Using Network Theory for Psychoeducation in Eating Disorders

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Abstract

Background Negative illness representations such as self-blame impede treatment-seeking behavior and therapy motivation in individuals with eating disorders (EDs). However, only one study so far has investigated how different explanatory models influence these beliefs in EDs. We aimed to expand these findings by introducing an explanatory model based on network theory (NT).

Methods We presented three explanatory models to a diverse web-recruited sample (n = 290, 141 females, 149 males) with clinically elevated ED symptomatology. Participants either watched a video with a biological-genetic (BG), cognitive-behavioral (CB) or an NT explanatory model and were asked about illness representations before and after watching the video.

Results The BG group showed significantly greater reductions in self-blame but a significant decrease in personal control and less optimistic expectation regarding timeline compared to the CB and NT groups. There were no group differences regarding the perception of the clinician, comprehensibility of the explanatory model and credibility of a CBT intervention.

Conclusions Given the increasing popularity of biological-genetic explanatory models of EDs, it is important to note the disadvantages we found to be associated with these models. Our findings indicate that explanatory models emphasizing cognitive-behavioral (CB) principles and/or network theoretical (NT) underpinnings of EDs may serve to promote optimism and greater perceptions of personal agency in affected populations.

This trial's registration number is 316.

Introduction

Eating disorders (EDs) represent one of the most severe and complex mental illnesses that occur with a lifetime prevalence of 0.3% to 4.1% in men and 0.9% to 8.6% in women (Deloitte Access Economics 2020; Hudson et al. 2007). Approximately one third of patients with bulimia nervosa (BN) and anorexia nervosa (AN) attempt suicide (Franko and Keel 2006). Overall, twice as many patients with BN and five times as many patients with AN die prematurely in comparison to the general population (Arcelus et al. 2011) with AN being one of the most lethal conditions among mental illnesses (Keshaviah et al. 2014). Alarming,

however, only a minority of those qualifying for an ED diagnosis are seen in primary care, and even fewer receive mental health treatment (Hart et al. 2011; Hoek and van Hoeken 2003), although evidence-based treatments for EDs exist (Hay 2013).

Illness Representation in EDs

According to the common sense model (CSM) of illness (Leventhal et al. 1980, 1992), individuals develop emotional and cognitive representations of health threats which influence the way they manage symptoms (e.g., avoidance or approach coping) and consequently the way individuals engage in help-seeking behavior or in therapy. There are five cognitive dimensions of illness representations: *cause* (i.e., individuals' understanding of the etiology/origin of their illness), *control/cure* (i.e., perceived personal control over the illness), *consequence* (i.e., perceived impact of the illness on their lives), *identity* (i.e., the extent to which they identify with their illness), and *timeline* (i.e., perceived chronicity of symptoms). Studies around mental illness show that negative illness representations can impede help-seeking

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and treatment effectiveness (Meyer et al. 2002; Rutherford et al. 2010). Moreover, they can facilitate the endorsement of *self-stigma* (Chan and Mak 2016) which, besides shame, represents the most cited barrier for individuals with ED who would otherwise seek help (for a systematic review see Ali et al. 2017).

Thus far, two studies have investigated illness representations in EDs. Holliday et al. (2005) asked 95 individuals with AN to complete the Illness Perception Questionnaire – Revised (IPQ-R, Moss-Morris et al. 2002) and found that affected individuals thought of their illness as chronic, distressing, barely controllable or curable, and associated with strong negative consequences. Participants identified their emotional state and personality as the most prominent causes for their illness. In contrast, another study employing the IPQ-R found that 98 females diagnosed with AN, BN, or an eating disorder not otherwise specified (EDNOS) described their illness as rather controllable or curable, but highly distressing, chronic, and associated with severe consequences (Marcos et al. 2007). Psychoeducation can be an effective tool to target illness perceptions, reduce self-blame and, potentially, foster help-seeking behavior, and motivation to engage in therapy. However, few studies so far have investigated how specific explanatory models influence the way individuals think about their pathology and even less is known about how explanatory models influence illness perceptions in individuals with EDs. Most research has focused on investigating the influence of purely genetic or biological explanations, (i.e., explanations that characterize mental illnesses as “brain diseases”; Deacon and Baird 2009; Kemp et al. 2014; Lebowitz et al. 2013), as such explanations have recently been put forward to call for recognition of EDs as biologically-based serious mental illnesses (Klump et al. 2009). However, genetic essentialism (i.e., the notion that mental illnesses have immutable essence; Dar-Nimrod and Heine 2011; Haslam 2011) introduces certain biases (e.g., an illness’s course is determined and barely influenceable) that, in line with attribution theory (Weiner et al. 1988), may reduce feelings of self-blame but foster feelings of diminished control and chronic timeline (for a review see Lebowitz and Appelbaum 2019). We were interested in exploring whether a new explanatory model of EDs that is less widely-recognized but supported by a sufficient evidence base (i.e., Network Theory [NT]) could show promise as an alternative psychoeducation approach.

Previous studies investigating the influence of different explanation models on stigmatization of AN in non-affected lay persons showed biological/genetic explanations to yield less stigma than sociocultural explanations (Crisafulli et al. 2008, 2010). Farrell et al. (2015) were the first to assess the effect of psychoeducation on illness perception in individuals with EDs. They presented videos of a clinician who either described the development of EDs from (1) a

cognitive-behavioral (CB) perspective, (2) a purely biological, biological-genetic perspective (BG), or (3) from a genetic perspective while at the same time pointing to potential environmental influences (i.e., biological malleability). Concerning self-efficacy and perceived controllability of symptoms, participants in the CB and biological malleability condition reported significantly greater self-efficacy in overcoming ED symptoms and perceived control over their symptoms than participants in the BG condition. Moreover, for participants in the CB condition, perceived symptom immutability was significantly lower than for participants in the BG condition. In contrast to other studies that showed greatest reductions in self-blame after the presentation of a BG rationale (e.g., Lee et al. 2016; Rüsch et al. 2010), there were no group differences concerning the predicted likelihood of symptom remission and in self-blame. As expected, participants in the CB group reported highest perceived credibility of cognitive-behavioral therapy (CBT) and greater expectations regarding its efficacy.

