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Ecological Momentary Intervention [EMI]: Incorporating Mobile Technology into a Disordered Eating Treatment Program for College Women

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Abstract

Psychosocial and health behavior treatments can be extended beyond research and clinical settings by using mobile technology to provide Ecological Momentary Interventions [EMI] to individuals as they go about their daily lives. This study integrates the assessment (i.e., Ecological Momentary Assessment; EMA) and intervention (i.e., EMI) capacities of palmtop computers to provide individually tailored EMI to participants in real time. The feasibility and efficacy of using EMI to augment a disordered eating treatment intervention for college women was evaluated. Participants were randomized to view psychoeducational videos on a computer (attention control), complete an interactive CD-ROM-based intervention aimed at reducing body dissatisfaction and disordered eating behaviors (CD), or receive the CD-ROM supplemented with EMI (CD+EMI). The content and timing of EMI was individually tailored in real time and provided on palmtop computers for one week following the CD intervention. Very high compliance rates with the EMA/EMI protocol were demonstrated and women were generally satisfied with the intervention, suggesting it is feasible to implement tailored EMI. An evaluation of treatment efficacy revealed the computerized CD-ROM intervention did not reliably produce significant improvements in body-related constructs and there was no unique or added benefit of EMI. This study was innovative in that it used palmtop computers to combine ambulatory assessment and intervention strategies to provide tailored and contextually sensitive EMI. As such, it adds to the relatively young, but growing EMI literature by identifying challenges and opportunities for ambulatory assessment and intervention methods in psychosocial and health behavior treatments.

Ecological Momentary Intervention [EMI]: Incorporating mobile technology into a disordered eating treatment program for college women

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Table of Contents

List of Illustrative Materials

Tables

Figures

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Ecological Momentary Intervention [EMI]: Incorporating mobile technology into a disordered eating treatment program for college women

Clinicians have long sought to extend psychotherapy into patients' everyday lives by encouraging skill building activities between treatment sessions. Between session assignments are most commonly associated with cognitive and behavior therapies, as these traditions formalized and popularized the idea of giving patients "homework" as a way to practice, generalize, and maintain therapeutic skills (Kazantzis, Deane, & Ronan, 2000). Using time between sessions for therapeutic gains, however, is advocated by nearly every major school of psychotherapy (e.g., psychodynamic, interpersonal, client-centered, acceptance-based, cognitive behavioral). The use of interventions in patients' natural environments is also being adopted outside of psychotherapy settings in behavioral health and psychosocial treatment domains more generally. The term Ecological Momentary Intervention [EMI] provides a framework for treatments characterized by the delivery of interventions to people as they go about their daily lives (Heron & Smyth, 2010; Patrick, Intille, & Zabinski, 2005). The key feature of all EMI is that the treatment is provided to people during their everyday lives (i.e., in real time) and settings (i.e., real world). Therefore, these interventions are *ecologically* valid in the sense that they occur in the natural environment, and are provided at specifically identified *moments* in everyday life.

Similar to the idea of extending interventions into everyday life, the assessment literature techniques have developed to capture information from people in their natural environments. A variety of methodologies for collecting ambulatory data have developed. One of the earliest and most basic strategies is the use of paper diaries to collect

information about individuals everyday experiences and behaviors (Favill & Rennick, 1924). Today, assessment methods that involve collecting data in people's everyday lives are broadly referred to as Ecological Momentary Assessment [EMA] (Stone et al., 2007). The notable feature of all EMA strategies is that they collect data in people's natural environments during their everyday lives.

Developments in the sophistication and affordability of mobile technology have created more opportunities for assessments and treatments to be available to people during times ("real time") and in places or situations ("real world") when they are most needed. Two of the more commonly used devices are palmtop computers and mobile telephones (see Shiffman, 2007 for a review of technology considerations). Palmtop computers (also referred to as personal digital assistants [PDAs], handheld computers, pocket computers, or PalmPilots) are small electronic devices that offer the advantage of allowing for applications (e.g., appointment book, customized programs to administer EMA or EMI) to be presented on a touch-sensitive screen. In addition, mobile phones typically have the capability to send and receive both voice and written text messages. More recently, so-called "smart phones" offer a variety of mobile capabilities, including access to (potentially customized) applications, voice and written text services, and internet access. Mobile technology is useful for collecting EMA or providing EMI for a variety of reasons that will be discussed in greater detail in the following sections.

In the following sections a brief history and general rationale for using both Ecological Momentary Assessment [EMA] and Ecological Momentary Interventions [EMI] is provided. Then the potential advantages of merging these methodologies for treatment/intervention are discussed. The more specific purpose of the present study is to

integrate the assessment and intervention capacities of mobile technology (specifically palmtop computers) to provide a tailored intervention for college women with disordered eating behaviors. Therefore, the research literatures regarding eating behaviors and related topics (e.g., body dissatisfaction) and the treatment of these issues are next discussed.

Ecological Momentary Assessment

Approaches to collecting data in everyday life have evolved in a variety of disciplines to fulfill specific research needs. Ecological Momentary Assessment [EMA] is a methodological tool that enables researchers to collected large amounts of specific information in people's natural environments. The idea of periodically signaling people to report on experiences as they go about their daily lives was first known as the Experience Sampling Method [ESM] (Csikszentmihalyi & Larson, 1987). Before mobile electronic technology was widely available, researchers gave participants pagers that were programmed to "beep" at random times throughout the day and participants would report on their subjective experiences on paper diaries they carried with them (Scallon, Kim-Prieto, & Diener, 2003; Stone et al., 2007).

Today, mobile technology such as palmtop computers and mobile telephones can be used to capture real-time experiences including internal states and external cues or events (e.g., social interaction, situational variables). Using mobile electronic technology, an EMA protocol typically involves asking participants to complete assessments at predetermined time periods (e.g., at 12:00 noon, before going to bed at night), in response to specific states or events (e.g., when feeling anxious, immediately after eating a meal) or in response to an auditory signal programmed by the researchers to alarm throughout

the day. Shiffman (2007) provides a more extensive review of these sampling strategies and a discussion of the benefits and challenges associated with each.

The rationale for using EMA rests on three central benefits of these methodologies. First, self-report data are traditionally collected via retrospective assessments, requiring participants to summarize their experiences over some time period. Information recall is affected by heuristics used in memory search and reconstruction (Scallon et al., 2003; Smyth & Stone, 2003; Stone & Shiffman, 1999), which can systematically bias participant responses. For instance, people are more likely to recall salient experiences (reconstruction bias) and tend to remember events according to what they currently know about the event or behavior (effort after meaning; Hufford, 2007; Smyth & Stone, 2003; Stone & Shiffman, 1994). Because EMA requires participants to report on current or recent experiences, retrospective recall (and the associated biases) is greatly reduced. Second, EMA occur in natural settings, thus increasing generalizability and ecological validity. Research and clinical settings (e.g., laboratory, hospital, etc.) are artificial environments in the sense that they cannot reflect all aspects of individuals' lives, making it difficult or impossible to assess important behaviors. Furthermore, it is unclear whether relationships identified in research or clinical settings are necessarily similar to those in individuals' everyday lives (Smyth & Stone, 2003). For example, there is evidence that some people have high blood pressure only when taken in a medical setting (so-called "white-coat hypertension"; Pickering & Freedman, 1991). Third, multiple assessments occur over time, so temporal relationships among variables can be explored. Such data allow more complex and nuanced research and clinical questions about dynamic associations and processes that occur over time to

be addressed (and are necessary to implement a dynamically tailored EMI, a point we return to below).

Using mobile technology such as palmtop computers or mobile telephones to collect EMA data provide additional advantages above and beyond the benefits that come from the ambulatory assessment alone. First, electronic devices are highly portable and convenient, making it possible for the assessment devices to be available to patients at any time. Information can be presented on palmtop computers or mobile phone screens, and users can enter information directly on the device. Similarly, Interactive Voice Response [IVR] systems allow for users to receive standard pre-recorded messages via mobile phone, and these automated systems can also record information that users provide by speaking directly into the telephone (e.g., Freedman et al., 2006; Levin & Levin, 2006). Second, mobile electronic devices can provide pre-programmed auditory signals that can be used to facilitate the completion of assessments (i.e., prompts), reducing the need for patients to remember to complete these on their own. Unlike early EMA studies that used a beeper to signal when people should complete a paper assessment, palmtop computers and mobile phones can be programmed to "know" when the assessment has actually been completed. In this way, the devices can continue to provide reminder signals until the assessment is completed to ensure more adequate compliance. Third, technology allows for the sequence, number and type of questions to be automatically adjusted based on individuals' responses. Item branching creates tailored assessments by eliminating unnecessary questions and, therefore, can reduce the length and time required to complete the assessment. Fourth, most mobile electronic devices allow for users' entries to be automatically time and date stamped. This allows

compliance rates to be more accurately tracked. Finally, these devices can be connected to a computer, allowing automatic data transfer, reducing the time needed for, and potential errors in, data entry.

Summary of EMA. Ecological momentary assessment [EMA] is a real-time data collection technique used to capture information as people go about their daily lives. This assessment strategy has many benefits over traditional methodologies, such as greater ecological validity and minimized memory biases. In addition, EMA methods provide information regarding dynamic, within-person processes as they occur in the real world. In the present study, EMA data provides information regarding dynamic, within-person risk processes and can be used to inform individually tailored, real-time interventions. In the following section, the history, use, and efficacy of Ecological Momentary Interventions [EMI] in health behavior and psychosocial interventions are reviewed.

Ecological Momentary Interventions [EMI]

As discussed, the delivery of interventions in patients' everyday lives has a long history in psychotherapy settings. More recently, however, this approach has been extended to include health behavior and psychosocial interventions outside of therapy. EMI can take many forms ranging from unstructured clinical recommendations (e.g., a psychotherapist requesting a patient practice relaxation techniques when anxious) to more formalized and structured interventions (e.g., a woman participating in a smoking cessation intervention receives a text message on her mobile phone with tips for dealing with cravings during a time when she typically smokes a cigarette). EMI can be used to supplement existing interventions or ongoing treatment (as is the case with the psychotherapy example), or could be implemented as an intervention on their own. The

important characteristic of all EMI is that the treatment is provided to people as they go about their daily lives.

Incorporating EMI into psychotherapy or psychosocial treatments has several benefits over traditional treatment formats. First, EMI extend the intervention beyond the standard treatment context by providing structure and support in patients' everyday lives. Traditional psychotherapy and psychosocial interventions are delivered during discrete times and communication between clinicians and patients outside the scheduled times is generally limited. It has been suggested that with the additional support provided by EMI, patients may feel better equipped to practice new behaviors and skills (Hay & Kinnier, 1998; Kazantzis & L'Abate, 2007; Newman, Consoli, & Taylor, 1997). Second, because EMI are provided in individuals' natural environments, patients have an opportunity to apply new skills and behaviors to their daily experiences. Although researchers and clinicians are generally interested in providing interventions that will help patients address real-world problems in naturally occurring circumstances, training and/or treatment is usually provided in clinical or research offices. Evidence suggests, however, that even when interventions produce effective skill acquisition when assessed in clinical or research settings, these skills do not necessarily translate to real life (e.g., Kalichman et al., 2002; Malow et al., 1994). A general premise for the use of momentary interventions is that EMI can reinforce the systematic use of treatment components in real-world settings, ideally at clinically appropriate times (e.g., moments of risk; see below), thus generalizing, and potentially enhancing, the intervention program's impact.

Many of the benefits of using electronic devices for EMA are also applicable to EMI, such as the portability, availability of auditory signals to prompt the use of

interventions, use of date and time stamps to track intervention compliance, and automatic data upload. In addition, using mobile technology to provide EMI has some unique advantages. First, although the use of electronic devices elicits a range of reactions from people, for some, it may increase the sense of privacy, comfort, and acceptance of treatment (Newman, Consoli et al., 1997). Second, technology-based systems can automatically tailor EMI content by selecting messages or interventions from a pool based on participant characteristics or assessment responses. Some evidence suggests that tailoring the content of health messages based on individual characteristics (e.g., readiness to change, motivation, self-efficacy) can improve message acceptance and willingness to change (e.g., Kreuter et al., 2000; Skinner et al., 1999). In addition to tailoring intervention content, mobile technologies also allow for the timing of messages to be individually tailored. In other words, EMI can be delivered to patients at specific times when they are in need of additional support. Finally, technology-based interventions can help patients and clinicians make more effective use of their time together. Electronic devices can perform basic and repetitious tasks (e.g., relaxation training), allowing clinicians to focus on the more complex aspects of care. Based on the benefits ambulatory and technology-based interventions have over more traditional treatments, there is potential to improve treatment efficiency and decrease overall treatment time, thus greatly reducing the intervention cost.

Mobile technology (e.g., palmtop computers, mobile telephones) has been used to deliver interventions in patients' everyday lives for a variety of conditions and health behaviors including healthy eating and physical activity, eating disorders, weight loss, anxiety disorders, smoking cessation, and alcohol use (Heron & Smyth, 2010). These

studies implemented interventions in a variety of different ways; in general, however, they provided EMI as only one component of the treatment. The treatment protocol generally consisted of EMI provided in addition to Cognitive Behavior Therapy [CBT] or interactive website interventions. In the following section, a brief description of previous EMI studies relying on CBT-based interventions and those using interactive computer programs is provided.

EMI and Cognitive Behavior Therapy [CBT]. In several previous studies of EMI, the treatment protocol included EMI provided in addition to Cognitive Behavior Therapy [CBT] for anxiety disorders, weight loss, and eating disorders. Although the study design and intervention implementation in these studies varied, participants typically took part in individual or group CBT and received palmtop computer-based EMI as a supplement to treatment. The EMI allowed participants to practice CBT skills in their everyday lives between sessions. For example, Gruber and colleagues (2001) provided patients participating in group CBT for social phobia with a palmtop computer programmed with customized intervention that provided an auditory signal every morning encouraging participants to "confront a social fear today." They could also initiate a cognitive preparation module (which reviewed skills taught in group CBT) on the palmtop computers before entering feared situations. After the situation, they were signaled by the palmtop computer to complete a cognitive debriefing module in which they reported their perceived success during the feared situation and an algorithm automatically provided feedback contingent on their reported success. Similar interventions were developed and tested for the treatment of phobias (Flynn, Taylor, & Pollard, 1992; Wiederhold et al., 2000), obsessive compulsive disorder (Baer et al., 1988), generalized anxiety disorder

(Newman, Consoli, & Taylor, 1999), and panic disorder (Kenardy et al., 2003; Newman, Kenardy et al., 1997).

Studies using CBT and EMI for weight loss have also been conducted. In these interventions, palmtop computer-based treatment modules allowed participants to track caloric intake and physical activity, facilitated goal setting, encouraged the use of behavioral weight loss strategies discussed in the treatment groups, and provided some limited individual feedback (Agras et al., 1990; Burnett, Taylor, & Agras, 1985, 1992). There is preliminary evidence that such EMI may be an efficacious means of providing weight loss treatment to overweight women. For example, in one study participants receiving an empirically validated CBT treatment for weight loss in addition to palmtop computer-based EMI lost more weight than those receiving CBT alone immediately post treatment (8 vs. 3 pounds), at 24 weeks (16 vs. 4 pounds), and at 40 weeks (18 vs. 2 pounds) after the intervention (Burnett et al., 1985). There is also evidence that overweight women encouraged to use intervention skills more often (via EMI) experienced larger treatment gains (Burnett et al., 1992). Similar to the anxiety treatment findings, these results provide evidence that EMI, which require minimal therapist time and effort, may be used to provide weight loss treatment or enhance existing CBT interventions.

Two additional pilot studies examined the efficacy of a mobile phone-based EMI, which was offered to patients after completing CBT treatment for bulimia nervosa (Bauer et al., 2003; Robinson et al., 2006). Although these interventions were provided as supplements to CBT, the EMI themselves were considerably less intense and comprehensive than those used in the anxiety and weight loss studies described above.

These EMI consisted of short motivational statements encouraging the use of CBT skills that were periodically sent to participants' mobile telephones. In one study Robinson and colleagues (2006) found that, after participating in CBT but before receiving EMI, 38% of patients experienced subclinical symptoms and 10% were symptom free. After receiving EMI for six months, 18% of patients continued to report subclinical symptoms and 29% were symptom free. The researchers concluded that these "after care" EMI might help to reduce binging, compensatory behaviors (e.g., vomiting), and (to a lesser extent) body dissatisfaction present in some patients with bulimia. Although promising, these findings are from two uncontrolled pilot studies and require replication in controlled trials and/or using superior within subject designs before more definitive conclusions about their utility with this population are warranted.

Overall, these studies suggest EMI can be successfully implemented in conjunction with CBT to reduce psychological symptoms (specifically anxiety) and encourage behavior change (specifically weight loss). Existing controlled trials demonstrated that abbreviated courses of CBT treatment supplemented with EMI can produce similar (and in some cases superior) statistical results to standard CBT interventions for panic disorder and social phobia, suggesting EMI may provide a cost-effective alternative to current anxiety treatments. Empirical evidence also suggests EMI can produce similar weight loss in overweight women to a validated CBT intervention and that adding EMI to CBT can enhance treatment efficacy.

EMI and Computer-Based Interventions. In addition to using EMI to supplement in person CBT interventions, several studies have examined the efficacy of EMI when provided in conjunction with a computer-based intervention. All of these interventions

were developed for smoking cessation and provided the intervention via an interactive website and mobile telephone messaging. Such interventions require substantially less ongoing involvement by researchers or clinicians than is needed with CBT. For example, Rodgers and colleagues (2005) tested the efficacy of a smoking cessation intervention delivered via mobile phone based text messaging to a large sample (*n*=1705) of young smokers in New Zealand. An interdisciplinary team developed over one thousand messages with information relevant to quitting and created a website where participants could complete questionnaires, access psychoeducation materials, seek social support, and track treatment progress. Participants received five daily text messages around their individual quit day and continued to receive three messages per week for a total of six months. In addition, when experiencing a craving, participants could either access the website or send a text message to a phone number provided and would immediately receive a reply message with tips for coping with cravings. Results showed that people receiving the EMI were significantly more likely to quit smoking than control participants, six weeks (28% vs. 13%) and twelve weeks (29% vs. 19%) after beginning the study, but group differences were not maintained at 26 weeks (25% vs. 24%). Two other studies showed similar treatment gains during the intervention, but did not assess maintenance of treatment effects after the intervention ended (Brendryen & Kraft, 2007; Obermayer et al., 2004). Overall, this research suggests EMI can be used in conjunction with a computer-based intervention to elicit behavior change (at least in the short-term). Interventions that rely on automated systems (such as those administered via computers and using mobile technology) have the potential for being able to reach a large number of people without requiring a great deal of resources.

Summary of EMI. To date, research primarily demonstrates EMI can elicit symptom and behavior change when implemented as one of several treatment approaches within a larger treatment protocol. EMI have been effectively implemented in conjunction with cognitive-behavioral and computerized interventions, addressing a variety of psychological symptoms and health behaviors. An important area for future EMI research to explore is the extent to which more individually tailored EMI programs can be developed, an issue that will be discussed in the following section.

Tailoring EMI

There is an emerging trend in health research to tailor behavior change interventions for individuals based on key variables or personal characteristics. Tailored messages are designed for specific individuals, which is in contrast to targeted interventions created for a subgroup of people who share one or more demographic characteristic (e.g., smokers, overweight Latinos; Kreuter, Strecher, & Glassman, 1999). The overarching rationale for using tailored versus generic messages is that tailored information is more personally relevant, increasing the likelihood of thoughtful consideration, which in turn helps enact behavior change (e.g., Kreuter et al., 2000).

EMI can be tailored to participants in two ways. First, the content of the EMI can be specifically designed for individuals based on information they provided during pre-intervention assessment or momentary assessments (i.e., EMA). About half of the existing EMI studies tailor the content of the interventions to individual participants (Heron & Smyth, 2010). For the most part, the tailored EMI included interactive CBT activities (e.g., relaxation, problem solving, goal setting), feedback based on concurrent EMA, or messages based on pre-intervention behavior patterns. For example in the study

by Gruber and colleagues (2001) described previously, the palmtop computer-based cognitive debriefing treatment module provided social phobia patients with feedback based on there reported success (or lack thereof) of managing their anxiety in a feared situation. Generic EMI content was also used in most studies and typically consisted of motivational statements or reminders to practice previously learned skills (e.g., CBT).

A second method of tailoring EMI involves delivering the interventions at specific times when individuals are especially in need of additional support. In order to provide time tailored EMI, the events or circumstances that trigger or initiate the delivery of the intervention must be clearly identified. Triggers are generally defined based on participants' responses to assessments. For example, several smoking cessation interventions inquired about participants' typical smoking times and intended quit date at the start of the study and later provided EMI to individuals during these times when they were likely to be in need of additional support (Lazev et al., 2004; Obermayer et al., 2004; Rodgers et al., 2005; Vidrine, Arduino, & Gritz, 2006). EMA is an alternate way to assess participants so that time tailored EMI can be developed. A few previous studies requested participants periodically complete EMA regarding their current affective state (e.g., anxiety level), or behaviors (e.g., calories consumed) and immediately provided tailored EMI based on the concurrent assessments (Agras et al., 1990; Burnett et al., 1985, 1992; Newman et al., 1999). Newman and colleagues tested a sophisticated integration of EMA and EMI in a pilot study with three patients who were participating in group CBT for generalized anxiety disorder (1999). Participants completed assessments of their anxiety levels at 8:00 am, 12:00 pm, 4:00 pm, and 8:00 pm every day. If, during these assessments, participants indicated they were highly anxious,

immediately after completing the assessment and again 30 minutes later they received reminders on the palmtop computer to practice CBT skills to cope with their anxiety. This study demonstrates that it is feasible to use mobile technology-based EMA to provide EMI at specific times when people are most in need of treatment, although data testing for differential outcome are still not widely available.

Theoretically, tailored interventions (either content or time tailored) should be more acceptable to recipients and efficacious. Empirical evidence suggests treatments relying on non-tailored EMI are less well accepted by participants. EMI in which the content of the interventions are not tailored generally consist of generic motivational messages urging participants to continue focusing on making behavior changes (e.g., "Keep up the good work!"). Generic, non-tailored EMI messages that are provided periodically throughout the day, but are not given at tailored times have drawn criticism from participants for being not helpful and repetitive (Joo & Kim, 2007; Newman et al., 1999; Weitzel et al., 2007). These criticisms suggest participants may be more receptive to EMI if they are provided at specifically tailored times.

Although generic (non-tailored) EMI may not be well received by participants, no clear pattern has emerged from previous EMI studies regarding the relationship between EMI tailoring and treatment efficacy. However, one study has experimentally manipulated the extent to which EMI timing is tailored and assessed treatment efficacy (Smyth & Heron, in preparation). In this study, adult men and women (n=90) took part in a stress management intervention. They were then given palmtop computers and five times daily for one week they were prompted to complete assessments of stress and mood. Participants were randomly assigned to one of three groups: (1) complete EMA

only and no further intervention (EMA only); (2) complete EMA and receive random prompting on the palmtop computers to use stress management skills (EMA+Random). These reminders came three semi-random times a day (morning, afternoon, and evening) and were unrelated to EMA reports; (3) complete EMA and receive prompting to use stress management techniques when high stress or negative affect were reported in the EMA reports (EMA+Tailored). The tailored prompts were given immediately after the EMA report and again 10 to 20 minutes after data collection. The EMA+Tailored group reported fewer stressors and less negative affect than the EMA+Random and EMA only groups; these effects remained after controlling for the number of prompts received. The EMA+Random group also reported fewer stressors, less severe stressors, and less negative affect than the EMA only group. Participants in the EMA+ Tailored and EMA+Random conditions reported less frequent eating, alcohol consumption, and smoking and better sleep quality than those in the EMA only group. These data suggest that providing EMI in addition to a stress management intervention can improve the efficacy of the intervention. In addition, tailoring the timing of the EMI so that they are provided when people are in particular need of stress management techniques improves the efficacy of the intervention over randomly delivered EMI.

Summary of Tailoring EMI. A limitation of previous EMI studies is that the EMI are not necessarily provided to people at specifically useful times. In addressing this concern, there have been some limited efforts to integrate the assessment and intervention capacities of palmtop computers. Specifically, EMI that are sensitive EMA reports in the natural environment can be created. The protocol for such an intervention involves providing individuals with palmtop computers that periodically signal them to complete

assessments of their current activities, emotional states, and behaviors. Based on their responses, interventions are tailored to the individuals' needs at that time and administered in real time on the palmtop computer. These EMI thus create an interactive and dynamic intervention strategy for use in everyday life. Trials examining the acceptability and efficacy of interventions that incorporate the assessment and intervention capabilities of palmtop computers are still needed. In the present study, both the content and timing of EMI were tailored based on participants' concurrent EMA reports.

Applying Ecological Momentary Interventions to Disordered Eating and Body Dissatisfaction

As has been discussed, EMI have been used as part of interventions for a variety of psychological and behavioral health concerns. EMI can be most easily applied to the treatment of symptoms and health behaviors with discrete antecedent states (e.g., cravings or urges prior to [over]eating, substance use, self-harm behavior) or events (e.g., anxiety provoking situation, stressors, mealtimes), as these can serve as "triggers" for the delivery of time tailored EMI. Several previous studies used EMI to reduce psychological distress, such as anxiety (Gruber et al., 2001; Kenardy et al., 2003; Newman et al., 1999; Newman, Kenardy et al., 1997), and to encourage healthier eating patterns (Agras et al., 1990; Atienza et al., 2008; Bauer et al., 2003; Burnett et al., 1985, 1992; Robinson et al., 2006). In the present study, EMI are incorporated into an intervention aimed at addressing unhealthy eating behaviors and psychological distress (e.g., negative affect, body image dissatisfaction) using cognitive behavioral techniques. The following sections provide an overview of current research on body image and eating pathology.

Body Image Dissatisfaction and Disordered Eating Behavior

Body image is the picture of our own bodies that we form in our mind (Pruzinski & Cash, 2002). This conceptualization emphasizes that body image is not about outward appearance, but is the internal representation of our physical features. Physical characteristics do not fully account for body image, as there are many other components that are important in developing this internal representation of the body; namely, cognitive, affective, and behavioral factors (Cash & Deagle, 1997; Thompson, 1996). Body image dissatisfaction is displeasure with one's appearance (Rosen et al., 1992), which occurs when there are inconsistencies between perceptions of one's actual physical attributes and those one would like to, or think one should possess. There are clear links between body image dissatisfaction and cognitive, affective, and behavioral outcomes that can impact quality of life (Thompson et al., 1999). Body image dissatisfaction can be conceptualized using a continuum model, with levels of disturbance ranging from none to extreme. Most people fall near the middle, experiencing mild to moderate distress or body dissatisfaction. Individuals with higher levels of body image dissatisfaction are likely to report impairment in social and psychological functioning, including lower self-esteem, and greater depression and anxiety (Thompson et al., 1999).

Body image dissatisfaction is an important problem in its own right, but it is also a critical risk factor for the development of eating pathology (Levine & Smolak, 2006b). Eating behaviors, similar to body image, can be conceptualized on a continuum with eating disorders (e.g., bulimia nervosa, anorexia nervosa) at one end and healthy eating habits at the other (Levine & Smolak, 2006a; Shisslak, Crago, & Estes, 1995; Striegel-Moore, Silberstein, & Riodin, 1986). Proponents of this continuum model argue for the

necessity of considering eating behaviors that falls between these two extremes. Disordered eating behaviors are characterized by the presence of some symptoms of eating pathology, such as calorie-restrictive dieting, but in the absence of a diagnosable eating disorder (e.g., according the *Diagnostic and Statistical Manual* criteria; American Psychiatric Association, 2000). Within this continuum perspective, disordered eating behaviors (e.g., restricting intake, binge eating) often co-exists with other aspects of eating disorders such as body dissatisfaction and over-concern with weight and shape, which together put a person at risk for developing an eating disorder (Levine & Smolak, 2006a).

Body image dissatisfaction is relatively common for college women in the United States (Thompson, 1990). Research has suggested that about 74% of students gain weight during their first semester of college (Anderson, Shapiro, & Lundgren, 2003), which can have implications for individuals' beliefs about their bodies. Furthermore, prevalence studies indicate that, although a minority of college women report clinical eating disorders, 61% report disordered eating patterns more generally (Anderson et al., 2003). This is notable as disturbed eating is strongly correlated with more negative body image, endorsement of sociocultural thinness norms, and weight and appearance concerns (Mintz & Betz, 1988). It is evident that college women experience many stressors related to their bodies, appearance, and food and, as a group, they experience significant body image and weight concerns.

Sociocultural Influences on Body Image Dissatisfaction

Sociocultural influences play an important role in the manifestations of body image dissatisfaction and subsequent pathology (Levine & Smolak, 2006c). Western

societies embrace a thin ideal that values women who have slender figures and devalues women who do not meet these standards. Concurrent assessments of internalization and body satisfaction suggest that women who internalize thinness norms are less satisfaction with their bodies (Morry & Staska, 2001). In prospective studies, Stice and colleagues (Stice, 2001; Stice & Bearman, 2001) have shown that sociocultural pressure to be thin and internalization of these standards in young women is associated with body image dissatisfaction, negative affect, and unhealthy eating patterns (e.g., binge eating, dieting) nearly a year later.

One influential source of thinness norm messages is the media. Correlational and experimental studies have demonstrated that there is an association between media exposure, body dissatisfaction, and eating disorder symptomatology. Women who watch more television and read more magazines report higher levels of body dissatisfaction and more eating disorder symptomatology even after controlling for BMI (Harrison & Cantor, 1997; Stice et al., 1994). Additional studies have experimentally manipulated media exposure to demonstrate a causal relationship between viewing images that represent the thin ideal and subsequent ratings of body image dissatisfaction. The general protocol for these studies involves presenting women with images of thin models and/or control images, including average size models, plus size models, or inanimate objects. Participants then make ratings of body image dissatisfaction. Overall, research shows that women who view thin models subsequently report more body dissatisfaction than other experimental conditions (Posavac, Posavac, & Posavac, 1998; Stice & Shaw, 1994). A meta-analysis of 25 experimental studies that manipulated media exposure found that body image dissatisfaction was greater after viewing thin media image than average size

models, plus size models, or inanimate objects (Groesz, Levine, & Murnen, 2002). The effects were stronger for participants who were already dissatisfied with their bodies and for younger women. These meta-analytic results suggest that the mass media (including television and fashion magazines) promote a thin ideal of beauty that may lead some women to feel poorly about their body weight and shape. These correlational and experimental results thus support the assertion that media exposure may influence women's perceptions of themselves, opinions about their bodies, and overt behaviors.

Body Image Dissatisfaction in Everyday Life

Most body image research focuses on the construct at the trait-level. For instance, assessments completed in laboratory settings consistently suggest that women want to be thinner and think that they should be thinner (e.g., Rozin & Fallon, 1988). However, there is limited research exploring body image dissatisfaction as it occurs in everyday life. In the last several years, Cash and his colleagues (Melnyk, Cash, & Janda, 2004; Rudiger et al., 2007) have begun to examine within person variability in college women's experience of body image dissatisfaction. In both studies, female college student participants completed initial trait measures of body-related concerns and dissatisfaction. They then completed the Body Image States Scale [BISS] (Cash et al., 2002), a measure of body dissatisfaction at a particular point in time. The BISS was completed twice daily (morning and evening) for six days by calling into an automated phone service in one study (Melnyk et al., 2004), and once daily for 10 days via a secure website in another (Rudiger et al., 2007). The mean and variability (standard deviation) of all the BISS scores were calculated. Based on correlations of trait and state measures, variation in BISS scores was unrelated to trait body image evaluation, suggesting that these two

constructs are distinct. These studies also showed that women reporting more body image cognitive distortions, perfectionistic self-presentation, body image investment, and eating attitudes evaluate their bodies more negatively and inconsistently (i.e., level of positive/negative evaluation changes more frequently).

As Cash and his colleagues note, there is a paucity of research assessing body image and variability in body dissatisfaction in everyday life, despite potentially important clinical and conceptual implications of unstable body image states. These two studies move beyond single-assessment trait body image by measuring day-to-day dissatisfaction using telephones and the internet. Although these studies assess body image outside of the laboratory and provide evidence that state body dissatisfaction is important to consider, they are limited to 1-2 assessments per day and participants must plan to complete the daily assessments at fixed times. This is a concern because participants may adjust their activities in anticipation of the specific times when they are expected to complete an assessment. For example, if a participant expects to be at a social gathering at the time of the scheduled assessment, he or she may leave or move to another location before completing the assessment or not attend the social gathering all together. By adjusting their lives in anticipation of assessments, it is unclear if the reports actually reflect processes that typically occur in everyday life. As was discussed previously, one of the benefits of EMA is that it allows for participants to be signaled via mobile electronic devices, such as palmtop computers, and they can complete the assessments as they go about their daily lives.

To more carefully examine this issue, one study used EMA to assess women's body image dissatisfaction in the real world (Heron, 2006; Heron & Smyth, in

preparation). The primary goal of this study was to determine whether reports of body image dissatisfaction reliably vary in everyday life and if so, to identify contextual cues associated with women's experience of body image dissatisfaction. Undergraduate college women (*n*=63) completed five daily assessments (including measures of body dissatisfaction, eating, exercise, social contact, media exposure, and negative mood) on palmtop computers for one week. Results suggested that women reported greater body image dissatisfaction after eating, while watching television, and when reporting depressed and/or anxious mood. They reported less body dissatisfaction after exercising and there was no significant relationship between social contact and body image dissatisfaction. Overall, these findings suggest that contextual factors can influence women's everyday experience of body dissatisfaction and identified specific contextual factors that could make women more likely to be concerned about their bodies. Coupled with the previously discussed research on EMI, these results suggest that interventions tailored to specific contextual factors in the natural environment may enhance treatments for body image and disordered eating concerns. In the following section, existing treatments for body image and eating concerns are discussed further.

Treatment Approaches for Body Image Dissatisfaction and Eating Concerns

Psychological treatments (e.g., cognitive behavior therapies) for a variety of disorders focus on changing maladaptive self-beliefs and emotional responses (e.g., Linehan, 1993), and therapies for body image and disordered eating concerns are no exception. Treatments for body image dissatisfaction (Cash, 1997; Cash & Pruzinski, 2002) explicitly focus on the role of discrepant body-related beliefs and emotional instability in maintaining maladaptive thoughts and behaviors. These treatments adopt a

cognitive behavioral approach to help patients understand the relationship between their thoughts, feelings, and behaviors so that they can begin to target and correct maladaptive appearance-related beliefs and behaviors. These interventions emphasize the importance of psychoeducation, cognitive restructuring, self-monitoring and behavior modification (Cash, 1997; Stice & Presnell, 2007; Thompson et al., 1999). Therapies for bulimia nervosa (Fairburn, Cooper, & Safran, 2003; Wonderlich et al., 2000) similarly focus on body-related beliefs and emotional instability in maintaining maladaptive behaviors. For example, integrative cognitive-affective therapy, an emerging treatment for bulimic behaviors, includes treatment modules (e.g., self-monitoring, cognitive restructuring) that can be administered on palmtop computers to help patients generalize therapy skills to their daily lives (Wonderlich et al., 2000).

Interventions designed to reduce disordered eating behaviors and body image dissatisfaction in women have been created for a variety of people (e.g., elementary though college students) to be administered in various settings (e.g., schools, community). In a meta-analysis, Stice and Shaw (2004) found that there are several promising programs that decrease eating pathology and risk factors (e.g., body dissatisfaction) for disordered eating. The most successful programs appeared to be those developed for women who already report body dissatisfaction (i.e., are “at risk” for developing an eating disorder), used interactive protocols (i.e., not only didactics), included multiple sessions, were presented only to women, and for individuals 15 years old or older.

