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Why Do You Regulate What You Eat? Relationships Between Forms of Regulation, Eating Behaviors, Sustained Dietary Behavior Change, and Psychological Adjustment[1]

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In 3 studies, the authors examined how autonomous and controlled forms of motivation for the regulation of eating behaviors were related to self-reported eating behaviors, and sustained dietary behavior change. Studies 1 and 2 supported the factorial structure and the psychometric properties of a scale designed to measure different forms of regulation as defined by Self-Determination Theory. A motivational model of the regulation of eating behaviors suggested that an autonomous regulation was positively associated with healthy eating behaviors whereas a controlled regulation was positively associated with dysfunctional eating behaviors and negatively associated with healthy eating behaviors. In Study 3, long-term adherence to healthier dietary behaviors in a population at risk for coronary artery disease was examined over a 26-week period. A general measure of self-determined motivation assessed at week 1 was found to be a reliable predictor of the level of self-determination for eating behaviors 13 weeks later. In turn, self-determination for eating behaviors was a significant predictor of dietary behavior changes at 26 weeks. Finally, the dietary behavior measures were related to improvements in weight and blood lipid parameters (LDL-cholesterol,

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HDL-cholesterol, triglycerides). Results are discussed in terms of their implication for the integration and maintenance of a successful healthy regulation.

KEY WORDS: Regulation of Eating Behaviors Scale; Self-Determination Theory; consequences of eating behaviors.

Ingestion of food is a behavior everyone needs to do for survival. Although common sense suggests that people eat when they feel hungry and quit when they become full, many people have difficulties controlling the amount and/or the quality of foods they consume, either occasionally or more generally (Baumeister, Heatherton, & Tice, 1994). Evidences of such difficulties are reflected in the high prevalence of overweight people, the high amount of money people spend in numerous weight-loss methods, and the inability for most people to maintain weight loss over time (Cogan & Rothblum, 1993; Garner & Wooley, 1991; Kuczmarski, Flegal, Campbell, & Johnson, 1994).

For most of the people, the difficulty to regulate their eating behaviors is not limited to sporadic situations. Rather, their self-regulatory processes lead them to repeatedly experience failure at controlling their food intake, and even in some cases, to pathological problems. For example, Bulimia Nervosa, results from a self-regulatory problem where one fails to exert control over his/her appetite and this, over several weeks, months, and even years. The person, most often a woman, experiences episodes of binge during which she consumes large amounts of food in a discrete period of time. During these episodes, she feels that she cannot stop eating or control what and how much she is eating (American Psychiatric Association, 1994). In this case, self-regulation failure may be the expression of a dysfunctional self-regulatory style. When not properly regulated, eating behaviors can have detrimental effects on physical and psychological health. For example, eating binges are often followed by a state of anguish feelings of guilt and disparaging self-criticisms that contribute to the experience of a depressed mood. The compensatory behaviors (e.g., self-induced vomiting) that are engaged to avoid weight gain following eating binges can lead to significant electrolytes disturbance that, in turn, can cause cardiac arrhythmias.

Chronic overeating, especially in high-fat and high-calorie foods, can also contribute to obesity that is associated with a significant number of medical complications such as cardiac problems, hypertension, and gastric impairments (VanIttalie & Lew, 1992). More specifically, eating patterns are widely recognized as assuming a prominent role in the development and course of a variety of illnesses, including heart diseases, diabetes, and cancers (McCann & Bovbjerg, 1998). Because the leading cause of death in most industrialized countries is cardiovascular disease (CVD) and because elevated blood cholesterol is one controllable risk factor, dietary regimens aimed at lowering blood cholesterol levels are particularly prevalent. Management of dyslipidemia through dietary means is the first line of recommended therapy. Furthermore, because obesity is highly stigmatized throughout the life span, its condition is often linked to low self-esteem,

depression, and heightened anxiety (Heatherton, 1993). In sum, because nutrition constitutes an important risk factor in the development of many health problems, many of these health problems could be prevented if people would adopt lifestyles that promote the proper daily regulation of healthful eating behaviors.