Network Theory in Eating Disorders

In recent years, researchers have increasingly been using network theory (NT; Borsboom 2017; Hofmann et al. 2016; McNally 2016) to describe the development and maintenance of mental illness. NT postulates that psychopathological symptoms *cause* one another and that these direct causal links can ultimately lead to the development of a mental disorder. For instance, sleep disturbance might lead to low energy and psychomotor slowing, which are three symptoms commonly observed in people who are depressed. This NT view differs from traditional medical views and genetic essentialism that posit the existence of an underlying ‘common cause’ whose presence is reflected by the symptoms it causes. Thus, NT postulates a more dynamic understanding of mental illness with an emphasis on the *interactions* between symptoms (e.g., in the context of EDs: fear of weight gain leads to restrictive eating, which fosters occasional binge eating). Network studies on ED symptoms have identified cognitive symptoms such as overvaluation of shape and weight to be especially important (“central”) for the network as a whole (e.g., Forrest et al. 2018; Meier et al. 2019; Wang et al. 2019). Preliminary results indicate that these symptoms are important predictors of treatment outcome (Elliott et al. 2020), and first studies investigate how NT can elucidate different treatment targets for individuals with EDs (Christian et al. 2020). Despite NT’s recent prominence in research and the availability of personalized networks (Epskamp et al. 2018), no study so far has investigated how an NT rationale could be integrated into psychoeducation, let alone how such a rationale would influence illness perception in affected individuals. Given EDs’ complexity, high rates of comorbidity and diagnostic crossover,

the illustration of illness pathways in the form of a symptom network and an emphasis on the influence of central symptoms might help affected individuals to better understand ED development and manifestation. By explicitly providing a rationale that no singular underlying (e.g., biological) cause determines ED onset or maintenance, patients might experience a boost in their sense of personal control. There appear to be many overlaps of NT with the rationale behind CBT. Overall, CBT targets maladaptive thinking to influence behavioral and emotional distortions. Enhanced CBT (CBT-E) which represents a transdiagnostic treatment approach for EDs (Fairburn et al. 2003), focuses especially on a dysfunctional scheme for self-evaluation (i.e., overevaluation of eating, shape, and weight) and its links to behaviors (dieting) and emotions (mood intolerance). While we do not suggest that NT and CBT models are completely different, we propose that NT offers another framework and another language that is worth exploring in the context of educating affected individuals about their condition. As pointed out by Levinson et al. (2018), network analysis (NA) could be used to directly test CBT models, could further support the development of treatment directly targeted at specific symptoms, and help clinicians to decide which symptom to address first. Moreover, we suggest that NT provides a framework that allows the integration of various factors (e.g., biological factors) which resonates with the diverse interdisciplinary research field around EDs. In light of these advantages, we aimed at investigating whether an explanation model based on NT would differ from CB and BG models.

Current Study

Our study built on Farrell's findings by developing four novel aims: First, we aimed at investigating the effect of a psychoeducational rationale comprising an NT explanatory model. This NT rationale differs from the CB rationale used by Farrell et al. (2015) in so far that it (1) clearly states that there is no underlying "essence", (2) links disorder development and maintenance in one coherent explanatory model, and (3) points to diverse explanatory factors such as cognitions, experiences, behavior, and emotions. Overall, we aimed to compare the effects of this rationale to the effects of a BG and a CB rationale on illness representation (prognostic expectation, perceived personal control, understanding of symptoms) and self-blame. To enhance comparability with prior research on illness representations in EDs (Holliday et al. 2005; Marcos et al. 2007), we included the IPQ-R. Second, we expanded on previous analyses by investigating whether the severity of depressive symptoms (i.e., greater severity of depression symptoms) impedes changes in illness representations, as negative affect has been found to account for 29% of the variance in the emotional representation of an illness (Moss-Morris et al. 2002). We were interested

in examining whether the severity of depressive symptoms broadly prohibits changes in illness representations (i.e., across conditions), and whether this interference differs depending on the psychoeducational rationale presented.

Third, we investigated how different psychoeducational rationales influence the perception of the clinician who presents these rationales. One study by Lebowitz et al. (2015) presented participants with different case vignettes and found that clinicians using a biological explanation model were described as less warm and, depending on the respective illness, more competent. We were interested in how a rather technical and analytic NT rationale would influence the perception of the clinician presenting the rationale as the perception of a clinician as warm and competent is crucial for the therapeutic alliance (Ackerman and Hilsenroth 2003). Fourth, a major limitation of previous studies was that participants exclusively rated illness perceptions and self-blame after receiving psychoeducation. We additionally assessed baseline illness perception and self-blame to control for *a priori* group differences and to detect to what degree these variables effectively changed through psychoeducation.

Considering previous findings (Farrell et al. 2015), we expected participants in the CB and NT conditions to report a greater change towards optimistic prognostic expectation (i.e., a more acute rather than chronic timeline), greater personal control over symptoms, and greater illness coherence than participants in the BG condition. With regard to Lebowitz et al. (2015), we hypothesized that participants in the CB and NT condition would perceive the clinician to be warmer than would participants in the BG condition and that they would rate the credibility and expectancy of a CBT intervention as more favorable than the BG condition. Considering Farrell et al. (2015) null-findings in self-blame differences, we expected to see no differences between conditions with regard to their feelings of self-blame. Exploratory analyses comprised ratings of logic/comprehensibility of the rationales and ratings of perceived clinician competence.