Given evidence that eating pathology is strongly influenced by sociocultural factors (Levine & Smolak, 2006b), many cognitive behavioral interventions draw from

Social Cognitive Theory [SCT] to elicit behavior change (Bandura, 1986). SCT is the underlying theoretical framework for many body image dissatisfaction and disordered eating interventions and prevention programs (Levine & Smolak, 2006d), including the intervention used in the present study, which was loosely based on SCT (Franko et al., 2005). SCT focuses on the ways individuals' knowledge, expectations, emotions, and behaviors are shaped by the physical, social, and cultural environment (Bandura, 1986). Two key components of SCT that influence behavior change are improvements in self-regulation and self-efficacy (Levine & Smolak, 2006d). The intervention used in this study promotes strategies for coping with dysphoric mood, regulating behavior, and improving self-efficacy for behavior change. Emotion regulation is taught by helping women to identify negative emotions (e.g., sadness, anger) in themselves and others, and generating adaptive coping strategies. Self-efficacy improvements are sought by teaching women to challenge beliefs and automatic thoughts about body shape/weight, and conducting behavioral exercises designed to reduce unhealthy dietary patterns (e.g., restraint, overeating). These treatment strategies are derived from SCT goals (Levine & Smolak, 2006d) and it is expected that such intervention will change individuals' ability to regulate negative emotions and improve self-efficacy, thus reducing disordered eating behaviors, attitudes, and beliefs about one's physical appearance.

Most SCT-based interventions fail to explicitly address individuals' thoughts and emotions as they occur in their everyday lives. A novel component of the present study is that the manner in which the interventions are delivered also draws from SCT. One of the key change processes posited by SCT is that individuals must have not only strategies for change (provided by the intervention), but also the means to guide one's self through the

necessary steps to make those changes. By providing EMI to women in their everyday lives, they receive additional support to help implement the changes introduced during the initial intervention.

The Present Study

The present research study integrates the assessment and intervention capabilities of palmtop computers to create ecologically sensitive EMI to enhance a standard CD-ROM-based intervention for disordered eating and body image concerns in college women. A diagram of the study procedures can be found in Figure 1. Undergraduate women reporting disordered eating behaviors were randomly assigned to one of three experimental conditions: (1) attention control; (2) CD-ROM intervention (CD); (3) CD-ROM intervention plus EMI (CD+EMI). This study was framed for participants as a study of college students' daily experiences, lifestyles, and psychological and physical health and well-being. Participants in all conditions completed EMA on palmtop computers one week before and one week after the intervention phase of the study. At the start of the intervention phase, the CD and CD+EMI conditions received the CD-ROM and the attention control condition reviewed videos related to college adjustment and academic issues on a computer (in an effort to more closely match groups for attention and treatment contact). After reviewing the CD or control videos, all participants completed one week of EMA and EMI were administered on the palmtop computers to the CD+EMI group based on individuals' concurrent EMA responses. EMI consisted of brief messages describing and reminding participants to use treatment techniques introduced during the CD intervention. The EMI were be provided when participants report three specific experiences (eating, media exposure, negative mood) via EMA, as

women are more vulnerable to body image dissatisfaction in these situations (Heron, 2006; Heron & Smyth, in preparation). All participants completed a 2-month follow-up assessment of disordered eating, body image dissatisfaction, and psychological well-being.

One criticism of EMA is that multiple assessments may increase participant reactivity to internal or external cues. It is plausible that frequent real-time assessment may change people's natural environment by introducing cues that could alter social, psychological, and behavioral aspects of their lives (i.e., reactivity), and thus not necessarily accurately reflect real-world processes. For example, it is possible that multiple daily assessments regarding body concerns affect disordered eating behaviors, attitudes, and body dissatisfaction. This issue has been tested empirically (Heron, 2006). In the previously described research study examining college women's body image dissatisfaction using EMA, participants completed laboratory measures of disordered eating, body dissatisfaction, and thinness norm internalization before and after completing one week of EMA. Findings suggested there were no changes in women's attitudes or behaviors regarding eating concerns, food restriction, or body weight concerns, body dissatisfaction, or thinness norm internalization before and after completing the EMA. These data can be taken to indicate that, although EMA may appear similar to self-monitoring (and thus could have beneficial effects), there is no evidence for reactivity (either improvement or worsening) in response to EMA monitoring. These findings are consistent with other studies suggesting that EMA is not reactive in eating disorder populations (le Grange et al., 2002; Stein & Corte, 2003). Taken together, these data indicate that EMA monitoring alone can serve as an attention-

matched control group, as is being done in the present study. However, in this study we also empirically tested for potential measurement reactivity to EMA as well.

Research Aims and Hypotheses

The primary goal of this study was to evaluate the feasibility, acceptability, and efficacy of a palmtop computer-based EMI for supplementing a disordered eating intervention for college women. In addition, several exploratory research aims were examined secondary to this goal. Each of the research aims and specific hypotheses are outlined below.

Research Aim 1. To determine the feasibility and acceptability of the CD-ROM intervention and palmtop computer-administered EMI for college women.

Hypothesis 1a. Participants will show content-specific knowledge gain based on the type of computerized materials reviewed (CD intervention vs. control videos).

Hypothesis 1b. Participants will be compliant with the EMA protocol, completing at least 70% of the momentary assessments.

Hypothesis 1c. College women will find the technology-based intervention acceptable, as measured by program satisfaction ratings.

Research Aim 2. To determine if providing time-tailored EMI (CD+EMI) lead to greater and more sustained treatment gains than a short-term intervention program (CD) or an attention-matched control condition.

Hypothesis 2a. College women's body dissatisfaction and disordered eating behaviors will not be reactive to the EMA protocol.

Hypothesis 2b. College women receiving the CD intervention (CD, CD+EMI) will show improvements in body dissatisfaction and disordered eating immediately after

completing the intervention as compared to participants viewing videos (control group).

Hypothesis 2c. College women receiving tailored EMI (CD+EMI) will show the greatest reduction in body image dissatisfaction and disordered eating behaviors, followed by those receiving only a short-term intervention and those in the control condition.

Hypothesis 2d. College women receiving tailored EMI (CD+EMI) will show treatment gains to a greater extent at the 2-month follow-up assessment than those individuals who do not receive EMI (CD, control).

Research Aim 3 (exploratory). To examine healthy body image and eating behavior self-efficacy and emotion regulation as potential variables mediating the treatment effects.

Research Aim 4 (exploratory). To identify characteristics of EMI use and the extent to which these are associated with treatment gains.

Hypothesis 4a. In an exploratory fashion, descriptive statistics on the frequency and content of EMI participants received will be examined.

Hypothesis 4b. In an exploratory fashion, the effect of EMI frequency and EMI content on treatment outcome will be examined among women in the CD+EMI group.

Methods

Participants

Undergraduate women were recruited to participate in a research study regarding daily experiences and life in college. Participants were recruited to complete the initial screening questionnaires using on-campus flyers and online postings, and through the Introductory Psychology subject pool. Interested college women were directed to a website where they provided consent for the screening procedures, and then completed

demographic information and a battery of questionnaires. The questionnaires included measures of college adjustment, mood, stress, and health behaviors, in addition to the target screening measures (Eating Disorder Examination – Questionnaire [EDE-Q] and Body Shape Questionnaire [BSQ]). A range of questionnaires assessing a variety of aspects of college student life were included in order to be consistent with the framing of the study as one regarding college life. The study was broadly framed and these additional questionnaires were included for two reasons. First, one-third of the participants were randomized to the attention control condition and reviewed videos that addressed general college student issues (e.g., academic success, roommate and peer relationships, etc.; these materials will be discussed in greater detail below). The broad description of this study and the inclusion of questionnaires assessing issues addressed in these videos (e.g., stress, college adjustment), allowed for the study to be framed in a consistent way that made sense for all participants. The second reason for the inclusion of additional questionnaires was to reduce demand characteristics. Although demand is a concern in all interventions, it could have been especially problematic in this study because participants received frequent cues (via EMA) about their participation in this study and, thus, may have experienced greater demand to respond in the "correct" way (i.e., report they are getting better). This would likely be more of a concern if the framing was less broad (e.g., participants were told this was a disordered eating intervention) and EMA and questionnaire items focused solely on eating behavior and body image, as the "correct" responses would be more readily apparent. Using a broader study framing allowed for the true purpose of the study to be masked, somewhat reducing concerns that demand characteristics could drive any significant treatment effects.

Undergraduate women with an average EDE-Q score ≥2.30 and/or a total BSQ score ≥110, did not report current diagnosis or treatment for an eating disorder, who were between the ages of 18 and 24, and who agreed to be contacted about additional studies were eligible to participate. These screening criteria were used in order to identify students with disordered eating behaviors (but not current clinical disorders), as research suggests body image dissatisfaction and disordered eating interventions are most useful when targeted to at-risk women (Stice & Shaw, 2004). The research evidence for using these cutoffs is provided in the following section. Older students were excluded because the CD-ROM and control video materials are designed for undergraduate college students in their late teens and early twenties.

Figure 2 contains detailed information regarding recruitment and attrition rates. Seven hundred ninety-five women completed the online assessment. Of these, 37% (n=296) met inclusion criteria. These individuals were contacted via email, provided with a more detailed description of the study (e.g., general study activities, frequency of appointments, duration of study), and instructed to contact the researcher via email or telephone with questions or if interested in participating. Of the eligible women, 48% (n=141) did not respond to two e-mail contact attempts by the researcher (sent to the e-mail address where the participant indicated she could be contacted for information regarding additional studies). Eight percent of eligible women (n=24) responded to the e-mail contact, but indicated they were not interested in participating. Forty-four percent of eligible women (n=131) enrolled in the study. Once enrolled, attrition rates were very low. After beginning the study, two participants (1.5%) dropped out before beginning the intervention, citing time constraints. Two participants randomly assigned to the CD+EMI

condition did not receive any EMI because they did report behaviors or moods that would prompt EMI (refer to the following section titled “EMA Triggers for Providing EMI” for details regarding the EMI triggers). Thus, these individuals continued their participation, but did not receive the intervention as randomly assigned (i.e., they effectively were treated as participants in the CD condition). Two additional participants (1.5%) were lost to follow-up; they completed the intervention, but did not respond to requests to complete the two-month follow-up assessment. The handling of missing data due to attrition is discussed in the Results section.

Measures and Assessments

All of the questionnaires were administered on a computer via a secure and confidential website. Individual identification numbers were assigned to ensure confidentiality. Each assessment measure is described below. Table 1 provides an overview of the purpose and timing of the questionnaires. Both

Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 1994) is a self-report version of the Eating Disorder Examination interview (Cooper & Fairburn, 1987). The EDE-Q focuses on the behavioral and attitudinal aspects of disordered eating including restraint, shape concern, eating concern, and weight concern. Twenty-two items measure disordered eating behaviors and attitudes on a 0 to 6 scale (sample item: Have you tried to follow definite rules regarding your eating in order to influence your shape or weight; for example, a calorie limit, a set amount of food, or rules about what or when you should eat?; see Appendix A for full scale). Higher scores are interpreted as greater disordered eating behavior. The EDE-Q is considered an acceptable alternative to the interview methodology (Black & Wilson, 1996). Cronbach

alphas for EDE-Q subscales range from .78-.93. Two-week test-retest reliabilities for the subscales are all adequate (.81-.94). Correlations between the questionnaire and interview formats of this measure range from .79 to .81 for the subscales, suggesting concurrent validity (Luce & Crowther, 1999). The EDE-Q was used to screen participants for study eligibility. Research suggests that a total EDE-Q score of 2.3 (computed as the average of the 22 item ratings on 0 to 6 scale) most appropriately identified women with potentially problematic disordered eating behaviors and attitudes (Mond et al., 2004b). In the present study, participants scoring 2.3 or higher on the total EDE-Q score were thus eligible to participate. The EDE-Q was also used as a primary outcome in this study and was administered at the beginning (i.e., screening) and end (i.e., 2-month follow-up) of the study. It was not administered on a weekly basis during the intervention because it inquired about thoughts, feelings, and behaviors during the previous four week (see Appendix A).

Body Shape Questionnaire (BSQ; Cooper et al., 1987) is a 34-item self-report questionnaire used to evaluate fear of putting on weight, feelings of low self-esteem because of one's appearance, desire to lose weight, and body dissatisfaction (sample item: Have you noticed the shape of other women and felt that your own shape compared unfavorably?; see Appendix B for full scale). Higher scores are interpreted as greater body dissatisfaction. The BSQ has high internal consistency (Cronbach alpha=.97), test-retest reliability (r=.88), and concurrent validity (r=.66) with other measures of body dissatisfaction (Rosen et al., 1996). The BSQ was also used to screen participants for study eligibility. A total BSQ score of 110 (computed as the sum of the 34 items rated on a 1 to 6 scale) has been used to identify women at risk for developing eating disorders

(Zabinski et al., 2001). This score is one standard deviation above the mean BSQ score for college women and one standard deviation below the mean for probable cases of bulimia (Cooper et al., 1987), suggesting it is identifying women at risk for eating pathology. In the present study, potential participants scoring 110 or higher on the BSQ were eligible to participate. The BSQ was also used as a primary outcome measure in this study and was only administered at the start and end of the study because, as with the EDE-Q, it asks about body-related thoughts and feelings during the previous month (see Appendix B).

Contour Drawing Rating Scale (CDRS; Thompson & Gray, 1995) includes nine female figure line drawings of increasing size. Participants select the figures that resemble their actual figure, how they would ideally like to look, and how they think they should look (see Appendix C for full scale). A discrepancy score (actual minus ideal) is calculated and interpreted as a measure of body dissatisfaction (Fallon & Rozin, 1985; Rozin & Fallon, 1988; Thompson et al., 1999). Larger discrepancy scores are interpreted as a greater desire to be thinner or beliefs one should be thinner; a score of zero suggests no body discrepancy. In college women the two-week reliabilities body image discrepancy were .82 (Heron, 2006) and discrepancy scores converge with digital manipulation techniques (r=.74) (Rowe et al., 2005). The CDRS was a secondary outcome measure in this study and was used to assess changes in body discrepancies on a weekly basis during the intervention.

Body Image Quality of Life Inventory (BIQOL; Cash & Fleming, 2002) quantifies how body image experiences affect life domains, including sense of self, social functioning, emotional well-being, eating, exercise, and grooming (sample item: How

much your feelings about your appearance affect your day-to-day emotions?; see Appendix D for full scale). Larger positive scores are interpreted as body image having a more positive impact on quality of life and larger negative scores indicated a more negative effect of body image on quality of life. A score of zero suggests a neutral effect of body image on quality of life. The BIQOL is internally consistent (Cronbach alpha=.95), has adequate two-week test-retest reliability (*r*=.79), converges with body satisfaction (*r*=.66) and diverges with body image dissatisfaction (*r*=-.20) and BMI (*r*=-.21) (Cash & Fleming, 2002). The BIQOL was a secondary outcome measure in this study and was used to assess body-related quality of life on a weekly basis during the intervention.

Sociocultural Attitudes Towards Appearance Questionnaire-3 (SATAQ; Thompson et al., 2004) assesses the extent to which women are aware of sociocultural thinness norms, experience pressure related to their appearance, and have internalized appearance standards (sample item: I would like my body to look like the models who appear in magazines; see Appendix E for full scale). Higher scores suggest greater awareness and internalization of appearance standards. In two samples of college women, Cronbach's alphas for the measure were .94-.96 (Thompson et al., 2004). The SATAQ converges with measures of thinness norm internalization (*r*=.51), drive for thinness (*r*=.54), and body dissatisfaction (*r*= .32; Thompson et al., 2004). The SATAQ was a secondary outcome measure in this study and assessed thinness-norm internalization weekly during the intervention phase of the study.

Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) assesses problems with emotional awareness, acceptance, regulation, and clarity, and impulse

control. Respondents rate items (sample item: I experience my emotions as overwhelming and out of control) on a 5-point scale (1=almost never, 5=almost always). Higher scores represent poorer emotion regulation skills. In college students Cronbach alpha was .93, and the DERS converged with experiential avoidance (r=.60) and diverged from emotional expressivity (r=-.23; Gratz & Roemer, 2004). In order to reduce participant burden, the original 36-item questionnaire was reduced to 18 items. Items with the highest factor loadings were selected for inclusion in this revised measure (Gratz & Roemer, 2004; see Appendix F for revised scale). In analyses, the DERS was included to test emotion regulation as an exploratory mediator of treatment effects.

Eating Disorder Recovery Self-Efficacy Questionnaire (EDRSEQ; Pinto et al., 2006) is a self-report measure of self-efficacy for eating and body image related constructs. The EDRSEQ contains two internally consistent subscales: normative eating self-efficacy (sample item: I can eat a meal without thinking about how many calories I'm consuming; Cronbach alpha=.97) and body image self-efficacy (sample item: I can accept my "figure flaws"; Cronbach alpha=.95). Higher scores represent greater self-efficacy. Convergent validity for the EDRSEQ was demonstrated with significant negative correlations with drive for thinness (r=-.71), body dissatisfaction (r=.61), and cognitive restraint (r=.66; Pinto et al., 2006). To reduce burden, the original 23-item questionnaire was revised to include 10 items that were selected based on previously reported factor loadings and applicability to the present sample (i.e., women with subclinical eating disorders; Pinto et al., 2006). See Appendix G for the revised scale. In analyses, the EDRSEQ was included to test healthy body image and eating behavior self-efficacy as an exploratory potential mediator of treatment effects.

Knowledge Test. A customized questionnaire to assess participants' knowledge before and after reviewing the intervention and control materials on the computer was developed for this study. The Syracuse University IRB approved this questionnaire development pilot study. This questionnaire was modeled after the knowledge questionnaire developed in conjunction with the *Food, Mood, and Attitude* CD-ROM intervention (Franko et al., 2005). Questions similar in difficulty and style were added to match the content of the materials presented to the control videos, yielding a total of 40 multiple-choice items. This measure was administered to 62 female undergraduate students via an internet survey to reduce the total number of questionnaire items and ensure that the measure was sufficiently difficult. Based on participants' responses, items that less than 50% of participants answered correctly (i.e., "difficult" items) were reviewed for importance and content validity. Twenty items (10 testing knowledge gain from the intervention CD and 10 testing knowledge from the control videos) were identified to create a revised knowledge measure and these items were reviewed to ensure that each subscale had a similar level of difficulty. The revised 20-item measure was piloted with an additional 21 female college students (see Appendix H). On the items contained in the revised measure, participants in the pilot study correctly answered a total of 2.90 out of 10 on the intervention content subscale (*SD*=1.73) and a total of 3.57 out of 10 on the control video content subscale (*SD*=2.18). This suggested that the knowledge measure was sufficiently difficult and "ceiling effects" would likely not be encountered after the intervention or control materials were presented. In the present study this measure was framed as an assessment of the type of information that college students know about college life, health, and well-being. Thus, all participants completed the full

20-item measure (with both intervention and control items) so that differential knowledge gain could be examined.

Body Mass Index (BMI). Height and weight were measured by the researcher at the participants' first visit to the research office and used to calculate BMI. BMI is a measure of relative weight based on height, and is computed by dividing weight in kilograms by the square of height in meters. A BMI less than 18.5 is considered underweight, 18.5-24.9 is normal weight, 25.0-29.9 is overweight, 30.0-39.9 is obese, and over 40.0 is morbidly obese (Bray & Gray, 1988). BMI was used to provide descriptive information about the sample and as a potential moderator of treatment outcome.

Demographics and Background Questionnaire. Participants provided information regarding age, race/ethnicity, relationship status, living arrangement, sorority membership, and mental health treatment (see Appendix I). Demographic and background information was used to describe the sample.

Treatment Acceptability and Satisfaction Questionnaire. A measure was created to access the acceptability of, and participants' satisfaction with, the various intervention components, including the computer interventions, EMA, EMI (where applicable), and the overall study experience. All satisfaction ratings were made using a seven-point scale (0=not at all, 3=moderately, 6=very much). For the computerized materials (CD-ROM or videos), participants rated the extent to which they enjoyed the materials, found them helpful, would recommend them to a friend, were satisfied with the content, and were satisfied with the quality of the materials. For the palmtop computer assessment, women rated how much they enjoyed completing the surveys, and satisfaction with the content

and quality of the surveys. Women in the CD+EMI condition also rated their satisfaction with various aspects of the EMI, including how helpful the EMI were, and satisfaction with the EMI content and frequency. Satisfaction with overall study experience was assessed by asking participants the extent to which they enjoyed participating in the study, found it helpful, would recommend participation to a friend, and were generally satisfied with the study experience. This information was used to describe women's acceptance of, and satisfaction with, the intervention components.

Supplemental Questionnaires. Given the study was framed as being about various aspects of college life and experiences to minimize demand characteristics, at all assessment points participants also complete several other questionnaires about their mental and physical health and college experiences in addition to those described above. These questionnaires included measures of stress, social support, depression, college adjustment, family life, self-esteem, personal initiative, and health behaviors (e.g., smoking, sleep, etc.). These questionnaires were not used for the purposes of the present study.

Computerized Treatment Materials

CD-ROM Intervention. Food, Mood, and Attitude is a CD-ROM-based intervention designed to decrease body image dissatisfaction and disordered eating in college women (Franko et al., 2005). It is the only empirically supported CD that uses evidence-based prevention techniques (e.g., cognitive reframing, behavioral changes) and multimedia technology to deliver information on healthy exercise, nutrition, self-esteem and body image. At the start of the intervention, the participant is asked to be a "peer counselor" on a virtual college campus. The user is introduced to three women, Jen (who

has medical issues related to her weight), Kate (who is an athlete who overeats and over-exercises) and Naomi (who is depressed and binge eats) and navigates through scrapbooks that each of the three women has compiled to describe their experiences.

When developing the content of the CD, the authors explicitly drew from a "disease-specific social cognition theory, which focuses on eliminating risk factors" for eating disorders by using "various agents of social influence (e.g., peers) to transmit information, teach skills, and increase knowledge (Franko et al., 2005, p. 568). Each scrapbook provides psychoeducational material and activities aimed at improving emotional self-awareness and regulation, and allowing individuals to develop and practice skills necessary to challenge automatic thoughts and identify and challenge the resulting behaviors. Consistent with the objectives of SCT, the goal of the CD is to improve emotional self-awareness and regulation, identify and challenge beliefs and automatic thoughts about shape and weight, and practice behavioral exercises designed to reduce unhealthy dietary patterns (e.g., restraint, overeating), thus improving self-efficacy. In an RCT women who completed the CD-ROM reported significantly less overeating and excessive exercise behaviors. Women at-risk for developing an eating disorder improved to a greater extant than low-risk individuals (Franko et al., 2005).

Control Videos. Participants in the control condition viewed videos on a computer. The videos contained information regarding a wide variety of social (e.g., peer relationships, roommates), academic (e.g., classroom success), and personal issues (e.g., finances) relevant to college students. These videos did not mention any issues related to healthy eating or body image. Similar to the CD-ROM intervention, the videos included current college students discussing issues they faced in college and tips for dealing with

these concerns. The videos were didactic in nature and did not include any interactive components. The videos were professionally produced and are commercially available (Baer, 2007). The videos took approximately two hours to view, which was equivalent to the time needed to review the CD, therefore attempting to match the groups on time, attention, and expectations.

Ecological Momentary Assessment and Interventions

Palmtop computers. Palm Z22 and m105 handheld computers (Palm Inc.) were used for the EMA data collection and delivery of EMI. These devices have 160x160 pixel LCD display screens and use the Palm OS® operating system. All of the customized surveys were downloaded onto these palmtop computers and participants were able to complete surveys directly on the display screen using an included stylus.

Customized EMA Survey. EMA surveys were developed using Satellite Forms MobileApp Designer (Intellisync Corporation, 2004) and were downloaded to the palmtop computers. The survey was completed five times daily (at semi-random intervals) based on a signal-contingent assessment protocol. At each assessment, items regarding current location, activity, social interaction, stress, exercise, eating behaviors, media exposure, and mood were measured. See Appendix J for the items in the customized EMA survey.

Conceptual Model for Delivering EMI. EMI were delivered via palmtop computers based on responses to the EMA survey. EMI were administered when women report dysphoric mood, specific eating behaviors, or media exposure. Previous EMA research with college women (Heron, 2006), and research regarding eating disorder risk factors (Groesz et al., 2002; Jacobi et al., 2004; Levine & Smolak, 2006c) suggest that

these events and experiences are associated with women's body image dissatisfaction. Several different models have been proposed to identify the links between psychosocial factors, body dissatisfaction, eating behaviors, and the development of clinical eating disorders (Keery, van den Berg, & Thompson, 2004; Stice, 2001). Yet there is ongoing debate about which specific psychosocial factors are most important and how these factors interact with one another (see Keery et al., 2004). In general, these models are based on cross sectional or longitudinal data taken over relatively long periods (e.g., every 6 months); the models identify either directional or bi-directional relationships between psychosocial factors (e.g., psychological functioning, pressure to be thin from the media, internalization of thinness standards, etc.) and body dissatisfaction and suggest that body dissatisfaction results in disordered eating behaviors (e.g., restricting, dieting, bulimic symptoms). Despite data in support of these models, it is as of yet unclear whether these processes operate in the same fashion within individuals at the momentary level. Within individuals, it is reasonable to expect that after engaging in disordered eating behaviors (e.g., binging), women might experience dysphoric mood (e.g., feel guilty, angry, ashamed), which in turn could increase body dissatisfaction. In fact, EMA data from bulimic patients suggests that immediately after a binge episode, women do experience dysphoric mood, which slowly subsides over the next 2-8 hours (Smyth et al., 2007). In this way, the relationships between the factors associated with the onset of eating disorders at the global level between individuals may be somewhat different from those operating at the momentary level within individuals. In particular, the momentary ebb and flow of affect, cognitions, and behaviors may produce more transactional relationships (i.e., bi- or multi-directionality) than is observed in studies conducted over

longer periods of time (and/or between individuals).

In the present study, we were targeting the relationships between psychosocial factors, body dissatisfaction, and eating behaviors at the *momentary* level. As noted, there is very limited evidence indicating how these variables are related within individuals at specific moments. There is some data from EMA studies suggesting women report more dysphoric mood (high negative affect, depression, anxiety, stress) prior to engaging in disordered eating behaviors (e.g., binge eating; le Grange et al., 2001; Smyth et al., 2007) and when experiencing real-time body dissatisfaction (Heron, 2006). There is also evidence (via EMA) that at specific moments when healthy young women were watching television, they reported greater body dissatisfaction than when they were not watching television (Heron, 2006).

Based on these limited findings the conceptual model presented in Figure 3 was developed to guide the identification of the EMI triggers. This model represents the dynamic associations between media exposure, dysphoria, body dissatisfaction and disordered eating, as they may occur at specific moments *within* individuals. Given this model, limited previous empirical evidence, and the content of the CD intervention, the three events or experiences that were identified to use as "triggers" for the administration of an EMI are high dysphoria, disordered eating behaviors, and media exposure (all assessed in the moment). As is illustrated in Figure 3, it seems likely that many other factors also influence the real-time experience of body dissatisfaction and these are important issues that remain to be addressed in future research.

EMA Triggers for Providing EMI. Appendix K includes the specific EMA questions and criteria that were use to identify when the situations or experiences occur.

These threshold criteria for triggering EMI were determined based on previous EMA research of body image in college women (Heron, 2006). These previous data were used to estimate the expected frequency of each "trigger" event, so as to ensure that the trigger criteria would allow for sufficient EMI to be provided, but would also continue to be tailoring the EMI to specific emotional, behavioral, and contextual factors (i.e., EMI would not be provided after every EMA report). A complete description of the analyses conducted to identify trigger thresholds can be found in Appendix L.

EMI Delivery Methods. Participants received only one theoretically selected EMI for each reporting moment, even if multiple target conditions were reported (e.g., high negative mood and disordered eating). This was done to avoid "overloading" participants with too many EMI at one moment, and has the further benefit of limiting participant burden and the amount of differential (virtual) contact between groups. Given that all the target situations are associated with the experience of greater body image dissatisfaction (Heron, 2006; le Grange et al., 2001; Smyth et al., 2007), provision of any of the EMI could benefit participants. A hierarchy of the relative importance of each of these EMI components was developed based on effect sizes reported in relevant meta-analyses to determine which EMI to provide in cases where more than one event or situation was reported. In a meta-analyses of risk factors for the development of eating disorders in longitudinal studies, Jacobi and colleagues (2004) identified unhealthy eating behaviors (such as restricting) as a strong predictor of the development of eating disorders (Cohen's *d*s>.80), and found mixed results for the importance of negative emotions (e.g., depression, anxiety). In another meta-analysis, Groesz and colleagues (2002) examined the effect of viewing thin models on subsequent body dissatisfaction and found a medium

effect (*d*=.50) for college-age women. Given these findings, when a participant reported more than one trigger situation, she received the one EMI associated with the situation that has the strongest empirical support. For example, if a woman reported both problematic eating and watching television, the content of the EMI was tailored to address the eating behaviors, as the eating behaviors have been reliably associated with larger effect sizes as a risk factor. Figure 4 provides a flow chart detailing this process.

Participants received the EMI message immediately following completion of the survey. When participants did not report any of the above situations or behaviors, they did not receive any EMI at that time (see Figure 4). The interventions are thus ideographically tailored to moments when the individual needs them, and this process is fully automated in real-time (i.e., these "decisions" are made by the palmtop computer). The customized application used to administer the EMA surveys on the palmtop computers automatically tracked EMI frequency, the situation or behavior that triggered the EMI (and thus, the content of the EMI), and the date and time each EMI was delivered.

EMI Message Content. EMI messages were developed to address three primary concerns associated with body dissatisfaction, namely disordered eating behaviors, media exposure, and dysphoric mood/stress. Within each of these categories, the content of the CD-ROM (*Food, Mood, and Attitude*) was reviewed to identify the primary clinical goals of the intervention. Based on these treatment goals, the content of the EMI was developed by extracting the clinically relevant messages from the CD-ROM intervention. The content was then compared to cognitive-behavioral treatment manuals for issues related to body dissatisfaction and mood (Cash, 1997; Greenberger & Padesky, 1995) to ensure

its relevance and importance in treatment. The CD, and as a result the EMI, address both cognitive (e.g., adjusting cognitive distortions) and behavioral (e.g., identifying and changing problematic behaviors) aspects of body image dissatisfaction and disordered eating behaviors. The EMI address issues of emotional awareness, self-regulation, and improving self-efficacy for engaging in healthy thoughts and behaviors (all of which are derived from SCT). The EMI consist of a 2-3 sentence reminders of a topic covered in the CD. Eight EMI were generated for each of the three categories (i.e., disordered eating behavior, media exposure, dysphoric mood/stress) so that the likelihood of participants receiving the same EMI multiple times would be minimized. Within each category the order of the EMI was arranged such that those EMI with the most clinically important content (as determined by the CD-ROM and relevant treatment manuals) was presented first. Appendix M contains a list of the goals, content, and order of all EMI.

Procedures

The Syracuse University Institutional Review Board [IRB] approved the present study. A diagram of the study procedures and payment schedule can be found in Figure 1. All eligible and interested participants were scheduled for a 1-hour appointment, provided informed consent and were randomized in blocks of six to an experimental condition. At computers separated by dividers for privacy, participants individually completed assessment measures (see Table 1). After completing the questionnaires each participant individually had her height and weight measured in a private room so BMI could be calculated. All participants were then trained in how to use the palmtop computer and EMA survey and completed the survey 5 times daily for the following week. The palmtop computer provided auditory prompts between 9:00 am and 10:00 pm

at semi-random times; participants were unaware of the exact alarm times in advance. The 13 hours of possible assessment time each day was divided into five equal time segments (one for each signal) and the alarm occurred at a randomly selected time within the time period. This method ensured that assessments sufficiently sampled times across the day, yet were not easily anticipated by participants (e.g., Stone & Shiffman, 2002).

Participants returned to the research office after one week to return the palmtop computers and completed a brief assessment on the computer (see Table 1). Next, participants began the intervention phase of the study, which consisted of reviewing either the CD-ROM (CD and CD+EMI groups) or videos (control group). All participants sat in front of a computer with headphones to view the CD-ROM or control videos. These activities took approximately two hours to complete and were matched for time so that all participants receive approximately equal treatment contact. The intervention was completed during two one-hour visits, separated by one week. After completing the CD or viewing the videos, participants completed the Time 3 assessment on computers (see Table 1). All participants were then given the palmtop computers again. The CD and control groups completed the same EMA survey, while the CD+EMI group completed the EMA survey and received individualized, tailored EMI. All participants returned the palmtop computers to the research office after the final week of EMA. On computers, they completed assessment Time 4 (see Table 1). All participants were contacted via email two months after completing this session and were directed to a website to complete the 2-month follow-up assessment (Time 5; see Table 1). All participants were provided with referral information for psychological counseling and were fully debriefed via e-mail at the conclusion of the study.

Participants completing the screening measures (regardless of eligibility for the randomized portion of the study) were entered into a drawing to win a gift card; the drawing included one $50.00 and ten $10.00 gift cards. In addition, women who participate in the randomized trial portion of this study were compensated for their time according to the following schedule. After the Time 2, Time 3, and Time 4 assessments, participants received $20.00 each time as compensation for completing the EMA, questionnaires, and computer programs. At the end of the Time 4 visit, participants who completed at least 80% of the EMA during the two week period received a $20.00 bonus. Finally, after the 2-month follow-up assessment, participants received a $20.00 payment, which was either picked up at the research office or sent to participants. This $100.00 was compensation for the approximately six hours spent completing assessments and intervention (or control) activities and the two weeks of EMA. In addition, participants completing all study were entered to win one $250.00 gift card that was awarded at the end of the study.

Results

Descriptive Statistics

Seven hundred ninety-five college women were screened to participate in the present study, of which 296 were eligible to participate (see Figure 2). Of the eligible women, 131 agreed to participate. Among participants, 82 (63%) met both the EDE-Q and BSQ requirements for eligibility, 7 (5%) met only the BSQ criteria, and 42 (32%) met only the EDE-Q criteria. The EDE-Q and BSQ were correlated at r=.70 at the screening assessment. Participants in the study did not reliably differ from eligible women who did not participate on measures of disordered eating behavior or body

dissatisfaction (*p*s<.26). Descriptive statistics for the 131 women who participated in the present study were conducted. The mean age of study participants was 19.6 years old (*SD*= 1.18, range 18-24). The majority of participants were Caucasian (71%, *n*=93), with a number of participants self-identifying as Asian (18%, *n*=24), Hispanic (*n*=5, 4%), Black (*n*=4, 3%), Native American (*n*=4, 3%) and Pacific Islander (*n*=2, 1%). The sample is fairly representative of the student population at Syracuse University, where 77% of students are Caucasian, 8% Asian American, 7% Hispanic, 7% Black, and 1% Native American. A significant minority of the sample was freshman (44%, *n*=58), followed by sophomores (26%, *n*=34), juniors (19%, *n*=25), and seniors (11%, *n*=14). Nine percent of participants (*n*=12) were in a sorority. The majority of participants lived on campus (86%, *n*=112) and most lived with other people (90%, *n*=118). Eleven percent of participants (*n*=14) reported they were currently in counseling (*n*=2 for "stress," *n*=2 for anxiety, *n*=2 for depression, *n*=8 did not specify reason for treatment) and 10% (*n*=13) were currently taking psychotropic medications (for anxiety, depression, and ADHD). Body Mass Index [BMI] was calculated for all participants based on their measured height and weight. Although an imperfect measure, BMI less than 18.5 is typically considered underweight, 18.5-24.9 is normal weight, 25.0-29.9 is overweight, 30.0-39.9 is obese, and over 40.0 is morbidly obese (Bray & Gray, 1988). In the present sample, using this scheme, 2% of participants were classified as underweight (*n*=2), 51% were of normal weight (*n*=67), 31% were overweight (*n*=41), 14% were obese (*n*=18), and 2% were morbidly obese (*n*=3).

Total scale scores were calculated for all primary and secondary outcome measures, according to the published scoring instructions. The distributions of these

variables were all evaluated for normalcy and to identify outliers; all outcome measures had appropriate distributions and transformations of variables were not needed.

