

EVALUATING THE EFFICACY OF INTERNET BASED
MOTIVATIONAL INTERVIEWING GROUP TREATMENT
FOR WEIGHT LOSS

Kelly Harmon Webber

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Approved by:

Advisor: Deborah F. Tate

Reader: Alice Ammerman

Reader: Michael Bowling

Reader: Cynthia Bulik

Reader: Dianne Ward

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ABSTRACT

KELLY HARMON WEBBER: Evaluating the Efficacy of Internet Based Motivational Interviewing Group Treatment for Weight Loss
(Under the direction of Deborah F. Tate)

The Internet has the potential to reach large numbers of the population and has shown great potential for use in the area of weight loss. The overarching goal of this dissertation was to explore the use of motivational interviewing (MI) to enhance Internet behavioral weight loss programs. This investigation included two distinct studies, one eight-week pilot, and one sixteen-week intervention. In the eight-week pilot, the use of MI in online chat sessions was found to be feasible and acceptable and to produce self-motivational statements. A values discussion in addition to other MI techniques was not found to have an effect on weight loss, self-motivational statements, or autonomous motivation. The average number of self-motivational statements uttered by participants was correlated with an increase in autonomous motivation over the eight weeks ($r = 0.58, p=0.05$). Higher autonomous motivation at eight-weeks was associated with greater weight loss ($r = -0.51, p<0.05$). In the sixteen-week intervention, sixty-six females were randomized to one of two interventions, which are entitled “Minimal MI” and “Enhanced MI” throughout the description that follows. In both interventions MI techniques were used to lead an initial face-to-face weight loss session. Both groups then received a 16-week Internet behavioral weight loss program. The Enhanced MI group also received weekly online chats led using MI techniques. Weight was measured in the clinic at baseline and 16 weeks. Both study groups lost weight over

time ($p < 0.001$), the Minimal MI group lost 5.22kg (4.72) and the Enhanced MI group lost 3.71kg (4.46). Autonomous motivation measured at four weeks was a strong predictor of adherence to self-monitoring throughout the study ($r = 0.40$, $p < 0.01$). Self-monitoring and years of previous Internet experience predicted a significant amount of variance in 16-week weight loss (adjusted $R^2 = 0.41$). These studies demonstrated the acceptability and efficacy of the use of MI in Internet behavioral weight loss interventions. Future studies should consider the use of MI to build motivation for weight loss and adherence to study procedures.

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CHAPTER I

INTRODUCTION

I.A. Overview

The US is facing an obesity crisis; the prevalence of overweight and obesity have been increasing for several years and presently 32 percent of US adults are considered obese, with a body mass index (BMI) of 30 or greater, and thirty-four percent of US adults are overweight, with a BMI of 25 or greater (Ogden et al., 2006; NCHS, 2007). Overweight and obesity increase the risk for several chronic diseases (NHLBI, 1998) and as a result have high economic costs (Wolf and Colditz, 1998). Weight loss has been shown to decrease risk factors for chronic disease (NHLBI, 1998); therefore effective weight loss treatments are essential.

Currently, among the most effective weight loss treatments are face-to-face cognitive behavioral programs involving weekly clinic visits (Wadden and Foster, 2000). One such successful face-to-face clinic based cognitive behavioral program was the Diabetes Prevention Program (DPP); this landmark study compared a placebo, metformin, and a behavior modification program for producing weight loss and decreasing diabetes incidence in adults with impaired glucose tolerance (DPP Research Group, 2002-A). The behavior modification program performed substantially better than the placebo or metformin at producing weight loss and decreasing the incidence of diabetes. Thus the DPP represents the gold standard in behavioral lifestyle intervention for weight loss. The DPP and other clinic-based treatments are effective but costly, require patients to travel to a clinic, reach a limited

audience, and do not provide a choice of formats for patients. As a result, the National Institutes of Health (NIH) has put forth a program announcement calling for adapting and translating the DPP into formats appropriate for dissemination (NIH, 2005). The Internet has shown great potential for public health use in many areas of health behavior including weight loss (Wantland et al., 2004). The Internet has many advantages over face-to-face treatment for weight loss; it may be a more cost-effective treatment than face-to-face interventions, and many more people can be reached by Internet interventions than in face-to-face clinic interventions (Klem, Viteri, and Wing, 2000; Sherwood et al., 1998). Behavioral Internet interventions to treat obesity and overweight have been successful, producing 4 -8 kg weight loss over six months (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003; Tate, Jackvony, and Wing, 2006; Gold et al., 2007); these results are promising and approach weight losses seen in traditional behavioral face-to-face weight loss treatments which average 10-12 kg over the first six months of treatment (Wing, 2002; Wadden et al., 1993).

One possible modification to current behavioral Internet weight loss programs is incorporating motivational interviewing (MI). MI is a counseling technique that focuses on resolving ambivalence and increasing motivation and confidence for change (Miller and Rollnick, 2002). This technique has been used in at least three face-to-face studies for weight loss (Wollard et al., 1995; West et al., 2007; Carels et al. 2007). MI has also been used in individual and group formats in the treatment of smoking, drug abuse, alcohol abuse, exercise, and diet and has been shown to consistently increase attendance and retention in treatment programs (VanWormer and Boucher, 2004; Bowen et al., 2002; Smith et al., 1997; Feld et al., 2002; Goldberg and Kiernan, 2005). Patient retention and attendance at weight loss sessions are predictors of weight loss (Tate, Wing, and Winett, 2001; Tate, Jackvony,

and Wing, 2003; Vitolins and Naughton, 2000; Jeffery, Bjornson-Benson, Rosenthal, 1984), therefore if attendance at weight loss sessions can be maintained more people may be able to reach weight loss goals.

The purpose of this research was to first test the feasibility and acceptability of Internet based weight loss chats led in an MI style and then to examine the impact of initial versus ongoing use of MI in a 16-week Internet weight loss program. In the 16-week study, sixty-six females (mean (SD) age 50.0 (9.9) years; BMI 31.1 (3.7) kg/m²; 86% Caucasian) were randomized to two groups, Minimal MI or Enhanced MI. Both groups received one MI face-to-face group weight loss session followed by a 16-week Internet behavioral weight loss program with weekly lessons, online monitoring form, separate message boards, and web links. The Enhanced MI group also received weekly online chats led in an MI style. Weight was measured in the clinic at baseline and 16 weeks with a 100% follow-up rate. Significant weight losses were achieved in both groups over time ($p < 0.001$), however the group by time interaction was non-significant ($p = 0.19$). The Minimal MI group lost 5.22kg (4.72) and the Enhanced MI group lost 3.71kg (4.46). Sixty-seven percent of Minimal MI participants and 45% of Enhanced MI participants lost at least 5% of their initial body weight ($p = 0.48$). Program utilization was associated with weight loss in both groups, including completion of self-monitoring diaries (avg. 8.9, $r = -0.673$, $p = 0.01$), and visits to the website (avg. 41.2, $r = -0.525$, $p = 0.01$). Both of these Internet programs started with one face-to-face MI session promoted weight loss; however, the addition of weekly MI based chats did not enhance weight loss at 16 weeks. Further research is needed on the type and frequency of group support that is most beneficial in Internet weight loss programs and could examine the independent contribution of an initial face-to-face MI group session.

I.B. Specific Aims

The specific aims and hypotheses of this study were:

Aim 1 - To compare an online weight loss chat group led with standard MI techniques to an online weight loss chat group led with standard MI techniques plus a values discussion on acceptability, self-motivational statements, and autonomous motivation.

Hypothesis 1 – The group approach using a discussion of personal values in addition to other MI techniques would produce more self-motivational statements and greater increases in autonomous motivation than the group approach that did not include a discussion of values in addition to other motivational interviewing techniques.

Aim 2 - To compare two Internet MI based behavioral weight loss interventions for promoting weight loss over 16 weeks.

Hypothesis 2 – The group receiving an initial MI session plus an Internet behavioral weight loss program with ongoing MI based group chats would have significantly greater weight loss at sixteen weeks than the group receiving the initial MI session plus the Internet behavioral weight loss program without weekly chats.

Aim 3 - To examine the relationships among motivation, program adherence in the form of completion of self-monitoring diaries, and weight loss in a 16-week intervention.

Hypothesis 3 – Motivation levels at baseline and four weeks would predict both adherence throughout the study and weight loss at sixteen weeks.

CHAPTER II

LITERATURE REVIEW

II.A. Prevalence of Overweight and Obesity

Overweight and obesity are a large and growing problem in the US; according to the continuous National Health and Nutrition Examination Survey (NHANES) for the years 2003-2004, two-thirds (66.3%) of US adults were overweight or obese and over 30 percent (32.2%) were obese (NCHS, 2007). Prevalence of overweight and obesity has also been increasing in the US over the past several years. Between NHANES III (1988-1994) and NHANES 2003-2004 the prevalence of overweight in adults increased 6% and the prevalence of obesity more than doubled (NCHS, 2007).

Overweight is defined as a body mass index (BMI) of 25.0 – 29.9 kg/m². Obesity is defined as a BMI of 30.0 kg/m² or greater. These cut points were determined after examination of epidemiological data which showed a modest increase in mortality at a BMI over 25 and a substantial increase in mortality, by as much as 50-100% over a BMI of 20-25, for a BMI of 30 or greater (WHO, 1995; VanItallie, 1985; VanItallie and Lew, 1990; Manson et al., 1987; Troiano, 1996).

II.B. Consequences of Overweight and Obesity

There were approximately 112,000 excess deaths due to obesity annually between 1976 and 2000 (Flegal et al., 2005). Those deaths were the result of diseases related to obesity including hypertension (Brown et al., 2000; Stamler et al., 1978; Criqui et al., 1982; Dyer and Elliot, 1989), type 2 diabetes (Westlund and Nicolaysen, 1972; Lew and Garfinkel, 1979; Larsson, Bjorntorp, and Tibblin, 1981; Medalie, Papier, and Herman, 1974), coronary heart disease (Hubert et al., 1983; NIH, 1985; Haffner, 1991; Lundgren, 1989), and cancers of the breast, prostate, and colon (Bostick, Potter, and Kushi, 1994; Chute, Willett, and Colditz, 1991; Garland et al., 1985). Many studies have found the risk of chronic diseases to increase with increasing levels of overweight and obesity. According to data from NHANES III, the prevalence of high blood pressure progressively increases with increasing BMI (Brown et al., 2000). Obesity is also a risk factor for type 2 diabetes (Pi-Sunyer, 1993) and studies have shown that an increase in BMI precedes an increase in type 2 diabetes prevalence (Holbrook, Barrett-Conner, and Wingard, 1989; Ford, Williamson, and Liu, 1997). Other studies have shown that the risk of diabetes increases with increasing weight (Westlund and Nicolaysen, 1972; Lew and Garfinkel, 1979; Larsson, Bjorntorp, and Tibblin, 1981) and the Nurses Health Study found that type 2 diabetes risk increases with increases in BMI above 22 (Colditz et al., 1990). The Nurses Health Study also found the risk of coronary heart disease to be higher in overweight and obese participants than normal weight participants (Willett, 1995). Risk factors for coronary heart disease such as high cholesterol and triglyceride levels also increase with BMI (Ashley and Kannel, 1974; Hershcopf et al., 1982; Shekelle et al., 1981; Denke, Sempos, and Grundy, 1993). Studies have found an association between obesity and increased incidence of colon cancer (Lew and Garfinkel, 1979; Bostick, Potter, and Kushi, 1994; Chute, Willett, and Colditz, 1991; Garland et al.,

1985; Giovannucci et al., 1995) and mortality from breast cancer is also directly related to obesity (Lew and Garfinkel, 1979).

The increased health risks associated with overweight and obesity are also associated with increased medical costs (Wolf and Colditz, 1996; Seidell, 1995). In 1995, over \$99 billion in medical and disability costs were attributable to obesity (Wolf and Colditz, 1998). Wolf and Colditz (1998) estimated the economic costs of overweight and obesity to be \$117 billion in 2001.

There are also psychosocial consequences of obesity. Obesity is associated with employment discrimination, decreased job earnings (Pingitore et al., 1994; Roe and Eickwort, 1976) social discrimination, and psychological distress (Wadden and Stunkard, 1986). Obesity has also been associated with increased depression (Stunkard and Wadden, 1992; Brownell, 1995; Wadden et al., 1993).

II.C. Benefits of weight loss

Weight loss has been associated with many health benefits including a decrease in blood pressure, cholesterol levels, fasting glucose and insulin levels, decreased all cause mortality, and improved quality of life. A 1987 meta-analysis of weight loss in hypertensive patients found that weight losses of 10 kg or more significantly lowered blood pressure (MacMahon and MacDonald, 1987). Since then, several trials have had similar results with weight losses as low as 4 kg producing significant decreases in blood pressure in hypertensive patients (Anderssen et al., 1995; Davis et al., 1993; Langford et al., 1991; Wassertheil-Smoller, 1985). Studies in non-hypertensive patients have also found weight loss to reduce blood pressure (Cutler, 1991). In healthy patients, weight loss of 5 to 13

percent of body weight produces a decrease in total cholesterol, triglycerides, and LDL-cholesterol, and an increase in HDL-cholesterol (Hellenius et al., 1993; Karvetti and Hakala, 1992; Puddey et al., 1992; Stefanick et al., 1998; Wood et al., 1991; Dengel, Katzel, and Goldberg, 1995). Moore and colleagues found diabetes risk to decrease by 33% in overweight patients who lost between 3.7 and 6.8 kg compared to patients who did not lose weight (Moore et al., 2000). Weight loss of 18-30 percent of total body weight in normoglycemic adults results in improved fasting glucose and insulin levels (Simkin-Silverman et al., 1995; Nilsson, Lindholm, and Schersten, 1992; Hjermann et al., 1980). In adults with impaired glucose tolerance weight loss of 6.9% of total body weight resulted in a 58% decrease in diabetes incidence in the Diabetes Prevention Program (DPP Research Group, 2002-A). Studies conducted with overweight diabetics found weight losses of 2.4- 5.0 kg to be associated with reductions in HbA1c levels, a marker of long-term glycemic control (Agurs-Collins et al., 1997; Ronnema et al., 1988; Heller et al., 1988).

Weight loss can also result in reduced mortality rates. Singh and colleagues (1992) found, in a one-year randomized trial, that in patients who had experienced a recent myocardial infarction, a reduction in weight of only 0.5kg produced a protective effect against cardiac events and overall mortality. Williamson and colleagues (1995) found that in women with obesity related co-morbidities, weight loss of any amount resulted in a 20 percent reduction in all cause mortality.

There are psychological benefits to weight loss also. Health related quality of life has been found to improve in many weight loss studies. Rippe et al. (1998) found that mental health and vitality improved following a 12-week behavioral weight loss treatment. Grimm et al. (1997) also found that mental health and vitality improved after a long-term behavioral

and pharmacotherapy intervention. Social functioning also improves after weight loss treatment (Kaukua et al., 2002; Messier et al., 2000). Many studies have found emotional benefits for patients who lose weight through use of a behavior therapy program (Wing et al., 1984). Wadden, Stunkard, and Smoller (1986) found that, in a randomized controlled trial, patients who received behavioral therapy not only lost weight but also decreased depression levels. Surgical interventions for weight loss also produce improvements in mood, self-esteem, and body image (Solow, Silberfarb, and Swift, 1974; Stunkard, Stinnett, and Smoller, 1986; Gentry, Halverson, and Heisler, 1984).

The benefits of weight loss are numerous and significant and include improvements in physical and psychological health. The consequences of overweight and obesity include increased risk of chronic disease, higher mortality rates, and social discrimination. The consequences of overweight and obesity coupled with the benefits of weight loss make a strong case for developing widely accessible successful weight loss treatments.

II.D. Current recommendations for weight loss

In 1998, the National Heart, Lung, and Blood Institute (NHLBI) published the Evidence Report on Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. This report recommended an initial target for weight loss of 5-10% of body weight in the first six months of treatment (NHLBI, 1998). To achieve that goal, the Report recommended a daily calorie deficit of 500-1000 kcal achieved through a balanced diet of 55% carbohydrates, 15% protein, and 30% fat, and physical activity in the amount of 30-45 minutes 3-5 days a week with an ultimate goal of 30 minutes or more of daily moderate intensity activity. The Report also recommended behavior therapy for

patients including stimulus control, social support, and encouragement to self-monitor diet and exercise. The Evidence Report was an important first step in setting evidence-based guidelines for practitioners in the treatment of overweight and obesity.

Since that time, there has been considerable research and controversy concerning the optimal content of the diet and the amount of exercise necessary to produce and maintain weight loss. In 2001, the American College of Sports Medicine (ACSM) released a position statement on, “Appropriate Intervention Strategies for Weight Loss and Prevention of Weight Regain for Adults”. The document recommended a reduction in caloric intake and an increase in caloric expenditure to achieve a daily energy deficit of 500-1000 kcal. The position statement also recommended a diet composed of less than 30% fat and a minimum of 150 minutes of moderate intensity physical activity per week. The ACSM also stated that increasing physical activity to 200-300 minutes per week might be advantageous for weight loss (Jakicic et al., 2001).

In 2002, a report was released from the Institute of Medicine (IOM) on the Dietary Reference Intakes for Energy, Carbohydrates, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. This report recommended that all adults and children should participate in 60 minutes of moderate intensity exercise each day. The report also recommended a dietary intake of 45-65% of calories from carbohydrates, 20-35% of calories from fat, and 10-35% of calories from protein (IOM, 2005).

The 2005 Dietary Guidelines for Americans recommends that to manage body weight and prevent weight gain, Americans must decrease caloric intake and perform 60 minutes per day of moderate or vigorous physical activity. The Dietary Guidelines also recommends a

balanced diet high in fruits, vegetables, and whole grains with 20-35% of total calories from fat (USDA, 2005). See Table 1 for a summary of the current recommendations.