Method

Participants

Initially, 800 individuals entered this survey. Four hundred and eleven individuals were excluded during the screening procedure after: indicating they were not fluent in English ($n=23$), failing a brief test of English proficiency ($n=27$), reporting they have either previously been ($n=80$) or were currently ($n=88$) in treatment for ED, failing an attention check meant to confirm engagement in the study ($n=6$) or not meeting the clinical cutoff on the Eating Disorder Examination Questionnaire ($n=187$; EDE-Q; Fairburn and Beglin 2008). Of the remaining 389 individuals who participated in

the study survey, data from a total of 99 individuals could not be included in our analyses because these participants did not pass an instructional manipulation check ($n = 27$; Oppenheimer et al. 2009), could not answer a straightforward multiple-choice question about the experimental manipulation ($n = 25$ in the NT condition, $n = 17$ in the CB condition, $n = 17$ in the BG condition), reported technical difficulties ($n = 17$), did not confirm that their de-identified data could be used for scientific purposes ($n = 1$), or stated to have all potential mental illnesses listed ($n = 1$). Our final sample comprises data from 290 individuals (141 women, $M_{\text{age}} = 36.11$, $SD_{\text{age}} = 10.22$, $\text{range}_{\text{age}} = 20\text{--}71$). Half of the participants held a Bachelor's degree (47.93%) and 289 were United States citizens, one participant in the CB condition stated currently living in the United Kingdom. On average, participants scored 3.76 on the EDE-Q ($SD = 0.83$). Participants were randomly assigned to the NT ($n = 94$), CB ($n = 94$), and BG ($n = 102$) condition. For demographic and clinical characteristics of the sample see Table 1.

Procedure and Materials

All participants were recruited via Amazon Mechanical Turk (MTurk). MTurk is a crowd-working platform that offers individuals opportunities to complete short tasks for monetary compensation. MTurk has increasingly been used for social science research as it allows for the recruitment of more diverse samples and subpopulations with specific characteristics (Mortensen and Hughes 2018) and reliability that is comparable to data obtained through traditional methods (Buhrmester et al. 2016). We used internet-based

recruitment as individuals with EDs rarely seek help and because we did not want to interfere with ongoing or past treatment which precluded on-site recruitment. As stated above, we tested participants' English language proficiency, attention, and their understanding of the experimental manipulation as a means of checking data integrity.

We asked individuals to participate if they believed that "thoughts about food, weight, and appearance may be taking up too much of [their] time." Following the study link, participants were informed about the study's procedure. If they gave informed consent, they entered a short screening for English proficiency, attention, and clinically relevant ED symptomatology. If they passed the screening and were willing to receive feedback on symptom severity, they first received feedback that they scored higher than average on a questionnaire measuring symptoms of EDs which potentially points to a heightened risk for developing an ED or that they might currently meet diagnostic criteria for an ED. Participants were then forwarded to the main survey. The main survey consisted of five parts: First, participants were asked about their current illness representations and feelings of self-blame. Second, participants were randomly assigned to one of three conditions. Each group watched a different video in which the third author (B.J.S.) gave a specific explanation for the manifestation and maintenance of EDs. Videos were standardized considering camera position, lighting, and introductory general information about EDs. In the NT condition, EDs were described as a network of interacting symptoms (3:26 min). In the CB condition, EDs were described to result from a vicious cycle of cognitions, emotions, and behaviors (3:19 min). In the BG

Table 1 Demographic and clinical characteristics of the sample

Scale	Total ($n = 290$)	NT ($n = 94$)	CB ($n = 94$)	BG ($n = 102$)
<i>M</i> age (<i>SD</i>)	36.11 (10.22)	34.45 (9.97)	37.04 (10.15)	36.78 (10.41)
% female	48.62%	41.49%	45.74%	57.84%
% no degree	0.69%	1.06%	0.00%	0.98%
% high school diploma	13.45%	19.15%	9.57%	11.76%
% college degree	24.83%	29.79%	26.60%	18.63%
% Bachelor's degree	47.93%	40.43%	51.06%	51.96%
% Master's degree	12.41%	9.57%	12.77%	14.71%
% other degree	0.69%	0.00%	0.00%	1.96%
<i>M</i> EDE-Q score (<i>SD</i>)	3.73 (0.83)	3.73 (0.78)	3.72 (0.81)	3.74 (0.91)
<i>M</i> restraint (<i>SD</i>)	3.76 (1.32)	3.68 (1.35)	3.86 (1.26)	3.74 (1.36)
<i>M</i> eating concern (<i>SD</i>)	2.65 (1.32)	2.59 (1.30)	2.54 (1.25)	2.81 (1.40)
<i>M</i> shape concern (<i>SD</i>)	4.42 (0.98)	4.48 (0.97)	4.38 (0.95)	4.39 (1.03)
<i>M</i> weight concern (<i>SD</i>)	4.10 (0.91)	4.17 (0.81a)	4.09 (0.89)	4.05 (1.02)
<i>M</i> PHQ-9 (<i>SD</i>)	10.11 (5.71)	9.35 (5.74)	10.29 (5.46)	10.65 (5.88)
<i>M</i> Number of Psychological Diagnoses (lifetime) (<i>SD</i>)	0.94 (1.36)	0.80 (1.45)	0.96 (1.16)	1.05 (1.44)

Note. NT network theory, CB cognitive-behavioral, BG biological-genetic, *M* mean, *SD* standard deviation, *n.s.* non-significant, *EDE-Q* Eating Disorder Examination Questionnaire, *PHQ-9* Patient Health Questionnaire (Depression)

condition, EDs were described as brain disorders (3:08 min). The script for these psychoeducational videos can be found in the supplementary materials (i.e., Supplementary Material 1). Third, participants rated the clinician's warmth and competence as well as the logic and comprehensibility of the rationale presented and were asked again about their illness representations and self-blame. Previous studies (e.g., Lebowitz et al. 2013; Farrell et al. 2015; Lee et al. 2016) had indicated that similar items assessing illness representations and self-blame were sensitive to change.

