over the phone.

In the initial, in-person session, each participant answered the eight comprehension questions before being presented with any information, establishing his or her baseline understanding of GAD and its treatments. The questions were read aloud by an experimenter in one of two fixed randomized orders, and participants' responses to each question were audio-recorded. Participants then received the information about GAD in either the auditory-only or visual causal model condition via Microsoft PowerPoint. In the auditory-only condition, the clinician's audio presentation was delivered while the participant sat before a blank screen. The visual causal model condition was identical except that the visual causal model was shown simultaneously with the audio presentation. In this condition, the relevant parts of the causal model appeared and remained on the screen when first mentioned by the clinician. Participants then answered the same eight comprehension questions a second time, in the same order.

Then, participants gave belief ratings on a Likert scale ranging from 1 (*do not believe it at all*) to 7 (*believe it completely*), reporting the extent to which they believed the information, and completed the short form of the Need for Cognition (NFC) Scale (Cacioppo & Petty, 1982; Cacioppo, Petty, & Kao, 1984), which consists of 18 statements designed to measure individual differences in inherent motivation to think about complex information (Cacioppo et al., 1984; e.g., "I like to have the responsibility of handling a situation that requires a lot of thinking") on a 9-point scale ranging from –4 (*strongly disagree*) to 4 (*strongly agree*). Participants in the visual causal model condition also rated (a) *visual causal model completeness* (i.e., how completely or insufficiently they felt the visual causal model illustrated the important points) on a scale of 1 (*very poorly*) to 7 (*very well*) and (b) *visual causal model helpfulness* (i.e., the degree to which they felt the visual causal model helped or hampered their understanding), on a 7-point scale ranging from 1 (*hurt understanding*) to 7 (*helped understanding*).

At the end of the first session, participants were asked to refrain from looking up any information regarding GAD until after we contacted them again for a telephone follow-up session. Participants were telephoned approximately 4 weeks after the initial session and were asked the comprehension questions a third time, in the same order. We then asked participants to verify that they had indeed refrained from looking up additional information on GAD between the two sessions. Experimenters transcribed participants' responses over the phone. Participants who could not be reached 7 weeks after the initial assessment were not contacted further. A total of 23 participants could not be reached (10 patients and 13 lay participants), yielding an 87.9% retention rate.

Results

Main Analyses

Responses to the eight comprehension questions were transcribed and scored on a 4-point scale for accuracy by two independent coders using a predetermined rubric. Discrepancies were resolved by discussion. Both coders were blind to participant type (lay person or patient), presentation (auditory-only or visual causal model), and assessment (before, after, and follow-up). Scores were summed for a maximum total knowledge score of 32; each participant had one total knowledge score for each of the three assessments (before, after, and follow-up).

Initial analyses indicated that none of the key findings differed by gender, race/ethnicity (divided by racial/ethnic minority participants and non-Hispanic White
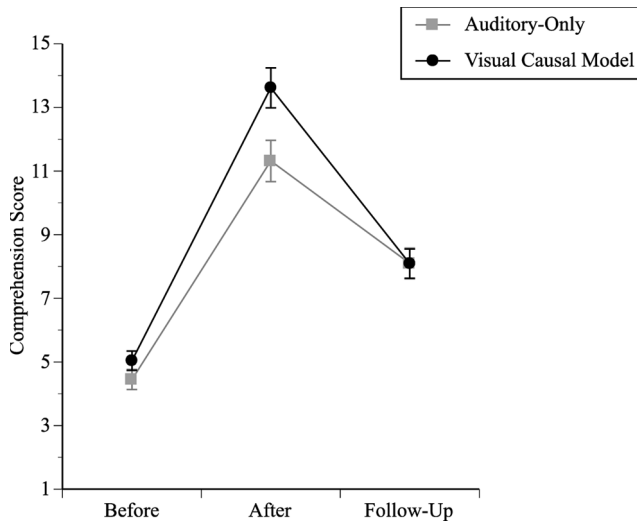
Figure 2. Mean comprehension scores before, immediately after, and 4 weeks following auditory-only and visual causal model (dual-mode) presentations of information about generalized anxiety disorder and its treatment. Bars depict standard errors.

participants), or level of education (divided by high school, college, and graduate school; all $ps > .23$); thus, these factors are not further discussed in this section. We consider demographic variables again in the Discussion section.