In 2006 the American Heart Association released diet and lifestyle recommendations to reduce the risk of heart disease in the general population (Lichtenstein et al., 2006). These recommendations encourage aiming for a healthy body weight by balancing dietary intake with physical activity. The specific recommendations include exercising between 30 and 60 minutes on most days of the week and keeping dietary fat intake to between 25-35% of total intake while limiting saturated fat intake to less than 7% of total calories.

Table 1. Current Dietary and Physical Activity Recommendations					
	1998 NHLBI Evidence Report	2001 ACSM Position Statement	2002 IOM DRI Report	2005 Dietary Guidelines	2006 AHA Recommendations
Exercise (Moderate Intensity)	90-225 minutes/ week to start Goal of 210 minutes/week	150 minutes/ week to start Goal of 200-300 minutes/week	420 minutes/week	420 minutes/ week	150-300 minutes/week
Dietary Fat (% total calories)	30 %	30%	20-35%	20-35%	25-35%
Carbohydrates (% total calories)	55%	No guideline	45-65%	No guideline	No guideline
Protein (% total calories)	15%	No guideline	10-35%	No guideline	No guideline

There is a consensus that there must be a reduction in caloric intake and an increase in caloric expenditure to produce weight loss. Current recommendations for fat intake range from 20-35% of total calories and recommendations for carbohydrate intake range from 45-65% of total calories. The reduction in caloric intake can be achieved through a decrease in carbohydrates, fat, or both in the diet. However a high dietary intake of fruits, vegetables, and whole grains is recommended (USDA, 2005) and NWCR data support intake of a lower

fat diet for weight maintenance (Klem, Wing, and McGuire, 1997; McGuire, Wing, and Klem, 1998).

There is some controversy over the amount of exercise needed to produce and maintain weight loss. The NHLBI Evidence Report states that physical activity will not make a measurable difference in weight loss at six months but is important for weight maintenance (NHLBI, 1998). Physical activity added to a dietary intervention does not significantly increase weight loss over a dietary intervention alone in four to six month interventions (Wing, 1999; Bertram, Venter, and Stewart, 1990; Marks, Ward, and Morris, 1995; Ross, Pedwell, and Rissanen, 1995; Sweeney et al., 1993; Wadden, Vogt, and Anderson, 1997). However, physical activity is important for weight maintenance as shown in post-hoc analysis of prospective trials and in large cross-sectional case studies (Jeffery, Bjornson-Benson, Rosenthal, 1984; Kayman, Bruvold, and Stern, 1990; Hartman et al., 1993; Marston and Criss, 1984). Physical activity is also important for its many health benefits including decreased cardiovascular disease (CVD) mortality (Lee, Blair, and Jackson, 1999; Wei, Gibbons, and Mitchell, 1999) and protection from development of CVD, type 2 diabetes, and osteoporosis (Fentem, 1994). Regular physical activity also promotes good mental health (Byrne and Byrne, 1993). Current evidence indicates that more physical activity is better; data from the NWCR, the 2002 IOM report, and the 2005 Dietary Guidelines for Americans support recommending 60 minutes per day of moderate intensity physical activity. Different amounts of exercise may be necessary for different people to produce weight loss, however all patients should be encouraged to increase the amount or intensity of physical activity above current levels.

II.E. Standard behavioral weight loss interventions

Currently, the most successful weight loss treatments are clinic-based behavioral programs that include diet and physical activity components (Wadden and Foster, 2000; Wing, 2002). These comprehensive group dietary and behavioral weight loss programs have been found to produce weight loss of 8-10 kg over the first six months of treatment (Wadden and Foster, 2000; Kramer et al., 1989). Behavioral weight loss programs focus on modifying an individual's dietary, physical activity, cognitive and behavioral habits to produce weight loss. These programs teach participants to use several behavioral strategies to enhance weight loss. These strategies include self-monitoring, environmental evaluation and modification, modification of eating behaviors, rewards for successes, cognitive restructuring, and nutritional training (Perri, Nezu, Viegner, 1992). The most important of these strategies is self-monitoring which involves logging daily food intake, exercise and weight. A 2005 review of weight loss interventions concluded that the addition of these behavioral strategies to a diet and exercise program significantly improved weight loss outcomes (Shaw et al., 2005).

II.F. The Diabetes Prevention Program (DPP)

One successful clinic based behavioral weight loss intervention was the Diabetes Prevention Program (DPP). The DPP was a large multi-center randomized controlled trial that investigated the effectiveness of a lifestyle intervention or metformin in preventing or delaying the onset of type 2 diabetes among individuals with impaired glucose tolerance. The DPP randomized 3234 participants to receive a placebo, metformin, or an intensive lifestyle intervention. The lifestyle intervention was delivered in a clinic setting with face-to-

face sessions. Each lifestyle intervention participant completed 16 DPP lessons with a counselor over the course of the first 24 weeks of treatment. The lessons covered diet, exercise, and behavior modification strategies for weight loss and maintenance. The DPP goals were for participants to lose 7% of initial body weight, maintain moderate intensity physical activity of at least 150 minutes a week, and to maintain dietary fat intake at or below 25% of total caloric intake (DPP Research Group, 2002-A, 2002-B, and 2004).

The lifestyle intervention was successful in reducing type 2 diabetes incidence; the incidence of diabetes was 58% lower in the intervention group than the placebo group and 39% lower in the intervention group than the metformin group at follow-up. The lifestyle intervention also produced an average of 6.5 ± 4.7 kg weight loss or 6.9% initial body weight at the end of the core curriculum, 16 sessions over 24 weeks. Participants also reported engaging in an average of 224 minutes of physical activity per week at the end of the core curriculum (DPP Research Group, 2002-A, 2002-B, and 2004). This landmark study represents the gold standard in behavioral lifestyle interventions for weight loss. This intervention was intensive and involved face-to-face, individual counseling with a case manager. The National Institutes of Health (NIH) is interested in seeing this successful program disseminated and therefore has put forth a Program Announcement calling for adapting and translating the DPP materials (NIH, 2005).

II.G. Translation of the DPP

The Internet is a promising media for dissemination of health information. The number of adults using the Internet has increased substantially over the past few years to approximately 73% of adults in 2006. The majority of those Internet users report searching

the Internet to find nutrition and diet information (Internet World Stats, 2004; Saperstein, Atkinson, and Gold, 2007). As a result, computer and Internet based interventions have been developed to promote change in a variety of health behaviors including smoking, depression, diet, exercise, and weight loss (Tate, Wing, Winett, 2001; Tate, Jackvony, and Wing, 2003; Wantland et al., 2004; Woodruff et al., 2001; Houston, Cooper, and Ford, 2002). The Internet provides many benefits including convenience, privacy while still allowing for interaction with peers or counselors, decreased cost, and a potential to reach large audiences (Neuhauser, 2003; Womble et al., 2004; Rothert et al., 2006). Many commercial weight loss programs already use Internet group chats, however these programs have not been formally evaluated or have not proven effective (Tsai and Wadden, 2005; Womble et al., 2004). Therefore, the translation of the DPP materials into a format that can be delivered via the Internet is worthwhile.

II.H. Computer and Internet based interventions

Two reviews of computer and Internet based interventions have found promising results (Wantland et al., 2004; Murray et al., 2005). A review of 24 randomized controlled trials of Interactive health communication interventions for chronic diseases, which included only interventions that had a knowledge based component and a component of support such as decision support, support for behavior change, or peer support, concluded that these interactive interventions had a significant positive effect on knowledge, social support scores, behavioral and clinical outcomes. These interventions also were likely to have a positive impact on self-efficacy for behavior change (Murray et al., 2005). A review that included 17 interventions that compared the efficacy of a web-based program to a non-web-based

program on several different health outcomes concluded that the web-based programs produced significantly greater improvements in knowledge and behavioral outcomes than non-web-based programs. These knowledge and behavioral outcomes included increases in nutrition knowledge, increased physical activity, and improved weight maintenance (Wantland et al., 2004). This review also found that programs that incorporated tailored feedback to participants reported greater participant usage and engagement with the web-based program in the form of longer visits to the website and increased frequency of log-ins (Wantland et al., 2004).

II.I. Internet based weight loss interventions

A recent review of randomized trials of Internet weight loss interventions for adults concluded that structured behaviorally based programs with some form of counselor feedback were efficacious in producing significant weight loss (Saperstein, Atkinson, and Gold, 2007). This review included six randomized controlled trials, and in five of the six, the Internet based program was effective in producing significant weight loss. The average weight loss over the first six months of these interventions was 5.5kg. These interventions also showed that tailored feedback was critical for success. Three of the trials included a comparison to a commercial Internet site (slimfast.com and eDiets.com). These commercial sites were not as successful in producing weight loss as the structured behavioral programs administered via Internet or the structured behaviorally based LEARN manual.

II.J. Motivational Interviewing

Motivational interviewing (MI) is one promising technique for changing health behaviors. Miller and Rollnick (1992) developed the technique and describe MI as a directive, client-centered approach that seeks to resolve ambivalence and increase intrinsic motivation for change. This technique is an adaptation of psychotherapy and includes five key elements: supporting self-efficacy, rolling with resistance, expressing empathy, developing discrepancy, and avoiding argumentation. MI has been adapted and used in the treatment of obesity, smoking, drug abuse, alcohol abuse, exercise, and diet. While main outcomes of studies using MI have varied, the technique has been shown to consistently increase attendance in treatment programs (VanWormer and Boucher, 2004; Bowen et al., 2002; Smith et al., 1997; Feld et al., 2002; Goldberg and Kiernan, 2005). Attendance at treatment programs has been consistently correlated with better health outcomes (Stewart, King, and Haskell, 1993; Smith et al., 1997; Schmid et al., 1991; Simpson et al., 2006).

II.K. Adherence and program outcomes

Adherence to treatment recommendations and procedures is essential for the efficacy of medical and behavioral interventions. Adherence to treatment recommendations has been associated with better outcomes in many areas of health behavior including adherence to medication regimens, attendance at treatment sessions, and monitoring of blood glucose (Jeffery, Bjornson-Benson, Rosenthal, 1984; Stewart, King, and Haskell, 1993; Smith et al., 1997; Schmid et al., 1991; Simpson et al., 2006). In weight loss interventions greater treatment adherence has been associated with better weight loss outcomes in both face-to-face and Internet weight loss programs (Teixeira et al., 2002; Williams et al., 1996; Vitolins and Naughton, 2000; Jeffery, Bjornson-Benson, Rosenthal, 1984; Stevens et al., 1989; Streit

et al., 1991; Tate, Wing, Winnet, 2001; Tate, Jackvony, Wing, 2003). Adherence, in the form of logins to the study website and completion of self-monitoring diaries has been shown in previous Internet weight loss studies to correlate with greater weight loss (Saperstein, Atkinson, and Gold, 2007). Program exposure, another measure of adherence, has also been correlated with positive outcomes in an Internet physical activity intervention (Steele, Mummery, and Dwyer, 2007). It appears that the same holds true for face-to-face programs, adherence and attendance have been correlated with weight loss in several previous face-to-face studies (Teixeira et al., 2002; Williams et al., 1996; Vitolins and Naughton, 2000; Jeffery, Bjornson-Benson, Rosenthal, 1984). Therefore, in Internet weight loss programs the use of techniques to maintain adherence to program guidelines for logging in to the study website and completing online self-monitoring diaries may help more participants reach weight loss goals.

II.L. Previous use of MI in individual settings

Several reviews of the use of MI in individual settings have been published. These reviews typically call MI interventions adaptations of motivational interviewing (AMIs) because they incorporate other counseling techniques or elements in addition to the MI techniques. A 1997 review of AMIs found 11 studies that used MI to treat problem drinkers (9) and drug abusers (2) (Noonan and Moyers, 1997). The authors concluded that nine of the eleven studies supported the efficacy of MI for the treatment of addictive behaviors. A 2001 review by Dunn, Deroo, and Rivara included 29 randomized trials that incorporated AMI. The authors concluded that AMI interventions were efficacious for the treatment of problem drinkers and also improved retention in substance abuse programs. Burke, Arkowitz, and

Dunn (2002) performed a qualitative analysis of 26 studies that used MI and found support for the use of AMI in treatment of alcohol addiction, drug addiction, and bulimia. A 2003 review of motivational interviewing included 30 controlled clinical trials that used AMIs in individually based interventions; 15 alcohol, 2 smoking, 5 drug addiction, 2 HIV risk behaviors, 4 diet and exercise, 1 eating disorder, and 1 treatment adherence study was included in this review (Burke, Arkowitz, and Menchola, 2003). AMI interventions showed significant effects when compared to no treatment controls and yielded medium effect sizes in the areas of drug addiction (0.56) and exercise and diet (0.53), and small to medium effects on alcohol abuse treatment (0.25-0.53). The authors also looked at sustained effects and found that the AMI effects did not diminish over time as far as 4 years post treatment. Also, attrition in these studies was found to be relatively low. It appears from these reviews that MI interventions have a medium effect size in weight loss related interventions, have long-lasting effects, and improve retention.

None of the reviews previously mentioned included a review the effect of MI based interventions on weight loss. In fact, few studies have been published about the effectiveness of MI in weight loss interventions. Woollard et al (1995) conducted an 18 month randomized controlled trial in which hypertensive adults were randomized into three groups. The control group received usual care; the low intervention group received an educational manual, behavior modification strategies, and five MI phone sessions; the high intervention group received an educational manual, behavior modification strategies, and six longer MI phone sessions. Results show that both intervention groups reduced blood pressure compared to the control group. There was also a significant reduction in sodium and alcohol

intake for the low intervention group vs. control and significant weight loss differences for the high intervention vs. control group (-1.70kg).

Smith, et al. (1997) conducted a 16-week weight control program with obese women with type 2 diabetes which employed the use of individual MI sessions. MI was added to a standard behavioral weight control program and compared to the standard behavioral weight control program alone. Both groups received diet, exercise, and behavior modification instruction; the MI group received only three motivational interviewing sessions in addition to the standard program. Participants in the MI group showed significant differences over the control group in attendance at group meetings, completion of food diaries, and recording of blood glucose levels. Both groups had significant weight loss as a result of the program with no significant differences between groups. The MI group, however, had better glycemic control than the control group at follow-up. The inability to see differences in weight losses between the two groups in this study could have been due to the small sample size (n=22) or may have been due to the intense nature of both programs.

West and colleagues (2007) conducted a face-to-face behavioral weight loss intervention that incorporated a comparison of five individual MI based sessions to five attention control sessions in addition to the usual program for producing weight loss over an 18-month intervention. Two hundred and seventeen overweight women with type 2 diabetes were randomized to the two treatment groups. The MI based group had significantly greater weight loss than the attention control group at six (-4.7 kg vs. -3.1 kg, $p=0.003$) and eighteen (3.5 kg vs. 1.7 kg, $p=0.04$) months. This effect appeared to be due to the increased program adherence of the MI group participants.

MI has also been used as part of a twenty-four week group based stepped care face-to-face behavioral weight loss program. In this program, all participants received a curriculum based on the LEARN manual. Participants who were not achieving weight loss goals were randomized to receive either no additional intervention or individual MI based counseling sessions with a psychology graduate student. Participants randomized to receive the MI sessions had significantly greater weight loss than the control group at follow-up (4.5 kg vs. 2.1 kg, $p < 0.05$) (Carels et al., 2007).

Results from the four previous studies that incorporated MI into a weight loss program have varied. Smith et. al (1997) found no effect on weight loss at four months (Smith et. al., 1997) from the addition of MI, while the other three studies found increases in weight loss due to the addition of MI ranging from 1.6-2.4 kg at six months and 1.7-1.8 kg at eighteen months. None of these previous weight loss studies compared the MI intervention to another potentially equivalent intervention. In all four of the studies MI was compared to usual care or an attention controlled comparison group. In general, it appears that the addition of individual MI sessions to standard face-to-face weight loss programs is beneficial for producing weight loss above the standard program.

II.M. Previous use of MI in groups

Group motivational interviewing has been used in a limited number of studies for treating a variety of health behaviors including alcohol dependency, smoking, eating disorders, coping with diabetes, and weight loss study retention. Only one study was found that compared the use of MI in an individual versus a group setting. John et al. (2003) compared group versus individual MI treatment for alcohol dependent patients and found that

the two intervention treatments did not differ on the primary outcome of abstinence from alcohol use at six months, however the group MI patients demonstrated more help seeking behavior at six month follow-up, a secondary goal of the treatment, than the patients receiving individual MI. It appears from this comparison that group MI treatment is as effective as individual MI treatment in the treatment of alcohol abuse and may increase support-seeking behaviors.

Knight et al. (2003) used group MI with type 1 diabetic adolescents in an effort to facilitate coping with the disease. Twenty teens were allocated to either a control group receiving usual care or a group receiving six one-hour weekly MI group sessions. At follow-up of six weeks and six months, the MI group had greater success with perceptions and coping with diabetes than the control group; they had more feelings of control and acceptance and felt less threatened by the disease. The group format was also found to be cost-effective in this setting.

MI has also been used in the development of a pretreatment motivational enhancement group (MET) for patients with eating disorders. The goal of the MET treatment group was to increase motivation and also increase the likelihood of treatment completion. Patients received four one-hour MI group sessions over four weeks; there was no control group. The group participants demonstrated significant increases in motivation, as measured by stage of change and three Likert motivation scales, and decreases in concerns about change, as measured by the concerns about change scale (CCS), from baseline to six-week follow-up. Also at follow-up, 90% of patients were still in treatment (Feld et al., 2002).