Fourth, following the methodology of Farrell et al. (2015), participants were presented with a description of a CBT intervention for EDs and were subsequently asked to rate credibility and expected efficacy of the interventions. Fifth, participants filled out a demographic questionnaire, were asked about the severity of current depressive symptoms, and were debriefed. Finally, all participants were directed to a list of resources as well as national suicide hotlines with embedded links. Participants received \$6.50 upon completing the survey. The study's protocol was pre-registered and approved by the Institutional Review Board of the University of Muenster, Germany.

Measures

Eating Disorder Examination-Questionnaire (EDE-Q)

The EDE-Q version 6.0 (Fairburn and Beglin 2008) is the self-report questionnaire version of the Eating Disorder Examination (EDE) semi-structured Interview (Cooper and Fairburn 1987). It assesses ED behaviors (e.g., binge eating, purging) and attitudinal features of ED (e.g., overvaluation of body shape) over the last 28 days. For this study, we only presented the 22 attitudinal items that are necessary to calculate the EDE-Q's global score. The 22 attitudinal items are assessed with a seven-point forced-choice format ranging from 0 to 6, with higher scores indicating greater levels of pathology. The EDE-Q has good psychometric properties (Berg et al. 2012) and reliably differentiates between clinically impaired and mentally healthy individuals (Mond et al. 2004). Studies with clinical samples indicated that nearly half of those with an ED diagnosis score lower than the cutoff of 4 on the EDE-Q (Aardoom et al. 2012). In line with studies using receiver operating characteristics analysis (Mond et al. 2004), we lowered the clinical cut-off from 4 to 2.3. In this study, the EDE-Q demonstrated good internal consistency ($\alpha = 0.85$).

Attitudes Toward Eating Disorder Symptoms (AEDS)

In line with Farrell et al. (2015), we assessed self-blame with two items taken from the AEDS, (adapted from Lebowitz

et al. 2013, i.e., "I think it is my own fault that I currently experience eating disorder symptoms" and "How personally responsible do you think you are for your eating disorder symptoms?") on a scale from 1 = not at all to 9 = very much. Internal consistency was excellent for both baseline and post ($\alpha = 0.95$).

The Illness Perception Questionnaire – Revised (IPQ-R)

The IPQ-R (Moss-Morris et al. 2002) assesses the cognitive illness representations from the CSM of illness (Leventhal et al. 1992). In this study, we presented the subscales (1) *timeline* (acute vs. chronic; e.g., "I expect to have this illness for the rest of my life") with five items, (2) *personal control* (e.g., "There is a lot which I can do to control my symptoms") with six items, and (3) *illness coherence* (e.g., "The symptoms of my condition are puzzling to me") with five items. The IPQ-R uses a five-point Likert scale from "strongly disagree" to "strongly agree". Internal consistency was good for *timeline* for both baseline and post ($\alpha = 0.88$ and $\alpha = 0.86$, respectively) and *control* ($\alpha = 0.88$ and $\alpha = 0.86$, respectively). Internal consistency was excellent for *illness coherence* for both baseline and post ($\alpha = 0.94$ and $\alpha = 0.91$, respectively).

Warmth/Competence Questionnaire

Following (Lebowitz et al. 2015), we used two sets of 9-point bipolar semantic-differential scales to assess participants' perception of B.J.S.'s warmth (e.g., warm – cold) and competence (e.g., unskilled – skilled) with eight scales each. Internal consistency was excellent for ratings of warmth ($\alpha = 0.91$) and good for ratings of competence ($\alpha = 0.86$).

Logic/Comprehensibility Questionnaire

To explicitly explore how logical and comprehensible each rationale was, we presented two short questions, i.e., "How logical/comprehensible did Dr. Summers' (the psychologist in the video) explanation for eating disorders appear to you?" Participants were asked to rate logic/comprehensibility on a 7-point Likert scale from "not at all" to "very".

Credibility/Expectancy Questionnaire (CEQ)

The CEQ (Borkovec and Nau 1972; Devilly and Borkovec 2000) assesses credibility and expectancy of a treatment. Three items assess the more cognitively-based treatment credibility (e.g., "At this point, how logical does the therapy offered to you seem?") and three items assess the emotionally-based expectancy efficacy (e.g., "By the end of the therapy period, how much improvement in your symptoms do you think will occur?"). In this study, we used the CEQ

to assess how participants thought/felt about the following CBT rationale for ED: “*Some clinicians recommend that psychotherapy for eating disorder symptoms should aim to change the way that individuals think about their weight and shape. Furthermore, they suggest that individuals suffering from disordered eating should try feared foods to break unhealthy patterns of dietary restriction*”. In line with Nock et al. (2007) we recoded items 4 and 6 that are scored on a 11-point scale (0–100%) by collapsing values 40–60% into one value to conform to the 9-point scale that was used for the other items. Each subscale thus ranges from 3 to 27, with high scores indicating greater perceived credibility or expected efficacy of CBT. The CEQ has demonstrated good internal consistency and test–retest reliability (Devilly and Borkovec 2000). Internal consistency was excellent for both credibility and expectancy ($\alpha=0.91$ and $\alpha=0.94$, respectively).

The Patient Health Questionnaire (PHQ)

The PHQ (Spitzer et al. 1999) is based on the DSM-IV (American Psychiatric Association 2013) criteria and assesses the symptoms for mental disorders and subthreshold diagnoses on different subscales. We only presented the PHQ-9 (Kroenke et al. 2001) which comprises nine symptoms that are listed in the DSM-IV for major depressive disorder. Subjects are asked how much these symptoms have bothered them over the last two weeks on a 5-point Likert scale from *not at all* to *barely every day*. The total sum score thus reflects symptom severity. We did not present item 9, which assesses suicidality. Internal consistency was good ($\alpha=0.87$).