Immediate Learning

A 2 (assessment: before, after) × 2 (presentation: auditory-only, visual causal model) × 2 (participant type: lay, patient) mixed-factor analysis of variance (ANOVA) on knowledge scores before and immediately after receiving information revealed the critical interaction of assessment and presentation ($F[1,186] = 4.3$; $MSE = 15.9$; $p < .04$). Specifically, the net gain in knowledge following the visual causal model presentation ($M = 8.7$, $SE = 0.6$) was larger than the net gain in knowledge following the auditory-only presentation ($M = 7.0$; $SE = 0.6$; $t[188] = 1.9$; $p = .05$). There were main effects of assessment ($F[1,186] = 352.5$; $MSE = 15.9$; $p < .01$) and presentation ($F[1, 186] = 6.3$; $MSE = 31.2$; $p = .01$); however, these were qualified by the above interaction (see Figure 2).

There was also an interaction of assessment and participant type ($F[1,186] = 12.8$; $MSE = 15.9$; $p < .01$); lay people's mean net gain in knowledge scores immediately after any information presentation ($M = 9.2$, $SE = 0.6$) was greater than the mean net gain for patients ($M = 6.3$, $SE = 0.6$; $t[188] = 3.5$; $p < .01$). There were no other findings (all $ps > .24$), and it is notable that there was no three-way interaction of assessment, presentation, and participant type, indicating that the relative advantage of the visual causal model presentation compared with the auditory-only presentation did not differ between patients and lay people.

Learning Retention

A 2 (assessment: before, follow-up) × 2 (presentation) × 2 (participant type) mixed-factor ANOVA on knowledge scores before and 4 weeks after receiving information

revealed a main effect of assessment ($F[1,163] = 107.3$; $MSE = 9.0$; $p < .01$). People's scores remained higher 4 weeks after the presentation ($M = 8.1$, $SE = 0.3$) than their initial scores before the presentation ($M = 4.7$, $SE = 0.2$). This finding was qualified by an interaction of assessment and participant type ($F[1,163] = 7.3$; $MSE = 9.0$; $p < .01$); lay people's mean net gain in knowledge scores 4 weeks later ($M = 4.3$, $SE = 0.5$) was greater than the mean net gain for patients ($M = 2.5$, $SE = 0.5$; $t[165] = 2.7$; $p < .01$). There were no other main effects or interactions (all $ps > .47$; see Figure 2).

Secondary Analyses

Belief Ratings
A 2 (presentation) × 2 (participant type) univariate ANOVA, conducted on people's ratings of how much they believed the GAD information, revealed no main effects or interactions (all $ps > .15$). Ratings were relatively high overall ($M = 5.9$, $SE = 0.1$, on a 7-point scale), suggesting that lay and client participants generally received the clinicians' information without significant amounts of skepticism.

NFC Scores
We obtained an overall NFC score for each participant by summing his or her numerical responses on the 18 items. Because each item was rated on a –4 to 4 scale, the range of possible NFC scores was –72 to 72, with the highest positive scores indicating that an individual is inherently very interested in thinking about complex information. A 2 (presentation) × 2 (participant type) univariate ANOVA conducted on participants' overall NFC scores revealed no main effect of presentation ($p = .89$). Therefore, our main findings are not attributable to past differences in NFC between people randomly assigned to the auditory-only and visual causal model conditions. There was no interaction ($p = .96$). There was a main effect of participant type; our sample of lay people had a higher NFC ($M = 20.7$, $SE = 2.2$) than did patients ($M = 12.1$, $SE = 2.7$; $F[1, 185] = 6.1$; $MSE = 565.8$; $p = .01$). This last finding may help explain why lay people's net gain in knowledge scores immediately after any presentation was greater than for patients.