In an effort to develop strategies to help people adopt and maintain healthful dietary patterns, research has drawn on various models of health behavior to identify relevant determinants of successful behavior change including the health belief model, social cognitive theory (Bandura, 1986), theory of reasoned action (Ajzen & Fishbein, 1980), and transtheoretical model of behavior change (Prochaska, DiClemente, & Norcross, 1992). Sociodemographic, psychosocial, cognitive, contextual, and situational variables related to health behavior have been examined within frameworks of intervention strategies, such as health risk appraisal, provision of incentives, removal of barriers, and provision of information/skill building. Although some factors (i.e., perceived risk to illness, health benefits, knowledge of dietary recommendations, motivational readiness, and self-efficacy) were found to be associated with the adoption of healthful dietary behaviors (e.g., Glanz et al., 1993; Kristal et al., 1995; Patterson, Kristal, & White, 1996; Zinder-Wernet & Weiss, 1987), they did not prove to be predictors of sustained change.

It makes sense to believe that successful and sustained dieting depend on individuals' willingness to undertake and maintain required behaviors. For the most part, it can be assumed that individuals are willing to change and that self-directed behavior change is both possible and desirable. Sustained health behavior change, however, is dependent on more than just good reason to act. Lasting behavioral change is the result of persistent self-regulation. Through self-regulation, individuals are able to prevent a natural response (e.g., action, thought, or desire) from occurring and substitute another response (or lack of response) in its place (Baumeister et al., 1994). Paying attention to what we eat is a prime example of the regulatory mechanism—the decision to keep a healthier diet overrides the natural urge to derive sensory pleasure from indulging in decadent foods. Competition between responses is inherent to the regulatory override process; successful self-regulation requires that the desired responses carry enough strength to override the lower tendencies. Achievement of desired behavioral outcomes then depends on the strength of motives that drive self-regulatory responses and accepting the regulation for change as one's own.

In sum, it seems that people are preoccupied by the regulation of their eating behaviors. Although some individuals may be successful at regulating these behaviors for a short period of time, many fail to do so over a longer period. Their failure to properly regulate their eating behaviors constitute an important risk factor in the development of many health problems that could be prevented if people would adopt a lifestyle that would, among other things, promote the proper daily regulation of healthy eating behaviors. Therefore, the challenge of addressing ways to help people maintain healthy eating behaviors and integrate them in their lifestyle remains a complex and prominent one for many individuals.

The purpose of the present studies was to examine why some individuals may be successful at regulating their eating behaviors whereas others may be at risk of repeated failures. One theoretical perspective that could have important implications for the understanding of a successful integration and maintenance of the regulation of eating behaviors is the Self-Determination Theory (SDT) proposed by Deci and Ryan (1985; Ryan & Deci, 2000). This theory is of particular interest for the following reasons. First, it postulates the existence of different regulatory styles that differ in the degree to which the regulatory processes underlying behaviors have been internalized and brought into harmony with other processes of the person's innate, core self. Second, it explains the process of internalization of behaviors that is, how behaviors initially regulated by sources outside the self (e.g., parents, partner) can be self-regulated and form a permanent part of the individual's character. Finally, it postulates various consequences associated with the different regulatory styles.

Self-Determination Theory

According to Deci and Ryan (1985, 1991; Ryan & Deci, 2000), the regulation of a behavior can take many forms that correspond to different behavioral regulatory styles. These behavioral regulatory styles can be differentiated according to their level of self-determination. The different behavioral styles of regulation are associated with one of the three basic types of motivation: intrinsic motivation, extrinsic motivation, and amotivation.