Data Analytic Plan

To investigate the influence of the rationales on illness perception, self-blame, and perception of the clinician, we performed general linear model analyses. For each of these dependent variables, a linear model was calculated using the rationales as an independent variable. We tested the respective beta weight differences against zero. This procedure is equivalent to carrying out an ANOVA and post-hoc t-tests. We adjusted for multiple testing by applying false discovery rate (FDR) correction to all p-values. We corrected per “family”, i.e., within each dependent variable family (illness perception, self-blame, clinician perception). Within-group effect sizes were calculated as standardized mean change using raw score standardization (d_{pp}). Between-group effect sizes for pre-post measures were calculated using the d_{ppc2} formula recommended by Morris (2008), which uses pooled pretest SD for standardization and will be denoted by d_{ppc} in the following. Between-group effect sizes for variables measured only once after the experimental manipulation

(e.g., variables related to the perception of the clinician) were calculated as Cohen’s d . For secondary analyses, we examined whether the severity of depressive symptoms, as well as comprehensibility and plausibility of the presented rationale had an impact on changes in illness perceptions beyond the influence of the rationale.

Results

Primary Analysis

Descriptives of the primary outcome measures are depicted in Fig. 1 (for details see Table S2 in the Supplementary Materials) and Table 2. For illness representations and self-blame the outcome was the change from baseline ratings to ratings after watching the psychoeducational video. Note that negative changes in timeline depict a more optimistic prognostic illness representation after watching the video whereas positive changes in personal control and illness coherence reflect a change towards a more positive illness representation. There were no baseline differences on any outcome measure between conditions (for details please see Table S1 in the Supplementary Materials). Outcome measures were analyzed in terms of whether they differed between conditions.

We inspected the data for outliers (i.e., ± 1.5 times the interquartile range) and ran analyses with and without these data points. The observed pattern of findings was largely more pronounced after excluding outliers. However, we opted to retain these data points in study analyses in order to be more conservative. Please refer to the Supplementary Material for a full description of the results of the analysis of influential observations.

Illness Perception

Timeline

Although participants in each condition reported a more optimistic prognostic expectation (i.e., shorter illness duration) after watching the video, participants in the CB and NT condition reported a significantly greater change than participants in the BG condition (CB vs. BG: $t(287) = -2.23$, $p = 0.033$, $d_{ppc} = -0.23$; NT vs. BG: $t(287) = -3.65$, $p < 0.001$, $d_{ppc} = -0.38$). Changes in illness perception in the CB and NT condition did not differ significantly ($t(287) = -1.39$, $p = 0.495$, $d_{ppc} = -0.15$). Within-group changes were significant for the NT and CB group ($ps < 0.001$, $d_{pp} = -0.44$ and -0.30 , respectively) but not for the BG group ($p = 0.53$, $d_{pp} = -0.06$).

Fig. 1 Means and standard errors of illness perception variables for each group at pre and post assessment. *NT* network theory, *CB* cognitive-behavioral, *BG* biological-genetic, *M* mean, *SE* standard error, *Pers. Control* personal control, *Coherence* illness coherence

Table 2 Primary outcome measures

Scale	NT (<i>n</i> = 94) <i>M</i> (<i>SD</i>)	CB (<i>n</i> = 94) <i>M</i> (<i>SD</i>)	BG (<i>n</i> = 102) <i>M</i> (<i>SD</i>)
Rating of warmth of the clinician	7.76 (1.00)	7.86 (1.02)	7.62 (1.32)
Rating of competence of the clinician	7.66 (0.91)	7.67 (0.94)	7.51 (1.28)
Credibility of a CBT intervention	21.96 (7.74)	22.41 (7.46)	22.93 (7.11)
Expectancy of a CBT intervention	9.16 (4.39)	9.59 (4.12)	9.81 (4.25)
Rating of rationale's logic	6.06 (0.91)	6.15 (0.79)	5.93 (1.10)
Rating of rationale's comprehensibility	5.98 (1.05)	6.11 (1.01)	6.08 (0.97)

Note. *NT* network theory, *CB* cognitive-behavioral, *BG* biological-genetic, *M* mean, *SD* standard deviation

Personal Control

Participants in the NT condition and the CB condition reported an increase in perceived personal control over their symptoms after watching the video, while participants in the BG condition reported a decrease. These differences between CB and BG ($t(287) = -2.22$, $p = 0.033$, $d_{ppc} = 0.28$) as well as NT compared to BG ($t(287) = 1.19$, $p = 0.038$, $d_{ppc} = 0.22$) were significant. CB and NT conditions did not differ significantly with regard to changes in perceptions of personal control ($t(287) = -0.17$, $p = 0.864$, $d_{ppc} = -0.02$). Within-group changes were significant for the NT and CB group ($p < 0.05$ and $d_{pp} = 0.15$, $p < 0.01$ and $d_{pp} = 0.24$, respectively) but not for the BG group ($p = 0.53$, $d_{pp} = -0.06$).

Illness Coherence

Participants in each condition reported greater understanding of their symptoms after watching the video. However, there were no significant group differences after FDR correction (CB vs. BG: $t(287) = 0.10$, $p = 0.462$, $d_{ppc} = 0.01$; NT vs. BG: $t(287) = 0.38$, $p = 0.422$, $d_{ppc} = 0.04$; NT vs. CB: $t(287) = 0.28$, $p = 0.864$, $d_{ppc} = 0.03$). Within-group changes were significant for the NT and CB group ($ps < 0.05$, $d_{pp} = 0.18$ and $d_{pp} = 0.16$, respectively) but not for the BG group ($p = 0.30$, $d_{pp} = 0.14$).

