BRIEF REPORTS

Do Adherence Variables Predict Outcome in an Online Program for the Prevention of Eating Disorders?

Jamie L. Manwaring
Washington University in St. Louis

Susan W. Bryson
Stanford University School of Medicine

Andrea B. Goldschmidt
Washington University in St. Louis

Andrew J. Winzelberg, Kristine H. Luce, and
Darby Cunning
Stanford University School of Medicine

Denise E. Wilfley
Washington University School of Medicine

C. Barr Taylor
Stanford University School of Medicine

Unlike traditional interventions, Internet interventions allow for objective tracking and examination of the usage of program components. Student Bodies (SB), an online eating disorder (ED) prevention program, significantly reduced ED attitudes/behaviors in college-aged women with high body image concerns, and reduced the development of EDs in some higher risk subgroups. The authors investigated how adherence measures were associated with ED attitudes and behaviors after treatment. Female SB participants ($n = 209$) completed the Eating Disorders Examination–Questionnaire (EDE-Q; C. G. Fairburn & S. J. Beglin, 1994) at baseline, posttreatment, and 1-year follow-up. Total weeks participation and frequency of utilizing the online Web pages/journals predicted pre- to posttreatment changes in EDE-Q Restraint but not in other ED symptoms. In participants with some compensatory behaviors, discussion board and booster session use were associated with increased weight/shape concerns during follow-up. In overweight participants, higher online Web page/journal use was related to decreased EDE-Q Eating Concern scores during follow-up. This is the first study to investigate the relationship between adherence to specific program components and outcome in a successful Internet-based intervention. Results can be used to inform future development and tailoring of prevention interventions to maximize effectiveness and facilitate dissemination.

Keywords: prevention, eating disorder, Internet, online, adherence

Internet delivery of various modes of healthcare is a burgeoning and evolving field (e.g., Wantland, Portillo, Holzemer, Slaughter, & McGhee, 2004). Among the advantages of Internet interventions (e.g., cost effectiveness, anonymity when used from home) is the

potential to obtain continuous measures of adherence to program components. Such data enable examination of the relationship between usage of online components and outcome, thus highlighting program features that might be eliminated or revised to shorten and/or optimize interventions.

One area that may be particularly well suited to Internet interventions is that of eating disorders (EDs). EDs are widespread, and despite their monetary and health-related costs (Fairburn & Harrison, 2003), treatment is often delayed or not pursued at all, in part due to feelings of shame (Fairburn, Hay, & Welch, 1993). As such, Internet interventions have the potential to reach large numbers of individuals who might otherwise suffer from ED symptoms indefinitely. To develop preventive interventions for EDs, researchers have investigated several potential risk factors in prospective studies; of these, dietary restraint and excessive weight and shape concerns have been most consistently associated with ED onset (e.g., Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004). By definition, a reduction in weight and shape concerns and dietary restraint should reduce the onset of EDs (Jacobi et al., 2004); indeed, several interventions targeting such risk factors have been

undertaken, with results indicating modest success (Stice & Shaw, 2004; Taylor, Bryson, Luce, Cunning, Celio, Abascal, et al., 2006).

To increase the effectiveness of a program, it is important that one examine potential processes by which the outcome is achieved, such as the contribution of specific program components to outcome. For instance, does participation in a moderated online discussion board relate to improved outcome? Online moderated discussion groups can be expensive to deliver due to their reliance on trained personnel, and thus may reduce effective dissemination of programs.

In a recent randomized controlled trial of 480 college-age women, Student Bodies (SB), an Internet-based ED program, reduced participants' weight/shape concerns and onset of EDs in two extremely high-risk subgroups identified through moderator analyses: (1) women with an elevated body mass index (BMI > 25 kg/m^2) at baseline ($n = 115$) and (2) at one site, women with low-level baseline compensatory behaviors (e.g., laxative use, $n = 88$; Taylor et al., 2006).

In this study, we examine the effects of type and amount of program adherence on outcome in the SB prevention trial (Taylor et al., 2006). To our knowledge, this is the first study to investigate the effects of adherence to an online intervention on outcome. The first primary objective was to determine whether overall adherence and adherence to specific program components (e.g., discussion board, booster session) were associated with outcome (i.e., ED attitudes and behaviors) from pre- to posttreatment and with the maintenance of gains at 1-year follow-up. It was expected that, consistent with previous research (Celio, Winzelberg, Dev, & Taylor, 2002), more frequent overall adherence and discussion board usage would be related to lower ED attitudes and behaviors. The second primary objective was to examine adherence among the high-risk subgroups identified by prior moderator analyses. We accomplished these objectives by first using principal components analysis to understand the relationship among the adherence measures.