Only one study was found that used group MI on the Internet. Woodruff et al. (2001) used on-line MI chat sessions with teen smokers. Eighteen teens ages 13-18 participated during the 2-month study period. During seven one-hour chat sessions the trained counselor explored ambivalence, elicited personal goals and motivational statements, formulated behavioral goals, and problem solved removing barriers using a motivational interviewing style. The main outcomes of the study were smoking behavior and attitudes. At the end of the study period, the teens demonstrated positive changes in behavior and attitude; there was a significant reduction in number of cigarettes smoked per day and intention to quit increased significantly from baseline.

Two studies have used motivationally enhanced groups in a weight loss program setting. Pierce and Stoltenberg (1990) used a motivational enhancement group based on principles of the Elaboration Likelihood Model in an attempt to increase attendance at a weight loss intervention. The motivationally enhanced group focused on making weight loss issues personally relevant and increasing central processing and motivation, similar to motivational interviewing interventions. The motivationally enhanced group had increased attendance and decreased attrition compared to three different control groups. Differences in weight loss between the groups was not addressed or reported in this study.

Goldberg and Kiernan (2005) explored the use of group MI in aiding retention in a face-to-face weight loss study. All participants attended a group orientation session prior to randomization; MI techniques were used during the orientation session to explore ambivalence around enrolling in a weight loss study. The results showed unusually high retention rates in all groups, 98% at 6 months and 96% at 18 months. This study had no comparison group, so it is impossible to say if retention rates were due to MI.

The use of MI in group settings appears to be effective in a variety of areas including the treatment of alcohol abuse, smoking cessation, coping with chronic disease, treatment of eating disorders, and for increasing retention in face-to-face weight loss programs. Similar to the use of MI in individual settings, these group based MI interventions have typically been compared to a no intervention control group or a group receiving usual care. However, the addition of MI to group treatment does appear to enhance outcomes and therefore may be potentially effective to use MI in a group setting for behavioral weight loss treatment.

Both individual and group based MI interventions have been effective in many areas of health behavior. In general, MI interventions have not been compared to other types of interventions, only to groups receiving usual care. However, MI has been used to increase fruit and vegetable intake (Resnicow et al., 2001; Resnicow et al., 2004) and decrease fat and cholesterol intake (Bowen et al., 2002; Berg-Smith et al., 1999). MI interventions have also produced increased weight loss (Wollard et al., 1995; West et al., 2007; Carels et. al., 2007), exercise adoption (Harland, 1999), daily energy expenditure (Brodie and Inoue, 2005), and retention in a weight loss program (Goldberg and Kiernan, 2005). MI has been successfully used in groups including one on-line group (Woodruff et al, 2001). While in most studies MI has been shown to increase adherence to a regimen, attendance at treatment sessions, or program retention, the exact mechanism by which MI works is still unknown (Burke, Arkowitz, and Dunn, 2002; Burke, Arkowitz, and Menchola, 2003). It is proposed that MI works through increasing motivation thereby increasing attendance, adherence, and retention. This study proposed to begin to elucidate the mechanisms by which MI has an effect on outcomes by measuring motivation, self-efficacy, adherence, and outcomes. Goals of this

study also included adapting MI to an online chat environment for weight loss and testing the efficacy of Internet MI-based interventions for weight loss.

CHAPTER III

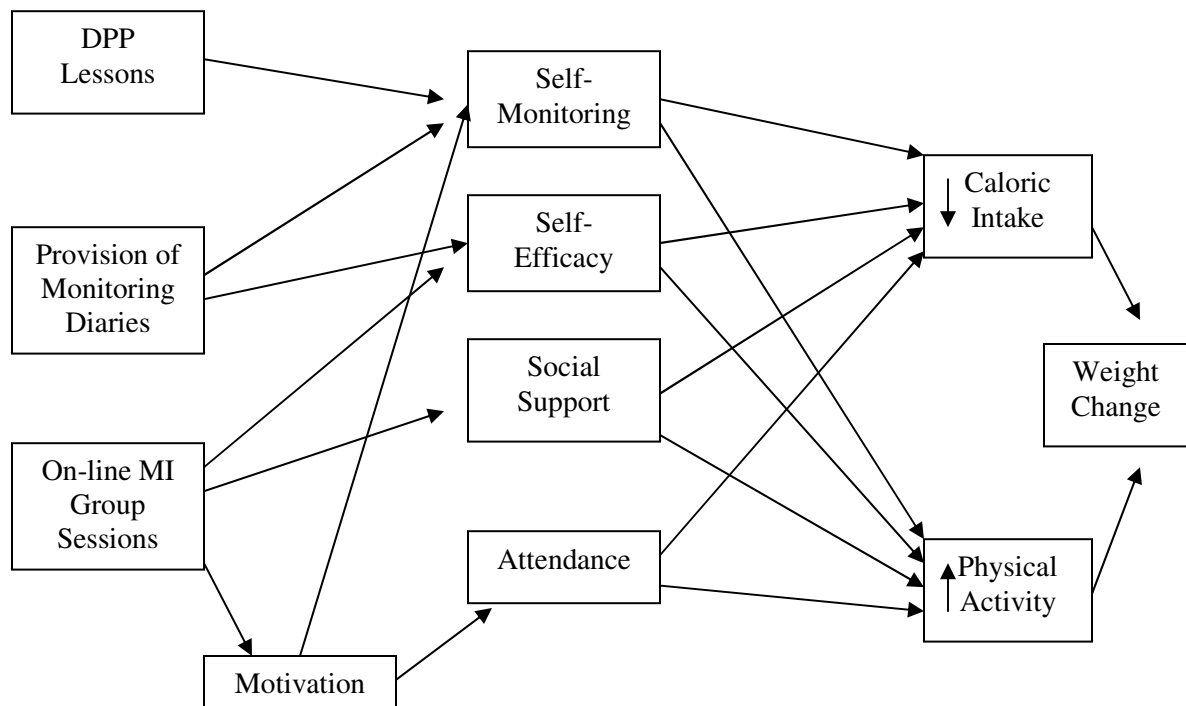
THEORETICAL FRAMEWORK

There are many possible mediators of change in a weight loss program. Variables that have had a consistent association with weight loss success in previous studies include: baseline self-efficacy (Jeffery, Bjornsen-Benson, and Rosenthal, 1984; Klem, Wing, and McGuire, 1997; IOM, 1995; Bernier and Avard, 1986; Teixeira et al., 2002; Teixeira et al., 2004-A), changes in eating and exercise self-efficacy (Bernier and Avard, 1986; Forster and Jeffery, 1986; Karlsson et al., 1994; Dennis and Goldberg, 1996), social support (Black, Gleser, and Kooyers, 1990; Foreyt and Goodrick, 1991; Williams et al., 1996), self-monitoring (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003; Klem, Wing, and McGuire, 1997; McGuire, Wing, and Klem, 1998; Foreyt and Goodrick, 1994; Wyatt et al., 2002), attendance at weight loss sessions (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003; Vitolins and Maughton, 2000; Jeffery, Bjornson-Benson, and Rosenthal, 1984), and motivation (Teixeira et al., 2002; Teixeira et al., 2004-B; Williams et al., 1996; Clifford, Tan, and Gorsuch, 1991; Bjorvell et al., 1994). Based on these empirical findings, this intervention proposed to influence each of these variables through the DPP standard behavioral weight loss lessons, provision of self-monitoring diaries, and an online MI chat sessions.

The DPP lessons explain and encourage self-monitoring and therefore were expected to impact self-monitoring directly. All participants were provided with self-monitoring diaries, calorie books, and instruction on self-monitoring, and this component of the

intervention was also expected to impact self-monitoring. The diaries could have also impacted self-efficacy as they gave participants a chance to see past successes and progress. The online MI support group sessions were the intervention component expected to have the biggest impact on weight loss. One of the key elements of motivational interviewing is supporting self-efficacy (Miller and Rollnick, 1992); therefore the group sessions were expected to have a direct impact on self-efficacy. It was also hypothesized that MI would increase motivation for weight loss. The increased motivation was expected to increase self-monitoring. Finally, the online group sessions were expected to provide increased social support for the intervention group participants. All of these variables, self-monitoring, self-efficacy, social support, motivation, and attendance, were expected to impact caloric intake and physical activity levels and thus impact weight loss.

Figure 1. Conceptual Model of Intervention



CHAPTER IV

MOTIVATIONAL INTERVIEWING IN INTERNET GROUPS: A PILOT STUDY FOR WEIGHT LOSS

Webber KH, Tate DF, Quintiliani LM.

IV.A. Abstract

Motivational interviewing (MI) is a technique for developing and maintaining motivation for change. This pilot study examined the feasibility and acceptability of MI in online weight loss treatment groups. Twenty females participated in the eight-week minimal contact intervention, received weekly e-mailed lessons, and were randomized to receive two online groups using MI, either with or without a discussion of values. Acceptability of format and content was measured following the second online group. Self-reported weight and motivation were measured at baseline and eight weeks. Qualitative analysis of group transcripts examined self-motivational statements and commitment language uttered by participants during online groups. Eighty-four percent of participants reported willingness to participate again and felt comfortable with discussion topics. The average number of self-motivational statements uttered by participants did not differ by group ($p=0.85$) and was correlated with an increase in autonomous motivation over the eight weeks ($r = 0.58$, $p=0.05$). Higher autonomous motivation at follow-up was associated with greater weight loss ($r = -0.51$, $p<0.05$). This study suggests that MI techniques are acceptable and may be useful for targeting and maintaining motivation in online weight loss groups.

IV.B. Introduction

The Internet has shown potential for public health use in many areas of health behavior (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003; Tate, Jackvony, Wing, 2006; Pull, 2006; Cunningham et al., 2006; Woodruff et al., 2001) and its advantages include increased access to programs and additional choice of program formats for patients. Synchronous (e.g., in real-time) online groups have extended the reach of individual psychotherapy (Shultze, 2006; Barak and Bloch, 2006; Mallen, Vogel, and Rochlen, 2005) and have been used in Internet interventions for weight loss maintenance (Harvey-Berino, Pintauro, Gold, 2002). Despite their growing use, little research has been conducted to determine the best way to deliver these sessions.

Motivational interviewing (MI) is a promising technique for building motivation for change and may be one method for leading online groups. MI is a counseling technique that seeks to resolve ambivalence and increase motivation for change by eliciting self-motivational statements, or change talk, from clients (Miller and Rollnick, 2002). Change talk includes reasons for change, discontent with the present situation, optimism for change, and intention to change. Elements of MI counseling include: supporting self-efficacy, expressing empathy, avoiding argumentation, and developing discrepancy between current and desired behaviors (Miller and Rollnick, 2002). MI has been effective in a variety of individual in-person or telephone delivered health behavior interventions including (Resnicow et al., 2001; Berg-Smith et al., 1999; Bowen et al., 2002) and exercise interventions (Harland et al., 1999; Brodie and Inoue, 2005). MI also has been used in face-to-face groups to increase retention in a weight loss program (Goldberg and Kiernan, 2005),

and improve glycemic control and self-monitoring in overweight women with diabetes (Smith et al., 1997).

To our knowledge, only one prior study has used MI in online groups: an online group smoking cessation program for teen smokers (Woodruff et al., 2001). Youth ages 13-18 (n=18) participated in the two-month study. During seven one-hour online group sessions a trained counselor explored ambivalence, elicited personal goals and motivational statements, formulated behavioral goals, and problem solved using an MI style. At follow-up a significant reduction in self-reported smoking and increase in intention to quit was reported.

Few studies have reported the topics and procedures used during MI group treatment (Woodruff et al., 2001; Van Horn and Bux, 2001). Several topics could comprise an MI-based discussion, including pros and cons of change, reviewing past successes, and readiness, importance, and confidence for change. Exploration of personal values and the relationship between values and behavior change may be included (Miller and Rollnick, 2002); however, little is known about the acceptability of adding this potentially sensitive topic to a group setting. Although discussion of values is believed to be helpful in promoting motivation, participants could consider the topic too personal and withdraw from the conversation in a group context. We hypothesized the boundaries created by an Internet chat may mitigate these concerns and make the addition of values acceptable. The specific aims of this pilot intervention were to prepare for a larger trial using MI-based Internet online groups, determine the acceptability of discussions of values in online group sessions, and determine if MI-based discussions produced self-motivational statements and changes in autonomous motivation.

IV. C. Methods

Subjects

After approval from the Institutional Review Board at the University of North Carolina at Chapel Hill, participants were recruited through a University listserv and screened via telephone interview. Eligibility criteria included female gender, age 22-65, body mass index (BMI) ≥ 25 and < 40 , and home access to a computer with Internet service. Exclusion criteria included a medical diagnosis of orthopedic or joint problems that might prohibit regular exercise, endorsement of any of the first three items on the Physical Activity Readiness Questionnaire (Shepard, 1988; Shepard, Cox, and Simper, 1981); endorsement of other items on the Physical Activity Readiness Questionnaire without a physician's consent, hospitalization for a psychiatric disorder within the last year, history of anorexia or bulimia nervosa, intention to move, medical diagnosis of cancer within 5 years, HIV, or a major psychiatric disorder, planned, current or recent pregnancy, and recent weight loss of ≥ 10 pounds. See Figure 1 for the participant flow diagram.

Design

Baseline questionnaires were mailed to eligible participants that assessed demographics, baseline weight, and motivation using the Treatment Self-Regulation Questionnaire (Williams et al., 1996; Williams et al., 1999; Ryan, Plant, O'Malley, 1995). Participants ($n=20$) were randomized to receive either two online group sessions with a basic MI led discussion or two online group sessions with an MI + values discussion. Each week during the eight-week study a different behavioral weight loss lesson was e-mailed to the participants (Research Group, 2002-B). Participants took part in online group sessions to discuss the weekly lesson during the first two weeks of the study only. Online group

sessions lasted for one hour and were led by a nutrition graduate student trained in MI. In order to facilitate the MI + values discussion, participants were e-mailed questions before the online sessions about personal values, definitions of those values, and relationship of those values to beginning a weight loss program. Values were discussed during both weekly online sessions for the MI + values group. Participants in both randomized groups were encouraged to discuss pros and cons of change and readiness, importance, and confidence for change at all sessions. See Figure 2 for examples of questions used during the online sessions.

Immediately following the second online session for both groups, a questionnaire assessing group cohesion and acceptability of the group format was e-mailed to participants. Group cohesion was measured using the Physical Activity Group Environment Questionnaire (Estabrooks, 2000; Estabrooks and Carron, 1999). Internal consistency of the four subscales is excellent ranging from $\alpha = 0.72-0.94$ in both younger and older adult populations. Final questionnaires on weight and motivation were e-mailed to participants at the conclusion of the eight-week study.

Analyses

The group sessions were conducted on the Internet over a secure server and the transcripts were analyzed using ATLAS.ti software v.4.2 (Berlin, 2002). Three independent coders analyzed the transcripts and came to a consensus over all coding and definitions. Five topics served as the deductive codes in the coding process: commitment language and four types of self-motivational statements including advantages of change, disadvantages of the status quo, intention to change, and optimism about change (Amrhein et al., 2003; Miller and Rollnick, 2002).

All statistical analyses were conducted using SPSS for Windows v.12.0 (Chicago, IL, 2003). Descriptive statistics characterized the sample population including education, race, age, and BMI. Due to the sample size limitations non-parametric statistics were used in all analyses; Wilcoxin Signed Ranks test for comparison of pre and post intervention scores for weight and motivation; Mann-Whitney U tests to examine differences between groups, and Spearman correlation coefficients to examine relationships between variables. An alpha level of 0.05 using a two-tailed test was the criterion for statistical significance.

IV.D. Results and Discussion

Participants (n=20) were age 40.6 (11.3) years, with BMI of 31.0 (4.2) kg/m² and were 75% Caucasian. In this group of university employees 40% had graduate degrees, 35% had a college degree, and 25% had less than a college degree. The two randomized groups did not differ on autonomous motivation at baseline (MI + values group= 5.08 \pm 0.94, MI without values group= 5.66 \pm 0.57, p=0.10; possible range 1.0-7.0).

Self-reported weight losses at eight weeks were -1.5 (2.2) kg in the MI + values group (n= 9) and -2.7 (2.9) kg in the MI without values group (n= 9). Weight decreased from baseline to eight weeks (p<0.01) and did not differ between randomized groups (p=0.56). Group cohesion did not differ between the two groups (MI + values group= 111 \pm 28, MI without values group= 123 \pm 14, p=0.35; possible range 21-189); and change in autonomous motivation over the eight weeks also did not differ between the two groups (MI + values group= 0.16 \pm 1.3, MI without values group= -0.04 \pm 0.57, p=0.60). Average number of self-motivational statements made per group session was 5.7 (3.8) in the MI + values group

and 5.0 (1.4) in the MI without values group ($p=0.85$). The total amount of commitment language in all of the online groups was too low (three statements total) for analysis.

For further analysis, the two groups were collapsed and the following data are reported on all participants. Participants who attended only one online group ($n=6$) lost 0.23 kg compared with 2.6 kg ($p=0.12$) for participants who attended both online group sessions ($n=14$). The average number of self-motivational statements made during the online sessions correlated with change in autonomous motivation during the study ($r=0.58$, $p=0.05$) and at follow-up ($r=0.67$, $p=0.01$). Higher autonomous motivation at follow-up was associated with greater weight loss ($r=-0.51$, $p=0.05$).

Two of the nineteen responding to the acceptability survey (one in each group) indicated being uncomfortable with the discussions. Two different participants reported that they were unlikely to participate in a similar chat group discussion again. Ninety-five percent of participants were comfortable having the online group transcripts e-mailed to all participants.

This eight week pilot study found that two online groups led with MI techniques were acceptable, even when they included values discussions, and that these MI based discussions produced self-motivational statements among participants. The number of self-motivational statements made by participants correlated with increases in motivation and motivation levels at follow-up correlated with weight loss. Therefore, MI may be a feasible and acceptable way to lead weight loss groups and appears adaptable to an online environment.