Self-blame

In contrast to our hypothesis, changes in self-blame differed significantly between conditions. Although participants in all conditions reported reductions in self-blame after watching the video, this effect was significantly more pronounced for the BG condition compared to the CB ($t(287)=3.64, p<0.001, d_{ppc}=0.59$) and NT ($t(287)=3.04, p=0.003, d_{ppc}=0.48$) conditions. Changes in self-blame did not differ significantly between the CB and NT condition ($t(287)=-0.58, p=0.562, d_{ppc}=-0.09$). Within-group changes were significant across group ($ps<0.001, d_{pp}=-0.58$ for CB, $d_{pp}=-0.64$ for NT, and $d_{pp}=-1.16$ for BG).

Perception of the Clinician

There were no significant differences between the conditions with regard to participants' perception of the clinician's warmth (CB vs. BG: $t(287)=1.47, p=0.143, d=-0.20$; NT vs. BG: $t(287)=0.87, p=0.193, d=-0.12$; NT vs. CB: $t(287)=-0.59, p=0.742, d=-0.10$) and competence (CB vs. BG: $t(287)=1.05, p=0.701, d=0.14$; NT vs. BG: $t(287)=0.94, p=0.701, d=-0.13$; NT vs. CB: $t(287)=-0.11, p=0.911, d=-0.10$). Instead, there were pronounced ceiling effects across conditions. Specifically, most participants were rating the clinician's warmth and competence around 7.5 (with 9 being the maximum).

Efficacy and Credibility of a CBT Intervention

In contrast to our hypothesis, there were no differences in ratings between expectancy (CB vs. BG: $t(287)=-0.38, p=0.858, d=0.07$; NT vs. BG: $t(287)=-1.08, p=0.858, d=0.13$; NT vs. CB: $t(287)=-0.69, p=0.675, d=-0.06$) and credibility (CB vs. BG: $t(287)=-0.48, p=0.858, d=0.05$; NT vs. BG: $t(287)=-0.91, p=0.858, d=0.15$; NT vs. CB: $t(287)=-0.42, p=0.675, d=-0.10$) of a CBT intervention between groups.

Influence of the Severity of Depressive Symptoms, Plausibility and Comprehensibility

We first estimated a model including both rationale condition and the severity of depressive symptoms (as assessed by the PHQ-9) separately for each illness perception variable. This model did not account for a significant amount of variance in illness coherence change ($R^2=0.01, F(3, 286)=1.38, p=0.250$) or changes in personal control ($R^2=0.03, F(3, 286)=2.54, p=0.057$), but did so for changes in prognostic expectation ($R^2=0.05, F(3, 286)=4.69, p=0.003$). The severity of depressive symptoms did not explain a significant amount of variance for changes in personal

control ($t(286)=1.36, p=0.174$) or timeline ($t(286)=-0.70, p=0.483$), but did so for changes in illness coherence ($t(286)=1.99, p=0.047$).

A model including both rational condition and perceived plausibility explained a significant amount of variance in changes in illness coherence ($R^2=0.03, F(3, 286)=3.46, p=0.017$), personal control ($R^2=0.03, F(3, 286)=2.89, p=0.036$), and timeline ($R^2=0.06, F(3, 286)=6.23, p<0.001$). However, perceived plausibility only contributed significantly to the explanation of variance in changes in illness coherence ($t(286)=3.20, p=0.002$) and timeline ($t(286)=-2.22, p=0.028$), but not in changes in personal control ($t(286)=1.70, p=0.091$).

A model including both rationale and perceived comprehensibility explained a significant amount of variance for changes in personal control ($R^2=0.03, F(3, 286)=3.20, p=0.024$) and timeline ($R^2=0.06, F(3, 286)=6.08, p<0.001$), but not for changes in illness coherence ($R^2=0.01, F(3, 286)=0.96, p=0.410$). However, perceived comprehensibility was found to only account for variance in changes in timeline ($t(286)=-2.12, p=0.035$), but not in changes in illness coherence ($t(286)=1.66, p=0.100$) or personal control ($t(286)=1.95, p=0.052$).

Discussion

This study is the first to investigate the effect of an NT rationale on illness representations in EDs. In line with our hypotheses, both the NT and the CB rationales led to better prognostic expectation (i.e., impression of a more acute timeline) and a strengthened sense of personal control over their symptoms than the BG rationale. In line with previous research, but in contrast to Farrell et al. (2015) and in contrast to our hypothesis, there were significant differences in self-blame between conditions as the BG rationale yielded significantly greater reductions in self-blame around their eating pathology. Other than expected, there were no differences in ratings of the clinician's warmth and expectancy and credibility of a CBT rationale. Exploratory analyses showed no differences in ratings of competence as well as ratings on the rationales' logic and comprehensibility and perceived illness coherence.

In line with previous studies on depression (Deacon and Baird 2009; Kemp et al. 2014; Lebowitz et al. 2013) and EDs (Farrell et al. 2015), participants in the BG condition reported greater prognostic pessimism (i.e., a more chronic timeline) than participants in the CB condition after watching the video. This is plausible given that BG explanations focus on latent and stable conditions (e.g., genes) whereas the CB and NT rationale mention factors that are more transient and influenceable (e.g., behaviors). Given that outcome expectancies are an important determinant of actual

prognosis (Rutherford et al. 2010), this is especially striking and underlines that CB and NT rationales such as the ones presented in this study might be superior to BG models in psychoeducation for EDs. Moreover, our study indicates that participants across conditions showed a decrease in pessimism, although this decrease is most pronounced in CB and NT rationales. We attribute this overall finding to the fact that each rationale closed with potential treatment strategies to target rationale-relevant developmental and maintenance factors. Future work is needed to investigate whether the mere notion of treatment targets changes prognostic expectation.