Method

Participants

Participants were 244 normal to overweight female students with high levels of weight/shape concerns (as assessed by the Weight Concerns Scale; Killen et al., 1994), but no ED.[1] They were recruited by means of flyers posted at academic institutions, campus mailings, and mass media announcements in southern and northern California, and then randomized to the SB intervention.

Procedures

Preliminary inclusion criteria were ascertained by phone or email and finalized after in-person interviews (for detailed inclusion and exclusion criteria, see Taylor et al., 2006). Eligible participants provided informed consent and were randomly assigned to the SB intervention or a wait-list control group. This study focuses on the three time points at which the full sample was potentially available for assessment: baseline, posttreatment, and 1-year follow-up.

Measures

To determine study eligibility, at baseline we asked participants to complete a diagnostic interview that included an abbreviated

diagnostic version of the Eating Disorder Examination (EDE; Fairburn & Cooper, 1993), whose full-length version has well-established reliability and validity (e.g., Cooper, Cooper, & Fairburn, 1989). A research assistant obtained height and weight to calculate BMI in kilograms per square meter.

Adherence to the SB intervention was electronically tracked each week for each participant. Overall utilization was measured by the number of weeks the participant logged onto the program (*weeks*). The specific SB program components were: (a) number of main topic screens visited (i.e., the Web pages visited by progressing through the program without viewing optional pop-up windows, audio clips, clinical vignettes, etc.); (b) total number of screens visited (this number included each time a screen was visited, including repeated visits to the same screen since this increased their exposure to SB); (c) number of discussion board postings made; (d) number of discussion board postings read; (e) number of body image journal entries made; (f) number of personal journal entries made; and (g) number of moderator postings read.

The Eating Disorder Examination–Questionnaire (EDE-Q), a self-report version of the EDE with good reliability and validity (Fairburn & Beglin, 1994; Luce & Crowther, 1999; Mond, Hay, Rodgers, Owen, & Beumont, 2004), was used to assess ED attitudes and behaviors. This measure includes the Restraint, Eating Concern, Weight Concern, and Shape Concern subscales.

Description of the Student Bodies Program

Student Bodies is an 8-week, cognitive–behavioral psychoeducational online program focused on body image dissatisfaction. Participants were expected to read SB content (review previous content, and read new material introduced weekly) and complete accompanying assignments, which included participating in the online discussion board, self-monitoring, and/or writing entries in their personal journal or body image journal. Participants received weekly emails and/or phone calls to reinforce participation, particularly for those who were not meeting expectations for study participation. The program was closed to further participation at the end of the 8 weeks, with the exception of a "booster" session that was available for 2 weeks approximately 9 months following program cessation (for a full program description, see Winzelberg et al., 2000).

Data Analysis

Of the 244 participants randomized to the intervention, 209 (86%) had complete posttest data and were used for this study's

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[1] Participants who exhibited low-level compensatory behaviors, defined as being below subclinical levels, were randomized. Subclinical levels were defined as follows (Taylor et al., 2006, p. 883): Subclinical bulimia nervosa was diagnosed if (a) the binge eating and inappropriate compensatory behaviors occurred at a frequency of less than twice a week or for a duration of less than 3 months, (b) one objective or subjective bulimic episode and one purge episode occurred at least once per week on average for 3 months, or (c) purge behavior occurred two or more times per week on average for at least 1 month.

analyses;[2] 192 (79%) were present at the 1-year follow-up. According to SAS (Version 9.1; SAS, Cary, NC), with 209 participants and four independent variables, we needed a power level of .85 to detect a partial correlation of .25 at an alpha level of .05.

To assess the effect of adherence on outcome, we used the EDE-Q subscales as dependent variables. The same dependent variables were used to determine the effects of adherence on maintenance of changes (from posttreatment to follow-up). To minimize redundancy, we performed principal components analysis on the adherence data. Two factors were formed that accounted for 58.1% and 19.9% of the variance, respectively. Varimax rotation revealed that participation in the readings and entries to the personal and body image journals formed the first factor, whereas activity on the discussion board formed the second. This information was used to construct two main variables out of the seven variables representing the adherence data: (a) *read*, consisting of total screens visited + number of personal journal entries + number of body image journal entries; and (b) *discuss*, consisting of discussion board postings made + discussion board postings read + moderator postings read. The seventh variable, number of main topic screens visited, was dropped as it was already included in the total screens read. A final measure of adherence during the maintenance period was determined by whether or not the participant visited the booster session (*boost*). Thus, the four measures of adherence were: *weeks*, *read*, *discuss*, and *boost*.