Baseline Group Differences

Mean values for key demographic variables and baseline measures (i.e., pre-intervention) were calculated by group and can be found in Table 2. Random assignment should result in equivalent groups across key variables. Groups were compared using analysis of variance (ANOVA) on all questionnaires collected prior to the intervention, including demographic variables and psychological measures (see Table 2). No significant pre-intervention group differences emerged, suggesting random assignment was successful.

Missing Data

Nearly all participants (97%; n=127) completed the study. Of the four participants who did not complete the study, two dropped out prior to beginning the intervention and two completed the intervention, but did not respond to requests to complete the two-month follow-up assessment (see Figure 2 for complete attrition rates by condition). Participants who dropped out did not differ from those completing the study on any demographic or psychological variables (ps<.05). There were no missing item data within questionnaires. Missing data for dropouts were imputed using the mean replacement method. In this method, the group mean value for a given scale was used to replace data missing due to dropout. Although more sophisticated techniques are available for imputing missing data (e.g., maximum likelihood methods), the mean replacement method is appropriate (i.e., should not significantly bias results) given the very low attrition rate (3%). All analyses were conducted both with (intent-to-treat) and without

(as-treated) dropouts. Intent-to-treat analyses include all randomized participants in the group to which they were assigned (regardless of treatment or follow-up adherence), while as-treated analyses only include those completing the study. Given the very low attrition rates (3%), there was no significant pattern of differences between the intent-to-treat and as-treated analyses. Intent-to-treat analyses provide a more conservative estimate of treatment effects (Lachin, 2000) and thus, all results presented are based on intent-to-treat analyses. Information regarding missing EMA is provided in the discussion of results for Hypothesis 1b.

General Analytic Strategy and Analyses

All analyses were performed using the SAS statistical package (SAS Institute, 2003). Each study aim and hypothesis is presented below. The specific analytic approach (i.e., statistical model) used to address the hypothesis is described, followed by the results.

Hypothesis Testing

The research aims for the study and specific hypotheses are presented below, followed by a discussion of the analytic strategy and predicted results.

Research Aim 1. To determine the feasibility and acceptability of the CD-ROM intervention and palmtop computer-administered EMI for college women.

Hypothesis 1a. Participants will show content-specific knowledge gain based on the type of computerized materials reviewed (CD intervention vs. control videos).

The knowledge questionnaire contained multiple-choice items assessing knowledge of information presented during the intervention phase of the study; 10 items assessed CD-ROM intervention content and 10 items assessed control video content. The

knowledge questionnaire was administered pre-intervention (Time 2), immediately post-intervention (Time 3), and at the 2-month follow-up assessment (Time 5). The total number of correct items on the intervention content (CD knowledge) and control video content (control knowledge) was calculated separately. The mean number of items correct (out of 10) by group is presented in Table 3. A repeated measures ANOVA (repeated assessments over time) with a between subject factor (group) was conducted. Significant main effects of group or the group*time interaction would indicate an effect of the intervention on knowledge. For the first set of analyses testing for immediate differential effects of treatment (i.e., Time 2 [pre-intervention] to Time 3 [post-intervention), the CD and CD+EMI conditions were combined and compared to the control condition. These analyses were conducted separated for the CD content items and the video content items. For the CD content items, there was a significant effect of group ($F(1,129)=27.04$, $p<.0001$, $R^2=0.17$), time ($F(1,129)=32.71$, $p<.0001$, $R^2=0.20$) and the group*time interaction ($F(1,129)=30.98$, $p<.0001$, $R^2=0.19$). As is depicted in Figure 5a, women viewing the CD showed superior knowledge gain on these items as compared to participants viewing the control videos. On the control video content items, significant effects of group ($F(1,129)=16.10$, $p=.0001$, $R^2=0.11$), time ($F(1,129)=51.82$, $p<.0001$, $R^2=0.29$) and the group*time interaction ($F(1,129)=47.98$, $p<.0001$, $R^2=0.27$). The response pattern for these items was reversed, such that participants viewing the control videos showed significant knowledge gain after viewing the videos, while those viewing the CD-ROM did not (see Figure 5b).

A similar analytic strategy was repeated to assess the maintenance of knowledge gains at the 2-month follow-up assessment. A repeated measures ANOVA with two

levels of the within-subject factor (time; Time 2 and Time 5) and three levels of the between subject factor (group; control, CD, CD+EMI) was conducted. Again, a significant main effects of group or the group*time interaction would indicate an effect of group on knowledge. Any significant effects were followed up with planned contrasts to identify which group(s) sustained improvements. These analyses were conducted separately for the CD content items and the video content items. For the CD content knowledge items there was a significant group ($F(2,128)=5.03$, $p=.008$, $R^2=0.07$), time ($F(1,128)=10.78$, $p=.001$, $R^2=0.08$), and group*time interaction effect ($F(2,128)=3.05$, $p=.05$, $R^2=0.05$). Planned contrasts comparing each of the three groups to one another revealed a significant sustained knowledge gain for the CD+EMI condition, as compared to the CD and control conditions (see Figure 6a). On the control content items there was no significant effect of group ($F(2,128)=1.07$, $p=.35$, $R^2=0.02$) or time ($F(1,128)=0.41$, $p=.52$, $R^2=0.003$), but a marginal group*time interaction ($F(2,128)=2.38$, $p=.10$, $R^2=0.04$). These findings suggest that knowledge gain from the control videos was only minimally maintained 2 months later (see Figure 6b).

Summary of Results for Hypothesis 1a. Overall, these results demonstrate differential knowledge gain based on the content of the computerized materials reviewed (CD intervention vs. control videos), immediately post-intervention. In other words, women reviewing the CD intervention showed improvements in knowledge items specific to the content of the CD, but not to the content of the control videos. Conversely, women viewing the control videos showed improvements in knowledge regarding material contained in the videos, but not the CD intervention. Women reviewing the CD-ROM showed significant sustained knowledge gain for material presented in the CD,

particularly for those in the CD+EMI condition. There was no sustained effect of knowledge gain for information presented in the videos for participants in the control condition two months post-intervention.

Hypothesis 1b. Participants will be compliant with the EMA protocol, completing at least 70% of the momentary assessments.

During the first week of EMA data collection, four participants experienced malfunctions with their palmtop computers (e.g., the batteries ran out, program errors) and their data were lost; two different participants had palmtop computer problems during the second week of EMA resulting in data loss. This data loss was due to technical failures, not participant non-compliance, and thus, these data are considered missing at random and are not "counted" against participants as missing assessments. Data loss for technical reasons is not a concern in the present study for two reasons. First, the concern with EMA non-compliance was that if participants were not completing EMA assessments, then those in the CD+EMI condition would not receive tailored EMI. However, in situations where data were lost due to technical problems, it is quite possible that participants were completing EMA, but the data to objectively verify compliance are unavailable. Second, the only instance where missing palmtop computer data due to technical failure would be especially concerning in the present study is if it occurred during the second week of EMA for a participant in the CD+EMI condition and EMI delivery could not be documented or tracked; this did not occur.

Although missing data are to be expected in any study, it is an especially important issue when using an EMA protocol. In the present study, compliance rates above 70% were considered acceptable, as these rates have been reported in studies using

similarly demanding EMA protocol (Stone & Shiffman, 1994). The large number of assessments that are required for each participant produces missing data for the majority of participants. Two categories of missing EMA data were identified for the purpose of this study. First, in some cases, individuals completely missed an assessment (e.g., they did not hear the prompt). These data are considered missing responses, as is the case in non-EMA studies when a participant does not complete an item or section of a questionnaire. To calculate compliance rates, the total percent of assessments completed was calculated for each participant. Participants completed an average of 88% of all assessments during the study (90% during the first week of EMA, 86% during the second week). Ninety-one percent of all participants completed at least 70% of the EMA assessments.

A more conservative method for calculating compliance rates was also used. There were instances when a participant completed an EMA assessment, but not at the time of the prompt. For example, this issue could arise if the participant was signaled while she is driving or taking an exam. In these cases, if the assessment was not completed within 30 minutes of the signal the data were not counted. This method was used to ensure that the recall period of each assessment remains short to avoid the problems associated with retrospective data collection (e.g., Scallon et al., 2003; Stone & Shiffman, 2002). Using this more conservative approach, 82% of all assessments were completed within 30 minutes of the alarm (85% during the first week, 80% during the second week). Eighty-four percent of all participants completed at least 70% of the assessment within 30 minutes of the prompt.

Compliance rates were also calculated to ensure adherence to the EMA protocol was consistent across days of the study. This was important to ensure participants were compliant with the protocol throughout the course of the study (i.e., not just completing assessments during days when they are coming into the research office). Day of EMA was coded and conservative compliance rates (i.e., based on responses occurring within 30 minutes of the prompt) were calculated for the sample. During the course of both weeks of EMA, compliance rates were fairly consistent across the week: day 1=83%, day 2=90%, day 3=86%, day 4=84%, day 5=81%, day 6=80%, day 7=77%. Compliance rates were also calculated throughout the day to ensure participants were not consistently missing assessments at specific times (e.g., early morning). To evaluate compliance throughout the day, beep number was used as a proxy for time of day (i.e., 1 is first beep of day, 2 is second beep of day, etc.). Compliance rates were similarly consistent throughout the day: beep 1=83%, beep 2=81%, beep 3=82%, beep 4=81%, beep 5=85%.

Summary of Results for Hypothesis 1b. Compliance with the EMA protocol in this study was very high, with overall rates ranging from 82-88% of all assessments; these rates were generally consistent throughout and across study days. Although at first glance this rate of missing data may seem alarming, it is quite representative of EMA studies with similarly demanding protocols (see Smyth & Stone, 2003; Stone & Shiffman, 1994). These rates translate to approximately 3,500-4,000 assessments collected for the sample during each one-week period.

Hypothesis 1c. College women will find the technology-based intervention acceptable, as measured by program satisfaction ratings.

All participants completed quantitative assessments of various aspects of the study, including the intervention materials, palmtop computers, EMI (when applicable), and overall study experience. First, participants rated qualities of the computerized intervention (CD-ROM or control videos), using a six-point scale (0=not at all satisfied, 3=moderately satisfied, 6=very much satisfied). Table 4 presents women's mean ratings of satisfaction with the computerized intervention materials by type of intervention (CD-ROM, control videos). Independent sample *t*-tests were used to compare group means. Participants using the CD-ROM reported higher satisfaction with the quality of the materials, were more likely to recommend the CD to a friend, and were marginally more likely to report finding the materials helpful, and being satisfied with the material content than participants viewing the videos. Given satisfaction ratings with the CD-ROM intervention are of primary importance in addressing this hypothesis, the percentage of participants in the CD and CD+EMI groups who reported at least "moderate" satisfaction with various aspects of the intervention was calculated (i.e., at or above the mid-point, as labeled on the scale where 0=not at all satisfied, 3=moderately satisfied, 6=very much satisfied). Figure 7 contains the distribution of satisfaction ratings for the CD-ROM. Participants ratings showed 80% of women reviewing the CD enjoyed the materials, 85% found it helpful, 70% would recommend it to a friend, 93% were satisfied with the CD content, and 92% were satisfied with the CD-ROM quality.

All participants next rated their satisfaction with the palmtop computer EMA assessments. They rated their enjoyment of using the palmtop computer as moderate to low (M=2.70, SD=1.60; 0=not at all satisfied, 3=moderately satisfied, 6=very much satisfied), but more moderate to good satisfaction with the EMA content (M=3.50,

SD=1.48) and EMA quality (*M*=3.89, *SD*=1.45). Figure 8 depicts the distribution of ratings for the EMA satisfaction items. Again, percentage of participants who reported at least "moderate" satisfaction ratings (i.e., ratings of 3 or greater) were calculated as above; 56% reported moderate enjoyment with using the palmtop computers to record their activities, 78% were moderately satisfied with EMA content, and 88% with EMA quality.

Women in the CD+EMI group evaluated various aspects of the EMI. They reported the messages were somewhat helpful (*M*=2.84, *SD*=1.57) and moderate satisfaction with the EMI content (*M*=3.53, *SD*=1.65) and frequency (*M*=3.59, *SD*=1.61) of the messages. The distribution of response to these satisfaction ratings is depicted in Figure 9. In describing the number of messages they received, on average they reported the number of EMI was "the right amount" (*M*=3.23, *SD*=1.31; 0=not enough, 3=the right amount, 6=too many). As above, the percentage of participants who reported at least "moderate" satisfaction ratings were calculated; 67% found the EMI at least moderately helpful, 81% were satisfied with the EMI content, and 81% were satisfied with the EMI frequency.

Overall, participants reported they enjoyed participating in the study (*M*=3.91, *SD*=1.35), found it moderately helpful (*M*=3.67, *SD*=1.47), would recommend the study to a friend (*M*=4.33, *SD*=1.44), and were satisfied with the overall study experience (*M*=4.29, *SD*=1.36). ANOVAs were used to identify any differences in overall study satisfaction based on group assignment; there were no significant differences between groups on any overall study satisfaction ratings (*p*s>.10). The overall percentage of participants reporting moderate or higher satisfaction on the overall study experience

were calculated; 90% of participants enjoyed participating, 81% found it helpful, 90% would recommend it to a friend, and 93% were at least moderately satisfied with the overall study experience.

Summary of Results for Hypothesis 1c. Participants were generally quite satisfied with the overall study experience, with 93% reporting at least moderate satisfaction with the study. Women also evaluated specific study components, including the computerized materials (CD-ROM or control videos), EMA, and EMI (where applicable). Participants reported moderate satisfaction with the computer materials, with women reviewing the CD-ROM indicating higher satisfaction on several dimensions (e.g., content, helpfulness, quality, etc.). All participants rated the use of the palmtop computers and EMI and although satisfaction with the content and quality of the assessments was moderately high, only 56% reported moderate enjoyment with using the palmtop computers to record their activities. Finally, participants in the CD+EMI group reported the EMI were moderately helpful, they were moderately satisfied with the EMI content, and most described the EMI frequency as "the right amount."

Research Aim 2. To determine if providing time-tailored EMI (CD+EMI) lead to greater and more sustained treatment gains than a short-term intervention program (CD) or an attention-matched control condition.

The present study was designed so that four distinct, and important, questions regarding treatment efficacy could be answered. In order to adequately address this research aim, four specific hypotheses were developed. Total mean scores were calculated for each primary and secondary outcome variable at each assessment time. Figure 10 visually presents the conceptual approach taken for making comparisons

between assessment times to address each specific hypothesis. First, the presence of measurement reactivity to the EMA protocol was evaluated by comparing participants' responses on outcome measures before (Time 1) and after (Time 2) completing one week of EMA (Hypothesis 2a). Second, the efficacy of the CD-ROM intervention was evaluated by comparing women in the CD and CD+EMI groups to those in the attention control group before (Time 2) and after (Time 3) the computerized materials were presented (Hypothesis 2b). Third, EMI efficacy was evaluated by comparing women immediately before (Time 3) and after the EMI (Time 4) across all three groups. In addition, the overall intervention efficacy (CD-ROM and EMI together) was evaluated through comparisons from the start of the intervention phase (Time 2) to the end of the intervention (Time 4), as well as from enrollment in the randomized controlled trial (Time 1) and the end of the intervention phase of the study (Time 4; Hypothesis 2c). Fourth, longer-term treatment gains were evaluated during the two-month follow-up assessment. Maintenance of any treatment gains at the end of treatment (Time 4) to the follow-up assessment (Time 5) were evaluated, as well as changes from initial study contact (Screening) to the two-month follow-up assessment (Time 5; Hypothesis 2d). Below, each of the hypotheses addressing this aim (2a-2d) is presented along with a description of the analytic models used and relevant results.

Hypothesis 2a. College women's body dissatisfaction and disordered eating behaviors will not be reactive to the EMA protocol.

Potential measurement reactivity was assessed to ensure women are not grossly reactive to the EMA. As was discussed in the Methods section, it is possible that frequent real-time assessment may change people's natural environment by introducing cues that

could alter social, psychological, and behavioral aspects of their lives (i.e., reactivity), and thus not necessarily accurately reflect real-world processes. Although previous research suggests little evidence of reactivity (Heron, 2006; le Grange et al., 2002; Stein & Corte, 2003), the present study was designed such that reactivity to the EMA protocol could be detected and quantified. Total scores on measures of body image dissatisfaction (CDRS), body image quality of life (BIQOL), and thinness-norm internalization (SATAQ) were used in these analyses. Separate paired sample *t*-tests were conducted to compare participants' pre-EMA (Time 1) and post-EMA (Time 2) scores for each body-related variable. Table 5 presents the pre- and post-EMA means and *t*-values; results suggested there were no changes in measures of A:I discrepancy ($t(130)=-0.16$, $p=.88$, $R^2=.001$; see Figure 11a), A:O discrepancy ($t(130)=-0.17$, $p=.87$, $R^2=.001$; see Figure 11b), body image quality of life ($t(130)=-0.21$, $p=.83$, $R^2=.002$; see Figure 11c), or thinness norm internalization ($t(130)=0.49$, $p=.62$, $R^2=.003$; see Figure 11d) as a result of completing EMA.

Summary of Results for Hypothesis 2a. As predicted, these results suggest completing intensive EMA for one week does not influence women's laboratory-based ratings of body image measures. Women reported similar levels of A:I discrepancy, A:O discrepancy, body-related quality of life, and thinness-norm internalization before and after completing one week of EMA. Thus, there was no indication that any of the outcome variables assessed were reactive to the EMA protocol in this sample of women.

Hypothesis 2b. College women receiving the CD intervention (CD, CD+EMI) will show improvements in body dissatisfaction and disordered eating immediately after completing the intervention as compared to participants viewing videos (control group).

As is depicted in Figure 10, this hypothesis was tested by comparing body-related measures at Time 2 (pre-intervention) and Time 3 (post-intervention). For the purpose of these analyses, the CD and CD+EMI groups were combined, because there was no differential treatment at this point in the study (i.e., at the Time 3 assessment the CD+EMI group had not yet received EMI). As with Hypothesis 1a, total scores on measures of body image dissatisfaction (CDRS), body image quality of life (BIQOL), and thinness-norm internalization (SATAQ) were used in the following analyses. Two-way repeated measures ANOVAs with group (2 levels: CD/CD+EMI, control), time (2 levels: Time 2, Time 3) and the treatment*time interaction as independent variables were conducted with each outcome measure (CDRS, BIQOL, SATAQ) as a dependent variable in separate models. A significant treatment*time interaction term would indicate that outcome(s) vary over time as a function of treatment group.

Table 6 presents the mean values for each secondary outcome measure by treatment group for Time 2 and Time 3. For A:I discrepancy, there was no significant effect of group ($F(1,129)=0.05$, $p=.83$, $R^2=0.0004$), or time ($F(1,129)=0.21$, $p=.64$, $R^2=0.002$), but there was a significant group*time interaction ($F(1,129)=6.49$, $p=.01$, $R^2=0.05$; see Figure 12a). Participants in the treatment groups (CD and CD+EMI) reported a decline in A:I discrepancies from Time 2 to Time 3, as compared to women in the control group. For A:O discrepancy, there was no effect of group ($F(1,129)=0.04$, $p=.83$, $R^2=.0004$), time ($F(1,129)=0.05$, $p=.83$, $R^2=.0004$), or the group*time interaction ($F(1,129)=1.71$, $p=.0.19$, $R^2=.02$; see Figure 12b). Similarly, for body image quality of life there were no significant group ($F(1,129)=1.88$, $p=.17$, $R^2=.02$), time ($F(1,129)=0.00$, $p=.95$, $R^2=.00002$), or group*time interaction ($F(1,129)=2.33$, $p=.13$, $R^2=.02$; see Figure

12c). Finally, on the thinness norm internalization measure, no significant effects of group ($F(1,129)=0.38$, $p=.54$, $R^2=.003$), time ($F(1,129)=0.01$, $p=.93$, $R^2=.00005$), or the group*time interaction ($F(1,129)=1.96$, $p=.16$, $R^2=.01$; see Figure 12d) were seen.

Although overall few effects of the intervention on body-related outcome were observed, it is possible that subsets of participants experienced improvements. Thus, three potential moderators of treatment outcome – initial disordered eating severity (EDE-Q), body image disturbance severity (BSQ), and BMI – were tested. Each moderator was tested separately in the models described above. These analyses were exploratory and no specific directional predictions were made a priori. Given the exploratory nature of these analyses and the large number of statistical tests being conducted, a more conservative alpha of .01 was used for significance testing. Table 7 provides the *F*-statistics from these models with each of the main effects (group, time, moderator), all the two-way interactions (group*time, group*moderator, time*moderator), and the three-way interaction (group*time*moderator). The primary test of interest is the three-way interaction, as a significant group*time*moderator interaction would suggest the group*time effect was moderated by that variable. As is shown in Table 7, no significant three-way interaction effects emerged.

Summary of Results for Hypothesis 2b. It was expected that after receiving the CD-ROM intervention, women in the CD and CD+EMI groups would show improvements in outcome measures, as compared to the control condition that did not receive the CD (Franko et al., 2005). Results provided very limited evidence supporting this hypothesis; a significant treatment effect was seen for A:I discrepancy, but not A:O discrepancy, body image quality of life, or thinness norm internalization. For each of the

non-significant time*group interactions, the effects were in the expected direction. There were no significant effects of time and no evidence that initial disordered eating severity, body image disturbance severity, or BMI moderated treatment effects.

Hypothesis 2c. College women receiving tailored EMI (CD+EMI) will show the greatest reduction in body image dissatisfaction and disordered eating behaviors, followed by those receiving only a short-term intervention and those in the control condition.

This hypothesis was addressed in three different ways (see Figure 10). First, changes in treatment outcome from Time 3 (post-intervention, pre-EMI) to Time 4 (post-EMI) were examined. Next, the overall effect of the intervention – including the CD-ROM and EMI – was examined by testing for changes from Time 2 (pre-intervention) to Time 4 (post-EMI). Finally, changes from Time 1 (pre-EMA) to Time 4 (post-EMI) were assessed. All analyses used a similar analytic strategy to as with Hypothesis 2b; two-way repeated measures ANOVAs with group (3 levels: control, CD, CD+EMI), time (2 levels: Time 3-Time 4; Time 2-Time 4; Time 1-Time 4) and the treatment*time interaction as independent variables were conducted with each outcome measure (CDRS, BIQOL, SATAQ) as a dependent variable in separate models. A significant treatment*time interaction term indicates that outcome vary over time as a function of treatment group. Significant effects were followed up with planned contrasts of treatment groups.

Table 8 contains the means and standard deviations for each outcome measure by group for assessment Time 1, Time 2, Time 3, and Time 4. In Table 9, the results from the ANOVAs are presented, including *F* and *p*-values for the main effects of group and time and the group*time interaction effect. These analyses were conducted for Time 3-

Time 4, Time 2-Time 4 and Time 1-Time 4. As can be seen in Table 9, there are no significant effect of group, time, or the group*time interaction for any outcome variables; thus planned contrasts comparing treatment groups were not needed. Figure 13 provides a graphical depiction of the mean values for the secondary outcome variables for assessment Times 1, 2, 3 and 4.

As with Hypothesis 2b, initial EDE-Q score, BSQ score, and BMI were tested as potential moderators of treatment effects. Each moderator was added separately to the models described above testing the added treatment effect of EMI (i.e., Time 3 to Time 4). Similar to previous moderator analyses, a more conservative alpha of .01 was used for significance testing. Table 10 contains the *F*-statistics from these models with each of the main effects (group, time, moderator), the two-way interactions (group*time, group*moderator, time*moderator), and the three-way interaction (group*time*moderator) presented. The primary test of interest is the three-way interaction, as a significant group*time*moderator interaction would suggest the group*time effect was moderated by that variable. As Table 10 shows, there were no significant three-way interactions, suggesting none of the variables tested moderated the group*time relationship.

Summary of Results for Hypothesis 2c. It was expected that adding EMI to the CD-ROM intervention would improve treatment outcome at the end of the intervention phase of the study (Time 4). As was seen in Hypothesis 2b, the intervention itself had little impact on women's ratings of body dissatisfaction and eating behaviors. Results suggested adding EMI to extend and enhance the intervention did not provide benefit at the end of the intervention (Time 4), when compared to the start of the randomized study

(Time 1), the start of the intervention phase (Time 2), and the start of the EMI (Time 3). Significant differences between all groups on all outcome variables were expected; the CD+EMI group was expected to experience significantly greater treatment gains than the CD condition, which in turn would show significantly greater gains than the control group. There was no evidence that initial disordered eating severity, body image dissatisfaction severity, or BMI moderated treatment response.

Hypothesis 2d. College women receiving tailored EMI (CD+EMI) will show treatment gains to a greater extent at the 2-month follow-up assessment than those individuals who do not receive EMI (CD, control).

The initial purpose of the two-month follow-up assessment was to determine whether treatment gains could be sustained and if adding EMI to the CD-ROM intervention improved long-term outcome. Given no treatment effects were demonstrated in Hypothesis 2b or 2c, maintenance of treatment gains could not be evaluated. Nonetheless, although unlikely, there may be delayed emergence of treatment effects of the CD-ROM or EMI when assessed two months after completing the intervention. That is, it is possible that participants did not demonstrate immediate changes in their thoughts and/or behaviors, but over time, such maladaptive patterns could begin to change and treatment gains could emerge at a later time. Treatment effects at the two-month follow-up were tested in two ways (see Figure 10 for analytic approach). First, as with the previous two hypotheses, changes in secondary outcome measures from the end of the intervention phase (Time 4) to the follow-up assessment (Time 5) were assessed. These tests assessed the emergence of treatment effects on measures of body image discrepancy, body-related quality of life, and thinness-norm internalization from the end

of the intervention to the two-month follow-up assessment. Second, one of the primary questions of interest in this study was the extent to which this intervention could change disordered eating behaviors and body dissatisfaction. This question was addressed by comparing participants on the primary outcome measures (EDE-Q, BSQ) from the baseline screening assessment to the follow-up assessment (completed three months after the screening). For both of these approaches, the same analytic strategy was used as in Hypothesis 2b and 2c, with a significant group*time interaction interpreted as an indication that outcome vary over time as a function of treatment group.

First, the emergence of treatment outcome on the secondary measures (CDRS, BIQOL, SATAQ) from the end of the intervention (Time 4) to the follow-up assessment (Time 5) was examined. Results suggested no significant group ($F(2,128)=0.59$, $p=.55$, $R^2=.01$), time ($F(1,128)=2.01$, $p=.0.16$, $R^2=.02$), or group*time interaction ($F(2,128)=1.54$, $p=.22$, $R^2=.03$) for A:I discrepancy score. For A:O discrepancy, no group ($F(2,128)=0.37$, $p=.69$, $R^2=.01$), time ($F(1,128)=3.62$, $p=.06$, $R^2=.03$), or group*time interaction ($F(2,128)=1.15$, $p=.32$, $R^2=.02$) effects emerged. On the body-related quality of life measure there were no significant group ($F(2,128)=0.70$, $p=.50$, $R^2=.01$) or group*time ($F(2,128)=0.90$, $p=.41$, $R^2=.02$) effects. There was a significant effect of time ($F(1,128)=7.26$, $p=.01$, $R^2=.07$), suggesting that all women reported a decline in body-related quality of life (i.e., indicated their body image concerns had a less positive impact on a variety of areas of their life) during the two month follow-up period. For thinness-norm internalization there was no effect of group ($F(2,128)=0.25$, $p=.78$, $R^2=.004$), time ($F(1,128)=1.02$, $p=.31$, $R^2=.01$), or the group*time interaction ($F(2,128)=0.85$, $p=.43$, $R^2=.01$).

As with previous hypotheses, initial eating behavior severity and BMI were tested as potential moderators of treatment effects. Significant group*time*moderator effects were interpreted as a three-way interaction, suggesting the moderator variable influenced the group*time interaction. Again, a more conservative alpha of .01 was used for significance testing of moderator variables given no a priori hypotheses were made. Table 11 presents the *F* statistics for the group*time*moderator interactions for each secondary outcome variable. Results suggest there were no significant three-way interactions for any moderator variables at the $p<.01$ level.

The second way in which this hypothesis was addressed was by comparing participants on the primary outcome measures (EDE-Q, BSQ) from the baseline screening assessment to the follow-up assessment (completed three months after the screening). This approach answers the question regarding longer-term changes in disordered eating behavior and body dissatisfaction as a function of the intervention. The overall and group means for the EDE-Q and BSQ are presented in Table 12. The same analytic approach as above was used, with significant group*time interactions, suggesting outcome vary over time as a function of treatment group. Results indicated that for the EDE-Q there was a significant effect of time ($F(1,128)=6.47$, $p=.01$, $R^2=.05$), indicating overall lower levels of disordered eating behavior from the screening to two-month follow-up; there was no effect of group ($F(2,128)=0.42$, $p=.66$, $R^2=.01$) or the group*time interaction ($F(2,128)=1.14$, $p=.32$, $R^2=.02$; see Figure 15a). The same pattern of results was seen for the BSQ, with a significant effect of time ($F(1,128)=16.13$, $p<.0001$, $R^2=.11$), suggesting overall lower levels of body dissatisfaction from screening

to follow-up, but no significant group ($F(2,128)=1.01$, $p=.37$, $R^2=.01$) or group* time effects ($F(2,128)=0.43$, $p=.65$, $R^2=.01$; see Figure 15b).

Summary of Results for Hypothesis 2d. There was no indication that, overall, women experienced improvements or worsening in secondary outcome measures between the end of the intervention phase of the study and the two-month follow-up assessment. There was no evidence that these effects were moderated by the initial level of disordered eating behavior (EDE-Q), body dissatisfaction (BSQ), or BMI. On the primary outcome measures (EDE-Q, BSQ), results indicate participants reported a decrease in both EDE-Q and BSQ scores (suggesting less disordered eating behavior and body dissatisfaction) from the initial assessment to the follow-up assessment occurring 2 months after the intervention. These changes, however, did not vary as a function of the intervention provided.

Research Aim 3. To examine healthy body image and eating behavior self-efficacy and emotion regulation as potential variables mediating the treatment effects.

Social Cognitive Theory [SCT] (Bandura, 1986) is the theoretical framework used to develop the intervention used in the present study (Franko et al., 2005). Variables identified by SCT as possible mediators of treatment effects, such as self-efficacy for behavior change and emotion regulation, have not yet been examined for this intervention. An exploratory aim of the present study was to evaluate these two potential mediators of treatment gains. However, given the findings in Hypotheses 2b-2d suggesting no treatment gains, the first step in the mediation model failed (Baron & Kenny, 1986; Kraemer et al., 2002), and no further mediational analyses were conducted.

Research Aim 4 (exploratory). To identify characteristics of EMI use and the extent to which these are associated with treatment gains.

Hypothesis 4a. In an exploratory fashion, descriptive statistics on the frequency and content of EMI participants received will be examined.

Given the use of EMI in health behavior and psychosocial treatments is relatively new, an exploratory aim of this study was to provide descriptive information regarding the frequency and types of EMI participants received in this study. Data regarding the delivery of EMI – including the frequency, timing, and content of EMI – was automatically tracked and recorded on the palmtop computer for participants in the CD+EMI condition. Overall, participants received an average of 7.9 EMI (*SD*=5.30, range: 0-18; see Figure 16) during the intervention week and received EMI after about one out of four (26%) of the assessments they completed. To assess patterns of EMI delivery, the percentage of EMA assessments after which participants received EMI was calculated for each study day; participants received EMI at a fairly consistent rate during the study period (day 1=28%, day 2=25%, day 3=20%, day 4=21%, day 5=25%, day 6=31%, day 7=32%). Similarly, rates were calculated within days using beep number as a proxy for time of day (as was done when calculating within-day compliance rates); similar rates of receiving EMI were across the day (beep1=22%, beep 2=21%, beep 3=26%, beep 4=26% beep 5=31%).

Although in this study there were three different types of events that could trigger an EMI (target eating behavior, media use, negative affect), participants only received one EMI following the assessment in order to limit participant burden (the order in which EMI were provided was empirically based; see Methods section). During the majority of

prompts (86%), participants reported only one event that would trigger an EMI, during 14% they reported two events, and during less than 1% of all assessments participants reported three events that could trigger EMI (i.e., reported target eating behavior, media use, and negative affect). This suggests that although there was concern about burdening participants with several different EMI topics following an assessment, using the present trigger criteria, participants reported multiple triggers during relatively few EMA surveys.

The EMI content was tailored to the type of trigger event participants received. Participants varied as to the types of triggers they reported and, as a result, they varied on the type of EMI they received. Figure 17 provides a graphical depiction of EMI content by participant. In this graph, data from each of the 43 participants in the CD+EMI condition are presented along the y-axis and the vertical bars represent the percentage of EMI by content area (adding to 100% for each participant). As is shown, some participants (e.g., participant number 1, 20, 37, etc.) received only one type of EMI, based on their responses to trigger EMA questions. Others received a combination of two or all three EMI content areas (e.g., participant 7, 16, etc.). Two participants (numbers 42 and 43 on this graph) received no EMI because they did not respond to the target EMA questions in such a way as to prompt EMI. These data show that across participants there was a great deal of variability in the types of trigger EMA items they endorsed and the resulting EMI they received.

Summary of Results for Hypothesis 4a. Participants in the CD+EMI condition received an average of 8 messages on the palmtop computers during the EMI week; these were relatively consistently distributed throughout the week and within each day.

Although three categories of EMA items could "trigger" an EMI (eating behavior, media use, negative mood), during the majority of times (86%) when women received EMI, they only reported one of these triggers, and thus, received an EMI with content appropriately tailored to the trigger type. The types of triggers, and resulting EMI content, that women reported varied greatly across participants as expected.

Hypothesis 4b. In an exploratory fashion, the effect of EMI frequency and EMI content on treatment outcome will be examined among women in the CD+EMI group.

Although there were no significant treatment gains, it is possible that EMI frequency moderated treatment effects. In other words, perhaps a subset of women who received more EMI experienced benefits from the treatment, despite no overall group effects. All of the subsequent analyses were conducted only on participants in the CD+EMI group, as these are the only women who could receive EMI. EMI frequency was calculated for each participant. Separate models were generated with EMI frequency predicting each of the secondary outcome variables at Time 3 (pre-EMI) and Time 4 (post-EMI) for participants in the CD+EMI group. This method was then repeated for primary outcome measures (EDE-Q, BSQ) at the initial screening assessment and 2-month follow-up (Time 5). A significant frequency*time interaction would suggest that EMI frequency influences change in outcome variables over time.

First, the effect of EMI frequency on change in secondary outcome measures from the start of the EMI (Time 3) to the end of EMI (Time 4) was assessed to determine whether more frequency EMI were associated with larger treatment gains during the EMI period. Table 13 presents the *F*- and *p*-values for the main effects of EMI frequency and time, and the EMI frequency*time interaction. There were no significant frequency*time

interactions, suggesting the number of EMI received during the EMI week did not influence treatment outcome in the short-term; that is, on the more proximal secondary variables. Second, the effect of EMI frequency on the primary outcome measures was also assessed. These analyses address the question of whether EMI frequency influenced changes in disordered eating behavior (EDE-Q) or body dissatisfaction (BSQ) over the long-term; that is, from the time of the initial screening assessment (Screening) to the two-month follow-up assessment (Time 5). As is presented in Table 13, there were no significant frequency*time interactions, suggesting EMI frequency did not influence changes in women's disordered eating behaviors or body dissatisfaction from the start to end of the study.

In addition to EMI frequency, the potential influence of EMI content on outcome was assessed. Recall, EMI content was tailored based on three different sets of target EMI items: disordered eating behaviors, media use, and negative affect. It is possible that women endorsing specific "types" of EMA triggers, and thus receiving the associated type of EMI content, experienced better (or worse) treatment outcome. This issue was explored by first identifying the number of disordered eating, media, and negative affect EMI each woman received. Then participants were coded based on which category (i.e., eating, media, negative affect) they received the most EMI. This new variable captures the preponderant EMI type for each participant. Women were fairly evenly distributed across the three treatment groups, with 29% of women receiving more disordered eating content EMI, 38% receiving more media-related content, and 33% more EMI addressing dysphoric mood.