With regard to perceived personal control over symptoms, this study contributes to a mixed body of literature addressing the effect of BG rationales (for a review see Lebowitz and Appelbaum 2019). Whereas participants with social anxiety disorder were found to report lower levels of hopelessness after receiving a BG explanation than a CB explanation (Lee et al. 2016), participants with depression (Lebowitz et al. 2013) showed a lower sense of personal control after receiving a BG explanation than after receiving an explanation focusing on the malleability of biology and genetics. Our findings support and expand previous research in ED: Similar to Farrell et al. (2015), we found BG explanations to yield lower control over symptoms than a CB explanation. In addition, the BG rationale was outperformed by the NT model with regard to changes in personal control. Above that, with our study design we were able to show that a BG explanation led to a *decrease* in perceived personal control. This is especially striking given the great importance of perceived personal control and self-efficacy for therapy. Potentially, these findings could confirm concerns by affected individuals that genetic framing could encourage “fatalistic self-fulfilling prophecies and genetic excuses” (Easter 2012, p. 1408).

In accordance with attribution theory (Weiner et al. 1988) and previous findings in the depression (e.g., Lee et al. 2016) and anxiety (Lebowitz et al. 2013) literature, we found self-blame to be significantly lower in participants after receiving a BG explanation model than in participants who received a CB or NT model. In contrast to other studies, however, we were able to not only investigate group differences after watching the video but to detect changes in illness perception per group. The finding that participants in all groups showed reductions in self-blame but the BG rationale led to a decrease in perceptions of personal control, underscores previous concerns (e.g., Lebowitz 2014; Lebowitz et al. 2015) that BG rationales may reinforce problematic beliefs about patients’ symptoms. Moreover, current study findings contrast previous work (e.g., Lee et al. 2016) suggesting that CB explanatory models worsen self-stigma and self-blame, as the CB model in our study led to a decrease in self-blame although

not as pronounced as in the BG condition. Moreover, this study gives first evidence that a model using NT lowers self-blame. Potentially, if more biological factors are integrated into an NT explanation model (e.g., “Imbalances in dopaminergic neurotransmitter systems can lead to mood swings which some individuals try to regulate through impulsive eating which potentially leads to recurrent self-induced vomiting which contributes to progressive impairments of dopamine signaling” [Bello and Hajnal 2010]), NT models could yield similarly large reductions in self-blame as BG models while at the same time boosting personal control and prognostic expectation. Overall, as this is the first study assessing illness representations before and after presenting psychoeducational elements, more research and replication efforts are needed to better understand the role of psychoeducation in influencing illness perceptions.

We found no group differences in their understanding of the illness (i.e., illness coherence). However, when excluding outliers, participants in the NT condition reported significantly greater increase in illness coherence than participants in the CB and BG condition. This finding aligns with participants’ perceptions of the rationales, as all three rationales were rated as comparably logical and comprehensible. Given that the NT of psychopathology is thus far primarily discussed by psychometricians and still in its relative infancy compared to ‘common cause’ model understandings, this finding offers preliminary evidence that the concept of NT can be effectively communicated to, and understood by, laypersons. Prospectively, with a growing availability of personalized networks, psychoeducation may incorporate networktheoretical explanation models to incorporate a variety of factors (e.g., genes, personality factors, cognitions, behaviors). Moreover, NT might help focus patients more on the illness-maintaining links between symptoms (e.g., restrictive eating and importance of shape and weight) instead of concentrating on the presence and absence of single symptoms.

Overall, the NT and CB rationale yielded very similar results. Given the substantial overlap between these rationales, i.e., both focusing on manifest symptoms and potential interplay between symptoms, may on the one hand suggest that network analyses of ED symptoms are applicable and might have implications for treatment of EDs. On the other hand, we cannot deduce if participants, had they watched the NT and CB video, would have perceived a difference. Future studies might need to test whether participants perceived the theoretical differences between an NT and a CB rationale as presented in this study to matter.

Efficacy and Credibility of a CBT Intervention

In contrast to Farrell et al. (2015) and Kemp et al. (2014), we found no difference in efficacy and credibility ratings of a CBT intervention between groups. This is surprising as rationales likely influence perceptions of treatment. We suggest four potential explanations for this finding. First, the interventions described may represent methods affected individuals already tried in the past (e.g., eating “forbidden” foods, trying to break unhealthy thinking patterns) and that helped. Second, CBT is a popular therapy approach and it is likely that, although participants themselves had not been in treatment, they learned about therapy methods via social media or through friends. Third, we may have found an effect if we had asked participants to choose between pharmacological treatment and CBT as previous studies giving options found the hypothesized effect (e.g., Iselin and Addis 2003). Fourth, the description of CBT that we provided was extremely brief and may not have had an effect on the participants.

Despite these limitations, it appears plausible that individuals in the NT condition see CBT interventions as helpful given the great overlaps between the concept of CBT and NT with a focus on interacting, causally connected symptoms (Kim and Ahn 2002). Moreover, it is reassuring that, irrespective of explanation model, participants find CBT, which is considered first-line treatment for many EDs (Hay 2013), helpful.

Warmth and Competence

Contrary to Lebowitz et al. (2015), we found no difference in perceived clinician warmth between conditions. Instead, we found strong ceiling effects for both ratings of warmth and competence across conditions. Given that Lebowitz et al. (2015) used descriptions of clinicians instead of videos showing a real clinician, we find it plausible that the rationale itself only influences the client’s perception of the clinician if more information (e.g., gestures, appearance, voice, facial expressions) are unavailable. Thus, explanatory models for the development and maintenance of mental illness may only influence clients’ perceptions of clinicians/institutions when not delivered face-to-face (e.g., voice recording without video, written text on a website). The ceiling effect regarding competence and warmth might be explained by a halo effect in the context of the clinician’s credentials stated at the beginning of the video (PhD degree, clinical psychologist, working at a large and widely recognized hospital).