Intrinsically motivated behaviors are engaged in for their own sake; for the pleasure, the interest, and the satisfaction derived from participation itself. They are performed voluntarily in the absence of material rewards or external constraints (Deci & Ryan, 1985). Performing the activity thus becomes an end in itself. Individuals who regulate their eating behaviors because they take pleasure in fixing healthy meals are considered intrinsically motivated. In contrast, extrinsic motivation pertains to a variety of behaviors that are engaged in as a means to an end and not for their own sake. The activity is performed to prompt agreeable consequences or to avoid disagreeable ones (Deci, 1975). It was originally thought that extrinsic motivation exclusively referred to non-self-determined behaviors associated with external contingencies. Deci and Ryan (1985) have proposed that there are different types of extrinsic motivation that vary to the extent the regulation of behavior is perceived as constrained by external sources or as freely chosen by the individual. These types of extrinsic motivation (external regulation, introjected regulation, identified regulation, and integrated regulation) can be ordered along a self-determined continuum. *External regulation* encompasses behaviors governed by external sources of control that is, behaviors that are compelled by reward and punishment contingencies. For example, individuals who regulate their eating behaviors, because a health professional or their partner is pressuring them to do so, are motivated by external regulation. In this case, regulation of eating behaviors

is performed to obtain rewards (e.g., recognition from health professional) or to avoid negative consequences (e.g., criticisms from their partner). With *introjected regulation*, the formally external source of control has been internalized such that its actual presence is no longer needed to initiate behavior. Instead, the control stems from within the person in the form of self-imposed pressures such as guilt or anxiety (Ryan & Connell, 1989). Individuals who regulate their eating behaviors because they would feel ashamed of themselves if they were not eating healthy are motivated by introjected regulation. At this level the internalization is only partial in the sense that one is still "being regulated" rather than operating from an integrated sense of volition. In contrast, with *identified regulation*, external regulatory processes have been internalized into one's sense of self. The activity is valued and perceived as being chosen by oneself. Although it may not be intrinsically enjoyable, one personally decides to do the activity because it is congruent with its own values and goals. Individuals who regulate their eating behaviors because they believe it is a good thing to do in order to feel better about themselves in general are motivated by identified regulation. When a behavior becomes consistent with other priorities in someone's life, it is said to be *integrated*. More specifically, integrated regulation results when the behavior is performed not only because an individual values its significance, but also because it is consistent with previous integrated experiences and values in the person's self-system. The regulation of food has been valorized to such an extent that it has become part of one's self-definition. For these individuals, eating healthy facilitates their engagement in the other priorities of their lives. They have come to realize that good eating behaviors energize them and promote efficiency for the different activities that they do.

Amotivation refers to a state where individuals fail to perceive contingencies between their actions and the outcomes of their actions. Thus, amotivated individuals are not able to foresee the consequences of their behavior. They have a pervasive sense that their behavior are caused by external forces beyond their control. They experience feelings of incompetence and lack of control (Deci & Ryan, 1985). Individuals who once had good reasons for regulating their eating behaviors, but now wonder whether they should continue are said to be amotivated.

The Self-Determination Continuum

According to Deci and Ryan (1985), the different behavioral regulatory styles presented above can be differentiated along a continuum that ranges from non-self-determined styles of regulation (i.e., amotivation, external regulation, and introjection) to self-determined ones (i.e., identification, integration, and intrinsic motivation). The gradation of reasons is a reflection of an internalization process where the regulation of behavior, which was initially reinforced by external sources, is taken in to be governed by the self and to form a permanent part of the person's character. This internalization process takes place because individuals are inherently motivated to internalize within themselves the regulation of

activities that are useful to effective functioning in the social world even though they may not be inherently interesting (Deci, Eghari, Patrick, & Leone, 1994). Because intrinsic motivation underlies regulation of behaviors that are freely initiated and performed for the pleasure inherent to the activity itself, it represents the highest level of self-determination on the continuum. Conversely, because amotivation depicts the absence of agency and involves feelings of incompetence and lack of control, it represents the least self-determined form (absence of self-determination). The various regulatory styles associated with extrinsic motivation are situated between these two ends.