Multiple linear regression was used to examine the relationship between the adherence data and changes on outcome variables. The adherence factors were used as independent measures and centered for the regression analyses. Raw treatment and maintenance change scores were used as dependent measures. Site was entered as an independent variable in all outcome analyses, and Site × Adherence interactions were included.

Because Taylor et al. (2006) found that two subgroups of participants (BMI ≥ 25 and/or low-level compensatory behaviors as assessed by the EDE) responded particularly well to SB, these two subgroups were examined independently for their response to the program components. The present study did not examine adherence as a predictor of ED development because these analyses were already provided by Taylor and colleagues; further, due to insufficient power, adherence as a predictor of ED development was not examined in the two subgroups for whom SB was effective. Taylor et al. found no significant effect of the interaction between BMI and compensatory behaviors on outcome, justifying the current exclusive examination of the main effects.

Results

The participants were ethnically heterogeneous and predominantly from highly educated families as determined by maximum parental education. The sample was composed of approximately half freshmen or sophomores, with a mean BMI of 23.8 ($SD = 2.9$). A minority of participants reported sporadic binge eating (9%) or compensatory behaviors (27.8%) as assessed by the EDE; anyone diagnosed with an ED was referred to treatment and not randomized. Participants included in this analysis had more highly educated parents, $\chi^2(5) = 16.4$, $p = .006$ than those excluded for lacking posttest data. See Table 1 for more demographic information.

Table 1
Baseline Participant Characteristics

Characteristic	n (%)	Range
Site		
Northern California	112 (54)	
San Diego	97 (46)	
Year in school		
Freshman	63 (30)	
Sophomore	45 (22)	
Junior	51 (24)	
Senior	31 (15)	
Graduate student	19 (9)	
Maximum parental education		
Less than high school	4 (2)	
High school graduate	16 (8)	
Some college	32 (15)	
College graduate	55 (26)	
Some graduate school	10 (5)	
Graduate degree	92 (44)	
Ethnicity		
White	121 (58)	
Black	3 (1)	
Hispanic	27 (13)	
Asian	38 (18)	
Other	4 (2)	
Multiethnic	15 (7)	
Has objective binge episodes	18 (9)	
Has compensatory behaviors	59 (28)	
	M(SD)	
Body mass index	23.8 (2.9)	18.4–32.48
EDE-Q subscale		
Restraint	2.4 (1.2)	0.0–5.20
Eating Concern	1.4 (1.1)	0.0–5.40
Weight Concern	2.9 (1.2)	0.0–5.80
Shape Concern	3.4 (1.2)	0.63–6.00

Note. EDE-Q = Eating Disorder Examination-Questionnaire.

Overall Rates of Adherence

Adherence (as defined by the four categories above) was not significantly related to ethnicity, baseline BMI, or any baseline EDE-Q subscale scores. Older relative age was associated with the *discuss* measure ($r = .14$; $p < .05$), but no other adherence measures. Rates of adherence were high for all measures, although the body image journal was less utilized than the other SB features (see Table 2). No Site × Adherence interactions were insignificant; thus, the following results pertain to all participants and are not site-specific.

Primary Hypothesis: Adherence Components Associated with Outcome

Predicting posttreatment outcomes. At posttreatment, *weeks* predicted decreased restraint scores ($R^2 = .05$). See Tables 3 and 4 for more information. In elucidating whether specific program components predicted outcome, we found that participants with higher *read* rates use had lower restraint scores at posttreatment. The *discuss* measure did not predict change in any of the ED

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[2] Thirteen participants used in the analyses (6%) never logged onto the program.

Table 2
Adherence Rates for the Student Bodies Intervention (N = 209)

Measure	M (SD)	Range	Mean %
Weeks of participation (out of 8)	7.2 (1.6)	0–8	90.0
Total number of screens viewed (out of 299)	196.3 (70.0)	0–299	65.6
Total number of main topic screens viewed (out of 69)	55.9 (16.8)	0–69	81.0
Total posted discussion board messages	6.7 (6.5)	0–41	
Total discussion board messages read	87.7 (58.3)	0–258	
Total personal journal posts	15.8 (6.4)	0–31	
Total body image journal postings	4.8 (4.3)	0–32	
Total discussion board messages posted by moderator	21.3 (10.9)	9–46	
Total moderator messages read	15.0 (11.3)	0–46	
Number booster session log-ins (for participants who used it)	1.9 (1.2)	0–7	

All information in this table is for the full sample ($N = 209$), except for the number of booster session log-ins ($N = 96$).

attitudes and behaviors at posttreatment. No other adherence variables significantly predicted outcome.