In this brief two-session analysis of the values discussion, it does not appear that a values discussion impacted the number of self-motivational statements made, motivation, weight loss, or group cohesion. There were a number of participant comments about the chat

groups ranging from “a fantastic source of support” to concern with values being very private and uncomfortable to discuss. This concern may have been due to the values discussion being introduced very early in the intervention. Since it appears to have produced no additional benefit when introduced early in this brief treatment, a discussion of values might not be valuable in these online discussion or might be best addressed in later online group sessions when group comfort and trust levels are higher.

This pilot study explored several new areas including the use of MI in online weight loss groups, the inclusion of measures of motivation during MI treatment, and the effects of a values discussion on participant comfort, self-motivational statements, and motivation. In addition, this study used qualitative and quantitative analysis of chat transcripts to examine the effects of an MI discussion on self-motivational statements. This study had several important limitations including a sample of highly educated women who indicated interest in taking part in an Internet study; a small sample size; short study duration; and self-reported outcomes. However, the validity of self-reported weight loss has been demonstrated in previous studies (30,31). In addition, this format worked well with a small group size, ten or fewer participants, but may not be applicable to larger chat groups.

IV.E. Conclusions

In summary this study showed that the use of MI in online groups for weight loss is acceptable and produces self-motivational statements, which are related to increased levels of motivation and weight loss. These results may provide a starting place for understanding the mechanisms by which MI works and may aid in further adapting the technique for use in the weight loss field. Future studies could explore the impact of a values discussion on weight

loss using a longer-term study with objectively measured weights. Future studies could also examine the objective benefit of MI in online groups by comparing an MI led group to a group led using other techniques.

Figure 2. Pilot Study Participant Flow

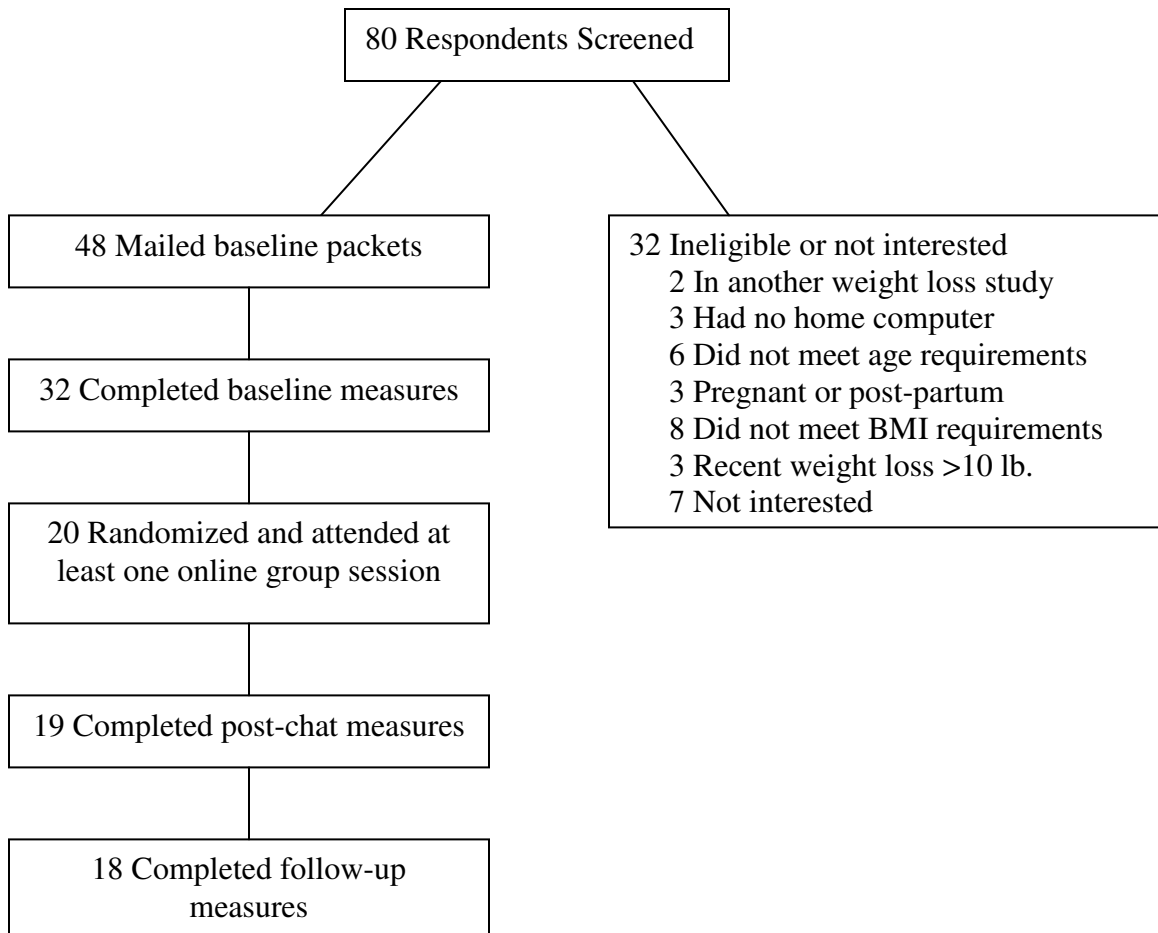


Figure 3. Examples of MI questions used during online sessions

On a scale of 1-10, with 10 being very ready, where would you rank your readiness for changing your eating behaviors? What made you say that number and not something lower?
On the scale of 1-10, with 10 being very confident, where would you rank your confidence in succeeding at losing weight this time? What made you say that number and not something lower?
On a scale of 1-10, with 10 being very important, where would you rank the importance of losing weight? What made you say that number and not something lower?
What might be some benefits of losing weight?
What are some of the cons of staying at your current weight?
What are some of your top core values?*
What kind of connection do you see between your values and losing weight?*
How might the value of family be related to losing weight?*

* These questions were used for the MI + values group only

CHAPTER V

A RANDOMIZED COMPARISON OF TWO INTERNET WEIGHT LOSS PROGRAMS ENHANCED BY MOTIVATIONAL INTERVIEWING

Webber KH, Tate DF, Bowling JM

V.A. Abstract

Background: This study examined the efficacy of two Internet behavioral weight loss programs enhanced with motivational interviewing. Motivational interviewing (MI) is a technique for developing and maintaining motivation for change and has been used in face-to-face programs to enhance outcomes and increase adherence and retention.

Methods: Sixty-six females were randomized to one of two interventions, which are entitled “Minimal MI” and “Enhanced MI” throughout the description that follows. In both interventions MI techniques were used to lead an initial face-to-face weight loss session. Both groups then received a 16-week Internet behavioral weight loss program, which included a study website with weekly lessons, an online self-monitoring diary form, web links to related sites, and separate message boards. The Enhanced MI group also received weekly moderated online chat sessions led using MI techniques. Weight was measured in the clinic at baseline and 16 weeks. Differences between groups and changes over time were examined using t-tests. Correlations were calculated using the Pearson R coefficient when data were normally distributed and Spearman’s rho when data were non-normally distributed.

Results: Both groups lost weight over time ($p < 0.001$), however the group by time interaction was non-significant ($p = 0.19$). The Minimal MI group lost 5.22kg (4.72) and the Enhanced MI group lost 3.71kg (4.46). Sixty-seven percent of Minimal MI participants and 46% of Enhanced MI participants lost at least 5% of their initial body weight ($p = 0.07$).

Conclusions: Participants in both Internet interventions lost weight over time; however, the addition of weekly MI based online chats did not enhance initial weight loss in this study. Further research is needed on the type and frequency of group support that is most beneficial in Internet weight loss interventions and could examine the independent contribution of an initial face-to-face MI group session followed by an Internet intervention.

V.B. Background

The Internet has shown great potential for public health use in many areas of health behavior including weight loss (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003; Tate, Jackvony, and Wing, 2006; Gold et al., 2007; Rothert et al., 2006) and weight maintenance (Harvey-Berino et al., 2004, Wing et al., 2006). A recent review of randomized Internet weight loss interventions for adults concluded that structured behaviorally based programs with some form of counselor feedback were efficacious in producing significant weight loss (Saperstein, Atkinson, and Gold, 2007). Previous Internet interventions in weight loss and maintenance have used individual e-mail follow-up (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003; Tate, Jackvony, and Wing, 2006) or on-line group sessions as a means of treatment support (Harvey-Berino, Pintauro, Gold, 2002; Wing et al., 2006; Gold et al., 2007). These studies have demonstrated that adding some ongoing support or guidance from a behavior change counselor in the form of individual or group support is

superior to self-directed programs (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003; Tate, Jackvony, and Wing, 2006) and to computer-automated counseling (Tate, Jackvony, and Wing, 2006).

While these previous Internet programs have produced significant weight loss, they have not achieved weight losses equivalent to face-to-face behavioral programs (Wadden and Foster, 2000). One possible way to enhance the efficacy of Internet interventions is by incorporating strategies to enhance motivation for weight loss. Building greater motivation for change might promote ongoing adherence to program procedures and attendance at online group sessions. This could be important because, although it is unclear what the optimal or even expected pattern of usage for an online treatment program is, it has been reported that program usage in the form of logins to the study website and completion of self-monitoring diaries is associated with better weight losses (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003). Opportunities for incorporating motivational techniques into Internet programs include the initial face-to-face session of the program which has been used in some previous Internet weight loss interventions to discuss safe weight loss practices, program goals, and to insure familiarity with website usage (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003; Tate, Jackvony, and Wing, 2006; Wing et al., 2006). Online programs might also promote continued motivation by using motivational counseling techniques in the form of ongoing counselor support.

One promising technique for building motivation for both individuals and groups is motivational interviewing (MI). MI is an adaptation of psychotherapy that uses a client-centered approach to resolve ambivalence and increase intrinsic motivation for change (Miller and Rollnick, 2002). One goal of MI is to elicit self-motivational statements, or

reasons for change, from participants. MI has been adapted and used successfully in the treatment of smoking, drug abuse, alcohol abuse, weight loss, exercise, and diet (Noonan and Moyers, 1997; Burke, Arkowitz, and Dunn 2002; Burke, Arkowitz, and Menchola, 2003; West et al., 2007; Carels et al., 2007). This technique has been shown to consistently increase attendance in treatment programs (Van Wormer and Boucher, 2004; Bowen, et al. 2002; Smith, et al., 1997; Feld et al., 2002; Goldberg and Kiernan, 2005), which may be one mechanism for promoting long-term behavior change.

To our knowledge, MI has been used in only a limited number of face-to-face studies for weight loss and one Internet based intervention. Participants in one face-to-face behavioral intervention with individual MI counseling showed significantly greater attendance at group meetings, completion of food diaries, and greater monitoring of blood glucose but not greater weight loss compared with a control group (Smith et al., 1997). Another study found that the administration of two MI sessions in addition to a face-to-face behavioral weight loss program produced greater weight loss over six months compared to the behavioral program alone (West et al., 2007). MI has also been used in a face-to-face initial group session to promote retention in a weight loss program and resulted in follow-up rates of 96-98% over 6-18 months (Goldberg and Kiernan, 2005). Finally, one previous study has used MI in an online chat group environment; online chats were led using an MI style in an effort to promote smoking cessation and resulted in more favorable self-reported outcomes compared to the control group (Woodruff et al., 2001). These studies suggest that MI could be used in Internet weight loss studies in the initial face-to-face session and also in an ongoing manner throughout the web based program and may be helpful for promoting adherence, retention, and weight loss.

The goal of the current study was to investigate the efficacy of two different behavioral weight loss programs enhanced by motivational interviewing for promoting weight loss. We hypothesized that an intervention which incorporated an MI base face-to-face session, an Internet behavioral weight loss program, and weekly online chats led in an MI style would produce greater weight loss than an intervention which included only an MI based face-to-face session and an Internet behavioral weight loss program without ongoing counselor support.

V.C. Methods

The University of North Carolina at Chapel Hill Institutional Review Board approved all procedures in this study.

Participants

Adult women ages 22-65 who had a body mass index (BMI) between 25 and 40, and had home access to a computer with Internet service were recruited. Exclusion criteria included a medical diagnosis of orthopedic or joint problems that might prohibit regular exercise, hospitalization for a psychiatric disorder within the last year, history of anorexia or bulimia nervosa, intention to move out of the immediate area within the study period, medical diagnosis of HIV, diagnosis with a major psychiatric disorder (i.e. bipolar disorder or schizophrenia), pregnant, nursing, or planning to become pregnant within the study period, less than nine months post-partum, cancer diagnosis within five years with the exception of skin cancer, and recent weight loss of ≥ 10 pounds. Exclusion criteria also included the endorsement of any of the first three items on the Physical Activity Readiness Questionnaire (PAR-Q) (Shepard, Cox, Semper, 1981; Shepard, 1988) which included heart problems,

chest pain, faintness, or dizzy spells, or endorsement of any of the other items on the PAR-Q without a physician's consent. Twenty participants required physician consent.

Participants were recruited through a newspaper advertisement and were screened for eligibility via telephone interview. Eligible participants were then invited to a study information session. At this information session participants learned further details about the study and interested participants were asked to sign a consent form, complete study questionnaires, and undergo height and weight measurements (Figure 1).

Design

Participants were randomized to one of two treatment groups: Minimal MI (n=33) or Enhanced MI (n=33). All participants were seen in the clinic at baseline and four months for measurement of body weight and completion of study questionnaires. Participants received \$40 for attending the follow-up appointment. Participants also completed questionnaires at four, eight, and twelve weeks via email.

Participants in both groups received one separate, but equivalent, face-to-face weight loss session at the beginning of the study which included a presentation of information on exercise and dietary goals, an overview of energy balance, instructions for self-monitoring, safe dietary practices, exercise safety recommendations, and orientation to the study website. The sessions were led in an MI style and also included a discussion of pros and cons of change, importance of change, and motivation for weight loss. All participants were provided with a calorie book and self-monitoring diaries at this session.

Both study groups were given equivalent goals for diet and exercise during the face-to-face weight loss sessions. These goals were based on the Diabetes Prevention Program and the recommendations of the Dietary Guidelines for Americans 2005 (USDA, 2005), the

American College of Sports Medicine (Jakicic et al., 2001), and The IOM report on Dietary Reference Intakes (IOM, 2002). The participants' goals were to eat a low-calorie and low-fat diet of not more than 25% of calories from fat and not more than 1200 kcal/day for participants weighing less than 200 pounds and a diet of 1500 kcal/day for participants weighing 200 or more pounds. Thirty to sixty minutes of moderate to vigorous physical activity per day was also recommended for all participants.

At the conclusion of the face-to-face session participants were given password protected access to the study website. The website was adapted from an existing website used in previous Internet behavioral weight loss programs (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003) and contained standard of care information, a message board feature, self-help resources available on the web, weekly lesson postings, and a link to a personal on-line self-monitoring report form which participants were asked to use to report, at least weekly, daily caloric intake, weight, and daily exercise. The website was identical for the two groups except for the link to the weekly chat on the Enhanced MI website.

Topics for the 16-week behavioral weight loss lessons were similar to the core of the Diabetes Prevention Program (DPP). The DPP lessons were developed for use in a face-to-face individual setting where counselors interacted with participants and provided problem solving and support verbally. These lessons were modified for use in this study in such a way that they were more self-directed and suitable for posting to the website. The modifications included adding an introductory section to the beginning of each lesson and adding more details throughout the lesson to fill in any information gaps.

The weekly on-line group sessions lasted one-hour, were led by a nutrition graduate student trained in MI, and followed the outline of a moderator's guide. The guide included a

brief discussion of the weekly lesson and focused on the pros and cons of the proposed behavior change and how the MI concepts of readiness, importance, and confidence in behavior change related to the weekly topic. The concept of the relationship between core beliefs or values and behavior change was introduced in week seven. The online group procedures and their efficacy in producing self-motivational statements were tested previously (Webber, Tate, and Quintiliani, 2007, under review). To ensure a group size that allowed for maximal participation and to allow for flexibility in time of attendance at the group session, the 33 participants in the Enhanced MI group were divided into two groups that met at different times on the same evening for the purpose of participating in the weekly on-line group sessions.

Approximately five months following the end of the study, participants were invited to complete an additional online survey. This survey assessed behaviors during the 16-week intervention including whether participants had contacted fellow study participants via email or met with them face-to-face. The survey also asked if participants had taken weight loss medications or participated in any other weight loss programs during the 16-week intervention.

Measures

A trained research assistant, blinded to group assignment, measured participant weight in the clinic at baseline and 16-week follow-up using a calibrated Tanita medical digital scale, model # BWB-800 (Arlington Heights, IL). Participant's height was measured using a calibrated, wall-mounted stadiometer (Perspective Enterprises, Inc., Portage, MI). Participants wore a hospital gown with no shoes for weight and height measurements.

In order to assess the impact of the intervention on dietary intake, the 2005 version of the Block food frequency questionnaire (ffq) (Block et al. 1986) was administered at baseline and four-month follow-up. The Paffenbarger Physical Activity Questionnaire, a self-report measure of physical activity, was administered at baseline and four-month follow-up (Paffenbarger, Wing, and Hyde, 1978). The Paffenbarger has demonstrated good test-retest reliability ($r=0.72$) and adequate criterion validity (Ainsworth et al., 1993). The following psychosocial variables were assessed at baseline and examined to determine possible between group differences at baseline. Weight loss self-efficacy was measured using the weight efficacy lifestyle questionnaire (WEL-Q) (Clark et al., 1991). Exercise self-efficacy was measured using the Marcus 5-item exercise self-efficacy scale (Marcus et al., 1992). Weight loss motivation was measured using the autonomous regulation subscale of the Treatment Self Regulation Questionnaire (TSRQ) for weight loss treatment (Williams et al., 1996; Williams et al., 1999; Ryan, Plant, O'Malley, 1995).