The validity of the self-determination continuum has been supported by several studies where a simplex pattern was obtained between the different behavioral regulatory styles forming the continuum (Guttman, 1954). Specifically, in that particular structure, each regulatory style displays positive correlations with adjacent regulatory style on the continuum and negative correlations with distant regulatory styles on the continuum (Ryan & Connell, 1989; Vallerand, 1997).

Consequences of Self-Determination

Because the different behavioral regulatory styles proposed by SDT coexist on a continuum of self-determination, and because higher self-determination levels are theoretically associated with beneficial consequences, the association between regulatory styles and consequences should vary with the level of self-determination. Specifically, the relationship between the self-determined forms of motivation and positive consequences should be positive, progressively decrease, and eventually grow negative for the least self-determined forms of motivation. Studies performed in a variety of life domains, such as education, work, interpersonal relationship, environment action, health, leisure, and sports, offer support for this proposition. In general, the more self-determined regulatory styles were found to lead to better learning, more interest, greater effort, better performance, higher self-esteem, increased life satisfaction, persistence, and enhanced health, whereas the less self-determined regulatory styles were negatively related to those outcomes (see Vallerand, 1997, for a review).

While both autonomous and controlled forms of regulation are purposive and motivated, their different source of initiation and regulation has important implications on the quality of behavioral engagement and functioning (Deci & Ryan, 2000). Lasting health behavior change depends on accepting the regulation for change as one's own. When regulation of behavior is self-determined, individuals tend to assume greater responsibility and exert greater effort toward the achievement of positive outcomes, and remain task involved in the face of setbacks or challenges (Ryan et al., 1996; Ryan, Plant, & O'Malley, 1995). All three forms of autonomously motivated regulation—intrinsic, integrated, and identified—have been shown to predict intended and actual effort (Deci & Ryan, 1991), with

intrinsic motivation often operationally defined in terms of persistence of self-initiated behavior.

This means internalizing values and regulation of relevant behaviors and then integrating them with one's sense of self so they can become the basis for autonomous regulation (Williams, Grow, Freedman, Ryan, & Deci, 1996). For example, Sheldon and Elliot (1998) found that autonomous, or self-determined, goals were better attained than controlled goals. Although, both autonomy and control were correlated with intended effort (geared toward objectives, one is typically trying to attain in one's daily life), only autonomy was correlated with early (8 weeks) and later effort (15 weeks), both of which were predictive of goal attainment. In addition to the mediated effect, autonomy also had a direct promotional effect on goal attainment. The positive effects of autonomy remained significant when controlling for expected competence, initial commitment, and the interaction of expected competence with initial commitment. The authors concluded that although control provided strong motivation at the decisional phase, this motivation faded during the preactional (in which planning occurs) or actional (in which plans are carried out) phases. In other words, individuals may have difficulty translating their controlled intentions into action. In contrast, people who experience motivational autonomy tend to invest more sustained effort into their goals and subsequently evidence greater task persistence (Ryan & Connell, 1989; Sheldon & Elliott, 1998). As goals play an important role in the organization of human behavior, these findings have relevant implications on outcomes of health-directed actions, including dietary goal attainment.

Addressing more specifically the relationship between self-determined regulation and sustained health behavior change more directly, a study by Williams et al. (1996) showed that patients participating in a weight-loss program for autonomous (i.e., identified, integrated, or intrinsic) reasons as opposed to controlled (i.e., external or introjected) reasons attended the program more regularly and showed greater maintained weight loss over a 23-month period. In a study on predictors of dietary change, Patterson et al. (1996) showed that perceived norms of social pressure were not related to dietary or weight change outcomes, suggesting that extrinsic motives (such as reward or perceived pressure by others) are not effective modes of promoting behavior change.