Predicting maintenance outcomes. There was little overall change in scores between posttreatment and the 1-year follow-up, indicating that changes made during the program that were evident at posttreatment were sustained. In the maintenance phase (i.e., posttreatment to follow-up), none of the adherence measures predicted changes in the outcome variables in the overall sample.

Secondary Hypothesis: Subgroup Analyses of Relationship Between Adherence and Outcome

Predicting posttreatment outcomes. For both the high-BMI subgroup and the subgroup with any baseline compensatory be-

haviors, none of the adherence variables predicted changes in pre- to posttreatment scores.

Predicting maintenance outcomes. For the high-BMI subgroup, higher rates for the *read* measure during the intervention phase were related to a continued decrease in eating concerns ($R^2 = .09$) from posttreatment to follow-up. Rates of the *boost* measure were not associated with any outcome measures. For the subgroup with any baseline compensatory behaviors, use of the discussion board (the *discuss* measure) during the intervention phase was related to a significant increase in eating concerns ($R^2 = .10$) from posttreatment to 1-year follow-up. Use of the booster session (the *boost* measure) was also related to increased eating concerns ($R^2 = .18$) during this period. All other associations

Table 3
Results of Multiple Linear Regression of Adherence to the Student Bodies Intervention and ED Psychopathology

Sample and EDE-Q subscale	Read/journal		Discussion board		Total weeks		Booster session	
	β[a]	Test statistic	β	Test statistic	β	Test statistic	β	Test statistic
Treatment phase (pre- to posttreatment)[b]								
Total								
Restraint	−.17	$T(204) = -2.40^*$	−.03	$T(204) = -0.35$	−.21	$T(204) = -2.9^*$		
Weight Concern	−.08	$T(205) = -1.00$	−.05	$T(205) = -0.60$	−.12	$T(205) = -1.6$		
Shape Concern	−.10	$T(205) = -1.30$	−.08	$T(205) = -0.92$	−.09	$T(205) = -1.2$		
Eating Concern	−.12	$T(205) = -1.70$	−.12	$T(205) = -1.30$	−.12	$T(205) = -1.6$		
Maintenance phase (posttreatment to 1-year follow-up)[c]								
High-BMI								
Restraint	−.11	$T(45) = -0.72$	−.21	$T(45) = -1.3$	−.04	$T(45) = -0.22$	−.09	$T(45) = -0.58$
Weight Concern	.10	$T(46) = 0.64$	−.18	$T(46) = -1.1$	.14	$T(46) = 0.83$	−.13	$T(46) = -0.89$
Shape Concern	.04	$T(46) = 0.28$	−.001	$T(46) = -0.008$	−.11	$T(46) = -0.74$	−.11	$T(46) = -2.0$
Eating Concern	−.29	$T(46) = -2.00^*$	−.18	$T(46) = -1.1$	−.22	$T(46) = -1.30$	−.28	$T(46) = -2.0$
Compensatory behaviors								
Restraint	.07	$T(51) = 0.51$	.17	$T(51) = 0.1$	.11	$T(51) = -0.82$	.09	$T(51) = 0.3$
Weight Concern	.14	$T(51) = 0.98$	.28	$T(51) = 1.7$	.09	$T(51) = -0.66$	.15	$T(51) = 1.1$
Shape Concern	.21	$T(51) = 1.40$	.21	$T(51) = 1.2$	.16	$T(51) = 1.20$	.18	$T(51) = 1.3$
Eating Concern	.02	$T(51) = 0.14$	.38	$T(51) = 2.2^*$	−.02	$T(51) = -0.16$	.33	$T(51) = 2.5^*$

Note. Site and Site × Adherence analyses are included, but all of these results were not significant. ED = eating disorder; EDE-Q = Eating Disorder Examination-Questionnaire; BMI = body mass index.
[a] All betas are standardized. [b] Pre-to-posttest analyses for the high-BMI and compensatory behaviors sample are not presented because none were significant. [c] Pre-to-posttest analyses for the full sample are not presented because none were significant.
* $p < .05$.