Self-monitoring was measured from online food diary forms. Completion of at least five days of monitoring for both diet and exercise was required for a participant to receive credit for monitoring in a given week. The number of logins to the website and the number of postings to the message boards were monitored and recorded. Group attendance at on-line sessions was also recorded at each session. Participants' previous Internet experience was assessed with a simple questionnaire at baseline.

Statistical analysis

This study had 84% power to detect a difference of 3 kgs between groups with a pooled standard deviation of 4.6 kgs with $\alpha = 0.05$ on the primary outcome of weight loss. All analyses were performed using the Statistical Package for Windows version 12.0

for the Social Sciences (SPSS, Chicago, IL). Differences between groups were examined using a t-test and changes over time were examined using Repeated Measures ANOVA. Correlations were calculated using the Pearson R coefficient when data were normally distributed and Spearman's rho when data were non-normally distributed.

V.D. Results

Baseline demographic, weight, and psychosocial characteristics did not differ between the two groups. All participants were female and 86% of participants were Caucasian. Thirty-five percent of participants had a graduate degree or equivalent. The average age of participants was 50 (9.9) years and baseline BMI averaged 31.1 (3.7). The two groups did not differ on amount of previous Internet experience or on any psychosocial measure at baseline (Table 1). The two groups also did not differ on caloric intake or expenditure at baseline (Table 2). All participants (100%) came into the clinic for final weight measurement and 98% (65/66) completed follow-up questionnaires.

Both groups lost weight from baseline to 16 weeks ($p < 0.001$), however the group by time interaction was non-significant ($p = 0.19$). The Minimal MI group lost 5.22kg (4.72) and the Enhanced MI group lost 3.71kg (4.46). Sixty-seven percent of Minimal MI participants and 46% of Enhanced MI participants lost at least 5% of their initial body weight ($p = 0.07$).

There was a significant decrease in calories consumed each day over time in both groups (avg. = 368 (814), $p < 0.01$) and this did not differ significantly between the two groups ($p = 0.31$). The decrease in average number of calories consumed each day was 488 (484) for the Minimal MI group and 253 (1034) for the Enhanced MI group. Participants in the Minimal MI group decreased fat intake by 2.4 (7.0)% and participants in the Enhanced MI

group decreased fat intake by 2.3 (5.7)%; this decrease did not differ significantly between the two groups ($p=0.92$).

There was a significant increase in the number of calories burned per week through physical activity over time for both groups (avg. = 1340 (2063) kcal, $p<0.01$). The increase in calories burned through physical activity was 1087 (2389) calories per week for the Minimal MI group and 1585 (1691) calories per week for the Enhanced MI group and did not differ significantly between the two groups ($p=0.79$) (Table 2).

Program usage was assessed through website visits, diaries completed, posts to the message board, and online group attendance (Enhanced MI only). The Minimal MI group visited the study website an average of 39.7 times the Enhanced MI group visited the website 42.8 times ($p=0.26$) over the 16-week study. The number of visits to the website was associated with weight loss in both groups (Minimal, $r= -0.53$, $p<0.01$; Enhanced $r=-0.62$, $p<0.01$). In general, logins decreased over time (Table 3), however participants in both groups continued to log in at or above the average recommended amount of one time per week (Figure 2).

The average number of weekly diaries completed by the Minimal MI group was 9.1 and the Enhanced MI group completed an average of 7.5 diaries ($p=0.23$). The number of diaries completed was associated with weight loss in both groups (Minimal MI, $r=-0.64$, $p<0.01$; Enhanced MI, $r=-0.68$, $p<0.01$). The Minimal MI group posted significantly more times to the message board than the Enhanced MI group, 7.2 vs. 2.4 ($p=0.03$). The number of posts to the website message boards was associated with weight loss in both groups (Minimal MI, $r=-0.34$, $p=0.05$; Enhanced MI, $r=-0.34$, $p=0.06$). In the Enhanced MI group the average number of chats attended was 8.0 of the 16 total chats and those attending more

chats achieved greater weight loss ($r=-0.65$, $p<0.01$). When the Enhanced MI group was divided into tertiles based on chat attendance, those participants in the top tertile lost significantly more weight than the participants in the lower two tertiles ($p<0.001$) (Figure 3).

To collect additional process measures, a brief follow-up questionnaire was posted to the Internet and participants were emailed and invited to complete the questionnaire approximately five months post intervention. Seventy-six percent of participants in each group (25/33) responded to the survey. Five participants in the Minimal MI group reported meeting with other study participants face-to-face during the study period for various activities including attending exercise classes, walking, and support. None of the Enhanced MI participants reported meeting with other study participants. Weight loss was highly correlated ($r=0.95$, $p=0.05$) with number of face-to-face meetings with other participants in the Minimal MI group.

V.E. Discussion

Modest but significant weight loss was achieved over the 16-week study in both intervention groups, with an average weight loss of 4.5 ± 4.6 kg. Contrary to our hypothesis, the addition of weekly MI based online weight loss sessions did not improve weight loss in the Enhanced MI group relative to the Minimal MI group. Consistent with other Internet weight loss interventions, program usage was associated with weight loss (Saperstein, Atkinson, and Gold, 2007; Tate, Jackvony, and Wing, 2003; Tate, Jackvony, and Wing, 2006). Participants who were more engaged with the program, i.e. logged into the study website more frequently, posted more messages to the website, completed more monitoring

diaries, and attended more chats (Enhanced MI only), lost more weight. These results confirm the need to promote ongoing program usage.

Previous weight loss studies of similar length and size have reported retention rates ranging from 76-88% (Teixeira et al., 2006; White et al., 2004; Tate, Wing, and Winett, 2001; Smith et al., 1997). Retention in this study was 100% for objectively measured weights and 98% for final questionnaires. These results are consistent with one previous weight loss study that used MI to promote retention (Goldberg and Kiernan, 2005); therefore it is possible that MI used in the face-to-face weight loss session promoted higher retention in this study. However, neither this study nor the previous study that used MI to promote retention compared MI to another treatment or control to determine the impact of MI on retention rates. Higher retention rates are important because they give the study more power to detect differences, allow for smaller sample recruitment, and allow for more accurate data analysis and conclusions. Future studies could compare the effect of an MI based intervention to a non-MI based intervention on retention rates.

The increased efficacy of additional counselor support over self-directed programs alone has been shown in previous Internet weight loss studies (Harvey-Berino, Pintauro, Gold, 2002; Gold et al., 2007; Tate, Jackvony, and Wing, 2003); however our results did not find counselor support, in the form of online group chats, to have added benefit. Both study groups achieved significant weight loss and it is notable that sixty-seven percent of participants in the Minimal MI group achieved a 5% or greater weight loss, which has been shown to be clinically significant for reducing chronic disease risk factors (Goldstein, 1992; Knowler et al., 2002). This unique finding could have been due to several factors. It is possible that the Minimal MI intervention was in itself sufficient to produce significant

weight loss. The efficacy of brief MI interventions in health behavior change has been supported by previous research in the field of weight loss and physical activity (West et al., 2007; Bennett et al., 2007). Brief MI treatments have also been successful in treating alcohol and substance abuse (Grenard et al., 2007; Vasilaki, Hosier, and Cox, 2006; Beckham, 2007; Stotts et al., 2006). Further research is needed to confirm the findings of this study because there is the potential for substantial public health benefit from minimal contact interventions.

Even though the two study groups were not different at baseline on our measures of motivation or self-efficacy it is possible that the Minimal MI group was different in some way that contributed to their success. Perhaps a different instrument to measure motivation or self-efficacy would have captured differences in the two groups. It is also possible that the Minimal MI group was different in some way that was not measured in this study that enabled them to succeed with the self-directed Internet program alone.

The success of the Minimal MI group could also have been due, at least in part, to reactivity to the study protocol. A discussion of the exact procedures for the two study groups was provided in the informed consent process and the Minimal MI group was told at the initial group session that they would not receive the online chat sessions. This could have caused the Minimal MI group to be more intentional in forming group support than if they had not known the Enhanced MI group was receiving additional counselor support. If this is the reason for the relative success of the Minimal MI group, it is likely that the Minimal MI intervention would not produce the same results if used as a stand-alone program because group support may not be as strong.

Peer support could have been a factor in the relative success of the Minimal MI group. Data collected on the follow-up survey showed that 15% of the participants in the

Minimal MI group met face-to-face on their own during the study period for support and exercise sessions, while none of the Enhanced MI participants arranged face-to-face meetings outside of the program. The Minimal MI group also used the message boards significantly more than the Enhanced MI group. It is possible that the message board and outside meetings were equivalent group support mechanisms to the counselor led online chats in the Enhanced MI group. The usage of the message board, chat group attendance, and contact with other participants outside of the study all represent sources of social support, and all were significantly correlated with weight loss. Therefore, it seems that group support, through any of those three channels, may have been beneficial for producing weight loss. Alternately, it could have been that those participants who were the most motivated and engaged in the weight loss process were more likely to seek out extra support from others through message boards, chat groups, and outside meetings. Perhaps building motivation for peer support at the initial face-to-face session and providing channels for peer support such as peer-led chats would be a cost-effective method for enhancing weight loss that could be explored in future studies. Different methods of counselor-led group support, including online and in-person, have been explored in weight maintenance studies and these different modes of support delivery were not shown to have differential effects on weight maintenance (Harvey-Berino et al., 2004; Micco et al., 2007).

One possible reason that the Enhanced MI group did not have greater weight loss could have been the lack of utilization of the online chat group sessions. While there was a high correlation between chat attendance and weight loss, attendance at the weekly chat sessions averaged only half of those offered (e.g., 8 out of 16 possible chats). The lack of attendance at the online chats could have been due to the chat format. Follow-up data on

chat usage and acceptability was not collected, but it is possible that the day or time of the online groups was inconvenient for participants or the necessity to have a scheduled chat session decreased the desired convenience of the Internet treatment. It is also possible that some participants may have found the format of the chat sessions difficult to follow and therefore unappealing. The lower than expected chat attendance could also have been due to the use of MI in the chat sessions. Perhaps the MI based topics of the chats were offensive or unappealing to participants, however, this is unlikely given the results from our previous research with similar participants which found the chat group format for weight loss to be acceptable and that participants reported being willing to participate in a similar online group again (Webber, Tate, Quintiliani, 2007, under review). One final possibility is that the participants did not find the MI based chats to be helpful. One of the weaknesses of this study was that there were no follow-up questions on chat acceptability. In the future, there is a need to follow-up on the acceptability of the chat topics, format, convenience of day and time, group interactions, and helpfulness of the chat. The lack of group differences and the success of the Minimal MI group in the 16-week intervention suggest several possible avenues for further research.

The weaknesses of this study include a small, highly educated, all female sample of participants; therefore the results may not be generalizable to other study populations. This study design also does not allow for the determination of the specific contribution of MI to outcomes because MI was used in the face-to-face sessions for both groups. In addition, there was no true control group in this study. It is possible that the weight loss seen in study participants could have been due to other secular influences; however, results from other interventions with control or minimal intervention groups (Tate, Wing, and Winett. 2001;

Elliot et al., 2007) and data on national trends (Brown et al., 2005; Lewis et al., 2000; Robbins et al., 2006) make this unlikely. Finally, the study period of 16 weeks was brief and did not allow for longer-term conclusions about this approach.

V.F. Conclusions

Both MI based interventions produced beneficial weight loss, with over half of all study participants achieving a 5% or greater weight loss in 16 weeks. The addition of weekly MI based chats did not increase weight loss over the basic Internet behavioral intervention. Our results indicate the possibility that one initial MI based face-to-face session, along with a self-directed Internet program that included a peer support mechanism, was sufficient to produce significant weight loss. There is great potential for public health benefit of minimal interventions and therefore the use of an initial face-to-face MI session to promote weight loss should be explored further.

Figure 4. 16-Week Study Participant Flow

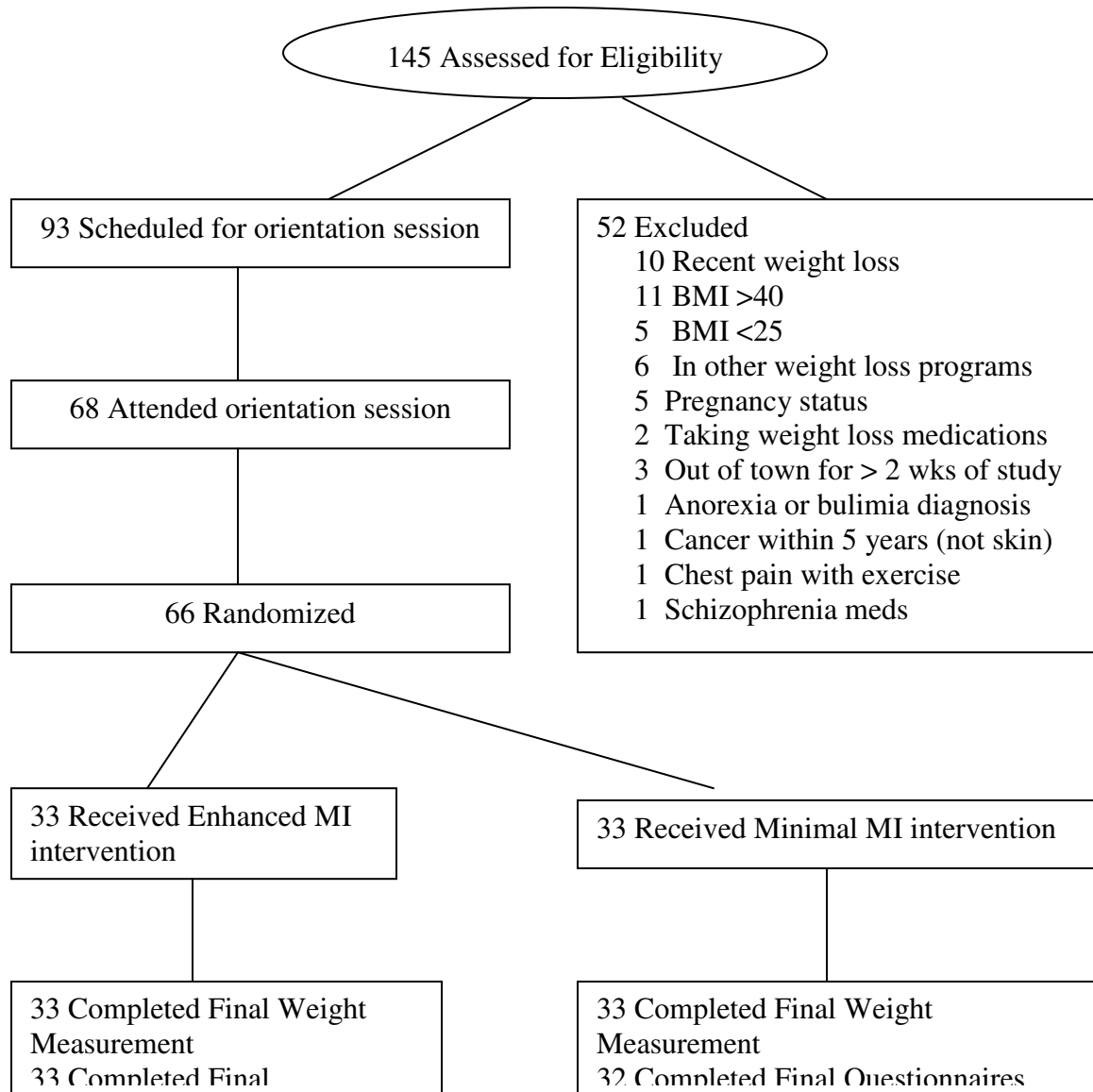


Table 2. 16-week Study Baseline Measures

	Minimal MI	Enhanced MI	p-value
Race	85% Caucasian	88% Caucasian	0.47
Education	72% college degree or greater	66% college degree or greater	0.29
Marital Status	67% married or living with partner	79% married or living with partner	0.72
Age	50.8 (9.3)	49.3 (10.6)	0.53
Weight (kg)	82.5 (8.4)	82.1 (13.6)	0.90
Height (inches)	63.8 (2.3)	64.2 (2.6)	0.49
BMI (kg/m2)	31.4 (3.3)	30.8 (4.0)	0.28
Internet Usage (months)	108 (37)	104 (43)	0.71
Weight Loss Self-efficacy (WEL-Q)	120.5 (23.4)	120.6 (32.3)	0.73
Physical Activity Self-efficacy	13.6 (3.1)	14.4 (2.8)	0.27
Autonomous Motivation (TSRQ)	5.85 (0.86)	5.56 (1.08)	0.25

Table 3. 16-week Study Energy Intake and Expenditure

	Baseline	16-week Follow-up	p-value*
Energy Intake (kcal/day)			
Minimal MI	1735 (806)	1232(538)	0.31
Enhanced MI	1723 (766)	1471 (1193)	
Percent Fat Intake			
Minimal MI	37.4 (6.8)	34.9 (5.8)	0.92
Enhanced MI	36.1 (6.1)	33.9 (4.3)	
Physical Activity (kcal/week)			
Minimal MI	1531 (2265)	2542 (1483)	0.79
Enhanced MI	819 (1065)	2403 (2137)	

***p-value indicates comparison in amount of change over time in the two treatment groups**

Figure 5. 16-week Study Logins per Month

The black line indicates the recommended average frequency of logins each month (one each week).