Visual Causal Model Ratings
Visual causal models were judged to be helpful overall ($M = 6.3$, $SE = 0.1$); again, lay people and patients did not differ ($p = .78$). Thus, not only did people learn more from visual causal models, they also explicitly reported that they were helpful. Lastly, visual causal models were considered complete ($M = 6.0$, $SE = 0.1$), and lay people and patients did not differ regarding this assessment ($p = .40$).

Discussion

Patients and lay people showed better comprehension of causal information about treatments for GAD when given a visual causal model to accompany an auditory presentation than when given the auditory presentation alone. The advantage from visual causal models held only for initial learning, but we suggest that initial learning will have the most effect on whether people choose to begin following treatment recommendations in the days immediately following the clinical session. We speculate that initial learning may be most critical from a practical standpoint, although this latter claim remains to be tested explicitly.

In both immediate learning and in longer-term retention, lay people's learning generally exceeded that of patients, regardless of the type of presentation. It is possible that this difference could be attributed to the cognitive impairment (e.g., diminished ability to concentrate) associated with mood disorders such as depression. Because we did include patients who were currently in treatment for a mood disorder, in addition to those who were no longer showing symptoms, a substantial subset of our patients could have been dealing with this impairment at the time of the study. This possibility is indirectly supported in that NFC scores were higher for lay people than patients. Thus, it is especially important to note again that there was no three-way interaction of assessment, presentation, and participant type for immediate learning; that is, our key findings did not differ between lay people and patients, despite any possible cognitive impairment in the patients. A 2 (assessment: before, after) × 2 (presentation: auditory-only, visual causal model) ANOVA conducted on only the patient data shows the same critical Assessment × Presentation interaction for immediate learning as for the full data set (F[1, 84] = 5.3; MSE = 14.4; p = .02). That is, even patients' net gain in knowledge following the visual causal model presentation (M = 7.6, SE = 0.8) was larger than that following the auditory-only presentation (M = 4.9, SE = 0.8; t[84] = 2.3; p = .02).

Overall, participants retained some new information for an entire month after a single presentation of information. Yet, memory, regardless of presentation mode, did drop substantially in the month after the initial information session (t[166] = 11.9; p < .001), reinforcing the need for clinicians to revisit basic information about treatment in follow-up visits. To create a stringent test of our main hypothesis, we explicitly asked study participants to avoid looking up the material after the clinical session, and we did not provide information to review at home. It seems likely that more encouraging results regarding retention may be seen when rehearsal is not prohibited. The present study instead highlights initial learning, which presumably sets the stage for future rehearsal and consolidation of information. Future research may reveal the relative effect of continued rehearsal, and the nature of the relationship between memory for the causal information and continued adherence to treatment. For example, it may be that once a patient establishes the initial habit of following the prescribed treatment plan, specific memories become less important.

This study provided an initial test of the application of multimodal theory (Mayer, 2006) to target enhanced learning of the causal structure of disorders by diagnosed mental health patients. We tested patients diagnosed with mood disorders and lay people for their comprehension of information about GAD, which lay people have been previously shown to inadequately understand (Coles & Coleman, 2010). To generalize to patients with other disorders, future studies are necessary. We speculate that the superiority of presentations incorporating visual causal models will be generally found, but we caution against extrapolating these findings to patients lacking insight, pending additional targeted research.

We view this clear demonstration of the immediate positive effects of visual causal models in clinical communication as a launching point for more expansive work in this field. Additional work will also be necessary to determine whether other visual formats will elicit similar positive effects on patient comprehension, and for what kinds of information (e.g., about different types of treatment). Extensive work in cognitive science has demonstrated the particular effectiveness of box-and-arrow diagrams in transmitting complex causal information (Tversky, 2011), but past research has also pointed to the usefulness of other visual media formats, such as animation. It may

also be the case that verbal delivery is sufficient for some kinds of information (e.g., noncausal); this, too, remains to be tested.