Similar to the above analyses with EMI frequency, predominate EMI type was

used to predict outcome measures in two ways. First, EMI content was used to predict the more proximal outcome measures from the start of the EMI (Time 3) to the end of EMI (Time 4) to determine whether EMI content affects treatment outcome immediately post-EMI. A significant content*time interaction suggests the EMI content influences change in outcome variables over time. Table 14 presents the *F*- and *p*-values for the main effects of EMI content and time, and the EMI content*time interaction. There were no significant content*time interactions, suggesting the type of EMI women received during the EMI week did not influence treatment outcome on any secondary variables. As with the above analyses, the effect of EMI frequency on the primary outcome measures (EDE-Q, BSQ) was also assessed. These analyses address the question of whether EMI content influenced changes in disordered eating behavior (EDE-Q) or body dissatisfaction (BSQ) from the initial screening assessment (Screening) to the two-month follow-up assessment (Time 5). As is presented in Table 14, there were significant content*time interactions for both the EDE-Q and BSQ outcome measures. The direction of these effects were such that women who received more disordered eating EMI experienced increases in EDE-Q score (i.e., more disordered eating symptoms; see Figure 18a) and BSQ score (i.e., greater body dissatisfaction; see Figure 18b) from the screening assessment to follow-up, while those receiving primarily media and negative affect EMI experienced a decline in symptoms (recall there was an overall effect of time on the EDE-Q and BSQ such that women reported significantly lower scores at the follow-up assessment as compared to the screening assessment).

Summary of Results for Hypothesis 4b. Despite the fact that no significant treatment effects were seen, it is plausible that a subset of women who received more, or

specific types, of EMI experienced treatment benefits. Results suggested there was no effect of the EMI frequency (i.e., the number of EMI received) on any primary or secondary outcome measures. EMI content (and thus, the "type" of EMI trigger: disordered eating, media use, or negative affect) was not associated with secondary outcome measures, but was significantly associated with both primary outcome (EDE-Q, BSQ). Participants who reported more disordered eating behaviors via EMA (and thus received more disordered eating-specific EMI), experienced a significant increase in both disordered eating symptoms and body dissatisfaction from the screening to follow-up assessment. Conversely, participants who predominately received EMI in response to media use and negative affect EMA trigger items reported an overall decline in disordered eating and body dissatisfaction.

Discussion

The purpose of this study was to evaluate the feasibility, acceptability, and efficacy of a computerized and palmtop computer-based intervention for college women with disordered eating behaviors. The results addressing each of the study aims and hypotheses are discussed in detail below, including a more general discussion of the implications of these findings, limitations of this study, and future research directions.

Feasibility of Implementing EMI

The first aim of this study was to determine the feasibility and acceptability of a disordered eating intervention for college women that consisted of a CD-ROM intervention and palmtop computer-administered Ecological Momentary Interventions [EMI]. Overall, results suggested participants were able to successfully complete the

intervention, demonstrate appropriate knowledge gain, show very high compliance with the EMA protocol, and were moderately satisfied with the intervention

Knowledge Gain. Intervention feasibility was first assessed by examining the extent to which participants were able to attend to, and learn from, the intervention materials. In order to ensure participants completed and attended to the computerized intervention, knowledge for intervention material was assessed before and after completing the CD-ROM. A customized knowledge measures was developed to assess information presented in the CD-ROM (adapted from Franko et al., 2005) along with items assessing information included in the control videos. Participants in all groups completed the same knowledge measure in order to assess for differential knowledge gain. Results demonstrated participants in the CD and CD+EMI conditions showed significant knowledge gain on the intervention items (but not control items), while control participants were able to answer more control items correctly (but not intervention items) after viewing the videos. These data provide strong evidence that participants attended to the information presented in the computerized materials. The present findings demonstrating that participants had more knowledge about disordered eating behaviors and risks after reviewing the CD-ROM are consistent with the previous study using the intervention CD (Franko et al., 2005). Meta-analyses also consistently demonstrate eating disorder prevention programs can produce significant gains in (and in some cases, maintenance of) eating disorder-related knowledge (Fingeret et al., 2006; Stice & Shaw, 2004). Although findings from this study suggest that adding EMI to an intervention may help participants to retain the information presented in the treatment program longer than women who did not receive EMI, it is unclear if these effects have

any practical relevance (i.e., could help reduce disordered eating behavior). There is no evidence that deficits in knowledge about eating disorders is a risk factor for the development of eating pathology (Stice & Shaw, 2004), and thus, increasing knowledge alone would likely not change women's attitudes or behaviors. Instead, meta-analyses suggest that in order to have a significant impact on eating pathology, disordered eating programs should focus on reducing empirically established risk factors (e.g., body dissatisfaction, internalization of sociocultural thinness norms) for eating pathology (Fingeret et al., 2006; Stice & Shaw, 2004; Stice, Shaw, & Marti, 2007), as was done in the CD-ROM used in the present study. Regardless of study outcome, the assessment of knowledge in this study provides evidence that women were compliant with the study procedures and the treatment manipulation was successful (i.e., they viewed and attended to the appropriate materials).

Protocol Compliance. Although compliance is an important issue in all studies, compliance with the EMA protocol was particularly important in the present study because EMA responses were used to trigger EMI. Very high compliance rates with the study protocol were seen in this study. Attrition rates of only 3% were demonstrated over the course of the 3-month study period. Eligible women were provided with a detailed explanation of the study procedures, time required for participation (including weekly office visits and EMA for two weeks). It is possible that women who were most likely to drop out are those who did not respond to recruitment efforts (i.e., e-mails describing the study) or declined to participate in the first place. Another aspect of protocol compliance that was carefully assessed in this study was participants' compliance with the EMA surveys. Women completed an average of 88% of the EMA surveys and 91% of all

participants completed at least 70% of the EMA. When a more conservative approach to calculating compliance was adopted and only assessments completed within 30 minutes of the prompt were included, compliance rates remained above 80%. A comprehensive review of compliance in EMA studies suggested most studies report similar compliance rates (i.e., ~80%; Hufford & Shields, 2002).

There were several ways in which efforts to improve compliance were built into the study protocol (see Hufford, 2007 for recommendations on increasing EMA compliance). First, participants were provided with a clear description of study expectations prior to enrolling in the study (e.g., in recruitment e-mails, during the informed consent process) so they could make an informed decision about participation. Second, participants were aware that the dates and times of their EMA entries would be automatically recorded, thus instilling a sense of accountability. Third, compliance was built into the protocol by providing monetary incentives for women who completed at least 80% of the assessments. Fourth, the hardware and software for the EMA survey program were easy to use and convenient for these young women. Fifth, all participants completed an in-depth training session, including instructions for completing the surveys and an opportunity to practice completing EMA in the research office. They were also provided with written instructions and given a phone number where they could reach the principle investigator should problems arise. As has been discussed elsewhere (Hufford, 2007), it is of critical importance for EMA studies for researchers to understand the high burden these protocols can place on people and build in ways to help participants to be compliant during study planning and design. It is likely that many of these strategies helped contribute to the high compliance rates in the present study.

Participant Satisfaction. Given EMI in behavior change interventions is a relatively new area of research, it is important to assess the extent to which participants are satisfied with, and are willing to use, these intervention methods. In a review of previous psychosocial and health behavior change EMI studies (Heron & Smyth, 2010), about half of the published interventions report on participant satisfaction with the EMI treatment program. One way in which the present study contributes to this growing area of literature is that it can provide information about young women's overall willingness to participate and satisfaction with this intervention method. In this study, 93% of women reported they were at least moderately satisfied with the overall study experience, 81% found participating helpful to them, and 90% would recommend the study to a friend. These findings indicate that the vast majority of participants were satisfied with the study experience, and are consistent with findings from previous EMI studies (Atienza et al., 2008; Gruber et al., 2001; Joo & Kim, 2007; King, Ahn, Oliveria et al., 2008; Newman et al., 1999; Newman, Kenardy et al., 1997; Obermayer et al., 2004). In many of the "early" EMI studies (e.g., those conducted in the 1990s) researchers and clinicians raised concerns about whether or not participants would find EMI treatment programs to be acceptable alternatives to more tradiational treatment methods (e.g., in-person therapies and interventions). Previous studies, as well as the present findings, demonstrate that treatments delivered via mobile technology are preceived as credible and acceptable to participants.

The present study included various treatment components (computerized CD/video materials, palmtop computer-based EMA and EMI), each of which participants evaluated separately. In the previous study validating the CD-ROM intervention (Franko

et al., 2005) most participants (80-90%) reported they were satisfied with, and found the information contained in the CD useful. These previous findings are consisting with the present study, with 93% of all participants completing the CD reporting they were satisfied with the content of the CD-ROM and 92% with the CD quality. There were some group differences noted for satisfaction ratings on of the CD-ROM and control videos, with participants reviewing the CD reporting higher satisfaction with the quality and content of the materials, finding the materials helpful, and were more likely to recommend the CD-ROM than participants reviewing the control videos. These group differences may be explained by the fact that the information presented in the CD was especially relevant to these women because participants were selected based on having high levels of disordered eating behavior and body dissatisfaction. In addition, the CD-ROM used an interactive format as compared to a didactic format for the control videos, which could also contribute to group differences in satisfaction. In a meta-analysis of eating disorder prevention programs, it was shown that programs that used interactive methods were more effective than those relying on didactic methods. The authors hypothesized interactive intervention formats for disordered eating increases participant engagement with the material (Stice & Shaw, 2004; Stice et al., 2007), and as was seen in this study, could also increase satisfaction. Despite significant group effects, women reviewing the control videos generally reported moderate satisfaction with the materials (similar to those in the CD and CD+EMI groups), suggesting the video materials were likely appropriate for the purposes of this study (i.e., for an attention control group).

All participants also provided feedback on the use of the palmtop computers to complete the EMA surveys. Satisfaction rates with the EMA content and quality were

relatively high, with 78% of women reporting at least moderate satisfaction with the content, and 88% reporting satisfaction with the quality of the EMA surveys (see Figure 8 for the full distribution of responses). However, a substantial minority of participants (44%) indicated that they did not enjoy completing the EMA surveys. Anecdotally, on the satisfaction questionnaire participants indicated the device was sometimes inconvenient to carry and the auditory alarms were bothersome (e.g., in class, when sleeping). Participants' (dis)satisfaction with the EMA could be influenced by several factors. First, although the devices used in this study represent a significant advance in technology over early EMA research (e.g., paper diaries), newer mobile technology, such as cellular phones, may be a more acceptable modality for delivering EMI to young adults. Cell phones are commonplace in the general population and according to the Pew Research Center, nearly 96% of adults ages 18-29 own cellular phones (Pew, 2010). By creating applications that are loaded directly onto participants' own phones, this may improve mobile intervention satisfaction, acceptance, and ease of dissemination. Using cellular phones could reduce problems participants raised regarding difficulty remembering to bring the palmtop computer with them as they went about their daily lives, as the majority of young adults likely have their cell phones with them much of the time. Using devices that allow greater flexibility regarding the alarm function (e.g., vibrate settings, silence options) may also improve participant satisfaction. Similarly, using mobile devices with internet capabilities, researchers could remotely track data and access data, thus reducing the need for participants to return to the research office to have data uploaded. By increasing such "livability functions" participants may be able to more

easily incorporate the assessments and interventions into their daily lives, thus increasing satisfaction and compliance rates (Hufford, 2007).

A second factor that may have influenced women's relatively low ratings of the EMA surveys is the length of the assessments and the resulting increase in participant burden. Although participants completed each assessment within 2-3 minutes, they were asked to answer as many as 60 brief questions (although given the response patterns and branching structure of the assessment, most were asked substantially fewer questions at each assessment). Previous EMA research experimentally manipulating participant burden has suggested that individuals who are required to complete more intensive EMA protocols rate the study as being more burdensome and interfering more in their lives than participants completing less intensive EMA schedules (Stone et al., 2003). In the present study, the large number of EMA questions was included primarily to help mask the true purpose of the assessment for two reasons. First, the study was framed as being about daily experiences and life in college. In an effort to be consistent with this framing, items regarding typical daily activities in college students' lives were included (e.g., class attendance, time management, social interactions, etc.) in addition to the trigger items. Second, one concern with the tailored EMI is that if participants could "figure out" the trigger items, and found the EMI sufficiently aversive, they could respond inaccurately in order to avoid receiving EMI. If participants received none or very few EMI, it would be impossible to evaluate their efficacy. Nonetheless, a potential downside to the lengthy EMA survey is that it increased participant burden and possibly negatively influenced study satisfaction. Regardless of the steps researchers take to minimize participant burden, EMA studies require significant time and energy on the part of participants, and

thus, variability in EMA satisfaction is inevitable. Consistent with previous research demonstrating such variability (e.g., Collins & Muraven, 2007), a subset of participants in this study (10%) reported "not at all" liking the EMA, while others (5% in this study) reported "very much" enjoying the EMA. However, given preliminary research demonstrating that the intensity of the EMA protocol is associated with lower satisfaction (Stone et al., 2003), it is important for future research to take into consideration the relative balance between research design concerns (e.g., masking study purpose) and participant burden, in an effort to maximize satisfaction and compliance with study protocol.

The feedback participants provided regarding the EMI in the present study was generally quite promising, with more than 80% of women who received EMI reporting at least moderate satisfaction with the content of the messages. Women who received more EMI (and therefore "saw" more of the EMI content), reported higher satisfaction with the EMI content ($F(1,42)=6.84$, $p=.01$, $R^2=.14$) than women who did not receive as many EMI. A unique feature of the present study is that the content of EMI were tailored to the "type" of trigger situation participants reported via EMA and, thus, may have been more relevant to women at the times when they received them. Many previous EMI studies did not tailor EMI content and received feedback suggesting the EMI messages were not well accepted by all participants (see Heron & Smyth, 2010). For instance, in a weight loss EMI study, one-third of participants receiving standard, non-tailored EMI text messages were dissatisfied with the content of the messages (Joo & Kim, 2007). Participants in two other studies indicated EMI content was repetitive and suggested creating a more diverse pool of feedback (Newman et al., 1999; Weitzel et al., 2007). In the present study, eight

unique EMI were developed for each of the three different content areas (disordered eating behavior, media exposure, dysphoric mood) in an effort to minimize instances where participants would receive the same message more than once. Nine participants did receive the same message on two occasions because they endorsed trigger items in a given category more than eight times. However, there were no significant differences in satisfaction ratings of EMI content between women who did and did not receive duplicate EMI ($F(1,42)=1.99$, $p=.17$, $R^2=.05$). In contrasts to low satisfaction ratings with non-content tailored EMI in previous research (Joo & Kim, 2007; Newman et al., 1999; Weitzel et al., 2007), feedback from participants in the present study seems to suggest that tailored EMI content was well received, even among participants who received the same messages more than once.

In addition to tailoring the EMI content in the present study, the timing of EMI delivery was also tailored such that women only received EMI at specific times when they reported a "trigger" event or experience via EMA. This tailoring method necessarily results in variability in the total number of EMI provided to each participant, as it allows for participants to receive more (or fewer) EMI depending on individual EMA reports. Women in the CD+EMI group described the EMI frequency as "the right amount" and 81% of the women were at least moderately satisfied with the frequency of the EMI delivery. Exploratory analyses examined the extent to which actual EMI frequency influenced satisfaction ratings. Women who received more EMI reported marginally higher satisfaction with the EMI frequency ($F(1,41)=3.06$, $p=.09$, $R^2=.07$). Given this was a statistical trend, this finding should be interpreted with caution, but does provide preliminary evidence that in the present sample, receiving more EMI was related to

increased satisfaction with EMI frequency. Recall that the range of total number of EMI participants received ranged from zero to 18 during the intervention week; at the maximum EMI frequency averaged about 2.5 messages per day. Receiving more frequent EMI (up to as many as 2.5 per day) might be especially useful if they are provided in a tailored manner.

Previous EMI studies that have not tailored the timing of EMI (and thus provided them at fixed times) were criticized by participants in one study who complained that receiving EMI for anxiety symptoms at the same time every day was not useful because they oftentimes came during the same activity each day (Newman et al., 1999). The present study provides preliminary evidence that the frequency of EMI provided was generally acceptable to participants. However, we cannot make conclusions regarding the relative acceptability of time-tailored and non-time-tailored EMI because both types of EMI were not provided in this study. Future research comparing participants' responses to EMI that are, and are not, time-tailored would be useful. For example, a research design similar to that employed in the previously discussed stress management EMI study could be used (Smyth & Heron, in preparation). In this study, participants received EMI at either random times throughout the day, or at specific times when they reported high stress or negative affect via EMA. This study design allows for comparisons of relative treatment efficacy, and also could be used to address the question of whether tailored EMI are better received by participants. Developing tailored EMI programs requires considerable time and effort on the part of researchers, and thus, determining the relative benefits of using time-tailoring methods is important for advancing the field.

Characteristics of EMI. The use of EMI in psychosocial and behavioral health interventions is a relatively new, but growing area of research. As such, when designing this study, there was limited previous research available to guide decisions regarding optimal EMI frequency and appropriate cut-off scores for EMA "trigger" items. Many previous research studies provided EMI at fixed times (e.g., Atienza et al., 2008; King, Ahn, Oliveira et al., 2008) or at a fixed frequency (e.g., Weitzel et al., 2007). However, some studies also allow for tailored EMI to be delivered (e.g., in response to craving in smoking cessation interventions; Obermayer et al., 2004; Rodgers et al., 2005), resulting in participants receiving an unequal number of EMI. These studies, however, do not regularly report on the frequency with which participants received time tailored EMI. This information can be helpful both for interpreting the results of individual studies (i.e., knowing the "intensity" of the intervention for individuals), as well providing information that can inform future research (e.g., frequency with which participants use EMI in given sample and under given circumstances). More consistent reporting of EMI characteristics in published studies is clearly necessary as this field continues to grow.

Given the paucity of research regarding the likely frequency of EMI in the literature, one of the contributions of the present study is that it provides information about the characteristics of EMI in this sample of young women. For the purpose of designing this study, existing data from an EMA study of eating and body image with college students (Heron, 2006) were used to inform decisions regarding the likely frequency of EMI in the present study (see Appendix L). In the present study EMI were delivered after about one out of every four EMA surveys. This suggests the criteria and threshold for delivering EMI (see Appendix K) was sufficiently high so that EMI were

not provided after every (or nearly every) assessment and were instead provided at tailored times. Based on the criteria used in this study participants received an average of about eight tailored EMI during the intervention week. Individual participants varied as to the frequency of EMI they received, ranging from 0 to 18 during the week; the majority of participants (72%) received 8 or fewer EMI. The frequency of EMI provided in previous studies has ranged from less than one EMI daily (e.g., every other day; Lazev et al., 2004) to as many as five per day (Rodgers et al., 2005). Although the rate of EMI provided in this study is similar to previous research, it does fall on the lower end of the spectrum (see Heron & Smyth, 2010). The descriptive information regarding EMI frequency (and frequency of EMI trigger events) in this sample may be useful for researchers designing EMI studies in the future, as it can provide data to inform decisions regarding the likely frequency of these specific trigger events in similar samples.

Although there were no significant treatment effects of EMI in the present study, the possibility that EMI characteristics moderated treatment gains was explored. For example, it is possible that women receiving more EMI or specific types of EMI experienced greater gains from the intervention. Very little research examining the ideal frequency and timing of EMI has been conducted, and the potential effect of EMI characteristics on treatment outcome is not well studied (Heron & Smyth, 2010). In the present sample, there was no effect of EMI frequency on treatment outcome, suggesting that the number of EMI participants received did not impact outcome measures. Only one previous study of which we are aware has evaluated the effect of EMI use on intervention efficacy. As part of a weight loss intervention, Burnett and colleagues (1992) provided participants with a palmtop computer, on which they were able to access

psychoeducational EMI at any time, and the frequency with which they self-initiated access to this information was recorded and used to predict treatment outcome. Results showed participants who used the EMI weight loss modules on the palmtop computers more frequently experienced greater treatment gains (i.e., lost more weight) than those who used the EMI less frequently (Burnett et al., 1992). The authors concluded that those participants who took advantage of the EMI treatment to a greater extent experienced more weight loss. This pattern of results could not be tested exactly in the present study because participants were not able to access the EMI on demand and thus, we only have a measure of the frequency with which participants received EMI. In addition, in the present study, EMI frequency is confounded with frequency of reporting "trigger" events. In other words, given the tailoring format used, EMI were provided at times when specific "trigger" events or experiences were reported (disordered eating behavior, media exposure, dysphoric mood), and these "trigger" events have been linked to the experience of greater momentary body dissatisfaction (Heron, 2006; Heron & Smyth, under review). Therefore, the present study design is not ideal for testing the extent to which EMI use (at least with respect to amount of use) may influence treatment outcome.

Exploratory analyses of the influence of EMI content on treatment outcome were also examined. These analyses revealed that although there was a decline in reported disordered eating (EDE-Q) and body dissatisfaction (BSQ) during the course of the study across all participants (likely due to regression to the mean, as will be discussed further in the limitations section), this was not the case for some women; a subset of women actually experienced an increase in eating pathology and body dissatisfaction during the study. Women who reported more disordered eating behaviors via EMA (and thus

received more disordered eating-specific EMI), experienced an increase in both disordered eating symptoms and body dissatisfaction during the three-month study period (see Figure 18), while those who predominately received EMI in response to media use and negative affect EMA trigger items reported an overall decline in disordered eating and body dissatisfaction (this decline can likely be explained by regression to the mean, as will be discussed further in the limitations section). In a study examining the natural course of eating disorder symptoms among a large sample of adolescent and adult women, results suggested that more severe behavioral symptoms (e.g., binging, purging; as compared to attitudinal symptoms) were associated with poorer disordered eating treatment prognosis (Helverskov et al., 2010). A similar pattern was seen in the present sample as well, with women reporting the most behavioral signs of eating disorders via EMA (i.e., more frequent reporting of disordered eating trigger items) demonstrating poorer treatment outcome over three months.

Evaluating Intervention Efficacy

The second aim of this study was to evaluate the efficacy of a computerized disordered eating intervention that was supplemented with palmtop computer-based EMI. This aim was addressed in several different ways. First the possibility that participants were reactive to the EMA protocol was assessed. Second, the efficacy of the CD-ROM intervention and the potential added benefit of EMI was assessed using both short- (immediately post-intervention) and longer-term outcome (two month follow-up). The findings from the efficacy evaluation and implications for the EMI and disordered eating literature are discussed below.

EMA Measurement Reactivity. As was described previously, one concern with EMA studies is that assessing participants multiple times throughout the day would increase reactivity to internal or external cues and may systematically bias response patterns. For example, in the present study it is plausible that frequent daily assessments regarding eating behavior could negatively influence reported behaviors, attitudes, and body dissatisfaction. This is of particular concern in the present study because EMA was used in the attention control condition, and thus, it was important to evaluate and quantify if EMA influenced women's response patterns (either negatively or positively). Consistent with previous research, there was no evidence of measurement reactivity on any measures of body-related constructs. This finding adds to a growing literature indicating EMA is not reactive in eating disorder or body image studies (Heron & Smyth, under review; le Grange et al., 2002; Stein & Corte, 2003). For example, in a study of women with binge eating disorder, all participants took part in a CBT intervention for binge eating and half used palmtop computers to self-monitor eating behaviors. It was hypothesized that the increased self-monitoring via EMA would be associated with greater treatment gains. However, this was not the case; all participants reported similar rates of improvement (le Grange et al., 2002). To date there are no known published reports providing evidence that eating or body-related measures are reactive to intensive EMA protocols. There is also little evidence for measurement reactivity to EMA in other research areas (e.g., pain, alcohol use; Hufford, 2007). Given these consistent findings that EMA does not systematically influence participants' self-reports of cognitive, behavioral, or affective processes in their everyday lives, it does appear as though EMA

can be used in attention control conditions without affecting participants' response patterns.

CD-ROM Intervention Efficacy. In order to assess the extent to which EMI could be used to supplement a computerized intervention, the efficacy of the CD-ROM intervention in the present sample had to first be evaluated. In the present study, there was very limited evidence suggesting the CD-ROM was effective. Participants in the intervention groups (CD and CD+EMI) reported a decrease in A:I discrepancy (suggesting a smaller ideal body discrepancy), but no significant changes in A:O discrepancy, body-related quality of life, or thinness-norm internalization were seen, as compared to women in the control group. These effects were not moderated by initial level of eating pathology (EDE-Q), body shape concerns (BSQ), or BMI. These limited findings are inconsistent with a previous study that evaluated the efficacy of the CD-ROM intervention in a sample of young college women and found significant results changes in disordered eating behaviors (Franko et al., 2005). In the prior study, women identified as "at risk" or "low risk" for developing eating disorders were recruited to participate. Similar to the present study, all participants completed an initial baseline assessment (consisting of a knowledge questionnaire, and measure of disordered eating [EDE-Q] and thinness norm internalization [SATAQ]). Participants were randomized to review either the CD-ROM or neutral videos addressing issues related to gender or women's health (e.g., sex differences in infants, menopause in women, etc.). Participants reviewed these materials in the research office in two sessions, separated by 1-2 weeks (as was done in the present study). They then completed the knowledge and SATAQ questionnaires at the end of the intervention (or videos) and the knowledge, EDE-Q, and

SATAQ three months later. Results demonstrated women reviewing the CD-ROM experienced significant improvements in measures of disordered eating behaviors (EDE-Q) and thinness-norm internalization (SATAQ), as compared to those women reviewing control videos. These effects were more pronounced for women who had been identified as “at risk” for developing an eating disorder (compared to those at “low risk”; Franko et al., 2005)..

Given Franko and colleagues’ findings that the CD-ROM intervention was efficacious for reducing disordered eating behaviors in young college women “at risk” for developing eating disorders, the design of the present study was modeled after this previous work. Similar methods were used in this study in order to maximize the likelihood that the brief CD-ROM intervention would successfully reduce disordered eating behavior in the present sample, as it did in the previous study. For example, “at risk” women were identified and enrolled in the study, similar intervention delivery procedures were used, and the same outcome were assessed.

Although the present study was similar to the CD-ROM validation study in many ways, there are several important differences that may account for the ineffectiveness of the CD intervention in this study. First, the present study was framed very broadly as being about various aspects of college student life and the true purpose of the intervention was masked from participants. As was discussed previously, this was done in order to reduce demand characteristics and maximize the internal validity. In the CD-ROM validation study by Franko and colleagues (2005), the purpose of the study was less well-masked, as the CD-ROM intervention was referred to as an eating disorder education tool and the study was described as being about women’s health and nutrition. It is plausible

that non-specific treatment factors, such as self-selection into a study about eating disorder treatment, motivation for treatment, and optimism about treatment effects are necessary for these women to experience the expected changes in behavior and cognitions. While these factors were present in the previous work by Franko and colleagues, they were greatly reduced or eliminated in the present study due to the study framing that was used.

A second difference between the present study and the study validating the CD-ROM intervention that could contribute to the lack of significant findings is that the level of eating pathology in the present sample was substantially higher than in previous work. The mean EDE-Q score for this sample was 3.4 (on a 6-point scale, higher scores indicate greater eating pathology), while the mean EDE-Q score in the Franko et al. study was 2.3 for the complete sample and 2.8 for women identified as "at risk" for developing an eating disorder. It is possible that in a sample with a lower level of pathology a 2-hour computer-based intervention is sufficient to produce significant effects, but for women with higher levels of disordered eating behaviors this relatively low-intensity intervention is insufficient to produce changes. It is possible that given the higher level of eating pathology in this sample, a more intensive intervention (e.g., face-to-face, longer in duration) would be more appropriate. Using a more intense intervention that created greater accountability and provided women with more opportunities to practice skills and receive feedback on their implementation of skills, may be more effective with women who have higher levels of disordered eating behaviors.

It is evident that the *Food, Mood, and Attitude* CD-ROM intervention, for the present sample, was insufficient for making a significant impact on women's body

dissatisfaction, body-related quality of life, or thinness-norm internalization in the short-term. In order for an intervention to be efficacious, it is presumed that participants must acquire knowledge, have the ability to implement the skills, and actually implement the skills (Bellg et al., 2004). In the present study, participants needed to acquire knowledge of relevant skills (e.g., learning behavioral strategies for coping with urges to binge), be able to enacts the skill (e.g., use the behavioral strategy in daily life), adhere to the target change in behavior (e.g., reduce binging), and the intervention must be efficacious for the intended outcome (e.g., reducing binge eating should be associated with lower likelihood of developing a clinical eating disorder). Data from this study provided evidence that participants receiving the intervention acquired knowledge of relevant skills. The extent to which women were able to implement these skills or adhere to the desired changes in behavior, however, was not adequately assessed. EMI could be especially useful for reminding participants to enact skills in their everyday lives and encourage adherence (Gruber et al., 2001). In future studies it will be important for researchers to measure the extent to which participants are implementing the skills being taught in order to adequately assess the potential added benefit of EMI (see Bellg et al., 2004 for suggestions on appropriate evaluation methods).

EMI Efficacy. The goal of providing EMI in the present study was to extend skill acquisition from the intervention completed in the research office into women's everyday lives. It was expected that participants would make treatment gains in response to the CD-ROM intervention; however, very few consistent improvements in body-related constructs were seen in this sample. Given that these women did not experience many changes in body dissatisfaction, body-related quality of life or thinness-norm

internalization after completing a two-hour intervention, adding (even briefer) mobile support to reinforce skills and information from the intervention did not increase treatment efficacy. Unfortunately, because limited treatment responses to the intervention were seen, the present study does not provide a fully adequate test of the extent to which EMI can be used to augment this intervention for disordered eating and body dissatisfaction.

Two previous studies have similarly found it difficult to change severe disordered eating behavior using brief EMI. In these pilot studies, women with bulimia nervosa first completed either inpatient (Bauer et al., 2003) or intensive outpatient (Robinson et al., 2006) treatment and then received text message-based EMI for the following six months. Although the samples in these studies have higher levels of eating pathology than in the present study, they also took part in more intensive, in-person, cognitive-behavioral therapy prior to receiving EMI. The EMI in these studies were conceptualized as an "after care" program, with the intention of motivating and encouraging patients to continue using CBT skills by periodically sending reminders via text message to patients' mobile phones. Both were small, uncontrolled pilot studies, so results must me interpreted with caution. Researchers found during the "after care" period when participants received EMI, they continued to experience some modest treatment gains. However, despite both intensive psychotherapy and "after care" EMI for six months, more than half of the participants continued to report clinical significant symptoms of bulimia (Robinson et al., 2006). Bauer and colleagues (2003) similarly found modest treatment gains during EMI, with some self-reported improvement in behaviors (e.g.,

binging, vomiting), but less consistent improvement in “dysfunctional” levels of body dissatisfaction.

Mechanism of Change. Social Cognitive Theory (SCT; Bandura, 1986) is the theoretical framework that drives the development of many interventions for disordered eating and body dissatisfaction. However, in the disordered eating and body image treatment literature, there is very little research investigating potential treatment mediators. As such, one of the secondary aims of the present study was to examine possible treatment mediators. Unfortunately, given reliable treatment gains were not demonstrated in the present study, meditational analyses could not be conducted.

The need for studies identifying possible mechanisms of change in disordered eating treatment programs remains. In the present study, self-efficacy and emotion regulation were assessed with the intention of testing them as mediators. These constructs were identified based on the fact that the CD-ROM intervention used in this study was loosely based on SCT (Franko et al., 2005), and primarily aimed to encourage behavior change through improvements in self-regulation and self-efficacy. Eating-related self-efficacy and emotion regulation were assessed in the present study (pre-intervention and post-intervention) and it was expected that the intervention would change individuals’ ability to regulate negative emotions and improve self-efficacy, thus reducing disordered eating behaviors, attitudes, and beliefs about one’s physical appearance. Still, there are other constructs described within SCT that could also be assessed as potential treatment mediators (e.g., goal setting, problem solving, outcome expectancies) and should be explored in future disordered eating intervention work. In order to be able to adequately measure these constructs, new assessment instruments should likely be developed for this

population as well. For example, no measure existed to assess young women's self-efficacy for changing disordered eating behaviors and an existing scale had to be adapted for this study. Adapting measures in this way is not ideal and future research focused on developing specific measures to assess target constructs of interest (e.g., self-efficacy, goal setting, outcome expectancies) in this area of research are needed.

Implications for Clinical Practice

Some have argued that ambulatory assessment and intervention can and should be disseminated for use in everyday clinical practice (Marks, 1999; Newman, Consoli et al., 1997; Piasecki et al., 2007) and this is beginning to be done in eating disorder treatment. For example, integrative cognitive-affective therapy, an emerging treatment for bulimic behaviors, includes treatment modules (e.g., self-monitoring, cognitive restructuring) administered on palmtop computers to help patients generalize therapy skills to their daily lives (Norton et al., 2003; Wonderlich et al., 2000). This therapy provides an example of how EMI can, and are, being incorporated into clinical practice. There are, however, several practical considerations that must be addressed when considering using EMI in clinical practice. First, hardware and software must be available to meet specific treatment needs (e.g., CBT for panic disorder, motivational program for smoking cessation), a task that can be accomplished if EMI treatments are manualized and marketed to practitioners (Newman, Consoli et al., 1997). Second, cost considerations must also be acknowledged, as the price of setting up and implementing EMI must be outweighed by the benefits of such a system. Clinicians must consider costs associated with purchasing treatment software, hardware (i.e., computers, mobile devices), and the time required to setup and implement the EMI system. One way to offset hardware costs

is to allow patients to use their own mobile devices, instead of clinicians supplying these (e.g., cellular phones or "smart" phones). In smaller clinical practices, the cost of setting up an EMI system may exceed any gains, but for larger practices, clinicians may ultimately save time by allowing electronic devices to take over repetitive aspects of treatment (e.g., teaching relaxation techniques) so that time can be devoted to more complex aspects of patient care (e.g., analyzing symptoms, treatment planning; Marks, 1999). It remains to be seen whether implementing such practices in the real world can also significantly improve existing treatment effectiveness.

In most EMI research, including the present study, EMI are used as a tool to help individuals continue to acquire, practice, and incorporate skills into their everyday lives during or immediately after the treatment phase. The EMI in this study were administered for one week immediately after the intervention was completed, with a focus on continuing skill acquisition in women's everyday lives. This approach has been used previously in EMI studies (Bauer et al., 2003; Robinson et al., 2006), but there are several alternates ways in which EMI could have been delivered in this study. For example, in some previous studies for anxiety treatment (e.g., Kenardy et al., 2003; Newman, Kenardy et al., 1997) and weight loss (e.g., Agras et al., 1990; Burnett et al., 1992), participants began using mobile technology-based EMI during the initial intervention phase (e.g., group or individual CBT). This provided participants the opportunity to begin to incorporate skills into their lives and have adequate time to practice skills and receive feedback, during the intervention phase. Although this research design was considered in the present study, it was not used in an effort to maintain a reasonable participant burden. There was concern that college students may have difficulty maintaining adequate

compliance with the current EMA/EMI protocol for several weeks time. As was discussed previously, however, there are many ways in which the current protocol could be adapted in an effort to reduce participant burden, such as reducing the number of EMA questions and using technology (e.g., cell phones) that young adults already use in their daily lives. By making these adjustments to reduce participant burden, it is possible that the EMI intervention period could be extended without negatively impacting compliance rates. Future EMI research for disordered eating and body dissatisfaction should consider ways in which to reduce burden and make the EMI protocol more "livable" for participants. This could allow for the EMI phase to be extended and potentially overlap with the intervention delivery. This treatment design would provide people the opportunity to practice implementing the skills they are learning in their everyday lives and receive feedback on their application of the skills (either in person or via EMI). By providing people with strategies for change (via the intervention), and also guiding them through the necessary steps to implement changes in their everyday lives (via the mobile technology and EMI), it is possible that improvements in people's ability to acquire and practice intervention skills will be more likely to occur.