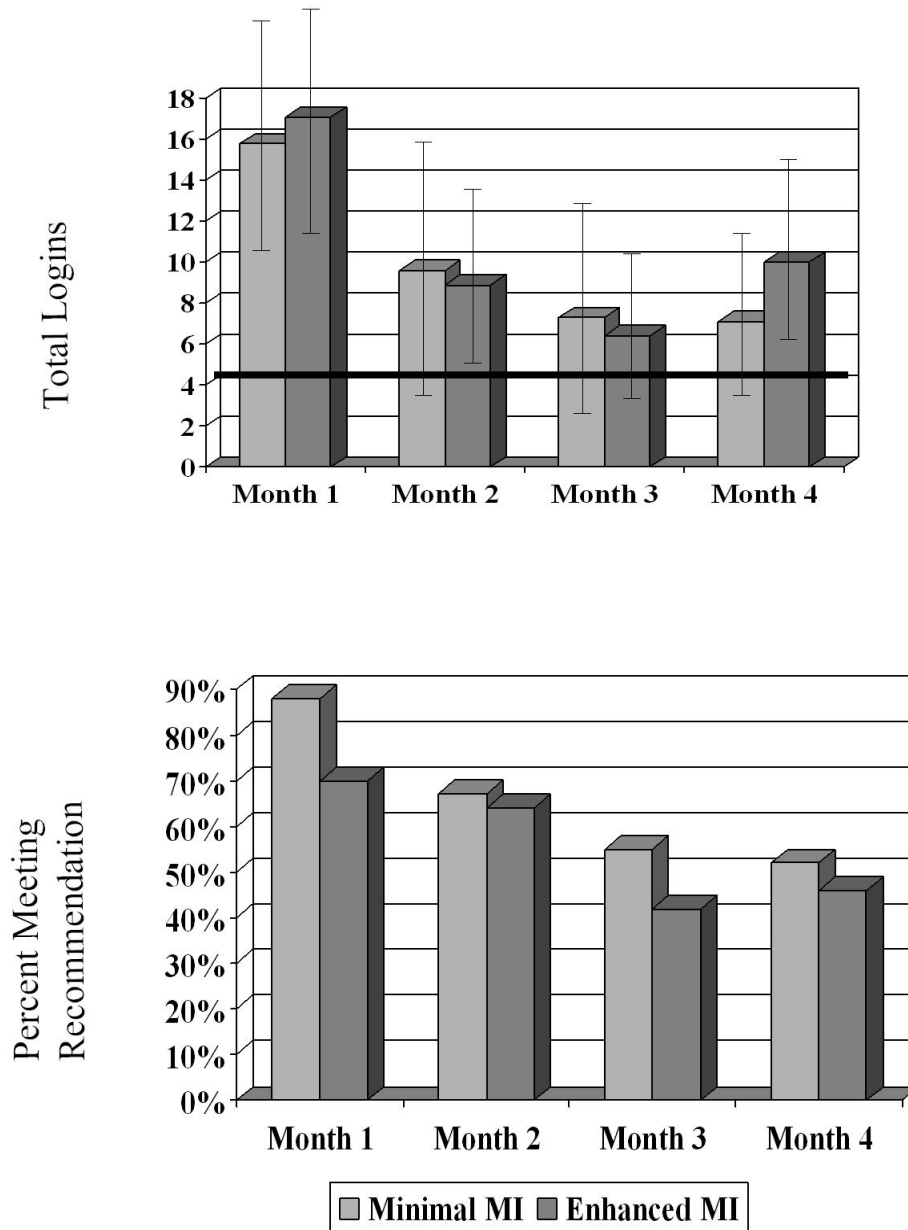
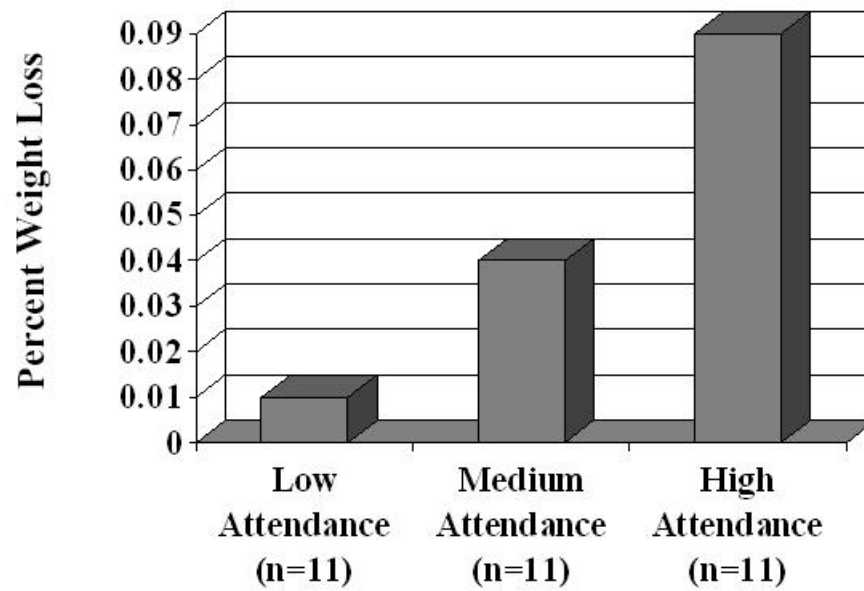


Figure 6. 16-week Study Chat Attendance Tertiles



CHAPTER VI

MOTIVATION, ADHERENCE, AND WEIGHT LOSS IN A 16-WEEK INTERNET BEHAVIORAL WEIGHT LOSS INTERVENTION

Webber KH, Tate DF, Ward DS, Bowling JM

VI.A. Abstract

Adherence to program procedures has been correlated with desirable outcomes in previous health behavior interventions. One way to increase adherence and possibly effect weight loss is the use of motivational interviewing (MI). MI is a counseling technique that has been shown to increase adherence in several health behavior change programs and to improve weight loss in at least one previous face-to-face behavioral program. The mechanism by which MI increases adherence has not been elucidated. In this study, two different 16-week interventions were compared, both of which were started with one face-to-face MI session. Both groups lost weight (4.5kg), though no between group differences were found. The sample (n=66) was collapsed to examine the relationships among autonomous motivation, adherence to completion of online self-monitoring diaries, and weight loss. Motivation was measured at baseline, at three time points throughout the study, and at follow-up. Changes in motivation over time were examined using repeated measures analysis of variance. The relationships among autonomous motivation, program adherence, and weight loss were examined using regression analysis. Autonomous motivation levels increased significantly between baseline and four weeks for the majority of participants.

Autonomous motivation at four weeks was found to be a predictor of weight loss ($r = -0.28$, $p < 0.05$) and adherence ($r = 0.40$, $p < 0.01$); baseline autonomous motivation was not found to predict weight loss or adherence. Regression analysis revealed that autonomous motivation at four weeks was a significant predictor of self-monitoring. Self-monitoring and years of previous Internet experience predicted a significant amount of variance in 16-week weight loss (adjusted $R^2 = 0.41$). It appears that motivation may impact weight loss through its' effect on self-monitoring. Future studies should focus on building motivation for weight loss and self-monitoring.

VI.B. Background

Adherence to treatment recommendations and procedures is essential for successful medical and behavioral interventions. Adherence can be measured in many ways, including adherence to medication regimens, attendance at treatment sessions, completion of self-monitoring diaries, and monitoring of blood glucose; these measures of adherence have all been positively correlated with better health outcomes in previous research (Jeffery, Bjornson-Benson, Rosenthal, 1984; Stewart, King, and Haskell, 1993; Smith et al., 1997; Schmid et al., 1991; Simpson et al., 2006). In weight loss interventions, treatment adherence is associated with weight loss in both face-to-face and Internet weight loss programs. In face-to-face programs, completion of self-monitoring diaries and attendance at treatment sessions are correlated with greater weight loss (Teixeira et al., 2002; Williams et al., 1996; Vitolins and Naughton, 2000; Jeffery, Bjornson-Benson, Rosenthal, 1984; Stevens et al., 1989; Streit et al., 1991). In Internet programs, greater adherence in the form of logins to the

study website and completion of self-monitoring diaries have also been correlated with greater weight loss (Tate, Wing, Winnet, 2001; Tate, Jackvony, Wing, 2003).

Different approaches have been developed to improve adherence to medical and behavioral recommendations. For example, several methods for improving short-term adherence to medication regimens have been successful, including counseling on the importance of adherence, providing written information, and making reminder phone calls (Haynes et al., 2005). However, a recent review concluded that there was insufficient evidence to support the use of contracts, written or verbal agreements for increasing treatment adherence (Bosch-Capblanch et al., 2007). Traditional self-monitoring of diet, exercise, and weight has been done with paper and pencil. In an effort to improve the convenience of monitoring, personal hand-held computer devices (PDAs) have been studied to determine if increased convenience would improve adherence to self-monitoring (Yon et al., 2007). No increase in adherence to self-monitoring was observed with PDA devices, however the frequency of self-monitoring with both methods was associated with weight loss (Yon et al., 2007).

Another possible way to increase self-monitoring in weight loss interventions is to use techniques to increase motivation for weight loss and monitoring. Motivational interviewing (MI) is a counseling technique (Miller and Rollnick, 2002) that has been adapted and used in interventions to increase weight loss (West et al., 2007; Wollard et al., 1995), improve dietary intake (Resnicow et al., 2001; Bowen et al., 2002), and increase physical activity (Harland et al., 1999; Brodie and Inoue, 2005). The use of MI in these interventions has led to improved program attendance, adherence, and retention (Resnicow et al., 2001; Bowen et al., 2002; West et al., 1997; Goldberg and Kiernan, 2005), however the

exact mechanism by which MI works is still unknown (Burke, Arkowitz, Dunn, 2002; Burke, Arkowitz, Menchola, 2004). The basic principles of MI include supporting self-efficacy, developing discrepancy between current and desired behavior, and eliciting self-motivational statements (Miller and Rollnick, 2002). Self-motivational statements include statements that acknowledge the benefits of change, recognize optimism for or commitment to change, and identify dissatisfaction with the status quo. One previous study has shown that the use of MI in Internet weight loss chat groups elicited self-motivational statements from participants and the number of these statements uttered correlated with autonomous motivation, a person's personal or internal reasons for change, at follow-up of the eight week intervention (Webber, Tate, Quintiliani, 2007, under review). To our knowledge, no study that has employed the technique of motivational interviewing has examined the relationships among autonomous motivation, adherence to program procedures, and program outcomes. Based on the principles of MI and the one previous MI-based Internet weight loss study, we propose that MI works through increasing autonomous motivation, thereby increasing adherence to program procedures.

In previous health behavior research, studies have found baseline measures of motivation to be predictive of weight loss. Baseline motivation, as measured by the Self Motivation Inventory (SMI), which measures internal or autonomous reasons for change, has been predictive of weight loss at follow-up of two different four-month interventions (Teixeira et al., 2002; Teixeira et al., 2004; Dishman and Ickes, 1981). Baseline scores on the Intrinsic Motivation Inventory (IMI), which measures internal or personally fulfilling reasons for change, also predicted weight loss at four months in a weight loss intervention (Palmeira et al., 2007).

Another measure of motivation, the Treatment Self-Regulation Questionnaire (TSRQ) based on the self-determination theory, measures both autonomous motivation and controlled motivation. Autonomous motivation is a measure of a person's internal or personal reasons for change including both intrinsic and extrinsic reasons such as feeling that performance of a behavior is the best way to help oneself and feeling that one wants to make changes for personal reasons. Controlled motivation is a measure of extrinsic reasons to change including the perceived pressure from others to perform a behavior and the performance of a behavior to avoid feelings of guilt (Williams et al., 1996; Williams et al., 1999; Ryan, Plant, O'Malley, 1995). This measure of motivation (TSRQ) was used in a cross-sectional analysis of physical activity in adult cancer survivors and a comparison group; results showed that autonomous motivation was positively correlated with moderate to vigorous physical activity, while controlled motivation was negatively correlated with physical activity (Wilson et al., 2006). Baseline autonomous and controlled motivation, as measured by the TSRQ, has also been shown to predict increased fruit and vegetable intake and increased physical activity in health behavior interventions of varying lengths (Levesque et al., 2006).

In the area of weight loss, the TSRQ has been used to measure motivation for weight loss a few weeks into a weight loss program, in order to capture a more realistic measure of motivation for change. This study found that greater autonomous motivation at five to ten weeks predicted greater weight loss at six months and better weight maintenance at 23-month follow-up, while greater controlled motivation was predictive of smaller weight loss at six months and was not related to 23-month weight maintenance (Williams et al., 1996). This same study found a relationship between autonomous motivation and adherence as measured

by program attendance; greater autonomous motivation was correlated with better program attendance, which was correlated with greater weight loss. The authors found that program attendance mediated the effect of autonomous motivation on weight loss.

The present research explored changes in motivation over time and the relationship between motivation, adherence, and weight loss in a 16-week behavioral Internet weight loss program enhanced by motivational interviewing. Motivation was measured at baseline, four, eight, 12, and 16 weeks of the program using both the autonomous and controlled motivation subscales of the TSRQ. We hypothesized that motivation would increase after the initial face-to-face MI based session. Consistent with prior research, we also hypothesized that autonomous, but not controlled motivation at baseline and four weeks would predict weight loss. Finally, concerning the relationships among motivation, adherence, and weight loss, we hypothesized that baseline and four-week measures of autonomous motivation would predict adherence, and that adherence would predict weight loss.

VI.C. Methods

The University of North Carolina at Chapel Hill Institutional Review Board approved all procedures in this study.

Participants

Adult women ages 22-65 with a body mass index (BMI) between 25 and 40, and a home computer with Internet access were recruited. Exclusion criteria included a medical diagnosis of orthopedic or joint problems that might prohibit regular exercise, hospitalization for a psychiatric disorder within the last year, history of anorexia or bulimia nervosa, intention to move out of the immediate area within the study period, medical diagnosis of

HIV, diagnosis with a major psychiatric disorder (i.e. bipolar disorder or schizophrenia), pregnant, nursing, or planning to become pregnant within the study period, less than nine months post-partum, cancer diagnosis within five years with the exception of skin cancer, and recent weight loss of ≥ 10 pounds. Exclusion criteria also included the endorsement of any of the first three items on the Physical Activity Readiness Questionnaire (PAR-Q) (Shepard, Cox, Semper, 1981; Shepard, 1988) which included heart problems, chest pain, faintness, or dizzy spells, or endorsement of any of the other items on the PAR-Q without a physician's consent. Twenty participants required physician consent.

Design

Participants were randomized to one of two treatment groups: Minimal MI (n=33) or Enhanced MI (n=33). All participants were seen in the clinic at baseline and four months for measurement of body weight and completion of study questionnaires. Participants received \$40 for attending the follow-up appointment. Participants also completed questionnaires at four, eight, and 12 weeks via email.

Participants in both groups received one separate, but equivalent, face-to-face weight loss session at the beginning of the study which included a presentation of information on exercise and dietary goals, an overview of energy balance, instructions for self-monitoring, safe dietary practices, exercise safety recommendations, and orientation to the study website. The sessions were led in an MI style by a nutrition graduate student trained in MI and included a discussion of pros and cons of change, importance of change, and motivation for weight loss. All participants were provided with a calorie book and self-monitoring diaries at this session.

At the conclusion of the face-to-face session, participants were given password protected access to the study website. The website was adapted from an existing website used in previous Internet behavioral weight loss programs (Tate, Wing, and Winett, 2001; Tate, Jackvony, and Wing, 2003), contained standard of care information, a message board feature, self-help resources available on the web, and weekly lesson postings. These sites were separate and equivalent for the two study groups except for the link to the weekly chat on the Enhanced MI website. The website also contained a link to a personal on-line self-monitoring report form which participants were asked to use to report, at least weekly, daily caloric intake, daily exercise, and weight.

Measures

A trained research assistant, blinded to group assignment, measured participant weight in the clinic at baseline and 16-week follow-up using a calibrated Tanita medical digital scale, model # BWB-800 (Arlington Heights, IL). Participant's height was measured using a calibrated, wall-mounted stadiometer (Perspective Enterprises, Inc., Portage, MI). Participants wore a hospital gown with no shoes for weight and height measurements.

Motivation for weight loss was measured at baseline, four, eight, 12, and 16 weeks using the Treatment Self Regulation Questionnaire (TSRQ) (Williams et al., 1996; Williams et al., 1999; Ryan, Plant, O'Malley, 1995). Participants rated different reasons for participating in a weight loss program on a scale of one to seven. Two motivation subscales, autonomous and controlled motivation, were measured separately by totaling the scores on all items on the subscale and dividing by the total number of items (Self-Determination Theory website, accessed March 2007).

Self-monitoring was measured from online food, exercise, and weight diary forms. Completion of at least five days of monitoring for both diet and exercise was required for a participant to receive credit for monitoring in a given week. Previous Internet usage was assessed at baseline with a simple questionnaire on previous Internet experience.

Statistical analysis

All analyses were performed using the Statistical Package for Windows version 12.0 for the Social Sciences (SPSS, Chicago, IL). Differences between groups were examined using t-tests when data were normally distributed or Mann-Whitney U tests in cases when the data were nonnormally distributed. Correlations were calculated using the Pearson R coefficient when data were normally distributed and Spearman's rho when data were non-normally distributed. Changes in motivation over time were examined using repeated measures analysis of variance. Linear regression models were employed to predict self-monitoring and 16-week weight loss. An alpha level of 0.05 using a two-tailed test was the criterion for statistical significance.

VI.D. Results

Baseline Characteristics

Baseline demographic, weight, and psychosocial characteristics did not differ between the two treatment groups. All participants were female (n=66); 86% of participants were Caucasian, 12% African American, and 2% Asian. Thirty-five percent of participants had a graduate degree, 35% had a college degree, and 30% had less than a college degree. The majority of participants were married or living with a partner. The average age of participants was 50 (9.9) years. At baseline, participants had an average BMI of 31.1 (3.7)

and, on average, 8.8 years of Internet experience (Table 1). All participants came into the clinic for final weight measurement and 98% (65/66) completed follow-up questionnaires.