Lastly, our study sample was characterized by a large proportion of racial and ethnic minority participants. Data from the 2010 U.S. Census (Humes, Jones, & Ramirez, 2011) indicates that whereas the non-Hispanic White population of the U.S. increased by 1.2% from 2000 to 2010, the racial and ethnic minority population increased by 28.8% in that same time period, with similar trends expected to continue; thus, our sample may be reflective of the future overall minority population of the United States. That said, despite implementing special recruiting efforts, we could not recruit as many Hispanic and Asian patients as we would have liked, which is perhaps not surprising given that marked underuse of mental health resources has been well documented in these subpopulations (e.g., G. Kim, Aguado Loi, et al., 2011; G. Kim, Jang, Chiriboga, Ma, & Schonfeld, 2010). Thus, as described in the Results section, we combined ethnic/racial minority participants together in our analyses, and we could not run more refined group comparisons. These broad analyses showed that the key findings did not differ by general ethnic/racial minority status, and our speculation is that they are likely to hold true across the different minority subpopulations in future, targeted experiments.

Practical Implications

Heavy caseloads can necessitate short clinical sessions, rushed explanations, and the inability to check for adequate comprehension of instructions about treatment. However, patient understanding of the causal structure of the disorder, and the causal effect of prescribed treatment, is critical. For example, some very commonly prescribed medications (e.g., selective serotonin reuptake inhibitors, frequently prescribed for both anxiety and mood disorders) and therapies (e.g., cognitive-behavioral therapies) can have the counterintuitive property of making symptoms temporarily worse before they get better (Deacon, 2012; Haslam, Brown, Atkinson, & Haslam, 2004; U.S. Department of Health and Human Services, 2009). A patient's failure to understand such counterintuitive properties of therapy can easily increase the likelihood of attrition from treatment. Increased patient understanding of exactly how such medications and therapies work upon the causal structure of the disorder, explicitly shown here to be facilitated by visual causal models, should lead to better-informed patient decisions, whether patients ultimately choose to follow prescribed treatment plans or not.

We therefore propose that it can be useful and practical for clinicians to use visual causal models to supplement their explanations in everyday practice. An effective strategy might be to predraw simple visual causal models customized to fit one's own usual explanations for common conditions and treatments, such as that depicted in Figure 1. Causal models can be easily constructed using the standard drawing tools in Microsoft Word or PowerPoint. For those who prefer a more flexible drawing tool, the open-source software package, ConceptBuilder (N. S. Kim & Park, 2009) is highly user-friendly, usability-tested software for drawing and presenting causal models that is compatible with all major platforms (including Microsoft Windows, Macintosh OS X, Linux). It is also publicly available for free download at www.northeastern. edu/ccl/?page_id=39. Using PowerPoint, ConceptBuilder, or other graphical drawing tools, clinicians can edit their visual causal models on an office computer while explaining to patients, and e-mail or print copies of these causal models for patients

to take home. Clinicians and staff could also prepare preprinted paper copies for clinicians to use while speaking with patients; clinicians could circle key points during the discussion (e.g., the point that it is crucial to keep taking the medication or continuing with therapy even if symptoms seem to get worse at first), and write in additional notes in response to patients' questions.

Ultimately, making visual causal models could also potentially help promote collaboration between health care professionals and reduce confusion and misunderstanding in patients who see more than one clinician. In addition, preparing visual handouts may make it more likely that patients reengage in clinical information at a later date, increasing learning. Having handouts could also make it easier for patients to formulate questions and engage in discussion with their clinicians instead of passively receiving information. These latter possibilities remain to be directly tested, and would further bolster the case for the use of visual causal models in clinical explanation.

Our findings also suggest avenues for further development of ways to transmit current and accessible information about disorders and their treatments to patients at large clinical settings and hospitals. For example, further investigations may determine whether hospitals should develop handouts or videos for patient use (e.g., to convey important information at discharge) that incorporate visual causal models.

In sum, we showed that presentations of information with visual causal models improve patients' and lay people's understanding of information about GAD and its treatment relative to a traditional, auditory-only presentation. These findings remain to be tested with other types of patients, other disorders, and in real-life settings, but these initial, experimentally controlled results strongly suggest that clinicians can apply the principles of causal concepts and of multimodal theory to help patients achieve a better understanding of their disorders and treatment.

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