Another way EMI could be used in clinical research and practice is as "boosters" to help people maintain treatment gains or prevent relapse. After a course of treatment is completed, over time people tend to lose some of the gains that were made during, and immediately after, the active intervention phase. One way to combat this pattern is to offer "booster" sessions of treatment to review and reinforce skills, and enhance motivation for continued behavior change. For example, research has demonstrated that boosters can be added to interventions for binge eating disorder (Schlup et al., 2009),

alcohol use (Connors & Walitzer, 2001), relationship difficulties (Braukhaus et al., 2003), and assertiveness training (Baggs & Spence, 1990) to improve maintenance of treatment effects. Although boosters can use in-person contact to provide additional treatment, in one study telephone-based booster sessions were provided to participants after completing an intensive in-person smoking cessation intervention. Participants receiving telephone booster sessions were twice as likely to quit smoking as compared to those who did not receive the boosters, six and 12 months after the intervention (Metz et al., 2007). Although we are not aware of existing work using mobile technology-based EMI to provide treatment boosters, they could prove to be a useful and cost-effective method for helping patients to maintain treatment gains over longer periods of time following psychological or health behavior interventions.

Study Limitations and Recommendations for Future Research

Sample Limitations. This intervention was conducted with college women at a private university. Although in recent decades more research has been examining body image and eating behaviors in men (Drewnowski & Yee, 1987; Pope et al., 2000) there is still a paucity of research relative to the study of these issues in women. Many of the measures used in the present study (e.g., discrepancies, body dissatisfaction, thinness norm internalization) were specifically constructed only for women, and thus could not have been used in a sample including men. Furthermore, there is evidence that the factors that influence body image in men and women are substantially different (Silberstein et al., 1988). For example, although many women value and internalize a thinness norm, many men idealize a muscular build. This is not raised to suggest that men do not experience body-related distress and disordered eating behaviors, but rather to say that

the processes responsible for establishing, maintaining, and triggering these issues are substantially different across genders. Clearly body dissatisfaction and disordered eating are important problems in a minority of men, and future research should address this population with studies that are carefully designed with the appropriate context for a male sample.

The sample used in the present study was predominately Caucasian (71%), with the largest minority describing themselves as Asian (18%). A substantial amount of research has been conducted suggesting that various ethnic groups hold different ideals regarding personal and cultural norms for body shape and size and eating behaviors (e.g., Altabe, 1998; Miller et al., 2000). For example, African American women tend to choose larger ideal body figures and Asian women chose smaller ideal figures than Caucasian women (Kronenfeld et al., 2010) and Caucasian women report greater weight-related body dissatisfaction than non-Caucasian women (Roberts et al., 2006). The CD-ROM intervention addressed issues related to cultural influences on body image (e.g., varying cultural norms and standards) and eating patterns (Franko et al., 2005). Nonetheless, given the sample the present data should not be generalized to minority groups within the United States, let alone to other cultures and countries outside the United States, and this is an important area for future research. In particular, it could be useful to explore how different contextual factors or cultural meanings (e.g., role of food, type of media use, cultural beliefs about beauty) may differentially influence women of varying racial, ethnic, or cultural backgrounds.

In any intervention study when no treatment effects are found, the sample size and statistical power come into question. Based on meta-analytic findings from eating

disorder prevention programs (Stice & Shaw, 2004), the present study was powered to detect a medium effect size (with power=.80, alpha=.05). A priori power analysis using G*Power 3.0.5 (Faul et al., 2007) suggested a total sample size of 117 participants (39 per group) was required to detect this effect. Assuming 10% attrition (although actual attrition was significantly lower) this required enrolling 129 women (43 per group). In the present study, 131 women were enrolled and 127 completed the study. Thus, based on these calculations, the present study should have sufficient power to detect moderately sized treatment effects, particularly between the attention control and the two intervention (CD, CD+EMI) groups. It is more difficult to estimate the differential effect sizes between the CD and CD+EMI groups, but it is likely that the current study was underpowered for such comparative effectiveness (i.e., the difference between two "active" treatment groups) if the addition of EMI provides only minimal utility (i.e., a small effect size). Nonetheless, given no significant effects of the CD-ROM intervention, non-significant EMI effects are not surprising, and it is unlikely that insufficient statistical power alone explains the overall pattern of generally null findings for the intervention.

Design Limitations. In this study the tailoring of EMI delivery was based on broad heuristics of self-reported disordered eating behaviors, media use, and negative affect assessed via EMA. These three factors were selected based on empirical data suggesting their relevance to the momentary experience of body dissatisfaction (Heron, 2006; le Grange et al., 2001; Smyth et al., 2007) and trigger items and thresholds for delivering EMI were estimated based on previous data (Heron, 2006; see Appendix L). As technology continues to advance, more sophisticated methods for tailoring EMI to

individuals' responses should be explored. For example, algorithms that continuously calculated mean values for participants' responses to specific EMA items could be created and EMI could be delivered when reports are above the individual person's mean value (and the person's mean could shift over time). Trends in responding (e.g., increasing levels of negative affect over several hours or a day) could also be automatically tracked and used to inform the delivery of EMI. The present study uses a significantly more sophisticated approach to tailoring the content and timing of EMI messages than many previous studies, thus representing an important contribution to the literature. However, future research should aim to develop EMI that allow considerably more flexibility in terms of their ability to individually tailor EMI content and delivery in real time.

In the present study, experimental group and intervention "dose" were confounded, with the CD+EMI group receiving more prompts than the CD and attention control groups. We attempted to minimize this effect by limiting the number of EMI participant received after a given EMI (i.e., even if endorsing several trigger items, they only received one EMI at the end of the survey). Given that no significant group effects were demonstrated, the intervention dose did not drive treatment effects. Nonetheless, future research using similar research designs should identify ways to control for the effect of dose. For example, if EMI frequency is tracked, in statistical analyses the number of EMI administered can be controlled to determine if group effects remain. Intervention dose could also be experimentally manipulated by yoking participants across groups based on the number of prompts or EMI received.

On the primary outcome measures (EDE-Q and BSQ) there was a clear effect of time, with all participants (regardless of group) reporting a significant decline in EDE-Q and BSQ scores (i.e., less disordered eating, body dissatisfaction) from the start to end of the study (i.e., screening to follow-up). Research on the natural course of disordered eating behaviors and attitudes in samples of adult women (Mond et al., 2004a; Rizvi, Stice, & Agras, 1999), as well as college women (Crowther et al., 1992), suggests measures of disordered eating behaviors and attitudes are relatively stable over longer periods time (e.g., one to six years), although there is some variability during this time (particularly in behavioral measures of eating pathology). The duration of present study was only three months, and thus, did not capture the relatively stability that may be seen over longer periods of time. Also, recall participants were selected for the present study based on having high EDE-Q ($\geq$2.3) or BSQ ($\geq$110) scores; these time effects can thus be parsimoniously explained by regression to the mean. Although potentially a problem in all research studies, regression to the mean is particularly problematic in studies (such as this one) where participants are selected to be initially "high" on a given variable. Given previous research demonstrating disordered eating and body dissatisfaction interventions are most efficacious with women who are experiencing some symptoms (Franko et al., 2005; Stice & Shaw, 2004), however, we chose to target the intervention in this study to women who were most at risk of developing eating disorders and compare differential treatment responses across groups over time (thus largely removing the regression of the mean effect from the estimate of treatment effects).

One additional way to control for regression to the mean would be to repeat the baseline assessment measures (before the intervention phase), so that any regression to

the mean seen during this time could be quantified and controlled for when examining long-term outcome. We considered repeating the EDE-Q and BSQ measures at the Time 1 assessment (pre-intervention) so that regression to the mean from the screening assessment to Time 1 could be measured and controlled. This was not done in the present study for two reasons. First, in an effort to be consistent with the framing of the study as being broadly about daily experiences and life in college, we wanted to reduce the number and frequency of disordered eating and body image measures administered. This framing was important in order to limit demand characteristics, as well as to provide a consistent message and experience for women randomly assigned to the control group. Second, both the EDE-Q and the BSQ ask participants to report on symptoms during the previous 28 days. In this study the screening and Time 1 assessments took place an average of 14 days apart and, thus, the assessment periods would overlap. Although the possibility of regression to the mean on the EDE-Q and BSQ measures was evident in the present study, it is important to recall that, as this trend was seen in all treatment groups (including the control group), it is unlikely that this effect is masking actual treatment effects (Davis, 1976; James, 1973).

Final Conclusions

The aim of this study to evaluate the feasibility, acceptability, and efficacy of a disordered eating intervention for college women. This intervention was highly innovative in that it used palmtop computers to integrate ambulatory assessment (i.e., EMA) and intervention (i.e., EMI) strategies to provided tailored and contextually sensitive EMI to augment a computerized intervention. This study demonstrated that EMI were feasible to implement and generally well received by this sample of young women.

In the present sample, analyses of intervention efficacy revealed that the computerized CD-ROM intervention did not produce reliably significant improvements in body-related constructs. In addition, there was no unique or added benefit of palmtop computer based EMI in this study.

Although EMI potentially offer a way to improve existing interventions, the use mobile technology for providing psychosocial and health behavior interventions is a relatively new, but growing, field of research. As such, many challenges in the design and implementation of EMI remain. Table 15 provides an overview of these challenges with regards to sample considerations, study design, intervention selection, EMI characteristics, and the measurement of outcome and change processes. In brief, questions remain regarding the best and most appropriate methods for implementing and testing the efficacy of ambulatory intervention methods. At the same time, there are also great opportunities for developing more acceptable and efficacious interventions for disordered eating behaviors, as well as other psychological disorders and health behaviors by using real-world assessment and intervention methods.

Appendix A

Eating Disorder Examination – Questionnaire (EDE-Q)

ON HOW MANY DAYS OUT OF THE PAST 28 DAYS…	**No days**	**1-5 days**	**6-12 days**	**13-15 days**	**16-22 days**	**23-27 days**	**Every day**
Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight?	0	1	2	3	4	5	6
Have you gone for long periods of time (8 hours or more) without eating anything in order to influence your shape or weight?	0	1	2	3	4	5	6
Have you tried to avoid eating any foods that you like in order to influence your shape or weight?	0	1	2	3	4	5	6
Have you tried to follow definite rules regarding your eating in order to influence your shape or weight; for example, a calorie limit, a set amount of food, or rules about what or when you should eat?	0	1	2	3	4	5	6
Have you wanted your stomach to be empty?	0	1	2	3	4	5	6
Has thinking about food or its calorie content made it much more difficult to concentrate on things you are interested in; for example, read, watch TV, or follow a conversation?	0	1	2	3	4	5	6
Have you been afraid of losing control over eating?	0	1	2	3	4	5	6
Have you had episodes of binge eating?	0	1	2	3	4	5	6
Have you eaten in secret? (Do not count binges.)	0	1	2	3	4	5	6
Have you definitely wanted your stomach to be flat?	0	1	2	3	4	5	6

ON HOW MANY DAYS OUT OF THE PAST 28 DAYS…	No days	1-5 days	6-12 days	13-15 days	16-22 days	23-27 days	Every day
Has thinking about shape or weight made it more difficult to concentrate on things you are in; for example, read, watch TV, or follow a conversation?	0	1	2	3	4	5	6
Have you had a definite fear that you might gain weight or become fat?	0	1	2	3	4	5	6
Have you felt fat?	0	1	2	3	4	5	6
Have you had a strong desire to lose weight?	0	1	2	3	4	5	6

Over the past 4 weeks (28 days)…	Not at all		Slightly	Moderately		Markedly	
Has your weight influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6
Has your shape influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6
How much would it upset you if you had to weigh yourself once a week for the next four weeks?	0	1	2	3	4	5	6
How dissatisfied have you felt about your weight?	0	1	2	3	4	5	6
How dissatisfied have you felt about your shape?	0	1	2	3	4	5	6
How concerned have you been about other people seeing you eat?	0	1	2	3	4	5	6
How uncomfortable have you felt seeing your body; for example, in the mirror, in shop window reflections, while undressing or taking a bath or shower?	0	1	2	3	4	5	6
How uncomfortable have you felt about others seeing your body; for example, in communal changing rooms, when swimming or wearing tight clothes?	0	1	2	3	4	5	6

Appendix B

Body Shape Questionnaire (BSQ)

OVER THE PAST <u>FOUR WEEKS:</u>

	Never	Rarely	Sometimes	Often	Very often	Always
1. Has feeling bored made you brood about your shape?	1	2	3	4	5	6
2. Have you been so worried about your shape that you have been feeling you ought to diet?	1	2	3	4	5	6
3. Have you thought that your thighs, hips or bottom are too large for the rest of you?	1	2	3	4	5	6
4. Have you been afraid that you might become fat (or fatter)?	1	2	3	4	5	6
5. Have you worried about your flesh being not firm enough?	1	2	3	4	5	6
6. Has feeling full (e.g. after eating a large meal) made you feel fat?	1	2	3	4	5	6
7. Have you felt so bad about your shape that you have cried?	1	2	3	4	5	6
8. Have you avoided running because your flesh might wobble?	1	2	3	4	5	6
9. Has being with thin women made you feel self-conscious about your shape?	1	2	3	4	5	6
10. Have you worried about your thighs spreading out when sitting down?	1	2	3	4	5	6
11. Has eating even a small amount of food made you feel fat?	1	2	3	4	5	6
12. Have you noticed the shape of other women and felt that your own shape compared unfavorably?	1	2	3	4	5	6
13. Has thinking about your shape interfered with your ability to concentrate (e.g. while watching television, reading, listening to conversations)?	1	2	3	4	5	6
14. Has being naked, such as when taking a bath, made you feel fat?	1	2	3	4	5	6
15. Have you avoided wearing clothes which make you particularly aware of the shape of your body?	1	2	3	4	5	6
16. Have you imagined cutting off fleshy areas of your body?	1	2	3	4	5	6

	Never	Rarely	Sometimes	Often	Very often	Always
17. Has eating sweets, cakes, or other high calorie food made you feel fat?	1	2	3	4	5	6
18. Have you not gone out to social occasions (e.g. parties) because you have felt bad about your shape?	1	2	3	4	5	6
19. Have you felt excessively large and rounded?	1	2	3	4	5	6
20. Have you felt ashamed of your body?	1	2	3	4	5	6
21. Has worry about your shape made you diet?	1	2	3	4	5	6
22. Have you felt happiest about your shape when your stomach has been empty (e.g. in the morning)?	1	2	3	4	5	6
23. Have you thought that you are in the shape you are because you lack self-control?	1	2	3	4	5	6
24. Have you worried about other people seeing rolls of fat around your waist or stomach?	1	2	3	4	5	6
25. Have you felt that it is not fair that other women are thinner than you?	1	2	3	4	5	6
26. Have you vomited in order to feel thinner?	1	2	3	4	5	6
27. When in company have your worried about taking up too much room (e.g. sitting on a sofa, or a bus seat)?	1	2	3	4	5	6
28. Have you worried about your flesh being dimply?	1	2	3	4	5	6
29. Has seeing your reflection (e.g. in a mirror or shop window) made you feel bad about your shape?	1	2	3	4	5	6
30. Have you pinched areas of your body to see how much fat there is?	1	2	3	4	5	6
31. Have you avoided situations where people could see your body (e.g. communal changing rooms or swimming baths)?	1	2	3	4	5	6
32. Have you taken laxatives in order to feel thinner?	1	2	3	4	5	6
33. Have you been particularly self-conscious about your shape when in the company of other people?	1	2	3	4	5	6
34. Has worry about your shape made you feel you ought to exercise?	1	2	3	4	5	6

Appendix C

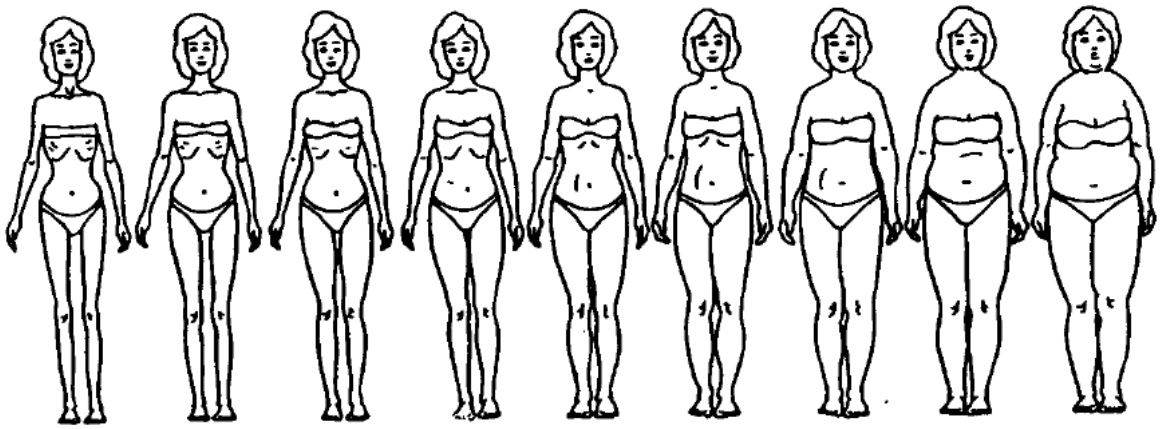
Contour Drawing Rating Scale

Your **ACTUAL** self: The figure that you ACUALLY possess. This is the figure you **currently** look like.

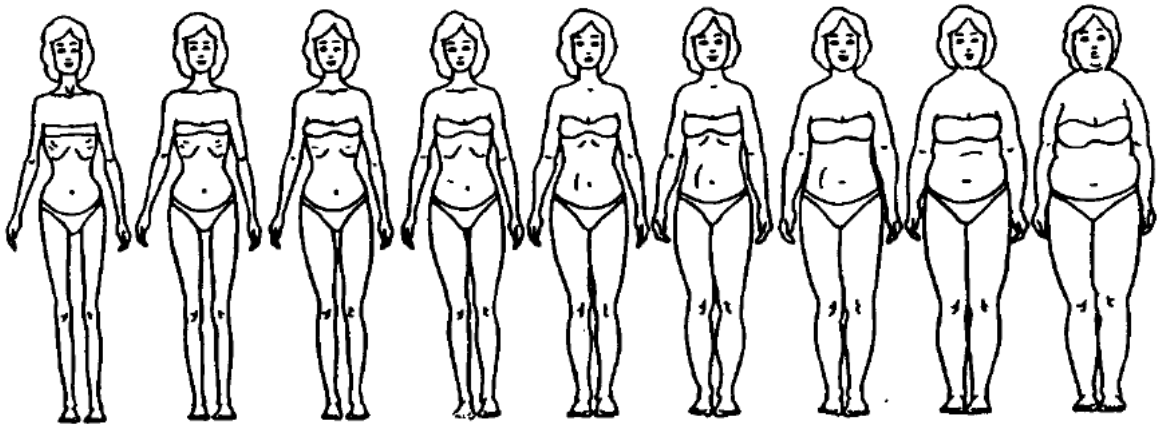
Your **IDEAL** self: The figure that you would IDEALLY like to possess. This is the figure you **wish**, **desire**, or **hope** to look like.

Your **SHOULD** self: The figure that you think you OUGHT to possess. This is the figure you have a **duty**, **obligation**, or **responsibility** to look like, or the figure that you are **morally obligated** to possess.

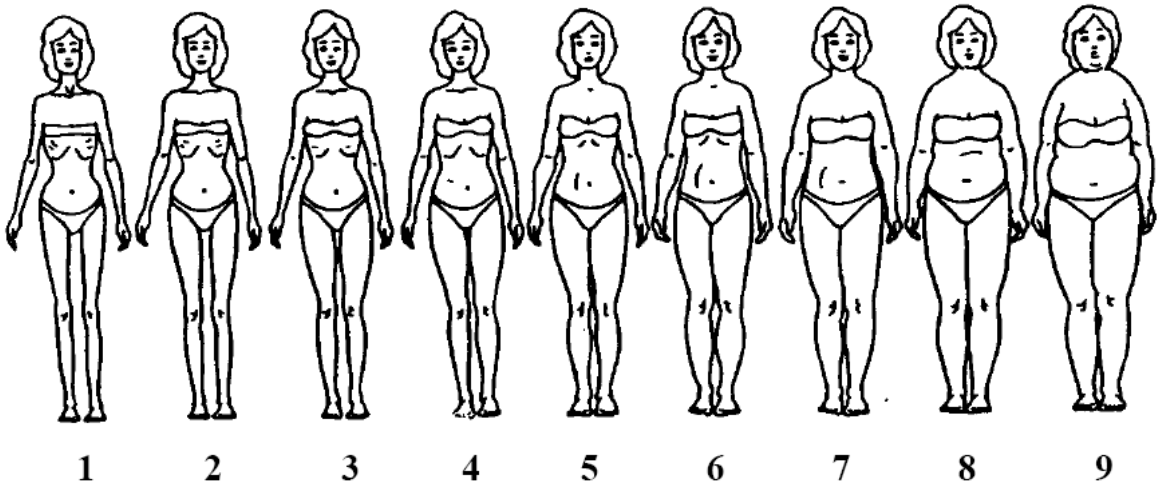
1. Which figure represents your ACTUAL self? This is the figure you **currently** look like.



2. Which figure represents your IDEAL self? This is the figure you **wish**, **desire**, or **hope** to look like.



3. Which figure represents your SHOULD self? This is the figure you have a **duty**, **obligation**, or **responsibility** to look like, or the figure that you are **morally obligated** to possess.



Appendix D

Body Image Quality of Life Inventory

Listed below are various ways that your own body image may or may not influence your life. For each item below, circle how and how much your feelings about your appearance affect that aspect of your life.

	Very Negative Effect	Moderate Negative Effect	Slight Negative Effect	No Effect	Slight Positive Effect	Moderate Positive Effect	Very Positive Effect
My basic feelings about myself – feelings of personal adequacy and self-worth.	-3	-2	-1	0	1	2	3
My feelings about my adequacy as a woman – feelings of femininity	-3	-2	-1	0	1	2	3
My interactions with other women	-3	-2	-1	0	1	2	3
My interactions with other men	-3	-2	-1	0	1	2	3
My experiences when I meet new people	-3	-2	-1	0	1	2	3
My experiences at work or at school	-3	-2	-1	0	1	2	3
My relationships with friends	-3	-2	-1	0	1	2	3
My relationships with family members	-3	-2	-1	0	1	2	3
My day-to-day emotions	-3	-2	-1	0	1	2	3
My satisfaction with my life in general	-3	-2	-1	0	1	2	3
My feelings of acceptability as a sexual partner	-3	-2	-1	0	1	2	3
My enjoyment in my sex life	-3	-2	-1	0	1	2	3
My ability to control what and how much I eat	-3	-2	-1	0	1	2	3
My ability to control my weight	-3	-2	-1	0	1	2	3
My activities for physical exercise	-3	-2	-1	0	1	2	3

My willingness to do things that might call attention to my appearance	-3	-2	-1	0	1	2	3
My daily “grooming” activities (i.e., getting dressed and physically ready for the day)	-3	-2	-1	0	1	2	3
How confident I feel in my everyday life	-3	-2	-1	0	1	2	3
How happy I feel in my everyday life	-3	-2	-1	0	1	2	3

Appendix E

Sociocultural Attitudes Towards Appearance Questionnaire

Please read each of the following items carefully, and indicate the extent to which you agree or disagree with each statement. Please use the following rating scale for each item.

Completely disagree			Neither agree nor disagree			Completely agree
1	2	3	4	5	6	7

1. Women who appear in TV shows and movies project the type of appearance that I see as my goal.	1	2	3	4	5	6	7
2. I believe that clothes look better on thin models.	1	2	3	4	5	6	7
3. Music videos that show thin women make me wish that I were thin.	1	2	3	4	5	6	7
4. I *do not* wish to look like the models in magazines.	1	2	3	4	5	6	7
5. I tend to compare my body to people in magazines and on TV.	1	2	3	4	5	6	7
6. In our society, fat people are not regarded as unattractive.	1	2	3	4	5	6	7
7. Photographs of thin women make me wish that I were thin.	1	2	3	4	5	6	7
8. Attractiveness is very important if you want to get ahead in our culture.	1	2	3	4	5	6	7
9. It's important for people to work hard on their figures/ physiques if they want to succeed in today's culture.	1	2	3	4	5	6	7
10. Most people *do not* believe that the thinner you are, the better you look.	1	2	3	4	5	6	7
11. People think that the thinner you are, the better you look in clothes.	1	2	3	4	5	6	7
12. In today's society, it's *not* important to always look attractive.	1	2	3	4	5	6	7
13. I wish I looked like a swimsuit model.	1	2	3	4	5	6	7
14. I often read magazines like *Cosmopolitan*, *Vogue*, and *Glamour* and compare my appearance to the models.	1	2	3	4	5	6	7

Appendix F

Difficulties in Emotion Regulation Scale - Revised

Read each of the statements below and indicate how often the statement applies to you in general.

	Almost never	Sometimes	About half the time	Most of the time	Almost always
I pay attention to how I feel.	1	2	3	4	5
I experience my emotions as overwhelming and out of control.	1	2	3	4	5
I have difficulty making sense out of my feelings.	1	2	3	4	5
I know exactly how I am feeling.	1	2	3	4	5
I care about what I am feeling.	1	2	3	4	5
I am confused about how I feel.	1	2	3	4	5
When I'm upset, I become embarrassed for feeling that way.	1	2	3	4	5
When I'm upset, I feel out of control.	1	2	3	4	5
When I'm upset, I believe that I will remain that way for a long time.	1	2	3	4	5
When I'm upset, I believe that my feelings are valid and important.	1	2	3	4	5
When I'm upset, I have difficulty focusing on other things.	1	2	3	4	5
When I'm upset, I can still get things done.	1	2	3	4	5
When I'm upset, I feel ashamed with myself for feeling that way.	1	2	3	4	5
When I'm upset, I know that I can find a way to eventually feel better.	1	2	3	4	5
When I'm upset, I feel guilty for feeling that way.	1	2	3	4	5
When I'm upset, I have difficulty concentrating.	1	2	3	4	5
When I'm upset, I have difficulty controlling my behaviors.	1	2	3	4	5
When I'm upset, I believe that wallowing in it is all I can do.	1	2	3	4	5

Appendix G

Eating Disorder Self-Efficacy Scale - Revised

Read each statement below and rate how confident you are that the statement applies to you.

	Not at all confident				**Very confident**
I can look at my stomach or thighs without wondering if I've gained or lost weight.	1	2	3	4	5
I can accept my "figure flaws".	1	2	3	4	5
I am able to not compare my body shape to other thin or attractive females I see.	1	2	3	4	5
I can feel proud of how I look.	1	2	3	4	5
I can wear a swimsuit in public.	1	2	3	4	5
I can eat a meal without thinking about how many calories I'm consuming.	1	2	3	4	5
I can buy food based on what I feel like eating, not because it is low fat and/or low calorie.	1	2	3	4	5
I can eat three balanced meals a day without binging, purging, exercising excessively, or taking diuretics or laxatives.	1	2	3	4	5
I can eat one serving of ice cream without feeling guilty or anxious.	1	2	3	4	5
I can eat a high fat/high calorie food without worrying that I will gain weight.	1	2	3	4	5

Appendix H

Knowledge Questionnaire

1. Which of the following can result from inadequate nutrition?

a.) Coughs, including whooping cough
b.) Vertigo and other problems with balance
c.) Hair loss, including baldness and brittle nails
d.) Asthma and other breathing problems
e.) All of the above

2. Your friend down the hall has a midterm worth 50% of her grade coming up next Thursday and is feeling stressed. You have already taken several exams this year and are feeling pretty good about your ability to cope with stress and manage your time. When you are giving your friend advice, which of the following is NOT something you would recommend?

a.) Ask upperclassman for copies of their old exams
b.) If a TA (and not the professor) is running the review session, skip it
c.) Study for the test as though it is next Wednesday, not Thursday
d.) b and c
e.) All of the above

3. A Class-Professor Investigation could include:

a.) Finding out the types of readings and assignments you will have for a class
b.) Asking friends at other universities about classes they have taken
c.) E-mailing professors you have had before to ask which professors in their department are the most difficult
d.) Finding out if the class has a graduate or undergraduate TA and becoming friends with the TA before the class begins
e.) All of the above

4. Assertiveness is:

a.) Being specific and direct
b.) Stating your opinion
c.) Speaking to the person your message is intended for
d.) Not putting others and their opinions down
e.) All of the above

5. Which of the following is the most important benefit of having a tutor?

a.) You are more likely to remember the course materials if you know you are paying someone to help you study
b.) It makes you commit to studying for the class during a set period of time
c.) Most tutors on campus are other students so it allows you to meet new people
d.) Professors regularly meet with tutors and give them information about the material that will be on exams
e.) All of the above

6. Why do we need folate (folic acid) in your diets?

a.) Folate aids the formation of red blood cells and DNA
b.) Folate aids digestion
c.) Folate strengths bones
d.) Folate helps heal wounds
e.) All of the above

7. John is new to college and is feeling pretty intimidated by his professors. Even when he thinks about talking to his professors before or after class it makes his palms sweaty and his heart pound. Which of the following "ice breakers" would you NOT recommend John use to help him feel more comfortable talking with his professors?

a.) "The lecture today was really interesting."
b.) "My grade on the last exam was lower than what I wanted. Could we meet sometime and go over the questions I missed?"
c.) "I really like this class and I want to apply for a geology internship next summer. Could you write me a recommendation?"
d.) In your lecture two weeks ago about sedimentary rocks I was confused about the principle of superposition, could you explain it again?"
e.) None of the above.

8. What is the difference between a Bachelor's of Science (B.S.) and a Bachelor's of Arts (B.A.) degree?

a.) Most graduate schools will only accept students who have a B.S.
b.) Students at liberal arts colleges all receive a B.A. and those at universities can choose which degree they receive.
c.) To receive a B.S., at least half of your elective courses must be science courses and to receive a B.A. at least half of your elective courses must be art courses.
d.) Although there used to be a difference between a B.S. and a B.A. degree, today there is not much of a difference.
e.) None of the above.

9. How many women try to lose weight to live up to the images they see in the media?

a.) Over 90%
b.) Over 70%
c.) Over 50%
d.) Over 25%
e.) Over 10%

10. Why is it important to get enough sleep the night before an exam?

a.) Sleep helps to "move" memories from short-term storage into long-term storage.
b.) When you sleep your brain releases adrenaline, an important neurotransmitter for memory formation.
c.) During sleep there is increased blood flow to your hippocampus (the memory center in the brain).
d.) b and c
e.) None of the above

11. Which of the following statements about diet pills and appetite suppressants is FALSE?

a.) They control hunger so you will lose weight.
b.) They do not affect appetite centers in the brain.
c.) They cause metabolic changes that are dangerous for your body.
d.) They do not cause significant permanent weight loss.
e.) All of the above.

12. Maria, an art history major, is trying to find a "study buddy" for her intro biology class. Which of the following people would be the best option for Maria to choose?

a.) Susan, because she is a pre-med major and is doing well in the class even though she never studies.
b.) Madison, because she is Maria's roommate so studying together is convenient.
c.) Hannah, because she prefers to study in the evenings like Maria.
d.) James, because males tend to out-perform females in science classes.
e.) None of the above.

13. Why is it important for a student to build rapport with his or her professors?

a.) The professor may be more lenient when grading writing assignments for students he or she knows.
b.) Nearly 90% of college graduates report that their first job out of college was because of networking with a professor.
c.) Professors often give students they like answers on exams.
d.) Socializing with professors can be a good way to have a social life while also focusing on academics.
e.) All of the above.

14. Why do we need social interaction when we eat?

a.) Social interaction divers our attention from food.
b.) People are watching what we eat so we will not overeat.
c.) Social interaction satisfies our emotional hunger.
d.) Lack of social interaction leads to under-eating.
e.) All of the above.

15. "He said he couldn't go to dinner with me. I know he doesn't like me." This statement is an example of which cognitive distortion?

a.) Polarized thinking
b.) Filtering
c.) Catastrophizing
d.) Mind reading
e.) All of the above

16. Purging is:

a.) Vomiting
b.) Laxative abuse
c.) Excessive exercise
d.) Diuretic abuse
e.) All of the above

17. You feel like your parents are putting pressure on you to achieve. What should you do?

a.) Talk about the pressure topic.
b.) Ask them not to focus on rankings and wins and losses.
c.) Don't share your thoughts or opinions with them.
d.) Avoid talking to your parents about how you're feeling or doing.
e.) All of the above.

18. A friend of yours eats alone because she does not want others to comment on what she's eating. What should she do?

a.) She should be direct and tell them that their comments make it hard for her to eat.
b.) She should practice using techniques like sarcasm or humor to silence her critics.
c.) She should practice using affirmations to encourage herself to eat what she wants despite their comments.
d.) She should try to find a new group of friends to eat with who do not comment on her food.
e.) All of the above.

19. Which of the following is NOT important for adequate time management?

a.) Set up the same schedule each semester.
b.) Create a study schedule
c.) Schedule classes at times that are convenient for you
d.) Plan time to hang out with friends
e.) All of the above.

20. Which of the following is NOT an important strategy for being successful in college?

a.) Choose the right courses
b.) Fund the Starsky to your Hutch
c.) Develop good relationships with your professors and TAs
d.) Avoid social activities during the week
e.) All of the above

Appendix I

About You

All information provided is used for classification purposes only. Your name will not be associated with the given information.

1. What is your birth date? Month ___ ___ / Day ___ ___ / Year ___ ___

2. What is your ethnic or racial heritage? (circle as many as apply)

(1) Black or African American
(2) White or Caucasian
(3) Latina or Hispanic
(4) Asian or Asian American
(5) Native American
(6) Other (specify) _____

3. What is your current enrollment status?

(1) Full-time (2) Part-time

4. How many years have you been enrolled in college?

(1) One (2) Two (3) Three (4) Four (5) Five or more

5. Based on your academic standing, what is your current year in school?

(1) Freshman (2) Sophomore (3) Junior (4) Senior

6. Are you currently a member of a social sorority? Yes No

7. Where do you live? (1) On campus (2) Off campus

8. Who do you live with? (Circle one.)

(1) Live alone
(2) Roommate(s)
(3) Family member(s)
(4) Partner/significant other

9. Which of the following options best describes your current relationship status? (Circle one.)

(1) Single (not dating)
(2) Dating one partner
(3) Dating several partners
(4) In a monogamous relationship
(5) Engaged to be married or married

10. Do you have any children? (circle one) Yes No

If yes, how many? _____

11. Are you CURRENTLY receiving any of the following types of mental health treatment?

a. Psychotherapy or counseling? Yes No

If yes, please describe: _____

b. Pharmacotherapy or medications? Yes No

If yes, please describe: _____

c. Other mental health treatment (e.g., chemical dependency)? Yes No

If yes, please describe: _____

12. In the PAST have you received any of the following types of mental health treatment?

a. Psychotherapy or counseling? Yes No

If yes, please describe: _____

b. Pharmacotherapy or medications? Yes No

If yes, please describe: _____

c. Other mental health treatment (e.g., chemical dependency)? Yes No

If yes, please describe: _____

Appendix J

EMA Questionnaire

[LOCATION/ACTIVITY QUESTIONS]
What were you doing when you were beeped? (drop down list)

- In class
- Other school activity
- Working
- House or yard work
- Socializing
- Relaxing
- Eating/Drinking
- Physical Activity
- Watching TV/Movie
- Other Activity

Where were you doing this activity? (drop down list)

- At home or in dorm room
- Other person's home/dorm
- On-campus academic building
- On-campus non-academic building
- Restaurant or bar
- Outside
- Other location on campus
- Other location off campus

[MOOD QUESTIONS]
On the following pages are several different types of questions about your mood, emotions, and feelings RIGHT NOW.

Rate how much each of the following statements is true of your emotions or feelings RIGHT NOW.

I am paying attention to how I feel. [0=not at all, 6=extremely]
I am confused about how I feel.
I care about what I am feeling.
My emotions seem overwhelming and out of control.

On the following pages are words that describe how you may feel right now. Rate how you are feeling RIGHT NOW.

Right now I feel: [0=not at all, 6=extremely]
**Depressed or sad
Excited

**Worried or anxious
**Angry or hostile
Relaxed
**Unhappy
Enthusiastic
**Frustrated
Content

[STRESS QUESTIONS]
The next several questions will ask you about some of the experiences you have had during the last several hours.