Finally, it is important to consider that the self has elements that are both stable and general in nature, and others that are more context-specific and may even vary with situation. In an effort to integrate both levels of motivation, Vallerand (1997) proposed a hierarchy of motivation to depict the relationship between intrinsic and extrinsic motivation at a general level of the self and motivation at a more specific or contextual level. According to this model, motivation can be represented within the individual at the general (or personality) level and the contextual (ex., regulation of eating behavior) level. *General motivation* refers to relatively enduring individual differences with respect to people's motivations. It has been associated with general life satisfaction as well as psychological functioning and depicts an individual's typical interactions with the environments. Research has also indicated

that general intrinsic and extrinsic levels of motivation reflected by broad measures of personality and adjustment may not be strongly related to more specific modes of functioning found in contexts and situations (Pelletier et al., 2003). To better predict such functioning, motivation needs to be assessed at the level of specific contexts and/or situations. Compared to general motivation, people's contextual orientation is more subject to changes and may vary drastically from one context to another (Vallerand, 1997). Consequently, a contextual measure of motivation is also more sensitive to influences specific to a particular context (e.g., perceptions of one's own health status may influence dietary patterns) and can thus be related more reliably to changes in behavioral outcomes. If we extend these ideas to the domain of eating behaviors, one would expect that self-determined regulatory styles toward eating behaviors would be positively associated with healthy eating behaviors that, in turn, would be associated with psychological adjustment. Conversely, it would be expected that non self-determined regulatory styles toward eating behaviors would be positively associated with dysfunctional eating behaviors (i.e., bulimic symptomatology) which in turn, would be negatively associated with psychological adjustment.

Goals of the Studies

The goals of the present studies are to examine how autonomous and controlled forms of motivation for the regulation of eating behaviors are related to successful and sustained eating behaviors. Because no scale has been developed or validated on the regulation of eating behaviors, in the first study we developed and examined the validity of a scale designed to measure the different behavioral regulatory styles proposed by Deci and Ryan's SDT (Deci & Ryan, 1985, 1991): intrinsic motivation, the four types of extrinsic motivation (integrated, identified, introjected, and external regulation) and amotivation. In the second study, the validity of the scale was further examined and a structural model that included the autonomous and controlled forms of regulations as well as measures of successful and dysfunctional eating behaviors was examined. Finally, in the third study, we examined how individuals' global level of self-determined motivation and their level of motivation for eating behaviors were related to long-term adherence to healthier dietary behavior change with a population of candidates for dietary changes that presented risks factors for coronary artery disease (CAD).

STUDY 1

Method

Participants

Data were collected from 343 female students who were enrolled in different courses at the University of Ottawa. The participants' age ranged between 17 and

50 years ($M = 21.2$ years). Participants received the information that researchers were interested in better understanding the reasons as to why women regulate their eating behaviors. With the permission of professors, some women completed the questionnaire at the beginning of a class whereas others completed the questionnaire at home and returned it for the next class in a sealed envelop. Participants did not receive any incentives for their participation in this study.

Scale Development and Procedure

A group of researchers who were familiar with SDT as well as the literature related to eating behaviors met to generate an initial pool of reasons as to why women regulate their eating behaviors. The most frequently reported reasons were then formulated into items that correspond to the six regulatory styles proposed. A total of 48 items comprised the initial version of the Regulation of Eating Behavior Scale (REBS; 8 items per subscale). Items were presented in random order. Participants were asked to indicate the extent to which each item corresponded to their personal motive for regulating their eating behaviors in response to the question: "Why are you regulating your eating behaviors?" They were asked to circle the appropriate number on a 7-point scale ranging from 1 (*Does not correspond at all*) to 7 (*Corresponds exactly*).

Results and Discussion

Preliminary analyses were performed to assess departures from basic assumptions. Values of kurtosis and skewness were first examined. With the exception of one item on the external regulation and one item on the amotivation subscales, all other variables of REBS had kurtosis and skewness values below |2|. The univariate distribution was deemed acceptable. No multicollinearity or singularity was present in the sample because all correlations were below .85 (Tabachnick & Fidell, 1996).