Influence of Severity of Depressive Symptoms, Plausibility and Comprehensibility of the Rationales

In this study, individuals with greater depression severity seemed to exhibit greater improvements in illness coherence

following the psychoeducational video, irrespective of the kind of rationale they were introduced to (i.e., condition assignment). At first glance, this is surprising, as the severity of depressive symptoms is associated with impaired cognitive functions (for a review, see Rock et al. 2014) that are necessary to understand such rationales. However, depression is a common comorbidity of EDs (Hudson et al. 2007) and research shows that individuals suffering from both depression and EDs are especially impaired (e.g., Berkman et al. 2007). One potential explanation for our finding is that individuals with greater impairment initially have greater struggle understanding their symptoms, due to complexity and comorbidity with depression. Thus, any explanation is likely to boost illness coherence, given that they have more room for improvement in this space.

Moreover, results indicate that the more comprehensible and plausible the rationale, the greater the change towards a more optimistic (i.e., more acute) timeline. Interestingly, change towards a better illness coherence (i.e., understanding of symptoms) was mainly influenced by the rationales’ plausibility. As there were no differences in comprehensibility and plausibility between rationales, future studies should target whether there are specific components of a given rationale that make it better-suited for enhancing comprehensibility and plausibility for certain populations. The finding that timeline was positively influenced by these factors suggests that individuals need to understand an explanation model before drawing conclusions about prognostic expectation.

Changes in personal control did not seem to be influenced by the degree of perceived comprehensibility and plausibility of the individual rationales. Instead, personal control was primarily influenced by the rationale which stresses the importance of choosing a rationale that underlines the impact patients can have on the course of their illness.

Limitations and Directions for Future Research

This study has several limitations that offer directions for future research. First, we used an online sample which restricts the ability to verify all inclusion and exclusion criteria the way one could in a laboratory setting. As we did not assess ethnicity, we cannot guarantee that our sample’s composition reflects ethnic distribution in the US. Further, current study findings speak to participants’ reception of psychoeducation delivered online and may not generalize to in-person settings. For instance, the videos were brief (approximately 3 min), and provided general information about the etiology of EDs; whereas, when delivering psychoeducation in person, clinicians normally tailor the information to individual risk and maintenance factors and allow time for the patient to ask questions. Second, gender distribution in our sample differed from most other ED samples

and prevalence data (Hudson et al. 2007) as we had nearly as many male as female participants. On the one hand, this may hinder comparison with other studies on EDs as well as other AMT studies exploring illness beliefs (e.g., Farrell et al. 2015; Lee et al. 2016) as samples consisted mainly of females. On the other hand, in our study males and females did not differ with regard to any dependent variable (changes in illness representations, ratings of clinician) and showed similar degrees of ED and depression severity. Thus, our results expand on previous studies targeting mainly females and suggest that psychoeducation has a similar effect on males and females with ED symptoms. However, future research is needed to investigate whether this is a robust finding across disorders. Third, we neither controlled for causes participants initially attributed to their ED symptomatology nor which etiology they rated as most plausible after watching the video. Preliminary work found that if individuals with EDs are asked about potential etiological explanations, they tend to endorse psychological factors such as behaviors and cognitions as opposed to external factors such as genes (Marcos et al. 2007). However, this preference for a rationale focusing on psychological variables adds to the existing body of literature underscoring the advantages of incorporating psychological variables such as in CB or NT rationales.

Although not touched on by this study, NT rationales might be especially fit for explaining comorbidity as CB rationales often focus on disorder-specific theories. Moreover, psychoeducation using NT offers the potential framework to explain how a variety of factors such as biological, environmental, and personality factors interact with ED symptoms to maintain symptomatology. Potentially, such a combination of explanatory factors (e.g., by endorsing biological factors in an NT model) conflates the benefits of a CB or NT rationale (strengthening personal control and optimistic prognosis) and BG rationales (lowering self-blame). Future studies could investigate whether such a comprehensive rationale on the basis of NT might have some advantages compared to traditional CB models.

Conclusion

Overall, this is the first study investigating the effect of an NT explanatory model. Despite its origins in psychometrics, it appears fit to be incorporated into psychoeducation for EDs as participants found it equally comprehensible and logical as long-established rationales. Besides the technical advantages of NT for psychoeducation (e.g., the possibility to incorporate multiple factors into a comprehensive framework), an NT rationale was found to lower self-blame, increase feelings of personal control, and improve prognostic pessimism as well as understanding of symptoms. Given that the NT model was the most comprehensive (i.e., discussing

the role of a variety of factors) and most closely aligned with the prevailing biopsychological model, it potentially is more accurate than a CB explanatory model which reflected in secondary analyses excluding outliers. Moreover, this study allowed to detect changes in illness representations through a study design using baseline and post assessments. Thereby, we could strengthen prior work that underlines the pitfalls of BG rationales: First, the BG rationale was the only one to lower feelings of personal control over symptoms. Second, in contrast to previous concerns, BG is not the only rationale lowering self-blame and self-stigma, although our findings suggest the effect to be most pronounced for BG rationales. Future work is needed to investigate the influence of NT rationales in more diverse, on-site recruited samples and as part of real-life psychotherapy.

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Data Availability The datasets generated during the current study are available from the corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of Interest Marieke Meier, Katrin Jansen, Berta J. Summers, Melissa J. Dreier, Nicholas R. Farrell and Ulrike Buhlmann declare that they have no conflict of interest.

Animal Rights No animal studies were carried out by the authors for this article.

Informed Consent Informed consent was obtained from all patients for being included in the study.

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