Since the last beep, has anything stressful or unpleasant happened? [Yes/No]

If yes: Which of the following types of experience did you have since the last assessment? (mark all that apply)

Difficulties involving school or work
Problems with significant other
Problems with friend/peer
Problems with family members
Medical or health problems
Negative event that happened to others
Missing a loved one
Other

Now think about the MOST stressful or unpleasant experience or thought you have had since the last beep. What is the MOST stressful experience you have had since the last beep? (mark one)

Difficulties involving school or work
Problems with significant other
Problems with friend/peer
Problems with family members
Medical or health problems
Negative event that happened to others
Missing a loved one
Other

How unpleasant was this experience for you when it happened? [0=not at all, 6=extremely]
**How unpleasant is this experience for you NOW. [0=not at all, 6=extremely]
Were you able to resolve this difficulty or problem? [yes/no]

If no: How confident are you that you will be able to resolve this difficulty or problem? [0=not at all, 6=extremely]

***Criteria for providing EMI(negative mood, stress): 1 or more negative mood (depressed/sad, unhappy, angry/hostile, frustrated, worried/anxious) or current stress severity rated 6 ("extremely")*

Do you think that you will have anything stressful or unpleasant happen in the next few hours? [yes/no]

If yes: How stressful or unpleasant do you expect it to be? [0=not at all, 6=extremely]
How confident are you that you will be able to manage or deal with this experience? [0=not at all, 6=extremely]

If no: If an unexpected stressful or unpleasant event happens, how confident are you that you will be able to manage or deal with it? [0=not at all, 6=extremely]

Do you think that you will have anything pleasant happen in the next few hours? [yes/no]

If yes: How pleasant do you expect it to be? [0=not at all, 6=extremely]

[ACADEMIC QUESTIONS]
The following questions are about your academic activities during the last several hours.

How many classes did you attend since the last beep?

None
One
Two
Three or more

If one or more: Think about the most recent class you attended. Approximately how many students were in the class?

Less than 10
10-25
26-50
51-100
100-300
More than 300

How much did you enjoy this class? [0=not at all, 6=very much]

Since the last beep, did you skip a class? [yes/no]

Since the last beep, did you study or work on a class assignment? [yes/no]

If yes: Did you study or work on a class assignment:

Alone
With a classmate
With a group of classmates
With a tutor

Where did you study or work on a class assignment?

My home/dorm room
Other person's home/dorm room

Library
Other on-campus location
Other off-campus location

Since the last beep, which of these other academic activities did you do? (check all that apply)

Emailed/called a professor or TA with a question
Went to a professor or TA's office hours
Met with a tutor
Met with an academic advisor
None of these activities

On the next page is a list of things people sometimes do to help manage their time. Think about which of these activities you did SINCE THE LAST BEEP.

Which activities did you do SINCE THE LAST BEEP? (check all that apply)

Use an appointment book
Make a list
Write yourself reminder notes
Have someone else remind you
Organize papers or workspace
Set or evaluate priorities
Set or evaluate goals
None of these activities

On the following pages are questions are about how you have spent your time during the past several hours, including questions about your daily activities and social interactions.

[MEDIA USE QUESTIONS]

**Have you watched TV since the last beep? [Yes/No]

If yes: When did you last watch TV?
I am currently watching TV
Less than 1 hour ago
1-3 hours ago
More than 3 hours ago

**Have you read a magazine since the last beep? [Yes/No]

If yes: When did you last read a magazine?
I am currently reading a magazine
Less than 1 hour ago
1-3 hours ago
More than 3 hours ago

Which type(s) of magazines did you read? (mark all that apply)

Beauty/Fashion
Gossip/Tabloid
Heath/Fitness
Hobbies
News/Politics
Sports/Outdoors
Other

<u>**Criteria for providing EMI:**</u> Currently watching TV or read a fashion or gossip magazine since last beep

Have you played a computer or video game since the last beep? [Yes/No]
<u>If yes</u>: When did you last play a computer or video game?
I am currently playing
Less than 1 hour ago
1-3 hours ago
More than 3 hours ago

Have you used the Internet since the last beep? [Yes/No]
<u>If yes</u>: When did you last use the Internet?
I am currently reading a magazine
Less than 1 hour ago
1-3 hours ago
More than 3 hours ago

What was the purpose of using the Internet? (mark all that apply)
Check e-mail
Use social network site
View videos or pictures
Shopping
Read gossip site
Read or post blog
Read news site
Play internet game
Academic information search
Other information search

[EATING BEHAVIOR QUESTIONS]
Have you eaten any food (including meals or snacks) since the last beep? [Yes/No]
<u>If yes</u>: When did you last eat?
I am currently reading a magazine
Less than 1 hour ago
1-3 hours ago
More than 3 hours ago

**When you most recently ate, how much:
Did you try to limit the amount of food you ate? [0=not at all, 6=very much]
Were you concerned about other people seeing you eat?
Did you binge eat, or eat unusually large amount of food given the circumstances?
Were you been afraid of losing control over your eating?
Did you try to follow rules regarding your eating (e.g., calorie limit, rules about what or when to eat)?

<u>**Criteria for providing EMI:**</u> 1 or more of the "how much" questions rated 6 ("very much")

When you most recently ate, did you eat with other people? [Yes/No]
<u>If yes:</u> Approximately how many other people did you eat with? [1-2, 3-5, 6-10, more than 10]
How pleasant was this company? [0=not at all, 6=very much]

<u>If no eating since last beep:</u>
How typical or normal is it for you to not eat during the last several hours? [0=not at all typical, 6=very typical]
How much did each of the following factors influence you to NOT eat since the last beep?
I was not feeling hungry. [0=not at all, 6=very much]
I am trying to control my weight and/or shape.
I did not like the food options available.
I did not have time to prepare or eat food.

[SOCIAL INTERACTION QUESTIONS]
Are you with other people RIGHT NOW? [Yes/No]
Who are you with right now? (Check all that apply).
Significant other
Friend(s)
Family member(s)
Roommate(s)
Classmate(s)
Professor(s)
Coworker(s)
Acquaintance(s)
Stranger(s)
Other(s)

Are you with:
Male(s) only
Female(s) only

Both males and females

How pleasant is this company? [0=not at all, 6=extremely]

Since the last beep, estimate how many FEMALES you had an interaction with. An "interaction" is talking with someone in person, on the phone, text messaging, or online. [0, 1-2, 3-5, 6-10, more than 10]

Since the last beep, estimate how many MALES you had an interaction with. An "interaction" is talking with someone in person, on the phone, text messaging, or online. [0, 1-2, 3-5, 6-10, more than 10]

Appendix K

EMA Trigger Questions and Criteria for EMI

Eating behavior EMA questions: (adapted from restraint and eating concern subscales of the Eating Disorder Examination-Questionnaire; Fairburn & Beglin, 1994)

Since the last time you completed this survey, have you eaten? [Yes/No]
When you most recently ate, how much:

Did you try to limit the amount of food you ate? [0=not at all, 6=very much]
Did you try to follow definite rules regarding your eating (for example, a calorie limit, a set amount of food, or rules about what or when you should eat)? [0=not at all, 6=very much]
Were you been afraid of losing control over your eating? [0=not at all, 6=very much]
Were you concerned about other people seeing you eat? [0=not at all, 6=very much]
Did you binge, or eat a large amount of food, given the circumstances? [0=not at all, 6=very much]

Criteria for providing EMI: 1 or more question rated 6 ("very much")

Media use EMA questions:

Since the last time you completed this survey, have you read a magazine? [Yes/No]
Which type(s) of magazines did you read? (mark all that apply)
Beauty/Fashion (Cosmo, Glamour, etc.)
Gossip/Tabloid (People, Star, etc.)
Heath/Fitness (Shape, Fitness, etc.)
Hobbies (American Photo, Travel & Leisure, etc.)
News/Politics (Newsweek, Time, etc.)
Sports/Outdoors (Sports Illustrated, Outdoor Life, etc.)
Other
When did you last read a magazine?
I am currently reading a magazine
Less than 1 hour ago
1-3 hours ago
More than 3 hours ago

Since the last time you completed this survey, have you watched TV? [Yes/No]
When did you last watch TV?

I am currently watching TV
Less than 1 hour ago
1-3 hours ago
More than 3 hours ago

Criteria for providing EMI: Currently watching TV or reading a fashion or gossip magazine

Negative mood and stress EMA questions:

How depressed or sad do you feel right now? [0=not at all, 6=extremely]
How unhappy do you feel right now?
How angry or hostile do you feel right now?
How frustrated do you feel right now?
How worried or anxious do you feel right now?

Since the last beep, has anything stressful occurred? [Yes/No]
How stressful is this event is for you NOW. [0=not at all, 6=extremely]

Criteria for providing EMI: 1 or more question rated 6 (“extremely”)

Appendix L

Supplemental Data and Rationale Supporting EMI Triggers

In an effort to predict the frequency with which these "triggers" will occur prior to conducting this study, data from a previously discussed study of college women's body image was used (Heron, 2006). In this study, 63 college women completed the EDE-Q and then were prompted five times daily for one week using palmtop computers. Participants completed EMA reports of their media use and stress. The data women provided in this study were used to estimate the frequency of these "trigger" events and specific findings are discussed in greater detail below.

Disordered eating behaviors will be assessed using items adapted from the restraint and eating concern subscales of the EDE-Q (Fairburn & Beglin, 1994). Rating any one of these four problematic eating behavior items as a 6 (i.e., "very much") can trigger an EMI**.** In a sample of 63 college women who completed these items on the EDE-Q (not via EMA), 21% reported experiencing one of the four eating behaviors described above at least daily (Heron, 2006). In the present study, women with body image dissatisfaction and disordered eating behaviors will be pre-selected to participate and thus, these problematic eating behaviors will very likely be reported frequently enough to provide EMI.

If participants report currently reading a beauty/fashion magazine or gossip/tabloid magazine, this can trigger an EMI. These specific types of magazines are the most likely to promote the thinness norm by showing images of slender models and celebrities. In order to estimate how often women typically read these materials we used EMA data from a sample of college women (Heron, 2006), and calculated how often participants reported currently reading a magazine at the time of the EMA prompt. Seventeen percent of the participants reported currently reading a magazine during a one-week period (i.e., would meet the above criteria). In the present study, currently watching TV can also potentially trigger an EMI. Unlike for magazines, it is unclear if specific "types" of television are more likely to portray the thinness standards. This is particularly problematic because even if participants report watching media that is less likely to portray thinness standards (e.g., the nightly news, a cartoon, etc.), it is possible that they are still exposed to these messages during the program or during commercials. As was discussed earlier, in a sample of college women, we found that at moments when they reported watching television, they reported greater body image dissatisfaction than during moments when they were not watching television (Heron, 2006). There was no evidence, however, that specific types of television programs (e.g., sitcom, reality television, soap operas, sporting events, etc.) were associated with concurrent reports of body image dissatisfaction. Therefore, for the purposes of the present study, participants can receive an EMI when they report currently watching any television, regardless of type. During a one week EMA assessment period, the majority of college women (81%) reported watching television at the time of an EMA report (i.e., when the palmtop computer "beeped") at least once. The median number of times this occurred for each participant

during the week was 3 (Heron, 2006), suggesting that although most participants will report currently watching TV at least once, this event will not be extremely common.

Women's level of dysphoria will be assessed by measuring both negative mood and the experience of stressors. Current negative mood state will be assessed via five single items (depressed/sad, unhappy, angry/hostile, frustrated, worried/anxious) rated on a 7-point scale (0=not at all, 6=extremely). A participant rating any one of these five negative mood items as a 6 (i.e., "extremely") can trigger an EMI. Rating current stress severity as a 6 (on 0-6 scale) can also trigger an EMI. In preliminary EMA research (Heron, 2006), participants reported experiencing a stressor during 20% of the EMA reports and rated only 13% of the stressors they experienced as "extremely stressful" (i.e., a 6 where 0=not at all stressful and 6=extremely stressful) during the one-week assessment period. This suggests that the report of severe stressors is not unduly common, and appears reasonable to use for triggering EMI. Based on these analyses, participants should receive 1-2 stress-based EMI per week.

Appendix M

EMI Goals and Content

Disordered Eating Behavior EMI

Goals of intervention:

1. Identify behavioral strategies for appropriate social eating (limiting eating alone, finding comfortable social groups)
2. Develop strategies for planning balanced meals and snacks
3. Highlight the connection between emotions and eating

EMI content and order:

When we feel down, we might turn to food to comfort ourselves. Although it might seem like eating makes us feel better in the short-term, people often feel even worse about themselves afterwards. Acknowledge and express your feelings by talking with a friend or writing in a journal, instead of using food to push them down. **(Goal 3)**

Making healthier food choices for your snacks and meals can make you feel better physically and mentally. Try eating foods from all of the food groups to get vitamins and minerals each day. Check with a dietician if you have questions about the best types of foods to be eating for your body type. **(Goal 2)**

When eating with others, sometimes people feel judged, guilty, or ashamed. Find a friend or group of friends who are not judgmental about eating. You can also tell yourself or others: "I am eating what I like and it's ok if it's different from others." **(Goal 1)**

Sometimes when we feel sad, angry, or anxious, we under- or overeat. Try keeping a food and mood diary to track how you are feeling and the amounts and types of foods you eat. This can help you to understand your personal emotional triggers for eating so you can deal with moods in ways other than eating. **(Goal 3)**

Get together with friends or family to eat meals. By avoiding eating alone or in secret and instead eating with other people who you feel comfortable with, you can feel more satisfied physically and psychologically. **(Goal 1)**

If you find yourself turning to food when you are stressed, notice that you are doing this. Instead of using food to cope with stress, take a break from the activity or situation that is causing stress. When you return to dealing with the stressful situation, concentrate on taking one step at a time. **(Goal 3)**

Make your mealtimes more enjoyable by talking or thinking about pleasant events while eating. Avoid topics or discussions that make you feel stressed, sad, or angry. **(Goal 1)**

Many people eat when they are bored. If you find yourself eating when you're bored (even though you're not hungry), try to distract yourself from food by talking to a friend, going for a walk, listening to music, or some other enjoyable activity. **(Goal 3)**

Media Exposure EMI

Goals of intervention:

1. Identify cognitive distortions that accompany viewing media (unfair comparisons, misattribution of qualities)
2. Challenge the thin ideal portrayed in the media
3. Identify behavioral changes that can limit excessive or unhealthy media use

EMI content and order:

Messages from the media about what the "ideal" women looks like can make us feel sad, inadequate, and dislike our body. Notice if you are adopting these ideals and pressuring yourself to live up to them. You do not have to allow your sense of self-worth to be determined by media images. **(Goal 3)**

Remember that on TV and in magazines models and actresses are often shown at an angle to make them look their best. Comparing yourself to these images is unfair! Notice when you make unfair comparisons about your appearance and instead think about your other qualities (a skill, personality trait) that compare more favorably to other people. **(Goal 1)**

Our society teaches us what is considered "beautiful," but women's ideal body shapes and sizes have changed throughout history. You do not have to adopt the ideals we see portrayed in the media today and pressure yourself to live up to them. **(Goal 2)**

Beware of messages saying you will have the perfect life if you look like the women on TV or in magazines. Remember it is most likely not true that just because you become thinner or change your appearance you will be happier and have a "perfect" life. **(Goal 1)**

Women's magazines contain 10 times more articles about dieting and weight loss than men's. Notice if watching certain TV programs or reading certain magazines makes you feel worse about yourself. Try to limit watching or reading media that portrays this thin ideal. **(Goal 3)**

The images of women seen in magazines and on television are not always realistic Most women (98 %!!) do not look like fashion models. Accept your body as it is by reminding yourself that everyone has a different body shape and size. **(Goal 2)**

Media images or other situations that make you think about your physical ideals can trigger self-conscious thoughts and feelings of inadequacy. Stop beating yourself up over not meeting unrealistic standards and create more realistic ideals for yourself. This can help you be more accepting of your body to have a healthier view of yourself. **(Goal 3)**

The media and advertisers use "ideal" people on TV and in magazines. Remind yourself of this fact by saying to yourself: "Nobody's perfect, even models have imperfections that are airbrushed out of sight." **(Goal 1)**

Dysphoric Mood & Stress EMI

Goals of intervention:

1. Identify the connection between situations, thoughts, feelings, and behavior.
2. Identify common cognitive distortions (black-and-white thinking, catastrophizing, mind reading, filtering)
3. Identify behavioral changes to cope with stress and negative emotions

EMI content and order:

When you are feeling down or stressed, use the ABCs to try to identify: **A**ctivating events or situations that lead up to the feelings, **B**eliefs or negative thoughts about yourself, and **C**onsequences, including bad feelings or negative behaviors. Writing down these ABCs in a log can help you start to start to understand where these feelings and stress are coming from. **(Goal 1)**

Sometimes when we feel stressed or sad we focus on negative aspects of a situation and ignore positive ones. Practice identifying times when you are focusing on only the negative aspects of situations and try to adjust your thinking to also notice more positive aspects. **(Goal 2)**

We all experience stress differently, but when we are stressed we many times end up feeling bad about ourselves. Help yourself to better manage your stress by including enjoyable activities into your schedule. This could be spending time with friends or taking some private time by yourself to relax. **(Goal 3)**

When we face challenges in our life – for example, don't do well on an exam, have a fight with a friend – sometimes we expect that everything is going to start going wrong. Notice times when you are "expecting the worst." Talking with someone we trust can sometimes help us to keep things in perspective. **(Goal 2)**

Things in our life do not always work out as planned and it is normal to feel disappointed. Remind yourself that you cannot always be perfect. If you have tried your best, you can always try again, even if you don't meet your standards the first time. **(Goal 3)**

Sometime we think we know what other people are thinking without them telling us. For example, you might think: "I know everyone is looking at me because I'm not pretty or thin enough. Remember, you are NOT a mind reader! Talk back to yourself by saying "I need to stop thinking about what others may be thinking and instead change what I am thinking." **(Goal 2)**

An important part of college is learning how to fit in and being true to yourself. In many situations you may need to practice being assertive. Remember, assertiveness involves: (1) being specific about your needs, (2) being direct, (3) not putting others down, and (4) talking with the person who the message is intended for. **(Goal 3)**

Our way of thinking about situations in our life does not always match reality. When this happens, we might feel bad about ourselves or angry with ourselves or others. Notice how your thoughts (or beliefs) and feelings are connected. Fight back against negative thoughts about yourself. **(Goal 1)**

Table 1. Description of measures and assessment timing

Measure	Construct	Number of Items	Purpose	Assessment					
				Screen	Time 1	Time 2	Time 3	Time 4	Time 5
Eating Disorder Examination-Questionnaire [EDE-Q]	Disordered eating behaviors & attitudes	22	Screening, primary outcome	X					X
Body Shape Questionnaire [BSQ]	Body dissatisfaction	34	Screening, primary outcome	X					X
Contour Drawing Rating Scale [CDRS]	Body image discrepancy	3	Secondary outcome		X	X	X	X	X
Body Image Quality of Life Inventory [BIQOL]	Body concerns interfere with life	19	Secondary outcome		X	X	X	X	X
Sociocultural Attitudes Towards Appearance Questionnaire [SATAQ]	Thinness norm internalization	14	Secondary outcome		X	X	X	X	X
Eating Disorder Recovery Self-Efficacy Questionnaire [EDRSEQ]	Self-efficacy for healthy body attitudes and eating behaviors	10	Treatment mediator			X	X	X	X
Difficulties with Emotion Regulation Questionnaire [DERS]	Emotion regulation	18	Treatment mediator			X	X	X	X
Demographics and background	Demographics	12	Describe sample	X					

Table 1 (cont.)

Body Mass Index [BMI]	Height, weight		Describe sample	X				
Knowledge Questionnaire	Knowledge of information in CD and videos	20	Treatment fidelity		X	X		X
Intervention acceptability and satisfaction	Acceptability, satisfaction		Treatment feasibility				X	X

Table 2. Pre-intervention mean (SD) values for descriptive and psychological measures (by group), and *F*- and *p*-values for group differences

Variable	Assessment Time	Control Group	CD Group	CD+EMI Group	*F* (df=2, 128)	*p*
Age	Screening	19.86 (0.97)	19.50 (1.39)	19.54 (1.14)	1.21	.30
Body Mass Index [BMI]	1	26.08 (5.02)	24.86 (3.95)	25.71 (4.92)	0.79	.46
Disordered eating	Screening	3.34 (0.90)	3.35 (1.05)	3.37 (0.84)	0.02	.98
Body dissatisfaction	Screening	122.65 (29.91)	122.30 (29.71)	129.02 (30.22)	0.70	.50
Actual:ideal discrepancy	1	2.49 (1.05)	2.39 (0.92)	2.57 (1.11)	0.34	.71
Actual:ought discrepancy	1	2.70 (1.28)	2.57 (1.21)	2.68 (1.31)	0.14	.87
Body-related quality of life	1	0.01 (0.83)	0.26 (1.01)	0.31 (1.21)	1.13	.33
Thinness-norm internalization	1	5.06 (0.80)	5.14 (0.81)	5.05 (0.89)	0.14	.87
Eating self-efficacy	1	2.47 (0.79)	2.49 (0.70)	2.53 (0.61)	0.09	.92
Emotion regulation	1	2.40 (0.60)	2.41 (0.56)	2.40 (0.55)	0.00	.99
CD content knowledge	2	2.81 (1.42)	3.19 (1.48)	3.18 (1.32)	0.99	.37
Control video content knowledge	2	4.67 (1.82)	4.58 (1.67)	4.55 (1.99)	0.06	.94

Table 3. Mean (SD) number of knowledge items correct by item content and group at Time 2 (pre-CD/pre-video), Time 3 (post-CD/post-video), and Time 5 (two-month follow-up)

	Time 2	Time 3	Time 5
Intervention (CD) content items			
Control group (*n*=43)	2.81 (1.42)	2.83 (1.07)	2.91 (1.23)
CD group (*n*=44)	3.19 (1.48)	5.19 (1.89)	3.48 (1.85)
CD+EMI group (*n*=44)	3.18 (1.32)	4.60 (1.69)	4.12 (1.37)
Control (video) content items			
Control group (*n*=43)	4.67 (1.82)	6.81 (1.72)	5.21 (2.36)
CD group (*n*=44)	4.58 (1.67)	4.60 (1.50)	4.19 (1.70)
CD+EMI group (*n*=44)	4.55 (1.99)	4.60 (1.88)	4.60 (1.93)

Table 4. Mean, standard deviations, and group comparisons of ratings of satisfaction with CD-ROM/control videos

	Control group (*n*=43)	CD, CD+EMI groups (*n*=86)	*F* (df=1,128)	*p*
Enjoyed materials	3.49 (1.50)	3.52 (1.42)	0.02	.90
Materials helpful	3.37 (1.51)	3.80 (1.35)	2.68	.10
Recommend to friend	2.70 (1.66)	3.40 (1.64)	5.16	.02
Satisfied with content	4.12 (1.28)	4.56 (1.26)	3.49	.06
Satisfied with quality	3.67 (1.53)	4.63 (1.28)	13.93	<.001

Table 5. Mean (*SD*) values for body image measures at Time 1 (pre-EMA) and Time 2 (post-EMA) and *t*- and *p*-values for *t*-tests (*n*=131)

	Time 1	Time 2	*t* (df=130)	*p*
Actual:ideal discrepancy	2.48 (1.03)	2.49 (1.11)	-0.16	.88
Actual:ought discrepancy	2.65 (1.26)	2.66 (1.37)	-0.17	.87
Body-related quality of life	0.19 (1.03)	0.20 (1.03)	-0.21	.83
Thinness -norm internalization	5.08 (0.83)	5.06 (0.90)	0.49	.62

Table 6. Mean (*SD*) values for body image measures at Time 2 (pre-intervention) and Time 3 (post-intervention) by group and *F*- and *p*-values for the group*time interaction

	Time 2	Time 3	*F* (df=1,129)	*p*
Actual:ideal discrepancy				
Control (*n*=43)	2.35 (0.90)	2.49 (0.88)	6.49	.01
Treatment (*n*=88)	2.56 (1.19)	2.30 (1.27)		
Actual:ought discrepancy				
Control (*n*=43)	2.56 (1.30)	2.67 (1.27)	1.70	.19
Treatment (*n*=88)	2.71 (1.40)	2.63 (1.59)		
Body-related quality of life				
Control (*n*=43)	-0.02 (0.87)	0.06 (0.86)	2.33	.13
Treatment (*n*=88)	0.31 (1.09)	0.23 (1.08)		
Thinness-norm internalization				
Control (*n*=43)	5.08 (1.05)	5.15 (0.99)	1.96	.16
Treatment (*n*=88)	5.05 (0.83)	4.98 (0.87)		

Table 7. *F*-values (df=1,127) for ANOVA results of moderation effects for Time 2 (pre-CD or videos) and Time 3 (post-CD or videos)

Outcome Variable	Moderator Variable	Group Effect	Time Effect	Moderator Effect	Group* Time Effect	Group* Moderator Effect	Time* Moderator Effect	Group*Time *Moderator Effect
Acutal:ideal discrepancy	EDE-Q	0.58	0.02	1.40	0.91	0.71	0.00	0.09
	BSQ	0.34	0.17	4.54	0.81	0.39	0.28	0.10
	BMI	1.12	0.03	7.51**	0.81	1.36	0.01	0.20
Actual:ought discrepancy	EDE-Q	1.15	0.00	0.10	0.06	1.35	0.01	0.01
	BSQ	0.13	0.04	1.46	0.32	0.17	0.02	0.08
	BMI	0.05	0.03	32.35***	0.00	0.12	0.04	0.05
Body-related quality of life	EDE-Q	2.89	0.66	1.43	3.21†	1.91	0.74	2.08
	BSQ	1.81	0.09	7.56**	1.86	1.01	0.11	1.07
	BMI	0.18	0.77	0.75	0.00	0.04	0.78	0.07
Thinness-norm internalization	EDE-Q	0.10	1.61	2.97	0.15	0.02	1.66	0.60
	BSQ	0.63	0.43	13.25***	0.00	0.38	0.41	0.14
	BMI	1.90	3.21	4.91	0.30	1.58	3.43†	0.16

Note. ** $p<.01$, *** $p<.001$; EDE-Q=Eating Disorder Examination-Questionnaire (measure of disordered eating), BSQ=Body Shape Questionnaire (measure of body dissatisfaction), BMI=body mass index

Table 8. Mean (*SD*) values for secondary outcome measures by group across assessment times

	Time 1	Time 2	Time 3	Time 4	Time 5
Actual:ideal discrepancy					
Control group (*n*=43)	2.49 (1.05)	2.35 (0.90)	2.49 (0.88)	2.35 (0.84)	2.44 (1.20)
CD group (*n*=44)	2.39 (1.07)	2.47(1.11)	2.26 (1.10)	2.23 (1.07)	2.54 (1.24)
CD+EMI group (*n*=44)	2.57 (1.11)	2.66 (1.27)	2.47 (1.42)	2.63 (1.22)	2.58 (1.35)
Actual:ought discrepancy					
Control group (*n*=43)	2.70 (1.28)	2.56 (1.40)	2.67 (1.27)	2.74 (1.40)	2.58 (1.52)
CD group (*n*=44)	2.57 (1.21)	2.63 (1.16)	2.42 (1.45)	2.49 (1.32)	2.49 (1.27)
CD+EMI group (*n*=44)	2.68 (1.31)	2.80 (1.61)	2.84 (1.71)	2.88 (1.45)	2.58 (1.28)
Body-related quality of life					
Control group (*n*=43)	0.00 (0.83)	-0.02 (0.87)	0.06 (0.86)	0.03 (0.90)	-0.02 (0.96)
CD group (*n*=44)	0.26 (1.01)	0.37 (1.14)	0.33 (1.09)	0.37 (1.04)	0.13 (1.20)
CD+EMI group (*n*=44)	0.31 (1.21)	0.26 (1.05)	0.13 (1.07)	0.28 (1.08)	0.07 (1.13)
Thinness-norm internalization					
Control group (*n*=43)	5.06 (0.80)	5.08 (1.05)	5.15 (0.99)	5.13 (1.08)	4.99 (0.94)
CD group (*n*=44)	5.14 (0.81)	5.10 (0.73)	5.01 (0.81)	4.97 (0.82)	4.91 (0.86)
CD+EMI group (*n*=44)	5.05 (0.89)	5.00 (0.91)	4.96 (0.94)	4.95 (0.89)	4.98 (0.78)

Table 9. *F* and R^2 statistics for post-EMI analyses of secondary outcome measures (*n*=131)

	Group		Time		Group*Time	
	F-value (df=2,128)	R^2	*F-value* (df=1,128)	R^2	*F-value* (df=2,128)	R^2
Time 3 – Time 4						
Actual:ideal discrepancy	0.91	.01	0.00	.00	2.16	.03
Actual:ought discrepancy	0.95	.01	1.08	.01	0.02	.00
Body-related quality of life	1.03	.02	1.63	.01	1.49	.02
Thinness-norm internalization	0.54	.01	0.50	.00	0.03	.00
Time 2 – Time 4						
Actual:ideal discrepancy	1.21	.02	2.05	.02	1.41	.02
Actual:ought discrepancy	0.52	.01	0.38	.00	1.76	.03
Body-related quality of life	1.58	.03	0.31	.00	0.08	.00
Thinness-norm internalization	0.25	.00	1.00	.01	1.51	.02
Time 1 – Time 4						
Actual:ideal discrepancy	1.05	.02	0.98	.01	0.77	.01
Actual:ought discrepancy	0.50	.01	0.45	.00	0.94	.02
Body-related quality of life	1.34	.02	0.34	.00	0.45	.01
Thinness-norm internalization	0.14	.00	1.57	.01	1.88	.03

Note. †p<.10, *p<.05, **p<.01, ***p<.001

Table 10. *F*-values for ANOVA results of moderation effects for Time 3 (pre-EMI) and Time 4 (post-EMI) (n=131)

Outcome Variable	Moderator Variable	Group Effect (df=2,125)	Time Effect (df=1,125)	Moderator Effect (df=1,125)	Group* Time Effect (df=2,125)	Group* Moderator Effect (df=2,125)	Time* Moderator Effect (df=1,125)	Group*Time *Moderator Effect (df=2,125)
Acutal:ideal discrepancy	EDE-Q	1.16	0.26	2.68	0.66	1.38	0.28	0.98
	BSQ	0.60	0.10	4.74	0.40	0.67	0.11	0.64
	BMI	0.65	0.01	10.82***	1.60	0.56	0.01	1.07
Actual:ought discrepancy	EDE-Q	1.20	2.30	0.25	1.28	1.27	1.68	1.34
	BSQ	0.41	1.01	1.13	1.36	0.28	0.67	1.40
	BMI	0.69	0.22	32.45***	0.68	0.50	0.09	0.73
Body-related quality of life	EDE-Q	0.91	0.02	3.06	0.55	0.50	0.04	0.24
	BSQ	0.73	0.84	11.12***	0.85	0.44	0.39	0.43
	BMI	1.54	2.87	1.71	1.59	1.28	2.23	1.11
Thinness-norm internalization	EDE-Q	0.15	0.17	2.20	0.45	0.11	0.06	0.42
	BSQ	1.39	0.12	13.82***	0.00	1.10	0.04	0.00
	BMI	1.64	2.07	2.55	0.19	1.37	2.50	0.21

Note. **p<.01, ***p<.001; EDE-Q=Eating Disorder Examination-Questionnaire (measure of disordered eating), BSQ=Body Shape Questionnaire (measure of body dissatisfaction), BMI=body mass index

Table 11. *F*-values for ANOVA results of moderation effects for Time 4 (post-EMI) and Time 5 (follow-up) (*n*=131)

Outcome Variable	Moderator Variable	Group Effect (df=2,125)	Time Effect (df=1,125)	Moderator Effect (df=1,125)	Group* Time Effect (df=2,125)	Group* Moderator Effect (df=2,125)	Time* Moderator Effect (df=1,125)	Group*Time *Moderator Effect (df=2,125)
Acutal:ideal discrepancy	EDE-Q	1.37	0.67	4.05	1.55	1.90	1.51	0.93
	BSQ	0.57	0.30	6.07**	0.44	0.78	0.80	0.22
	BMI	0.22	0.54	13.67***	0.65	0.13	0.95	0.47
Actual:ought discrepancy	EDE-Q	2.58	9.60**	1.22	1.60	2.80	7.18**	1.05
	BSQ	0.31	2.46	1.65	0.58	0.26	0.24	0.56
	BMI	0.82	0.73	27.14***	1.94	0.74	1.54	1.75
Body-related quality of life	EDE-Q	1.31	1.11	5.55	1.97	0.92	3.41	2.30
	BSQ	0.57	0.00	14.09***	4.09	0.33	0.59	4.13
	BMI	1.19	0.65	2.29	0.75	1.05	0.13	0.52
Thinness-norm internalization	EDE-Q	0.72	0.52	3.36	2.36	0.60	0.21	3.32
	BSQ	1.39	0.23	14.17***	3.82	1.12	0.51	4.19
	BMI	0.88	0.53	3.57	2.35	0.80	0.29	1.92

Note. **p<.01, ***p<.001; EDE-Q=Eating Disorder Examination-Questionnaire (measure of disordered eating), BSQ=Body Shape Questionnaire (measure of body dissatisfaction), BMI=body mass index

Table 12. Mean (*SD*) for primary outcome variables at the initial screening assessment and 2-month follow-up by group and overall mean

	Screening	Follow-up
Disordered eating (EDE-Q)		
Control group (*n*=43)	3.34 (0.90)	3.18 (1.16)
CD group (*n*=44)	3.35 (1.05)	2.95 (1.04)
CD+EMI group (*n*=44)	3.37 (0.84)	3.27 (1.24)
Overall mean (*n*=131)	3.35 (0.92)	3.13 (1.15)
Body dissatisfaction (BSQ)		
Control group (*n*=43)	122.65 (29.91)	115.16 (34.51)
CD group (*n*=44)	122.30 (29.72)	109.14 (32.15)
CD+EMI group (*n*=44)	129.02 (30.22)	119.37 (33.36)
Overall mean (*n*=131)	124.67 (29.88)	114.55 (33.36)

Note. EDE-Q=Eating Disorder Examination-Questionnaire (measure of disordered eating), BSQ=Body Shape Questionnaire (measure of body dissatisfaction)

Table 13. *F* and R^2 statistics for ANOVA results for the main effect of EMI frequency, time, and the frequency*time interaction for secondary outcome assessed pre-EMI (Time 3) and post-EMI (Time 4) and primary outcome measured at the screening assessment and two-month follow-up assessment (Time 5) for participants in the CD+EMI group (*n*=43)

	EMI Frequency		Time		Frequency*Time	
	F-value (df=1,42)	R^2	*F-value* (df=1,42)	R^2	*F-value* (df=1,42)	R^2
Time 3 – Time 4						
Actual:ideal discrepancy	0.62	.01	0.03	.00	0.81	.02
Actual:ought discrepancy	0.13	.00	0.53	.01	1.31	.03
Body-related quality of life	0.11	.00	3.62†	.08	1.17	.03
Thinness-norm internalization	0.10	.00	0.27	.01	0.63	.02
Screening – Time 5						
Disordered eating	1.48	.03	2.21	.05	1.91	.05
Body dissatisfaction	2.41	.05	4.73*	.10	1.78	.04

Note. † $p<.10$, * $p<.05$, ** $p<.01$, *** $p<.001$

Table 14. *F* and R^2 statistics for ANOVA results for the main effect of EMI content, time, and the content*time interaction for secondary outcome assessed pre-EMI (Time 3) and post-EMI (Time 4) and primary outcome measured at the screening assessment and two-month follow-up assessment (Time 5) for participants in the CD+EMI group (*n*=43)