An *exploratory* factor analysis using maximum likelihood extraction with oblique rotation was performed on REBS, with the specific purpose of reducing the number of items to four per subscale. Because we were expecting to find support for the proposed factors, three solutions (5, 6, 7 factors) were examined. A clean factorial solution that offered support for the proposed six subscales represented the best solution. Specifically, five factors had eigenvalues superior to 1 whereas the sixth factor had an eigenvalue of .94. In total, the six factors explained 71.4% of the sample variance. The number of items for each factor was reduced to 4 by selecting the items that loaded exclusively on their appropriate factor, and that the highest coefficients (all above .30). Results of the *exploratory* factor analysis are presented in Table I. Evaluation of the internal consistency of the subscales revealed to be adequate. Cronbach's alphas ranged from .79 to .91

Table I. Results of the Exploratory and Confirmatory Factor Analyses of REBS

Items	Intrinsic Motiv.	Integr. Reg.	Ident. Reg.	Introj. Reg.	Ext. Reg.	Amo.
Intrinsic motivation ($\alpha = .89$)						
It is fun to create meals that are good for my health	.90 (.74)					
I like to find new ways to create meals that are good for my health	.89 (.59)					
I take pleasure in fixing healthy meals	.80 (.72)					
For the satisfaction of eating healthy	.33 (.72)					
Integrated regulation ($\alpha = .91$)						
Eating healthy is an integral part of my life		.86 (.84)				
Eating healthy is part of the way I have chosen to live my life		.86 (.78)				
Regulating my eating behaviors has become a fundamental part of who I am		.73 (.75)				
Eating healthy is congruent with other important aspects of my life		.65 (.64)				
Identified regulation ($\alpha = .83$)						
I believe it will eventually allow me to feel better			.90 (.62)			
I believe it's a good thing I can do to feel better about myself in general			.80 (.60)			
It is a good idea to try to regulate my eating behaviors			.48 (.57)			
Is a way to ensure long-term health benefits			.44 (.45)			
Introjected regulation ($\alpha = .85$)						
I don't want to be ashamed of how I look				.93 (.73)		
I feel I must absolutely be thin				.88 (.73)		
I would feel ashamed of myself if I was not eating healthy				.58 (.72)		
I would be humiliated I was not in control of my eating behaviors				.57 (.66)		
External regulation ($\alpha = .79$)						
Other people close to me insist that I do					.80 (.80)	
Other people close to me will be upset if I don't					.77 (.74)	
People around me nag me to do it					.72 (.69)	
It is expected of me					.50 (.59)	
Amotivation ($\alpha = .82$)						
I don't really know. I truly have the impression that I'm wasting my time trying to regulate my eating behaviors						.83 (.73)
I don't know why I bother						.81 (.73)
I can't really see what I'm getting out of it						.63 (.72)
I don't know. I can't see how my efforts to eat healthy are helping my health situation						.60 (.60)

Note. The first numbers correspond to the results of the exploratory factor analysis (Study 1), and the numbers in parentheses correspond to the results of the confirmatory factor analysis (Study 2).

(see Table I). In sum, the results of this first study supported a six-factor structure scale for the regulation of eating behaviors that corresponds to the six regulatory styles of behavior postulated by Deci and Ryan (1985; Ryan & Deci, 2000).

STUDY 2

The purpose of the second study was to further examine the REBS factorial structure, its psychometric properties, and its construct validity. Also, we were interested to test a motivational model of the regulation of eating behaviors. This model incorporates two global forms of regulation of eating behaviors (autonomous vs. controlled), two types of eating behaviors (healthy vs. dysfunctional), and psychological adjustment. In agreement with SDT (Deci & Ryan, 1985), it was proposed that an autonomous form of regulation toward eating behaviors should be related to healthy eating behaviors that, in turn, should lead to psychological adjustment. Conversely, it was hypothesized that a controlled form of regulation would be positively associated with dysfunctional eating behaviors (e.g., bulimic symptoms), which in turn, should be negatively associated with psychological adjustment. Also, it was hypothesized that an autonomous form of regulation should be negatively associated with dysfunctional eating behaviors whereas a controlled form of regulation should be negatively associated with healthy eating behaviors.