Overall Treatment Outcomes

Both treatment groups lost weight over time, an average of 4.5 ± 4.6 kg at 16 weeks, however there were no between group differences. Fifty-six percent of participants lost at least 5% of their initial body weight. The two treatment groups did not differ on levels of autonomous or controlled motivation at any time point or on the number of self-monitoring diaries completed throughout the 16-week study. Both groups had a significant increase in autonomous motivation between baseline and four weeks (Enhanced MI avg. increase= 0.64, $p=0.01$; Minimal MI avg. increase= 0.44, $p=0.01$) and that increase did not differ between the two groups ($p=0.62$). Both groups also increased in controlled motivation between baseline and four weeks (Enhanced MI avg. increase= 0.32, $p=0.10$; Minimal MI avg. increase= 0.32, $p=0.03$) and that increase did not differ between the two groups ($p=0.99$).

Changes in motivation over time

Due to the lack of treatment group differences, the entire sample of 66 participants was collapsed. To examine the relationship between motivation and achieving a significant weight loss, the group was then divided into those who lost 5% of initial body weight at 16 weeks and those who did not. A 5% loss of initial body weight has proven to be clinically significant in improving health risk factors, including decreasing blood pressure, improving blood glucose control, and decreasing total cholesterol (Goldstein, 1992; Knowler et al., 2002). After dividing the sample based on achieving the 5% goal, the two groups were comparable in size and did not differ at baseline on any demographic characteristic or on autonomous or controlled motivation (Table 2).

Between baseline (following the initial face-to-face session) and four weeks, there was an increase in both autonomous (Achieved goal avg. increase=0.54, $p=0.001$; Did not achieve goal avg. increase=0.52; $p=0.10$) and controlled motivation (Achieved goal avg. increase=0.31, $p=0.04$; Did not achieve goal avg. increase=0.33; $p=0.09$) for both groups with no difference in increase between groups for either autonomous ($p=0.92$) or controlled motivation ($p=0.91$). The group who ultimately achieved the 5% weight loss at 16 weeks had greater levels of autonomous motivation at four, eight, 12, and 16 weeks ($p=0.01$) compared to the group who did not reach a 5% weight loss (Figure 1). Controlled motivation levels differed between the groups at weeks 12 and 16 only. Autonomous motivation remained steady between weeks four and 16 for the successful group ($p=0.33$), but declined significantly for the unsuccessful group during the same time period ($p<0.001$).

Relationship between motivation and adherence

Correlational analysis in the total study sample ($n=66$) revealed that neither autonomous nor controlled motivation at baseline predicted completion of self-monitoring diaries; however autonomous motivation at four weeks was strongly correlated with the number of diaries completed during the 16-week study (Table 3). Regression analysis was then used to determine the relationship between autonomous motivation measured at week four and self-monitoring over the entire 16-week study and self-monitoring between weeks five and 16. The model controlled for years of previous Internet usage because reporting of self-monitoring was done via the online diary form, and for treatment group, because self-monitoring was encouraged in the online group sessions received by one of the treatment groups. In this model, autonomous motivation at four weeks predicted a significant amount

of the variance in completion of self-monitoring diaries over 16 weeks (adjusted $R^2=0.20$; $p=0.001$) and between weeks five and 16 (adjusted $R^2=0.14$; $p=0.01$).

Predictors of Weight Loss – Mediation Analysis

Predictors of 16-week weight loss in the total sample were examined using correlational analysis. The relationship between the two subscales of the TSRQ, autonomous and controlled motivation, at each time point measured, and 16-week weight loss were explored. Neither measure of motivation at baseline was correlated with 16-week weight loss; however, autonomous motivation at four weeks was correlated with 16-week weight loss (Table 3). Completion of self-monitoring diaries over the entire 16-week study was strongly correlated with 16-week weight loss ($r = -0.63$; $p<0.01$). There was also a significant correlation between total years of previous Internet usage and 16-week weight loss ($r = -0.30$; $p=0.02$).

Predictors of 16-week weight loss were then examined using regression analysis. Four-week autonomous motivation was entered into the model first because the principal purpose of this study was to investigate the impact of a motivational intervention on outcome. Four-week autonomous motivation predicted a small but significant amount of variance in 16-week weight loss (adjusted $R^2 = 0.05$; $p = 0.05$). The number of self-monitoring diaries completed was entered into the model next. Self-monitoring was selected for inclusion because it had a strong correlation with 16-week weight loss in this study and because measures of adherence have been related to weight loss in other studies. This model predicted a significant amount of variance in 16-week weight loss (adjusted $R^2 = 0.32$; $p<0.001$) however four-week autonomous motivation was no longer a significant predictor of weight loss. The final model included only the number of self-monitoring diaries completed

and years of previous Internet usage. This model predicted 41% of the variance in 16-week weight loss (Table 4).

VI.E. Discussion

While excess weight is related to increased morbidity and mortality (NHLBI, 1998), weight loss of as little as 5% of initial body weight has been shown to decrease chronic disease risk factors (Goldstein, 1992; Knowler et al., 2002). Since effective weight loss treatments have the potential to greatly impact public health, it is imperative to continue to develop more effective weight loss treatments. Understanding the predictors of weight loss may be important in the development of more effective treatments. There has been considerable interest in the predictors of weight loss and previous research has focused on either pretreatment cognitive factors such as self-efficacy, outcome expectations, and motivation or weight loss behaviors such as change in eating or exercise behaviors or self-monitoring. The present research elucidates the relationships among the cognitive measure of motivation, the behavior of self-monitoring, and the outcome of weight loss.

The majority of participants had a significant increase in autonomous motivation between baseline and four weeks into the program. While it is not possible to tell the exact mechanism by which MI impacts program adherence and outcomes, this increase in motivation could have been due to the initial face-to-face MI session. However, because motivation was not measured immediately before and after the initial MI session it is not possible to determine if the increase in motivation was due to the MI session or some other factor. In fact, our data indicated a correlation between self-reported weight loss at four weeks and increased autonomous motivation between baseline and four weeks and it has

been suggested that early weight loss is a marker for motivation (Stotland and Larocque, 2005). Previous research has also found early weight loss success to predict later success (Carels et al., 2003). Thus, it is possible that the increase in autonomous motivation was not due to the initial MI session but was only a marker of success at that time point.

Differences in motivation levels between participants who achieved a clinically significant weight loss and those who did not were also examined. Participants who ultimately achieved a 5% weight loss and those who did not achieve a 5% weight loss had similar increases in autonomous motivation between baseline and four weeks; however, at four weeks the level of autonomous motivation was significantly higher in the group that achieved the 5% weight loss. Further research is needed to determine if the increase in autonomous motivation early in a weight loss study is important for predicting success, or if the absolute amount of autonomous motivation at a given time point is a better predictor of long-term weight loss success. Future studies should also consider measuring motivation, self-efficacy, social support, depression, program satisfaction, and other psychosocial factors a few weeks after an intervention has begun in order to capture the effect of early program experience on those factors and to determine if change in those factors impacts long-term success. Early weight loss should also be measured, because it is possible that early change in cognitive measures is due to early weight loss success and not early program experience.

Autonomous motivation was significantly higher for participants who achieved a 5% weight loss than participants who did not achieve a 5% weight loss at four, eight, 12, and 16 weeks. Even at baseline, autonomous motivation was higher among those who achieved the 5% weight loss and approached significance ($p=0.09$). Interestingly, measures of autonomous motivation followed different patterns over time for participants who were

successful and participants who were not successful; autonomous motivation increased between baseline and four weeks and then remained stable in successful participants but in unsuccessful participants autonomous motivation increased between baseline and four weeks and then decreased between weeks four and 16. To our knowledge, this research is the first to publish levels of autonomous motivation throughout a weight loss intervention. This elucidation of motivation patterns and absolute levels of motivation, as measured by the TSRQ, throughout a weight loss intervention may be a base on which to build evidence for levels of motivation or patterns of motivation change which might indicate a participants' likelihood of success or failure in weight loss programs. In future interventions, participants with low or declining levels of motivation could be given more intense support or different types of interventions including more frequent contact from a weight loss counselor in the form of emails, phone calls, or face-to-face meetings with the goal of increasing motivation and weight loss.

It is possible that the levels of motivation over time found in this study only reflected weight loss progress over time, with those participants who did not lose as much weight as desired losing interest and motivation for the weight loss program. Since we did not have weight loss measures at eight and 12 weeks, it is not possible to more fully disentangle the relationship between weight loss success and motivation in this intervention. Future studies could explore separating the effects of early weight loss and motivation on long-term weight loss success by using a larger sample size, more frequent weight measurements coupled with statistical methods, and by utilizing more and different measures of motivation that capture different dimensions of the construct.

In this brief Internet behavioral intervention, autonomous motivation at four weeks was strongly related to adherence in the form of completion of self-monitoring diaries. Adherence to program procedures was a strong predictor of weight loss success in this study as it has been in other studies (Tate, Wing, Winnet, 2001; Tate, Jackvony, Wing, 2003; Stevens et al., 1989; Streit et al., 1991). Future interventions could focus on building motivation early and continuously for weight loss in general and for adherence to specific behaviors related to weight loss including sticking to calorie limits, meeting physical activity goals, and self-monitoring. One way to build motivation may be through the use of MI techniques.

In previous face-to-face studies, motivation measured at both baseline and a few weeks into an intervention were predictive of weight loss (Teixeira et al., 2002; Teixeira et al., 2004; Palmeira et al., 2007; Williams et al., 1996). In this Internet study, when controlling for years of previous Internet experience, four-week autonomous motivation did not predict 16-week weight loss. Autonomous motivation did not have a direct effect on weight loss, but had an influence through self-monitoring. The lack of a direct effect of motivation on weight loss in this study could have been due to the effect of previous Internet experience on weight loss. The effect of previous Internet experience is somewhat surprising considering that all participants willing signed up for an Internet-based program and averaged almost nine years of Internet experience. However, the entire program, except one face-to-face weight loss session, was delivered via the Internet. Participants were required to go online to read weekly lessons, read and post messages to the message board, and enter data into their online self-monitoring forms.

Other studies have found mixed results on the impact of controlled motivation on health behaviors (Levesque et al., 2006; Williams et al., 1996). However, the current study found that controlled motivation at baseline and at four weeks was not a significant predictor of weight loss but that greater controlled motivation at 12 and 16 weeks correlated with greater 16-week weight loss. Controlled motivation, as measured by the TSRQ, captures the strength and number of reasons one would stay in a weight loss program due to extrinsic pressures. Participants who achieved a 5% weight loss in this study had slightly, but not significantly, higher controlled motivation levels than participants who did not achieve a 5% weight loss. It is possible that in weight loss interventions, the total number of reasons, both internal and external, for staying in a weight loss program is beneficial for weight loss.

Strengths of this study include measures of both autonomous and controlled motivation at various time points and a measure of the weight loss behavior of self-monitoring. Weaknesses include a study design that does not allow for the determination of the impact of MI on motivation levels because motivation was not measured immediately following the face-to-face session but at four weeks. Other weaknesses of this study include a small sample size and an all female study population.

This research elucidated the changes in autonomous and controlled motivation that took place over the course of a 16-week behavioral weight loss intervention. A critical question for future research concerns how to build motivation early in weight loss treatment. The use of MI may be important for building motivation, but further research is needed on the exact mechanism by which MI works. In future studies, one possible way to disentangle motivation and early weight loss success would be to determine if motivation can be impacted by a single MI session. Motivation must be measured before and after the session

and then the impact of the change in motivation due to one MI session on long-term weight loss could then be assessed. This initial face-to-face session may be the only point at which we have a chance to impact and measure change in motivation apart from weight loss progress. Future studies could also compare an MI intervention with a non-MI intervention to determine the effect of MI on motivation, self-efficacy, and adherence.

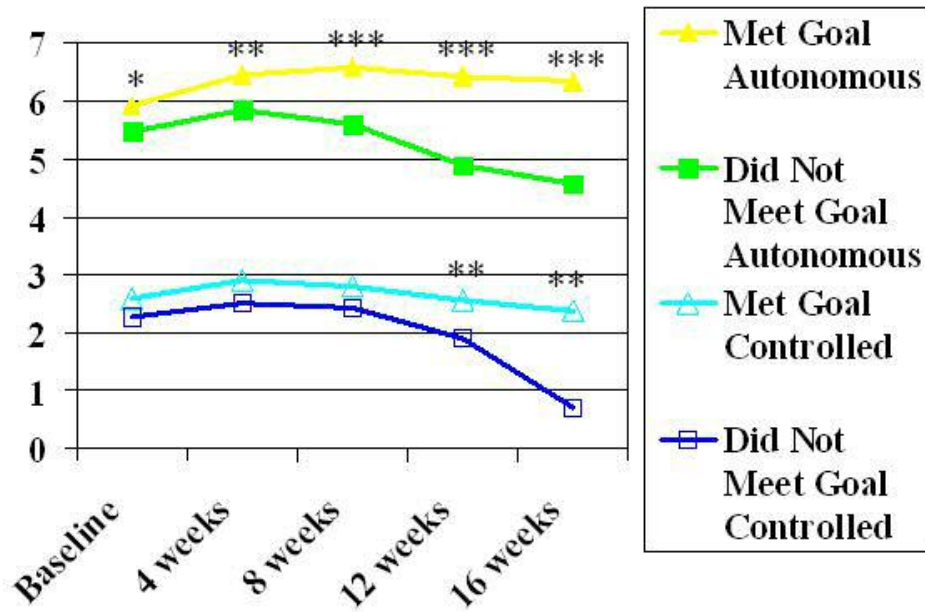
Table 4. 16-week Study Demographics of Total Sample

Race	
Caucasian	86%
African American	12 %
Asian	2 %
Education	
Less than college degree	30%
College degree	35%
Graduate degree	35%
Marital Status	
Married or living with partner	73%
Divorced	20%
Widowed	4%
Never married	3%
Age (years)	50.1 (9.9)
BMI (kg/m²)	31.1 (3.7)
Internet usage (years)	8.8 (3.3)

Table 5. 16-week Study Baseline Characteristics Based on 5% Goal Achievement

	<u>Achieved 5% goal (n=37)</u>	<u>Did not Achieve 5% goal (n=29)</u>	<u>p-value</u>
Race	89% Caucasian	83% Caucasian	0.48
Education	73% college degree or greater	66% college degree or greater	0.27
Marital Status	76% married or living with partner	69% married or living with partner	0.85
Age	50.1 (10.6)	50.0 (9.1)	0.99
BMI (kg/m²)	30.4 (3.7)	32.0 (3.6)	0.08
Internet Usage (years)	9.3 (3.5)	8.3 (3.1)	0.23
Autonomous Motivation	5.91 (0.75)	5.46 (1.18)	0.09
Controlled Motivation	2.60 (0.99)	2.26 (1.07)	0.18

Figure 7. 16-week Study Motivation Over Time



* $p=0.09$; ** $p<0.05$; *** $p<0.001$

Table 6. 16-week Study Correlations Between Motivation and Self-monitoring and Weight Loss

	Self-monitoring diaries		Weight loss	
	Autonomous Motivation	Controlled Motivation	Autonomous Motivation	Controlled Motivation
Baseline	0.17	0.12	-0.14	-0.21
Four Weeks	0.40**	0.14	-0.28*	-0.21
Eight Weeks	0.43**	0.19	-0.44**	-0.13
Twelve Weeks	0.57**	0.20	-0.65**	-0.29*
Follow-up	0.69**	0.34**	-0.65**	-0.30*

*p<0.05; **p<0.01

Table 7. 16-week Study Predictors of 16-week Weight Loss

	β	Adjusted R ²
Number of Self-monitoring Diaries Completed	-0.59**	0.41
Years of Previous Internet Experience	-0.21*	

*p<0.05; **p<0.01

CHAPTER VII

SUMMARY OF AIMS, RECOMMENDATIONS, AND FUTURE RESEARCH

VII.A. Summary of Aims

Overweight and obesity are significant problems in the US, contributing to early mortality and increased chronic disease risk. Modest weight loss can reverse the health effects of overweight and obesity. Several approaches to weight loss exist, among the most effective are individual in-person behavioral weight loss programs. These behavioral programs can be delivered via the Internet to increase accessibility and convenience. Continued improvement in both face-to-face and Internet behavioral weight loss treatments is needed, including increased adherence to program procedures and increased retention. The purpose of this research was to explore the use of MI to enhance Internet behavioral weight loss programs. Results from this research provide information on the implementation, acceptability, and efficacy of MI in Internet behavioral weight loss programs. This research also elucidates the relationships among motivation, adherence, and weight loss in a 16-week Internet behavioral weight loss intervention.

The first aim of this research was to investigate the acceptability and utility of the values component of MI discussions. From this brief eight-week study, it appears that a discussion of values did not have a positive or negative impact on autonomous motivation, self-motivational statements, or weight loss. While 89% of participants reported finding the chat group topics acceptable, one of the 20 participants indicated she was uncomfortable with

the values discussion. No previous research has isolated the values component of MI and demonstrated that a discussion of values is critical for building motivation. Similarly, results from this study did not show an added benefit from a values discussion. This seems to suggest that if the potentially sensitive topic of values is included in future Internet weight loss chat groups, it should be introduced later in an intervention after group cohesion and trust have formed, if at all.

Analysis of the chat group transcripts revealed that the MI-based Internet chats produced self-motivational statements. The number of these self-motivational statements uttered by participants during the chat sessions was correlated with increases in autonomous motivation between baseline and eight weeks. Because this increase in autonomous motivation was correlated with weight loss at eight week follow-up, it appears that MI may impact weight loss through producing self-motivational statements, which thereby increases autonomous motivation. This could be the first step in discerning the mechanism by which MI impacts outcomes. This research has contributed to the literature by elucidating the relationships among self-motivational statements, autonomous motivation, and outcomes in an MI-based study. However, further research of this type is needed to determine the exact mechanism by which MI influences outcomes.