Table 4
Means (and Standard Deviations) of Dependent Measures of Eating Disorder Psychopathology

Phase and EDE-Q subscale	Baseline	Posttest	Baseline-posttest change	
Treatment (pre- to posttreatment; $N = 209$)				
Restraint	2.4 (1.2)	1.5 (1.3)	−0.9 (1.2)	
Weight Concern	2.9 (1.2)	2.3 (1.3)	0.5 (1.1)	
Shape Concern	3.4 (1.2)	2.7 (1.3)	−0.7 (1.2)	
Eating Concern	1.4 (1.1)	1.0 (0.9)	−0.4 (0.9)	
Maintenance (posttreatment to 1-year follow-up; $N = 192$)				
	Baseline	Posttest	1-year follow-up	Posttest-follow-up change
Restraint	2.4 (1.2)	1.5 (1.2)	1.9 (1.3)	0.3 (1.3)
Weight Concern	2.8 (1.1)	2.3 (1.2)	2.3 (1.3)	0.04 (1.1)
Shape Concern	3.4 (1.2)	2.6 (1.2)	2.6 (1.3)	0.0 (1.1)
Eating Concern	1.4 (1.0)	1.0 (0.8)	0.9 (0.9)	−.03 (0.7)

Note. EDE-Q = Eating Disorder Examination-Questionnaire.

between adherence measures and outcome during the maintenance phase for this subgroup were not significant.

Discussion

To our knowledge, this is the first study to demonstrate that specific aspects of adherence are related to outcome (in this case, reduced ED attitudes and behaviors) in a multifaceted Internet-based intervention. The main finding was that the amount of SB program use (i.e., accessing content pages and posting in the journals) and the number of weeks of participation were associated with baseline to posttreatment changes in measures of dietary restraint. Use of the online discussion board was not associated with any of the outcomes from pre- to posttreatment. Treatment gains were maintained from posttreatment to follow-up and were not associated with any of the adherence measures for the overall sample.

For the overall sample, the discussion board did not appear to contribute to SB's efficacy, an important implication for dissemination due to the effort necessary to maintain a moderated discussion board. This is supported by Low and colleagues (2006), who found that SB participants in an unmoderated discussion group had reduced risk for eating and body image concerns compared to participants in the moderated discussion group. However, the social aspect of discussion board usage may still serve to attract participants to SB initially. In the subgroup with baseline compensatory behaviors, increased use of the discussion board from pre- to posttreatment was associated with *increased* eating concerns during maintenance (posttreatment to follow-up). It is possible that participants' eating concerns increased once they were no longer receiving the active program intervention, prompting them to seek out additional support from these intervention components; alternatively, use of the discussion board may have been detrimental to this subgroup of participants. If a discussion board is offered in a program that includes participants with some compensatory behaviors, their progress may merit additional monitoring. In the subgroup with overweight participants, increased use of the online Web pages/journals was related to decreased eating concerns during maintenance.

Similarly, we found no evidence that the booster session was beneficial. Indeed, in the subgroup with some baseline compensa-

tory behaviors, use of the booster session was associated with somewhat increased eating concerns. It is possible that participants who were struggling with eating concerns turned to these resources and received little benefit; alternatively, using these resources may also have been harmful. Both possibilities must be considered in light of the fact that the overall rate of ED onset was reduced in this subgroup: 4% of participants in the intervention group developed EDs at 1 year, and 14.4% by 2 years. Rates for the comparable control group were 16% and 30.4%, respectively (Taylor et al., 2006).

Some features were utilized less than anticipated. The program offers a body image journal as a way to identify thoughts related to poor body image and to develop alternative cognitions. On average, participants used this journal 4.8 times, which may be sufficient for change; however, greater use of this feature might be associated with improved outcomes.

Strengths of this study include the ethnically diverse sample and the detailed adherence data obtained from online tracking. Limitations include those inherent in any Internet-based study, for example, the potential that in tracking adherence, a participant glancing at a screen will be registered equally with a participant reading the content on the screen. However, the results of this study support the validity of tracking adherence by computer, given that adherence predicted reduced ED attitudes and behavior. We were also unable to analyze how adherence affected the 35 participants who did not have posttest data, and who likely had low levels of adherence overall. We cannot rule out the possibility that the number of analyses conducted produced artificial significant results (Type I error). Finally, the definition and measurement of dietary restraint varies greatly between studies, and the literature currently debates which aspects of dietary restraint increase risk for an ED. While Jacobi et al. (2004) state that longitudinal research collectively supports weight concerns, negative body image, or dieting as a strong, well-supported variable risk factor, other literature (e.g., Stice, Presnell, Groesz, & Shaw, 2005) suggests that successful dietary restriction may actually decrease bulimic pathology.

In conclusion, this study suggests that some aspects of adherence may be more important than others in promoting participant improvement, and moreover, that these effects may differ by

high-risk subgroup. The necessity of a moderated discussion group is particularly important because its inclusion requires more training and staff time than other aspects of the program and thus limits effective dissemination. Given the overall efficacy of the intervention in reducing ED onset, it would seem premature to drop the discussion group. To help clarify this issue, future researchers should randomize high-risk students to the intervention with and without a moderated group.

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