	EMI Content		Time		Content*Time	
	F-value (df=2,39)	R^2	*F-value* (df=1,39)	R^2	*F-value* (df=2,39)	R^2
Time 3 – Time 4						
Actual:ideal discrepancy	5.39**	.22	2.28	.06	0.83	.04
Actual:ought discrepancy	4.59*	.19	0.06	.00	1.64	.08
Body-related quality of life	2.52†	.11	3.66†	.09	0.87	.04
Thinness-norm internalization	0.23	.01	0.11	.00	1.07	.05
Screening – Time 5						
Disordered eating	3.16*	.14	0.13	.00	4.14*	.17
Body dissatisfaction	1.23	.06	2.94†	.07	3.64*	.16

Note. † $p<.10$, * $p<.05$, ** $p<.01$, *** $p<.001$

Table 15. Opportunities and challenges for implementing EMI

Sample Considerations	• Utilize appropriate technology and training methods for the sample • Consider issues such as participant age, familiarity with technology, and education/work time constraints when selecting mobile devices, teaching them to use technology, and designing the study (e.g., intensity/duration of EMI)
Study Design	• Focus groups could be used to inform study design and intervention development, by providing feedback on the specific challenges and opportunities for EMI within the specific population • Consider the most appropriate timing of EMI within the overall study design (e.g., during or immediately after intervention, as booster after the intervention) • Improve "livability" (the ease with people can incorporate the intervention into their lives) by attending to the type of technology used and level of intrusion (frequency and duration of EMA/EMI) in everyday life • Balance participant burden with ideal duration of EMI (both length of individual EMA/EMI and duration of time during which EMI are provided)
Intervention Selection	• Employ intervention methods that are well validated for the population being studied • More carefully match the intervention intensity with level of pathology; duration of treatment and intervention modality (e.g., in person, computerized) should be considered
EMI Characteristics	• Weight the potential benefits (participant satisfaction, efficacy) and drawbacks (development complexity) of tailoring the timing of EMI • If EMI time-tailoring is used, consider using mobile technology to allow for more idiographic approaches (e.g., calculating person-level means versus relying on broad heuristics for determining EMI delivery timing) • Consider if and how the content of EMI can be individually tailored
Assessing Outcome and Change Processes	• Assess both skill acquisition as well as real-world skill use in order to better measure treatment fidelity • Identify and assess plausible mediators of treatment efficacy

Figure 1. Diagram of study procedures

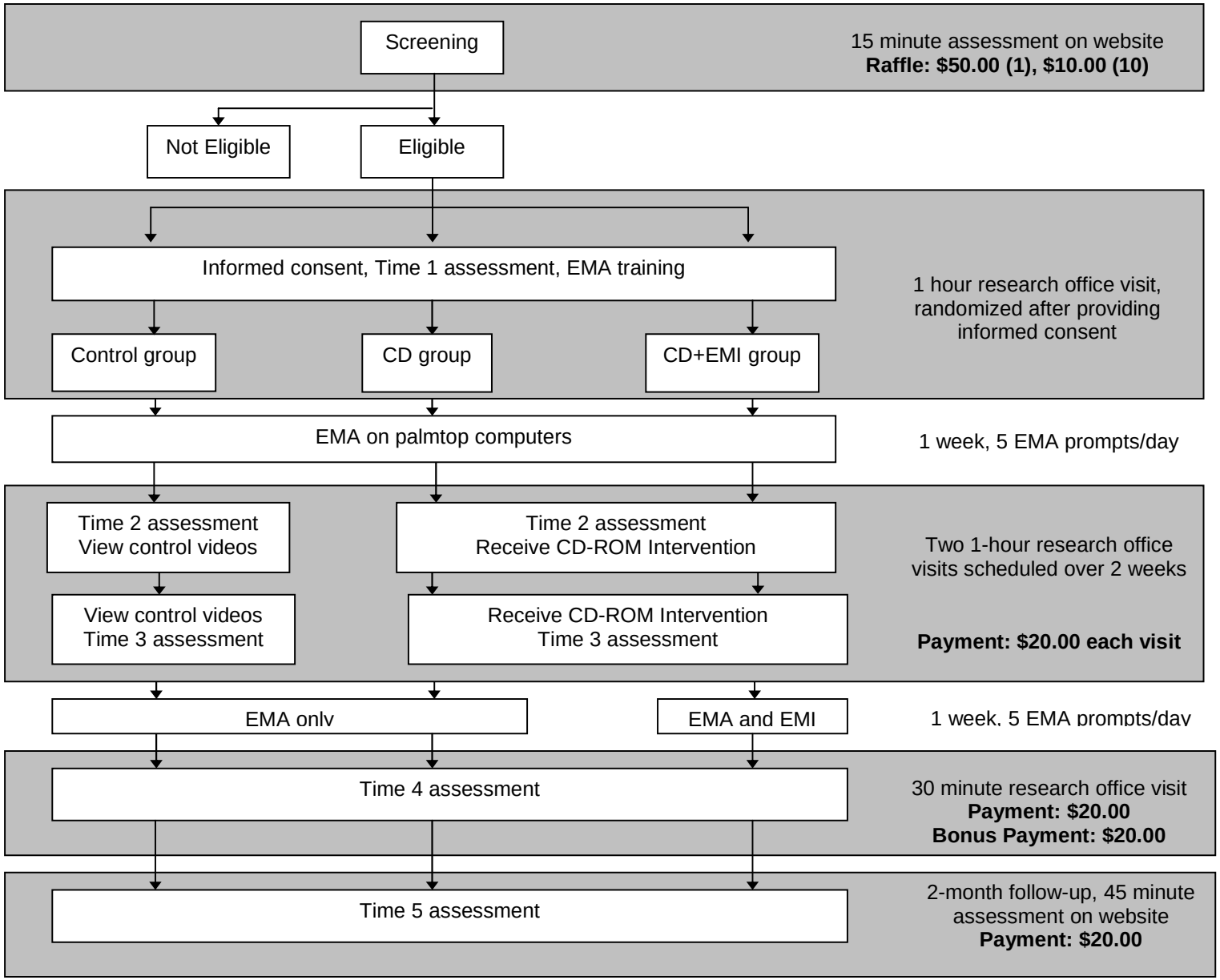


Figure 2. Recruitment and attrition numbers

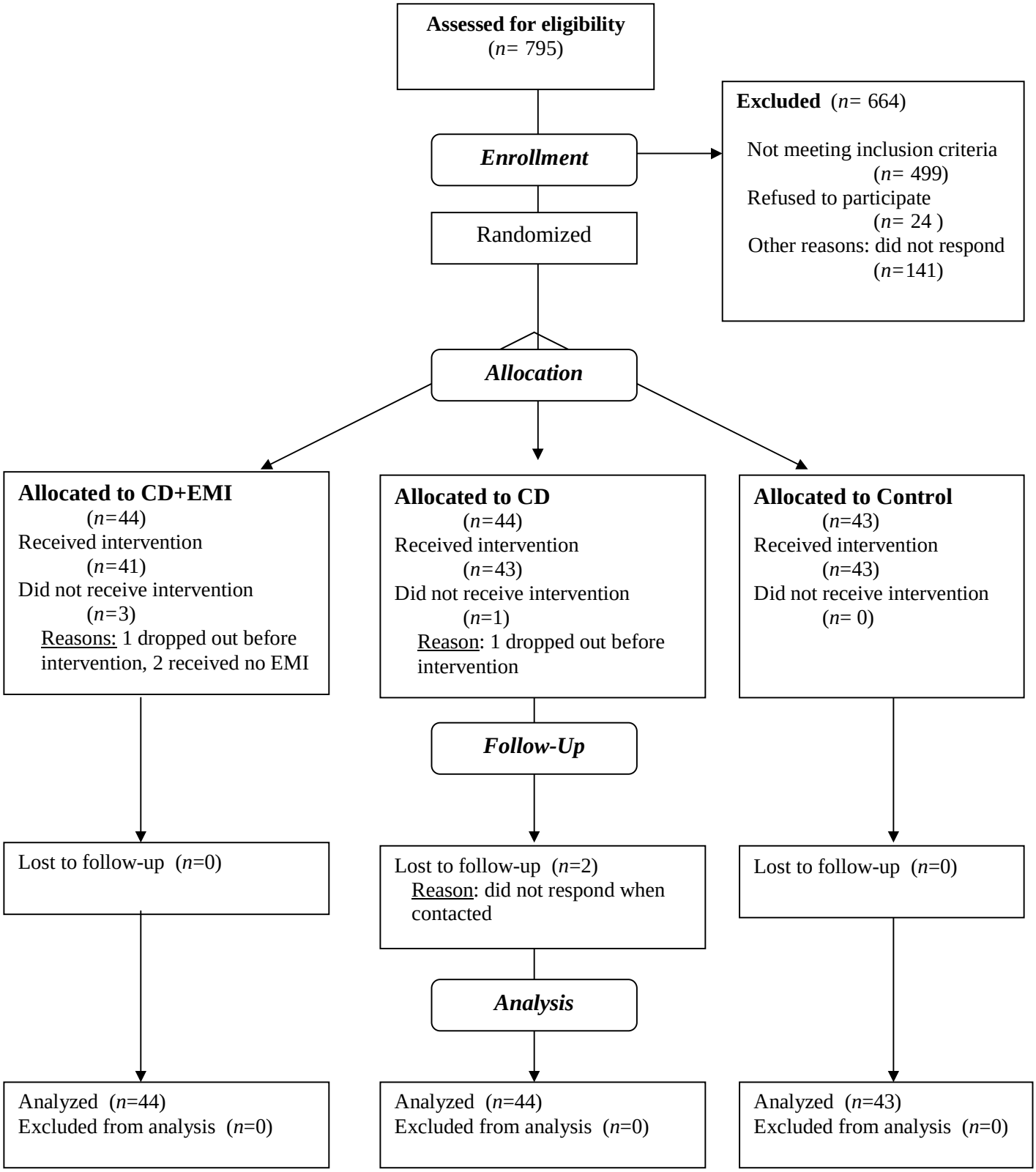


Figure 3. Conceptual model for the intervention

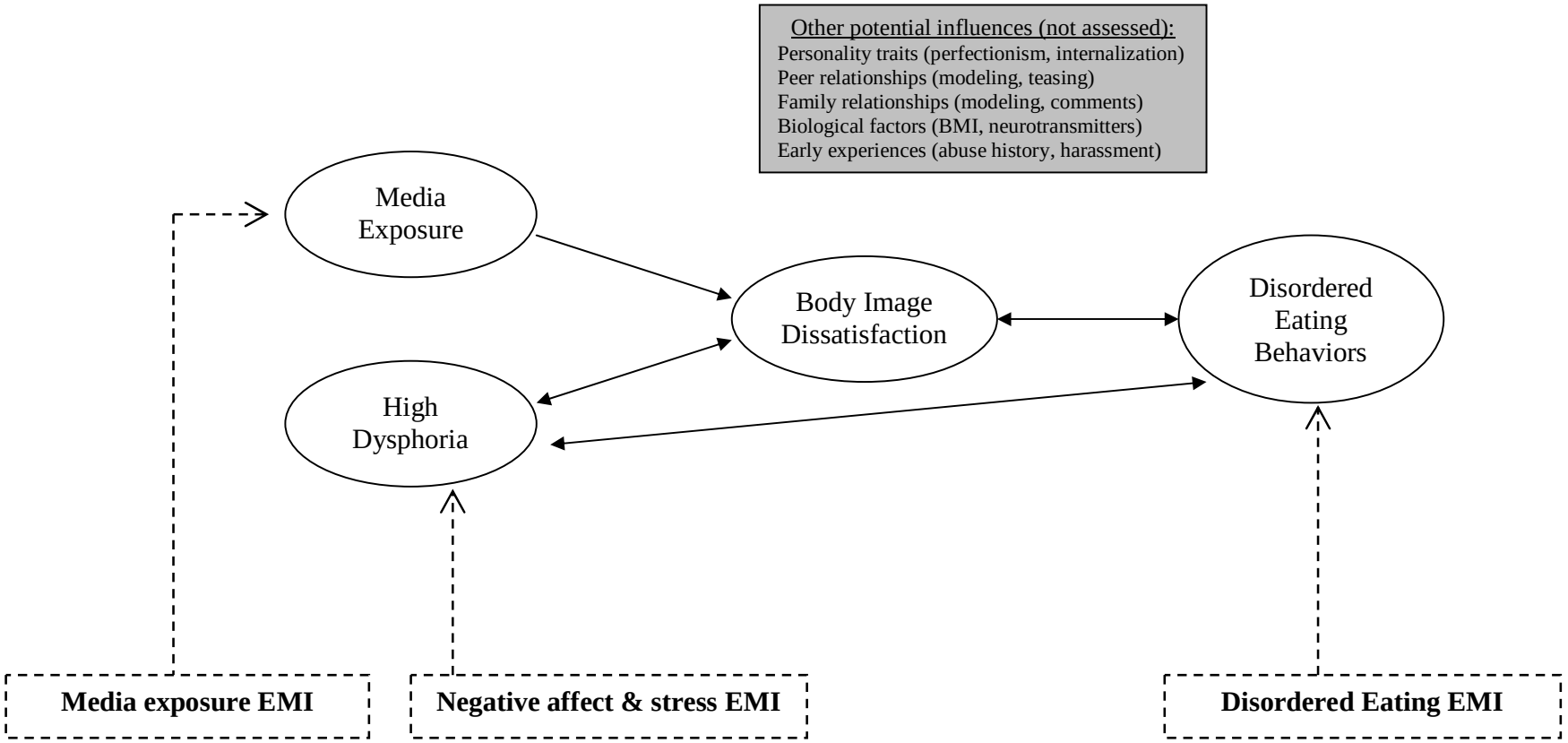


Figure 4. Diagram and description of EMA criteria and EMI

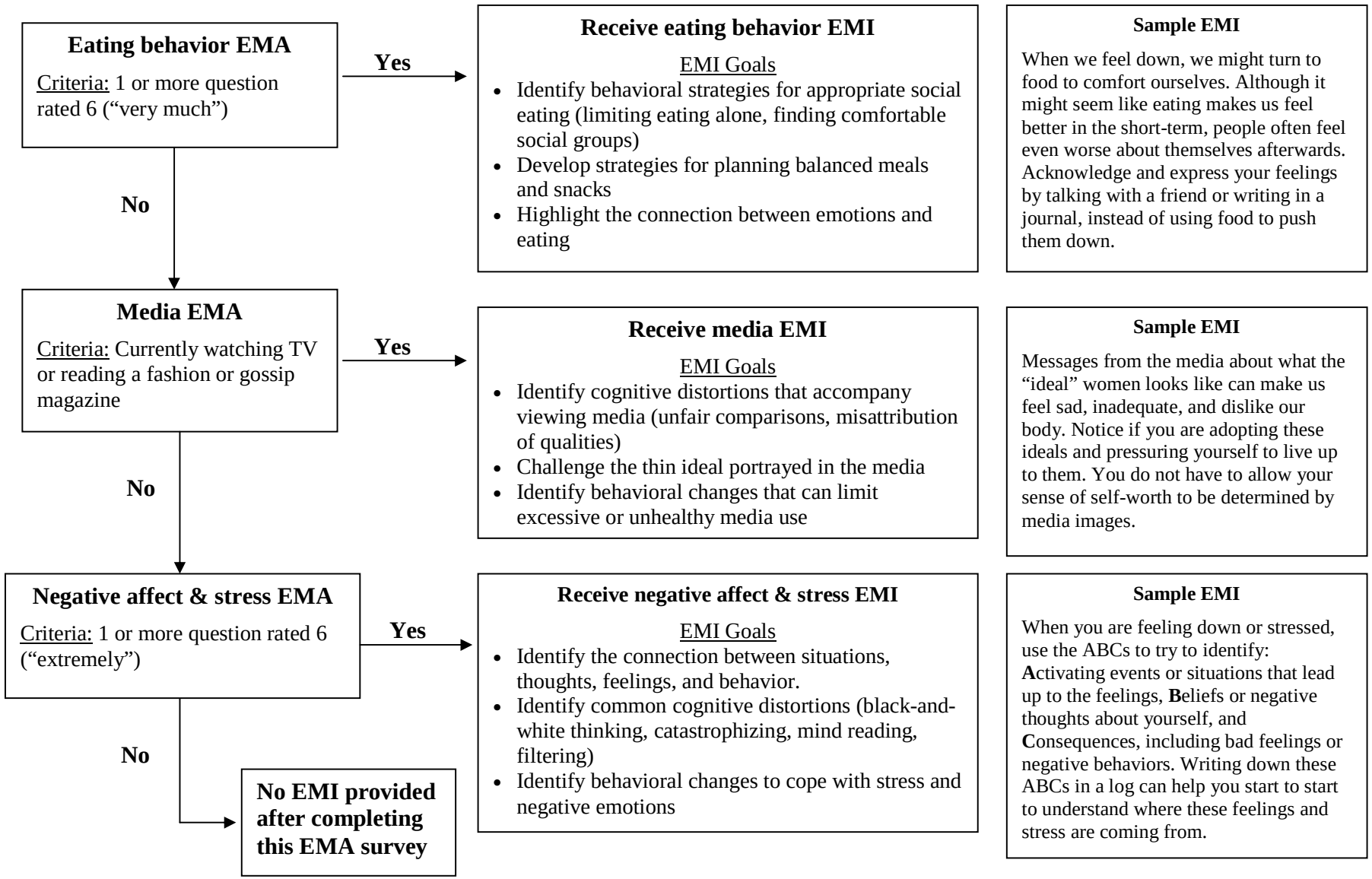


Figure 5a. Number of intervention (CD) items correct by group pre-intervention (Time 2) and post-intervention (Time 3)

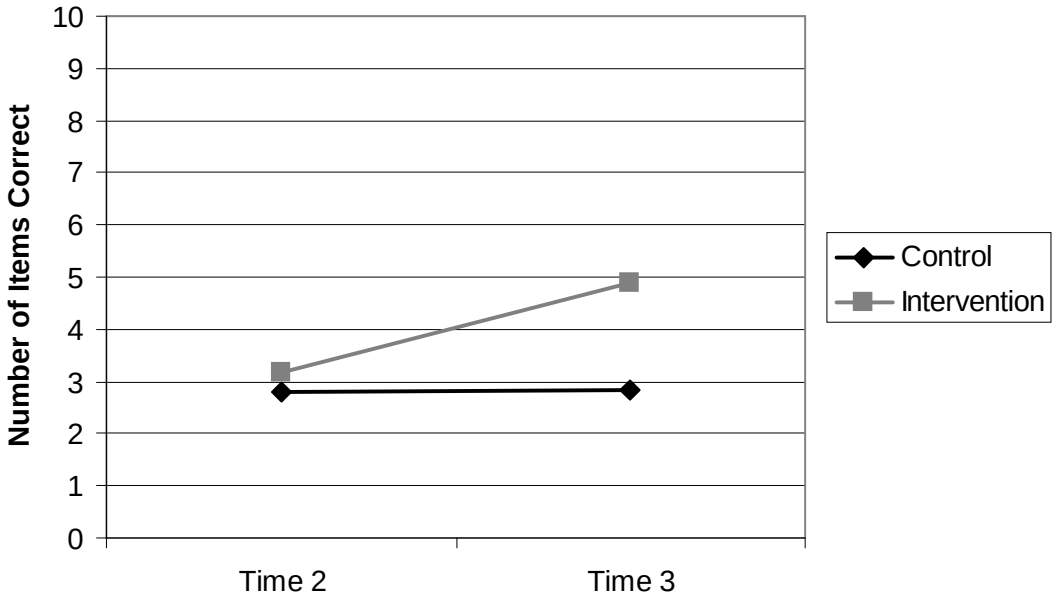


Figure 5b. Number of control (video) items correct by group pre-intervention (Time 2) and post-intervention (Time 3)

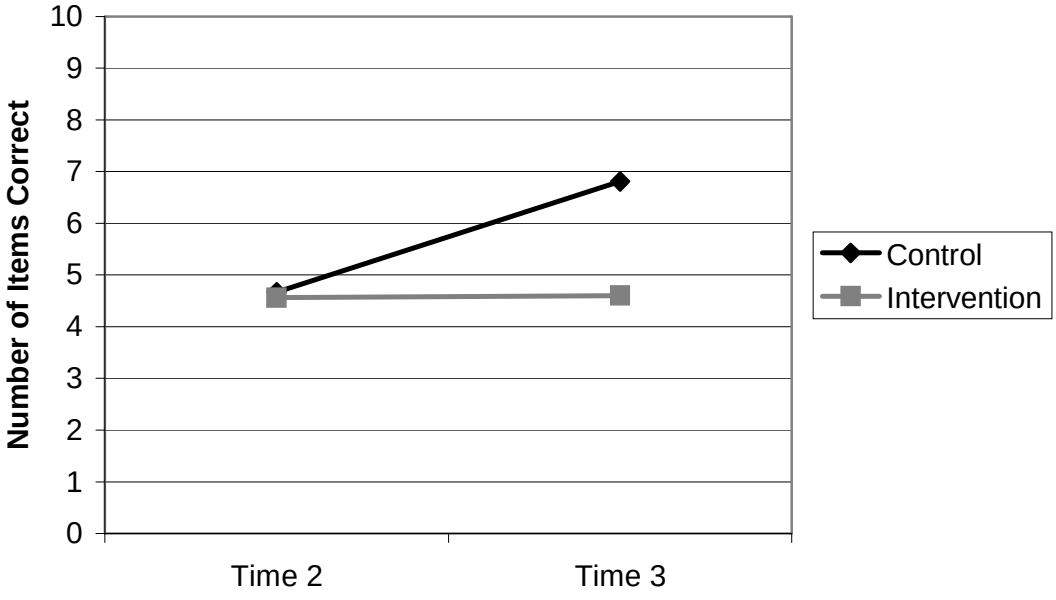


Figure 6a. Number of intervention (CD) items correct by group pre-intervention (Time 2) and follow-up (Time 5)

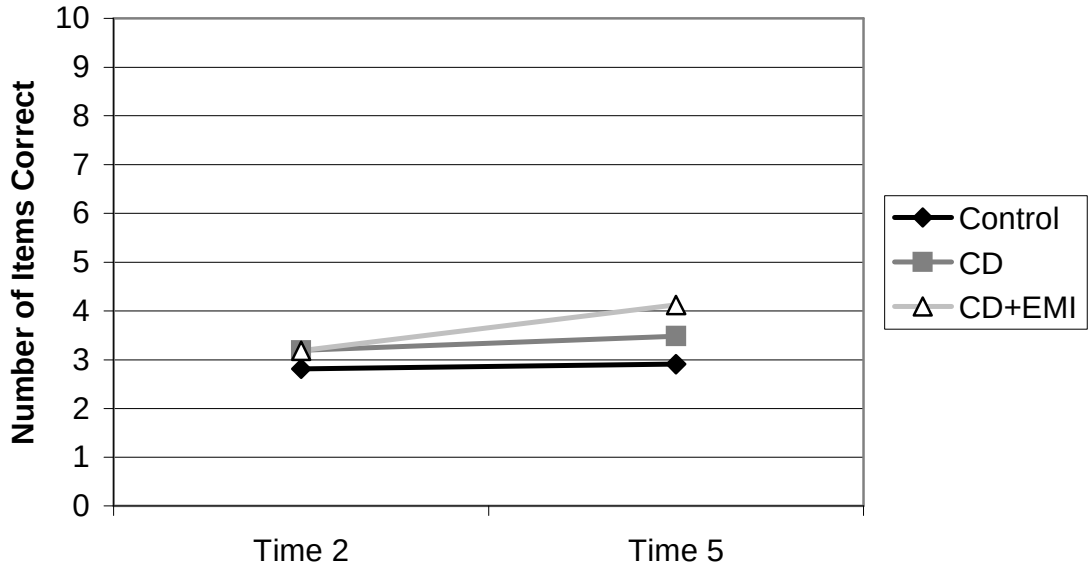


Figure 6b. Number of control (video) items correct by group pre-intervention (Time 2) and follow-up (Time 5)

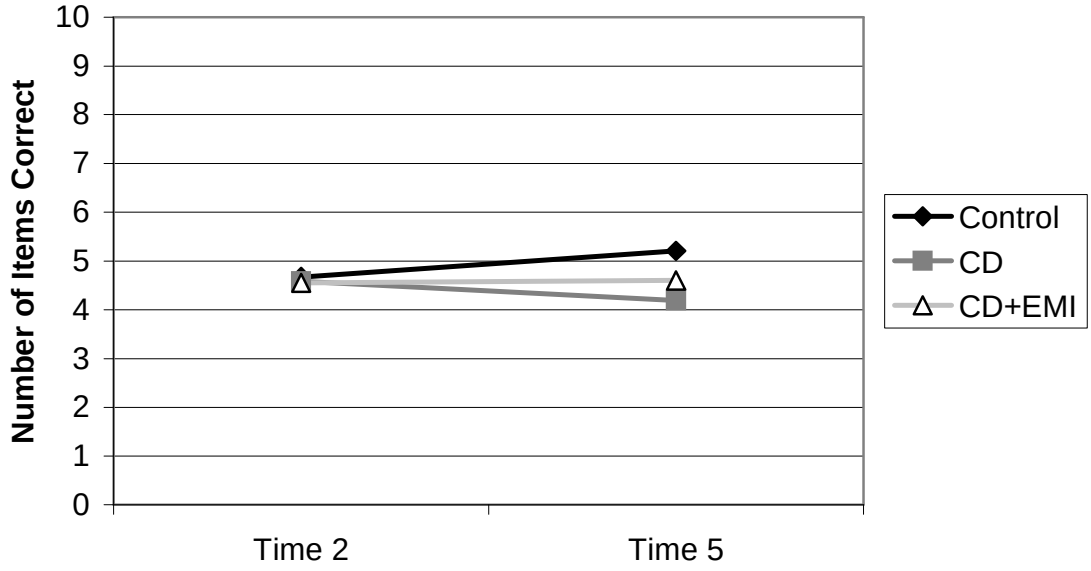


Figure 7. Distribution of satisfaction ratings for the CD-ROM intervention, where 0=not at all satisfied, 3=moderately satisfied, 6=very much satisfied (for participants completing the CD)

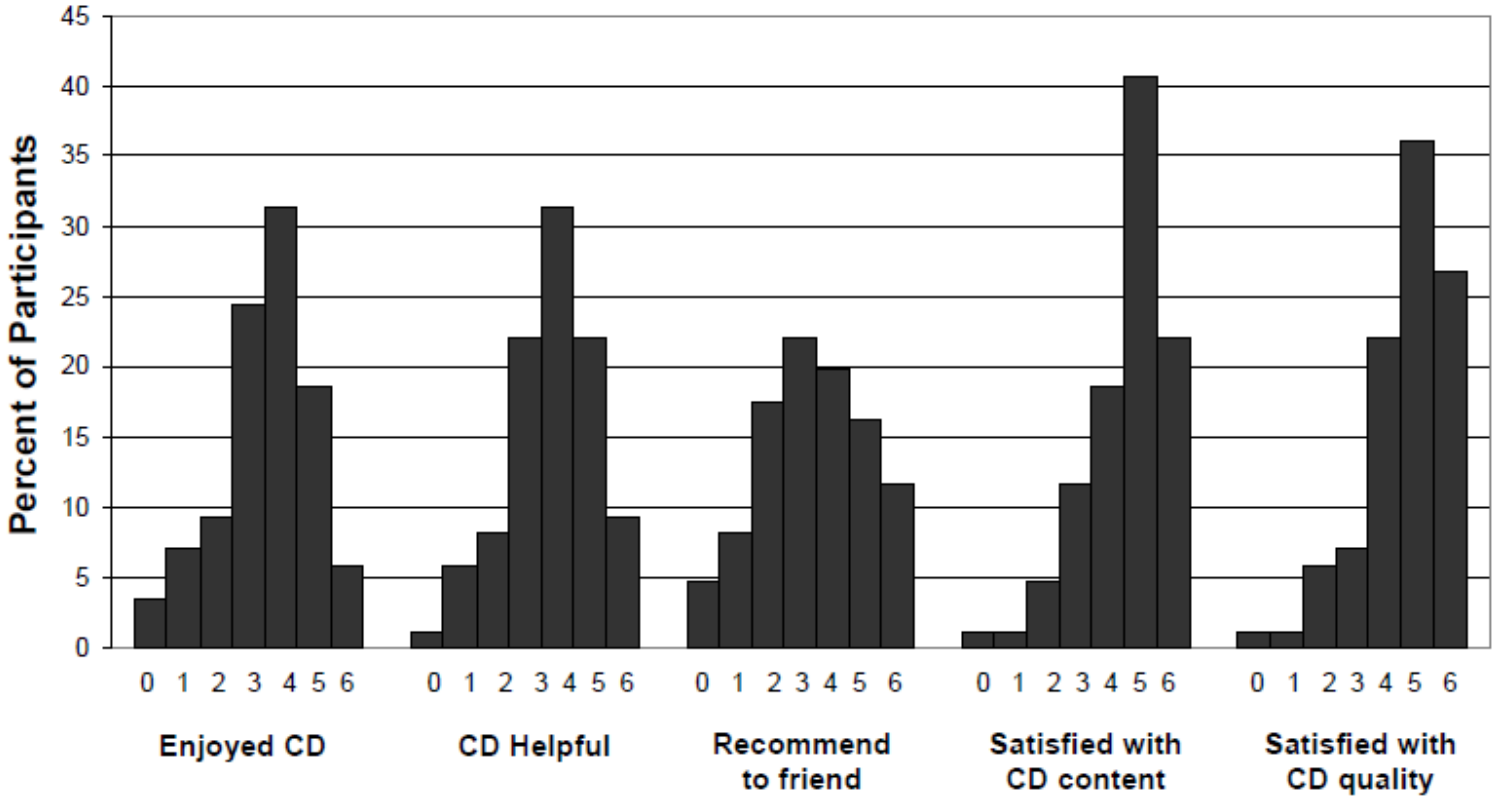


Figure 8. Distribution of satisfaction ratings for the palmtop computer-based EMA, where 0=not at all satisfied, 3=moderately satisfied, 6=very much satisfied (for all participants)

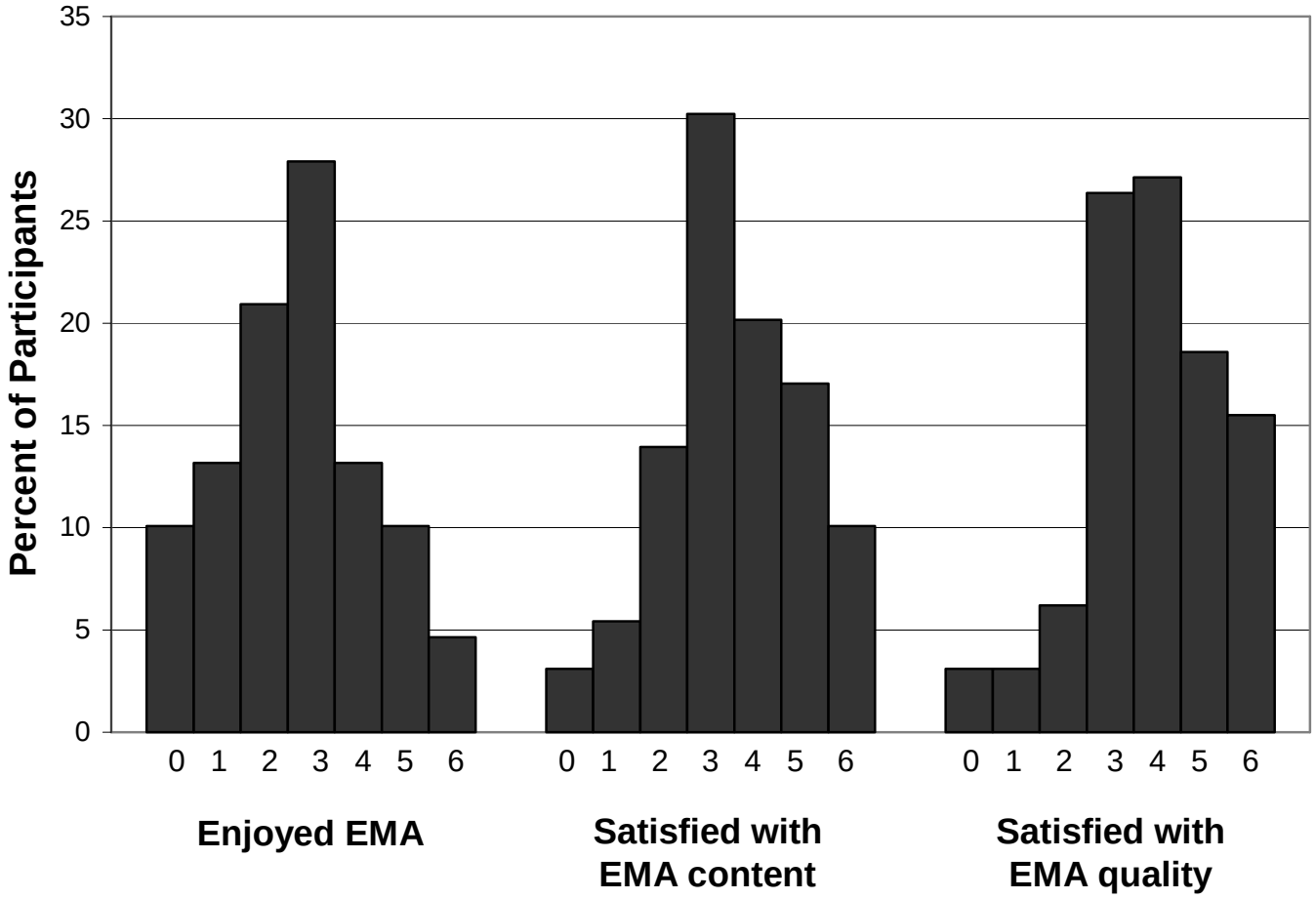


Figure 9. Distribution of satisfaction ratings for the EMI, where 0=not at all satisfied, 3=moderately satisfied, 6=very much satisfied (for participants in CD+EMI group)