The results of this study indicated that the use of MI in Internet weight loss group chats is feasible, acceptable, and produces self-motivational statements. A discussion of values does not appear to impact autonomous motivation, self-motivational statements uttered or weight loss. Based on results from this pilot study, a values discussion was used in the online chat group sessions in the 16-week intervention, however the topic of values was renamed “priorities” and the topic was not introduced until the seventh week of the study.

The second aim of this research was to examine the efficacy of adding weekly MI based online chat groups to a 16-week standard behavioral Internet weight loss program that started with an initial face-to-face MI based session. The Minimal MI group (n=33) received an initial face-to-face MI based weight loss session followed by a 16-week self-directed Internet behavioral weight loss program. The Enhanced MI group (n=33) received a separate but equal face-to-face MI based weight loss session, the self-directed Internet program, and weekly one-hour online chats led in an MI style by a trained counselor.

The two groups did not differ at baseline on demographic, weight, or psychosocial characteristics. One hundred percent of participants returned for follow-up weight measurements. Both treatment groups lost weight over time ($p < 0.001$), however the group by time interaction was non-significant ($p = 0.19$). The Minimal MI group lost 5.22kg (4.72) and the Enhanced MI group lost 3.71kg (4.46). Fifty-six percent of all participants achieved a clinically significant 5% weight loss. Main results of this study indicated that the addition of online group sessions led using an MI style did not significantly improve weight loss over the standard Internet behavioral intervention started with an initial face-to-face MI based session. The two groups also did not differ on decrease in caloric intake or increase in physical activity over the 16-week period.

All measures of adherence and program utilization, including number of self-monitoring diaries completed, number of weeks participants logged onto the study website at least once, number of posts to the message board, and the number of chats attended (in the Enhanced MI group only) were correlated with weight loss. The two groups did not differ on the number of weeks logged in to the study website or the number of self-monitoring diaries completed. However, the Minimal MI group posted more to the online message board than

the Enhanced MI group, and 15% of participants in the Minimal MI group met face-to-face during the study for exercise and general support.

This study found that a minimal MI intervention produced significant weight loss, and that weight loss was not increased by the addition of ongoing weekly online chat groups led in an MI style. This was an unexpected finding and contrary to findings from previous Internet weight loss interventions which have found added weight loss benefit from the addition of counselor support. This unique finding could have been due to several factors. It is possible that the Minimal MI intervention was in itself sufficient to produce significant weight loss. The efficacy of brief MI interventions in health behavior change has been supported by previous research in the field of weight loss and physical activity (West et al., 2007; Bennett et al., 2007). Further research is needed to confirm the findings of this study because there is the potential for substantial public health benefit from minimal contact interventions.

The success of the Minimal MI group could have been due in part to reactivity to the study protocol. A discussion of the exact procedures for the two study groups was provided in the informed consent process and the Minimal MI group was told at the initial group session that they would not receive the online chat sessions. This could have caused the Minimal MI group to be more intentional in forming group support than if they had not known the other group was receiving additional counselor support. This seems evident from the fact that the Minimal MI group used the message board more extensively than the Enhanced MI group, and some Minimal MI group participants had independently organized face-to-face meetings. If this is the reason for the relative success of the Minimal MI group, it is likely that the Minimal MI intervention would not produce the same results if used as a

stand-alone program because group support may not be as strong. For these reasons, the Minimal MI group protocol should be replicated in a study in which participants do not perceive that they are not receiving the full weight loss program in order to determine the efficacy of the minimal MI intervention for producing weight loss.

Even though the two study groups were not different at baseline on our measures of motivation or self-efficacy, it is possible that the Minimal MI group was different in some way that contributed to their success. For example, different measures (not included in our protocol) of self-efficacy and motivation might have captured group differences. It is also possible that the Minimal MI group was receiving more support for weight loss from family and friends than the Enhanced MI group, however social support was not measured at baseline in this study so that cannot be determined.

One possible reason that the Enhanced MI group did not have greater weight loss could have been the lack of utilization of the online chat group sessions. While there was a high correlation between chat attendance and weight loss, attendance at the weekly chat sessions averaged only half of those offered (e.g., 8 out of 16 possible chats). The lack of attendance at the online chats could have been due to the chat format. Follow-up data on chat usage and acceptability was not collected, but it is possible that the day or time of the online groups was inconvenient for participants or the necessity to have a scheduled chat session decreased the desired convenience of the Internet treatment. It is also possible that some participants may have found the format of the chat sessions difficult to follow and therefore unappealing. The lower than expected chat attendance could also have been due to the use of MI in the chat sessions. Perhaps the MI based topics of the chats were offensive or unappealing to participants, however, this is unlikely given the results from the pilot study

found MI based chats to be acceptable to similar participants. One final possibility is that the participants did not find the MI based chats to be helpful and preferred a different format. One of the weaknesses of this study was that there were no follow-up questions on chat acceptability. In the future, there is a need to follow-up on the acceptability of the chat topics, format, convenience of day and time, group interactions, and helpfulness of the chat. The lack of group differences and the success of the Minimal MI group in the 16-week intervention suggest several possible avenues for further research.

The third aim of this research was to examine the relationships among motivation, adherence, and weight loss, and to examine changes in motivation over time using data from the 16-week intervention. Autonomous motivation increased for the majority of participants between baseline and four weeks, following the initial face-to-face MI led session. Although it is not possible to determine with this study design, this increase in autonomous motivation could have been due to the use of MI in the initial face-to-face session. However, because motivation was not measured immediately before and after the initial MI session it is not possible to determine if the increase in motivation was due to the MI session or some other factor. For example, the increase in autonomous motivation between baseline and four weeks was also correlated with four-week self-reported weight loss, so an alternative hypothesis is that this change in motivation was related only to early success with weight loss. Further research is needed to determine the impact of one MI session on autonomous motivation in a weight loss intervention.

To our knowledge, this study was the first to report on motivation levels throughout a weight loss intervention. The pattern of motivation change for participants who achieved a 5% weight loss was significantly different than the pattern of motivation change for

participants who did not achieve a 5% weight loss. A decline in motivation was seen between weeks four and eight for the group not achieving the 5% weight loss goal and this decline continued until the end of the study. This elucidation of motivation patterns throughout a weight loss intervention may be a base on which to build evidence for patterns of motivation change that identify participants in need of additional support or different intervention strategies in future studies. If motivation is a modifiable factor, and one amenable to therapeutic techniques such as MI, then it might be a treatment target in future interventions at a point where motivation declines among those who are not succeeding. Thus, weight loss behaviors can be targeted indirectly via targeting motivation for those behaviors and for weight loss itself. Alternatively, if declining motivation is merely a marker of failure to lose weight and not amenable to increase other than through weight loss, interventions should not target motivation but instead target weight loss more directly via food provision, exercise sessions or other techniques.

Analysis of the 16-week intervention data revealed a correlation between four-week weight loss and autonomous motivation at four weeks. This correlation between weight loss and motivation makes it difficult to determine the effect of motivation on long-term weight loss independent of weight loss. In fact, in regression analysis four-week autonomous motivation predicted 16-week weight loss before controlling for four-week weight loss. In order to disentangle the relationship between motivation and weight loss progress future studies could examine this relationship in a larger sample with measures of both variables at multiple time points. Future studies might also include different measures of motivation because it is possible that a different measure might capture another dimension of motivation. The motivation measure used in this study, the TSRQ, measured reasons for staying in a

weight loss treatment program. In this study, this measure was related to program adherence and adherence was strongly related to weight loss. It is possible that a different measure of motivation, which captures reasons for desiring weight loss, would not be correlated with adherence and weight loss and might allow for full assessment of the motivation construct. Frequent measures of both motivation and weight loss in future studies would also allow for the use of statistical methods in separating the effects of motivation and weight loss.

One other possible way to separate motivation level from weight loss success could be to determine if motivation changes due to a single MI session. Motivation could be measured before and after the session to determine the impact of MI on motivation apart from weight loss. The impact of the change in motivation due to one MI session on long-term weight loss could also then be assessed. An initial MI-based face-to-face weight loss session may be the only point at which change in motivation can be measured apart from weight loss success.

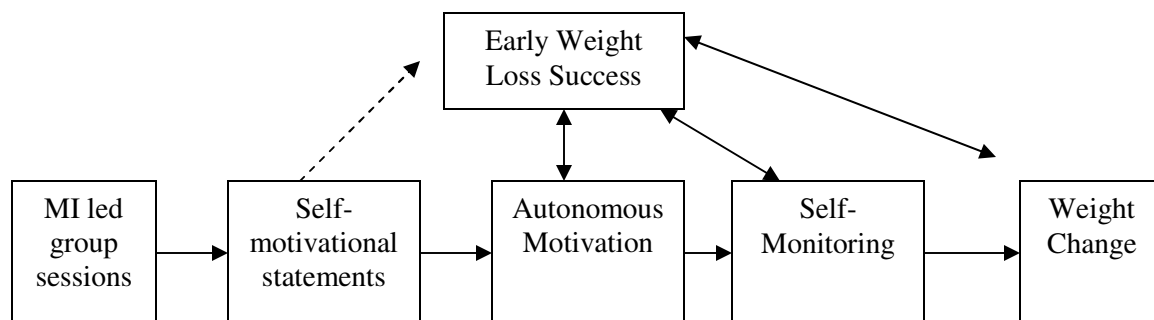
Data from the 16-week intervention suggested several variables that are indicators of longer-term weight loss success. Early weight loss, early motivation levels, and early self-monitoring all predicted 16-week weight loss. Program usage in the form of self-monitoring, logins to the study website, chat attendance, and message board posts, was correlated with weight loss in the 16-week intervention. Therefore, future Internet behavioral weight loss interventions could build motivation for adherence to the program, including attending chats, completing self-monitoring diaries, posting to the message boards, and logging in to the study website to read the weekly lesson. It might also be beneficial to monitor participants' levels of early weight loss, motivation, and program adherence in order to intervene with participants who are at risk of failing at longer-term weight loss. These future studies might

employ high intensity methods to maintain program adherence. In Internet studies, this could be done by using MI in the initial face-to-face session around the desired behaviors of self-monitoring, logging into the website to read the weekly lesson, and attending online chat sessions. MI could also be used to build peer support in the form of posting to the message board. Other possibilities for promoting adherence include monitoring online diary forms and emailing participants who do not complete them on a regular basis. A phone call reminder could be used as a follow-up if the email reminder did not prompt completion of the diaries. These emails and phone calls could incorporate MI techniques in order to explore participants' reasons for lack of adherence. This may facilitate problem solving to overcome barriers or may increase motivation for program adherence. Alternately or in addition to the emails and phone calls, the study website could provide tailored feedback for participants in order to make logging in to the website more interesting and beneficial to participants. This tailored feedback could be based on self-monitoring diary entries from the previous week. Finally, in order to increase adherence, a weekly email could be sent to participants to notify them of the posting and topic of the new weekly lesson. Adherence to program procedures, early motivation levels, and early weight loss success were all predictors of weight loss in this study. Future Internet weight loss programs could employ the aforementioned techniques at relatively low cost in order to enhance program adherence, motivation, and early weight loss.

Although it is not possible to determine definitively from this research, it appears that the use of MI in Internet weight loss programs might be beneficial. The pilot study showed that MI based group sessions produce self-motivational statements and the more self-motivational statements a participant made the greater the increase in autonomous

motivation. Greater increases in autonomous motivation were associated with greater weight loss. The 16-week intervention showed that autonomous motivation was correlated with self-monitoring and greater self-monitoring was correlated with greater weight loss. The working mechanism for MI might be through the elicitation of self-motivational statements, which increase levels of autonomous motivation. This increase in autonomous motivation might lead to an increase in adherence to program procedures; adherence to program procedures then leads to better treatment outcomes. Further research is needed to confirm this hypothesis on the mechanism of the effect of MI on adherence and outcomes because we cannot separate changes in motivation from weight loss success in these two studies.

Figure 8. Proposed MI Mechanism



In sum, this research showed that MI might be beneficial for weight loss in Internet interventions and does not appear to be detrimental when used in the initial face-to-face session. From the 16-week intervention we are left with few answers and many questions. For instance, what are the reasons for low chat attendance? Did MI increase autonomous motivation between baseline and four weeks or was the increase due to early weight loss success? Is it possible to build enough peer support in Internet programs with one MI session

to supplant the need for trained counselor support? These results suggest several possibilities for future research.

VII.B. Recommendations

Recommendations based on this research include the following:

1. When conducting Internet behavioral weight loss programs it would be beneficial to promote and build motivation for program usage in the form of logins to the study website, use of message boards, and completion of self-monitoring diaries. This could be done at an initial face-to-face session and with weekly emails using MI techniques.
2. There is a need to establish reference values for motivation levels on the Treatment Self-Regulation Questionnaire (TSRQ) in order to better screen participants who are at risk of not succeeding at weight loss so that they may receive more intense support or different types of interventions.
3. When conducting MI based studies, in order to assess the impact of MI on motivation levels, motivation should be measured immediately before and after MI sessions.
4. Future Internet weight loss studies should incorporate a measure of global social support at baseline and at frequent intervals throughout the intervention to assist in understanding the impact social support has on weight loss outcomes.

VII.C. Future Research

This dissertation suggests several possible avenues for further research in Internet behavioral weight loss programs including the use one initial face-to-face MI session to promote weight loss, the use of peer support mechanisms to promote weight loss, and the exploration of the mechanisms by which MI affects adherence, retention, and outcomes. This research did not allow for the assessment of the longer-term effects of these two brief MI interventions on weight; therefore future studies could also explore the use of brief MI interventions for weight maintenance. Finally, there are possible avenues of research concerning the measurement of motivation.

The 16-week intervention was designed to determine the benefit of the addition of weekly online chats led in an MI style. In order to control for the effect of the initial face-to-face session, both study groups received initial sessions that were led using an MI style. Contrary to our hypothesis, both groups lost weight and the addition of ongoing counselor led MI-chats did not improve weight loss; due to the study design, we were unable to definitively delineate the individual contribution of the initial MI session to weight loss or determine the mechanisms by which MI may have impacted adherence, retention, and outcomes. The surprising results of this study suggest an interesting direction for further research. A future study could compare an initial face-to-face MI-based session to a standard initial face-to-face session on the effects on motivation, adherence, and weight loss in a self-directed Internet behavioral weight loss program.

Similarly, future studies could compare MI based online chats to non-MI based chats to determine the effects on self-monitoring, chat attendance, motivation, and weight loss. These future studies could also evaluate participant satisfaction with the chat sessions.

Satisfaction could be assessed with questions on the acceptability of chat topics and format, the usefulness or relevance of the online discussions, and group cohesion among chat group participants.

Another possible avenue for research is the impact of peer support on weight loss in Internet interventions. The treatment group that did not receive the weekly counselor led MI based online chats (Minimal MI) achieved a similar significant weight loss to the group that received the weekly on-line counselor led sessions (Enhanced MI), and there was even an unexpected trend for more of the Minimal MI participants to achieve the 5% weight loss goal than Enhanced MI participants. The main differences that were detected between these two groups were that the Minimal MI group posted significantly more to the message board, and some participants in the Minimal MI group also had face-to-face meetings with other participants during the study period. At the end of the study, participants in the Minimal MI group had similar levels of autonomous motivation to participants in the Enhanced MI group who attended at least 75% of the online chats. These data indicate that peer support could have played a similar role to the counselor-led chats in providing support and motivation or that people who posted to the message board and attended chats were already somewhat motivated. Future research could explore increasing peer support through encouraging participants to meet face-to-face during the Internet intervention or by giving participants the option to join in peer-led online chats.

It was not possible to determine the impact of the single MI session on autonomous motivation in this study because motivation was not measured immediately following the MI session, but at four weeks. Future research could determine if it is possible to build motivation in one face-to-face session using MI techniques. In this future study, it would be

beneficial to measure motivation immediately before and immediately after the face-to-face session in order to determine more accurately the influence of MI on autonomous motivation. The impact of the change in motivation that occurs as a result of that one MI session on weight loss could then be assessed. Measuring motivation immediately before and after an MI session may be the only opportunity to assess change in motivation apart from change in weight.

We were unable to determine the long-term impact on weight loss and maintenance produced by these brief (eight & 16 week) interventions. There is great potential benefit for efficacious brief interventions for long-term weight maintenance on individual health, public health and health care costs. Based on the success of the Minimal MI group, the impact of a brief MI intervention on weight maintenance could be explored in a future study with a longer follow-up period.

Finally, there is a need for research to determine norms for levels of motivation on the TSRQ that predict success in weight loss interventions. The 16-week intervention found that levels of motivation at four weeks were more highly correlated with weight loss than baseline levels of motivation. Participants who ultimately achieved a 5% weight loss and those who did not achieve a 5% weight loss had similar increases in autonomous motivation between baseline and four weeks; however, at four weeks the level of autonomous motivation was significantly higher, and was maintained at that level, in the group who achieved the 5% weight loss. Further research is needed to determine if the increase in autonomous motivation early in a weight loss study is important for predicting success, or if the absolute amount of autonomous motivation at a given time point is a better predictor of long-term weight loss success. If it can be determined that motivation at a particular time point is most

important or critical for success, then future interventions could focus on building motivation at the critical time point. Further research concerning the TSRQ could also include a factor analysis to determine if all of the questionnaire items are necessary, or if the questionnaire could be shortened to reduce participant burden.

This research found MI to be acceptable in Internet weight loss chats, and that the addition of weekly MI based chats did not produce additional weight loss above the standard Internet behavioral weight loss program. Results of these studies raise many questions and provide areas for further exploration. These future research directions provide potential areas for improving weight loss in Internet behavioral weight loss treatments, while maintaining the convenience and accessibility of an Internet study and potentially decreasing costs through the use of peer support mechanisms.

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