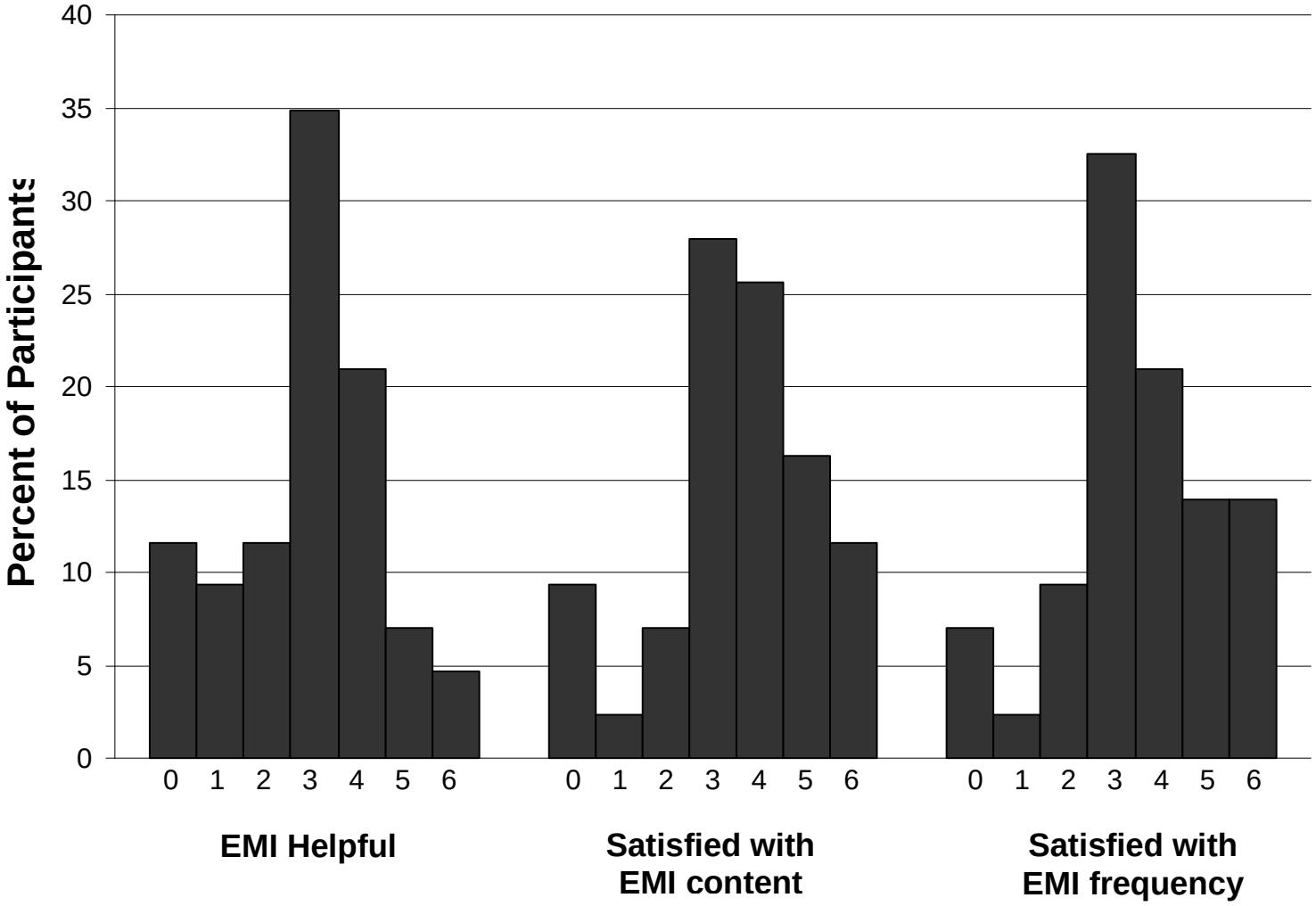


Figure 10. Analytic approach for Hypothesis 2a-2d

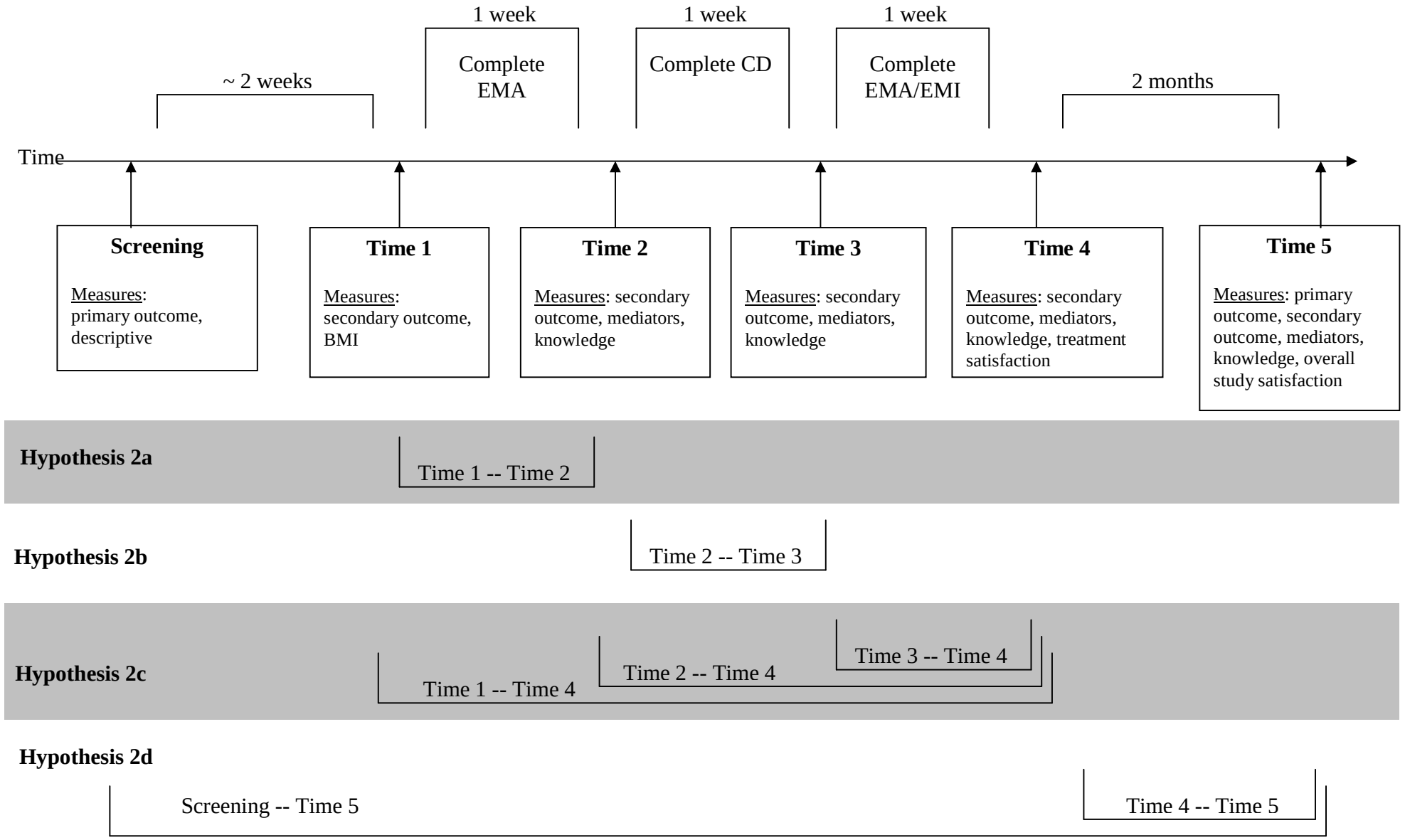


Figure 11. Mean values for secondary outcome variables pre-EMA (Time 1) and post-EMA (Time 2)

Figure 11a. Actual:ideal (A:I) discrepancy scores

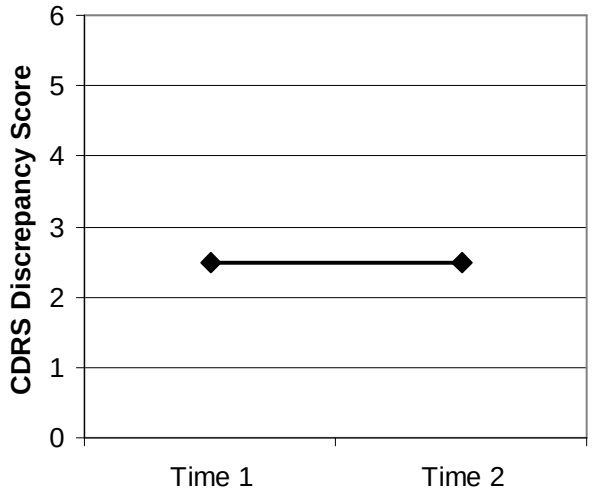


Figure 11b. Actual:ought (A:O) discrepancy scores

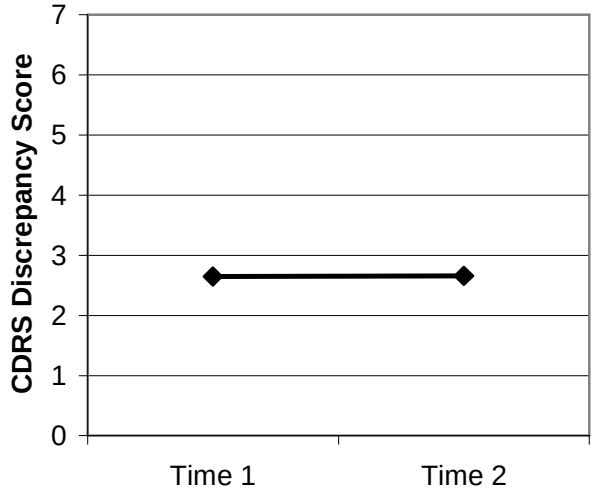


Figure 11c. Body-related quality of life scores

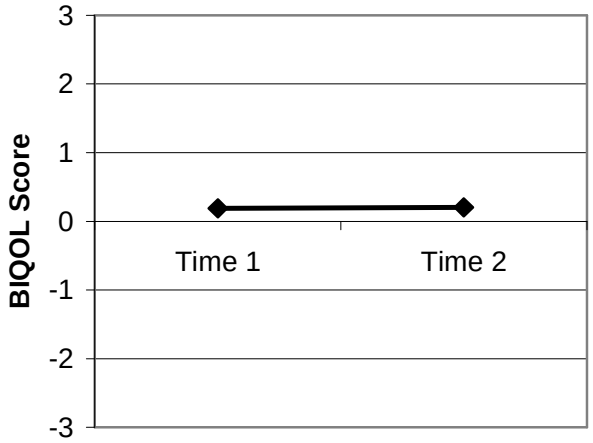


Figure 11d. Thinness-norm internalization scores

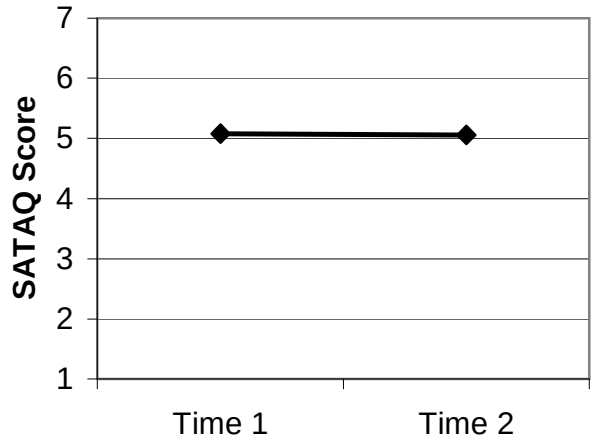


Figure 12. Mean values for secondary outcome variables pre-intervention (Time 2) and post-intervention (Time 3)

Figure 12a. Actual:ideal (A:I) discrepancy scores

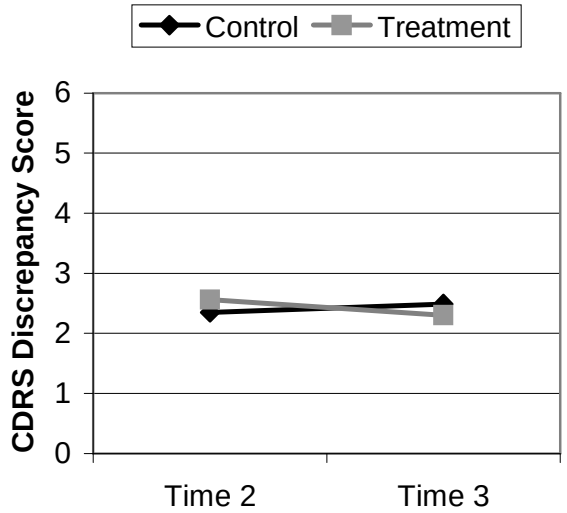


Figure 12b. Actual:ought (A:O) discrepancy scores

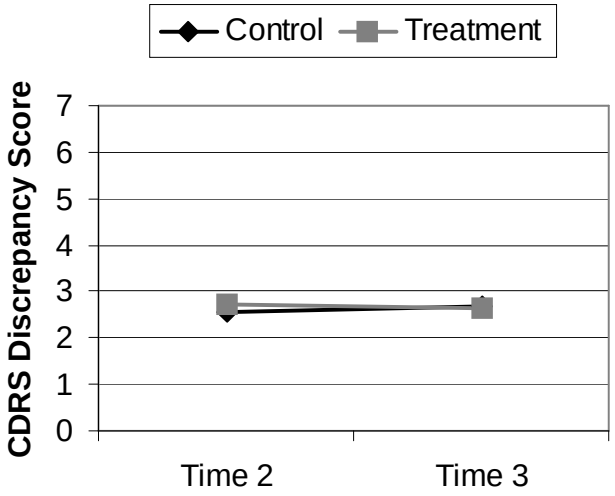


Figure 12c. Body-related quality of life scores

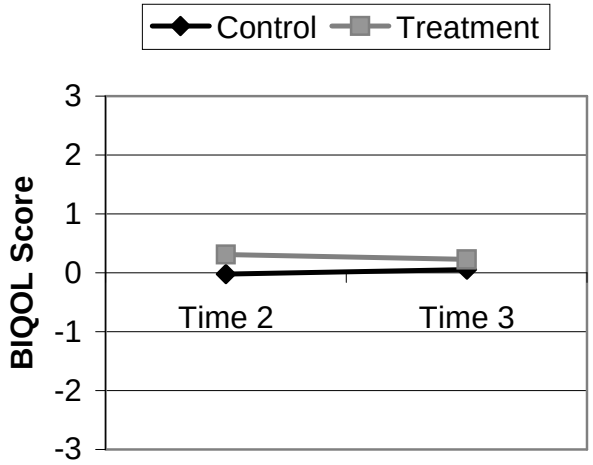


Figure 12d. Thinness-norm internalization scores

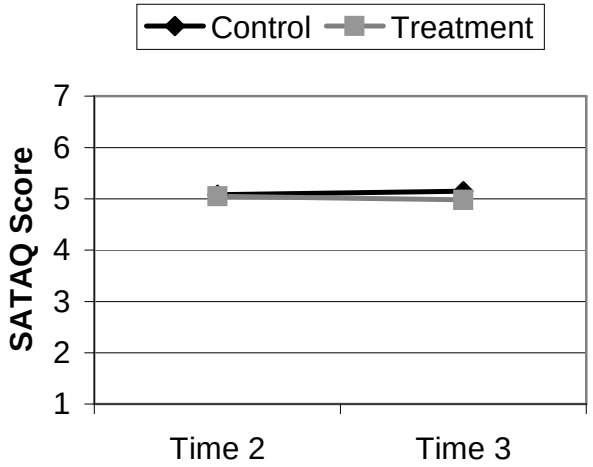


Figure 13. Mean values for secondary outcome variables for assessment Times 1, 2, 3 and 4

Figure 13a. Actual:ideal (A:I) discrepancy scores

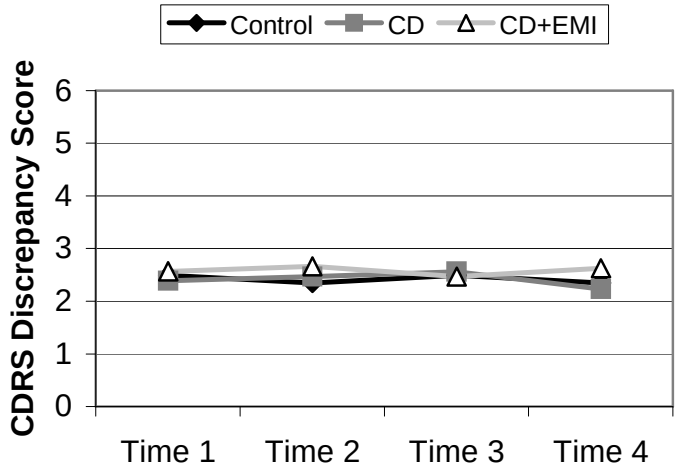


Figure 13b. Actual:ought (A:O) discrepancy scores

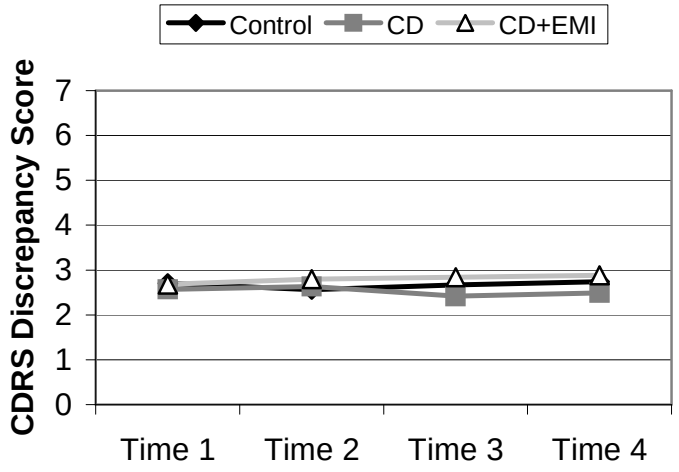


Figure 13c. Body-related quality of life scores

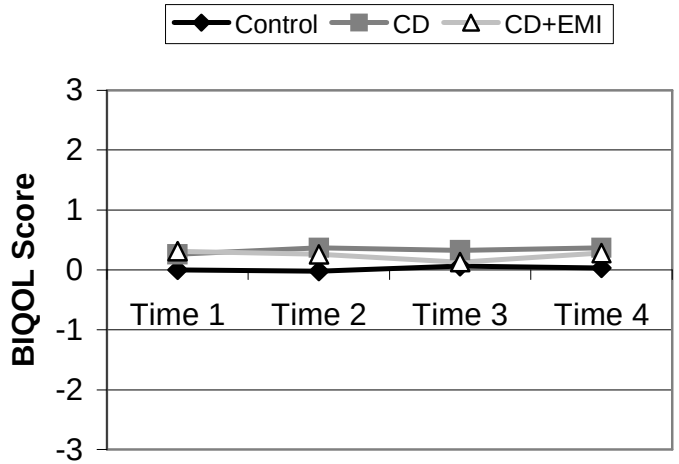


Figure 13d. Thinness-norm internalization scores

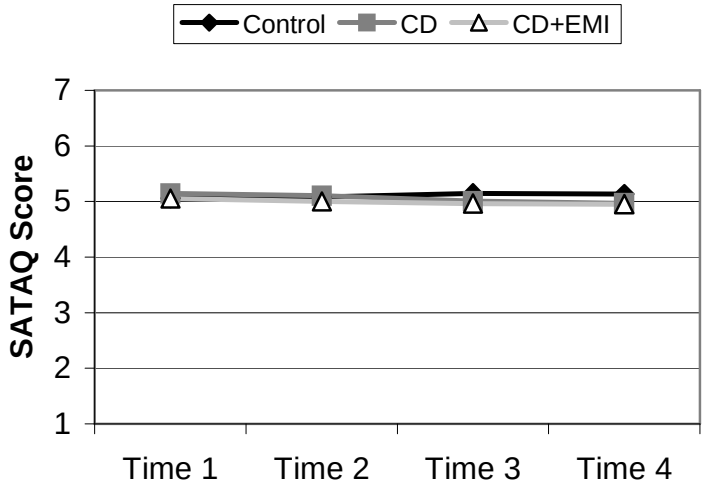


Figure 14. Mean values for secondary outcome variables post-EMI (Time 4) to 2-month follow-up (Time 5) by group

Figure 14a. Actual:ideal (A:I) discrepancy scores

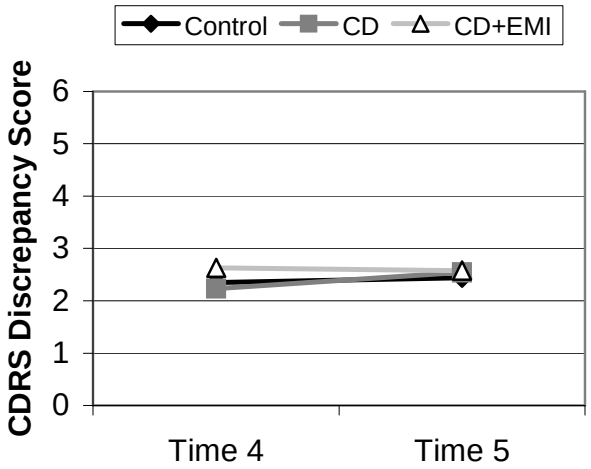


Figure 14b. Actual:ought (A:O) discrepancy scores

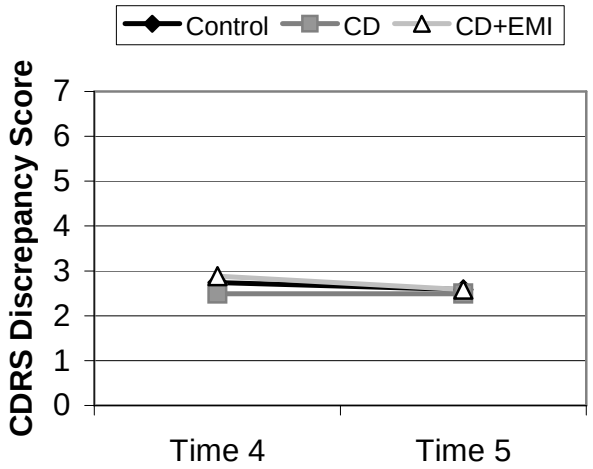


Figure 14c. Body-related quality of life scores

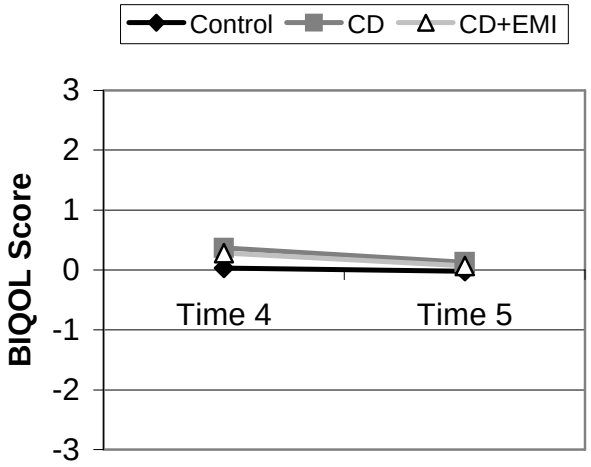


Figure 14d. Thinness-norm internalization scores

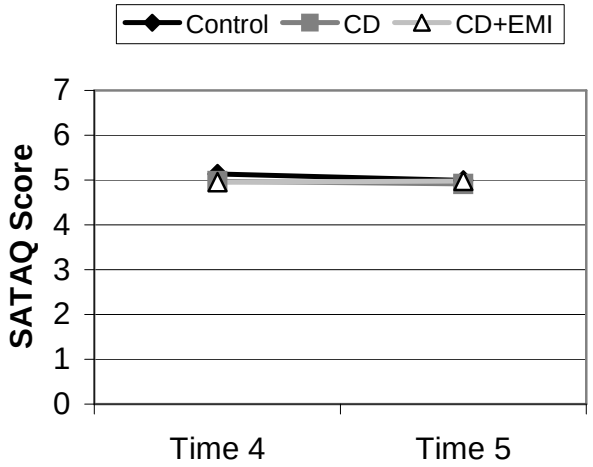


Figure 15. Primary outcome variables by group at initial screening assessment and 2 month post-intervention follow-up assessment

Figure 15a. Disordered eating behavior score

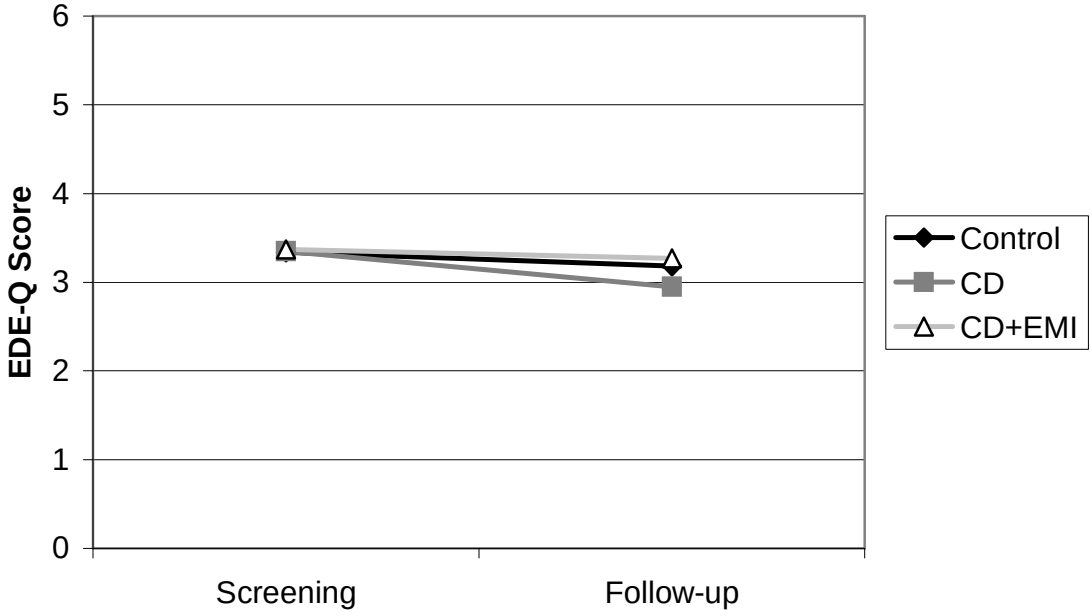


Figure 15b. Body dissatisfaction score

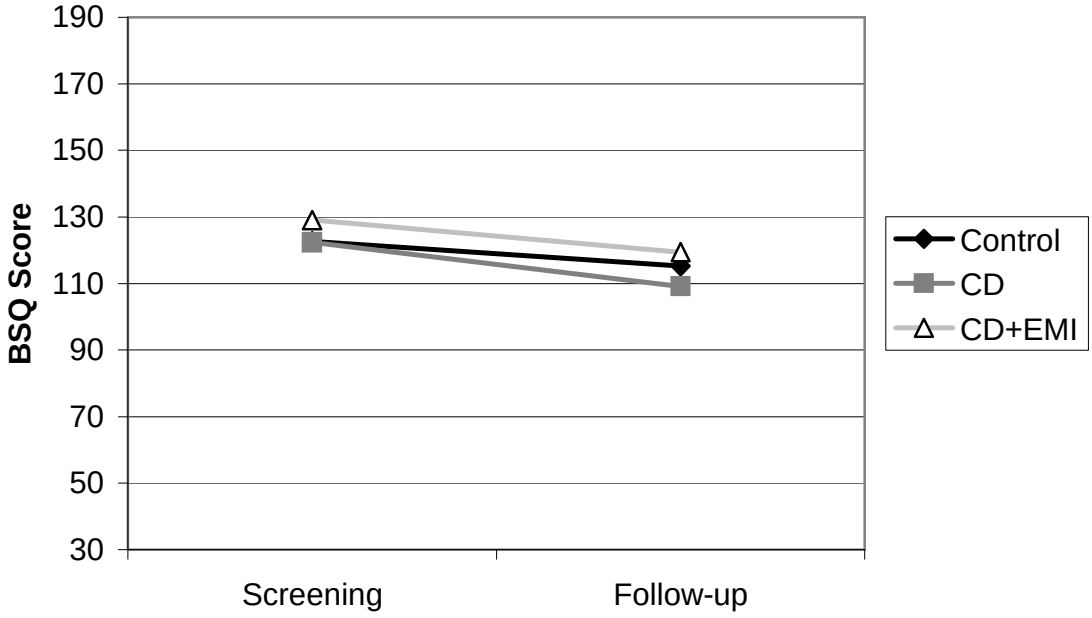


Figure 16. Number of EMI received for each participant in the CD+EMI group.

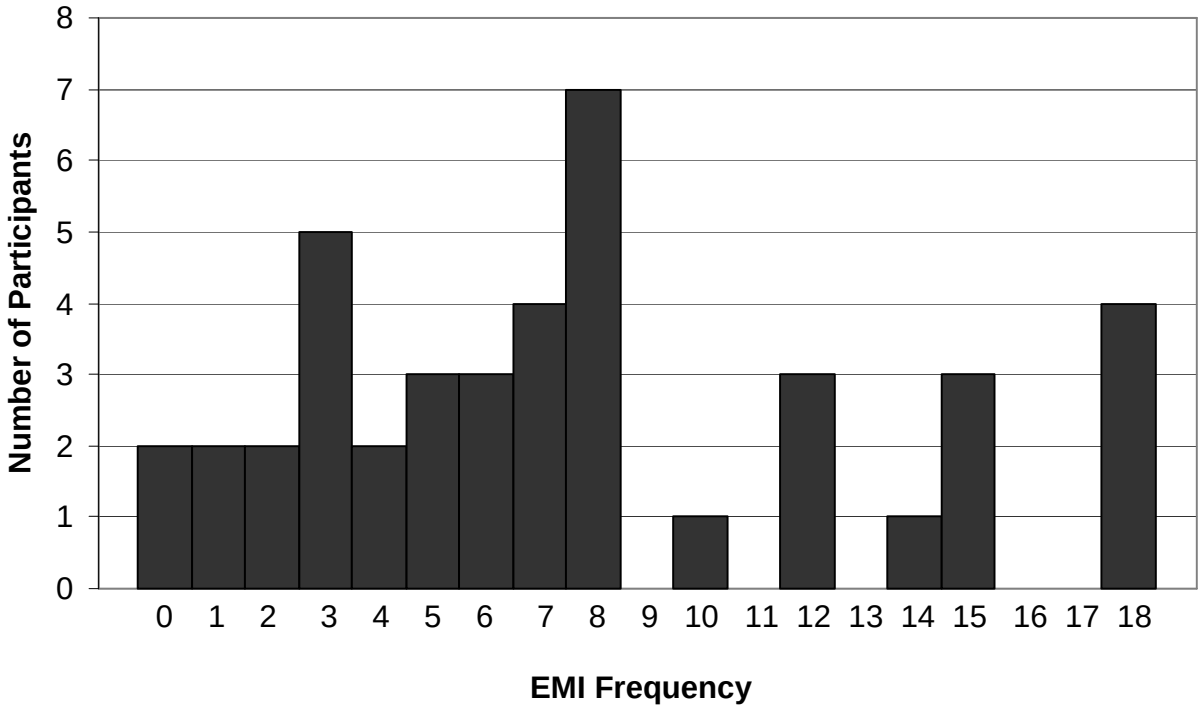


Figure 17. Percentage of EMI by content area (eating behavior, media use, negative affect) for each participant in the CD+EMI group.

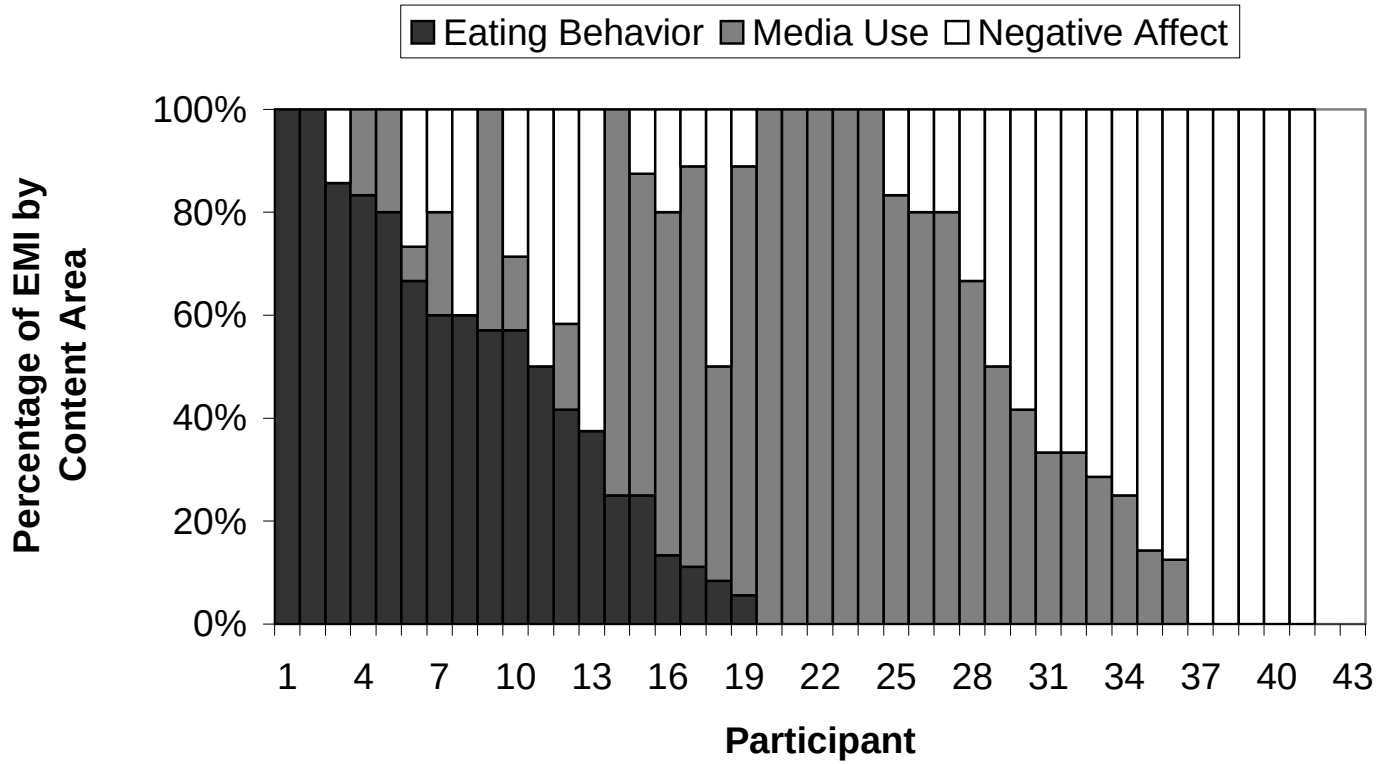


Figure 18. Primary outcome variables at initial screening assessment and 2 month post-intervention follow-up assessment by predominate type of EMI content received

Figure 18a. EDE-Q score by EMI content at screening and follow-up

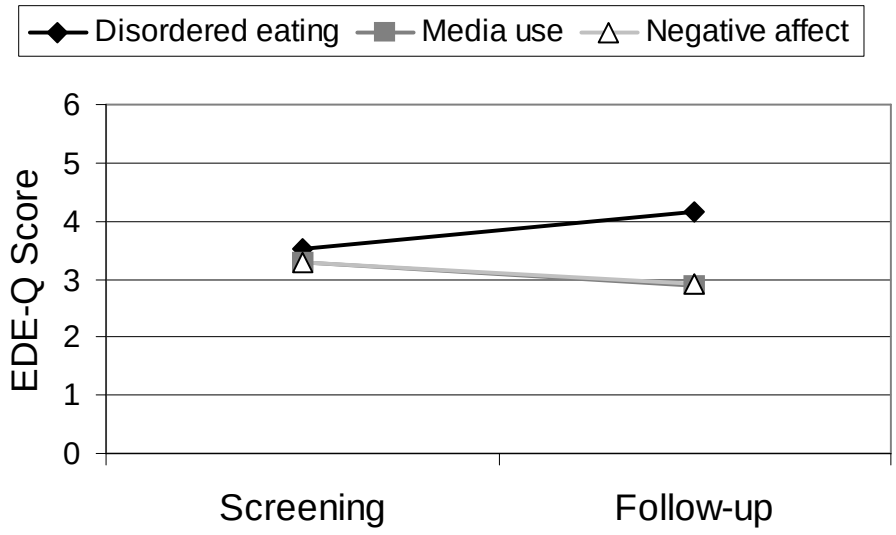
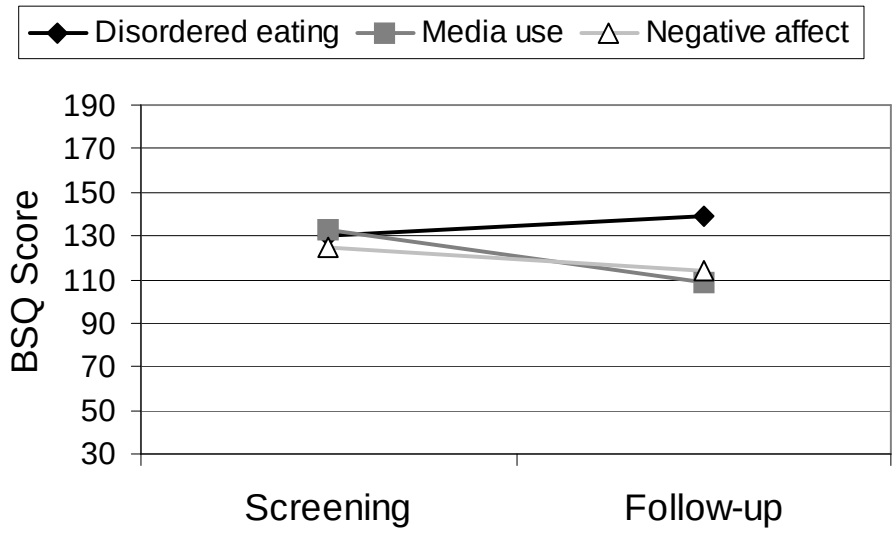


Figure 18b. BSQ score by EMI content at screening and follow-up



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