Method

Participants and Procedure

A questionnaire package containing the 24 items of REBS obtained in Study 1, as well as other measures related to the regulation of eating behaviors, was distributed to 339 female students who were enrolled in different courses at the University of Ottawa. Participants' ages ranged from 17 and 49 years ($M = 22.5$). The average Body Mass Index (BMI; kg/m^2) for the sample was 22.5 ($SD = 4.2$). Using the BULIT-R cutoff provided by Thelen, Farmer, Wonderlich, and Smith (1991), 2.9% of the women would be classified as putative bulimics. As for study 1, with the permission of professors, some women completed the questionnaire at the beginning of a class whereas others completed the questionnaire at home and returned it for the next class in a sealed envelop. Participants did not receive any incentives for their participation in this study.

Instruments

In addition to REBS, each questionnaire package contained measures related to consequences associated with the forms of regulation of eating behaviors (e.g.,

healthy and dysfunctional eating behaviors), as well as indicators of psychological adjustment.

Healthy Eating Behavior Scale. This scale was developed for the purpose of this study. It was inspired from recommendations made by the Canadian Food Guide concerning healthy eating behaviors (Health & Welfare Canada, 1992). It is composed of eight items divided in two subscales (four items/subscale). The scale displays a good factor structure. A Confirmatory Factor Analysis revealed an adequate fit for the model, $\chi^2(19, N = 339) = 50.85$ $p < .001$, CFI = .93, IFI = .94, RMSEA = .07, and PCFI = .60. One of the subscales refers to "healthy foods" whereas the other refers to "foods that should be eaten with moderation." The items for the healthy foods subscale are as follows: "I eat vegetables, fruits and grain products; I eat a variety of foods from each of the four groups recommended by the Canadian Food Guide; I eat foods that are low in fat, saturated fat, and cholesterol; I drink water." Factor loadings for this subscale ranged from .40 to .77. The items for the foods eaten with moderation subscale are as follows: "I eat foods such as chips, chocolate, and candies; I eat fried food; I use white sugar; I use salt." Factor loadings for this subscale ranged between .38 and .73. Participants were asked to indicate on a 5-point Likert scale how frequently they consume each type of food. Internal consistency coefficients for the present sample are acceptable ($\alpha = .74$ for the "healthy foods" subscale, $\alpha = .69$ for the "foods eaten in moderation" subscale).

Bulimic Symptomatology (BULIT-R; Thelen et al., 1991). The BULIT-R was used to assess bulimic symptomatology in accordance with the *DSM-III-R* criteria. This instrument is composed of 28 items and useful to identify subjects who are most likely to be diagnosed as bulimic on the basis of an interview. Prior research has shown that this self-report scale is a valid indicator of bulimia nervosa in both clinical and nonclinical populations. Participants are asked to choose among five answers (1–5), the one that applies best to them. Thelen et al. (1991) have suggested that a total score above 104 is indicative of putative bulimia nervosa. The scale has been shown to have high internal consistency ($\alpha = .97$) to discriminate well bulimics from "normal," and to correlate with other measures of eating pathology. It has good test–retest reliability ($r = .95$). Internal consistency for the current sample was .95.

Psychological Adjustment. A psychological adjustment index that consists of different variables (depressive symptomatology, self-esteem, and life satisfaction) associated with psychological well-being and mental health was used in this study (Pelletier et al., 1995). *Center for Epidemiological Studies—Depressed Mood Scale* (CES-D; Radloff, 1977). This scale is composed of 20 items that were designed to measure depressive symptomatology in the general population. The items of the scale represent symptoms associated with depression. It has been shown to have high internal consistency (i.e., .85 for the general population and .90 for the patient sample), acceptable test–retest reliability, and excellent concurrent

validity. The scale has also been found to discriminate well between psychiatric inpatients and the general population. Finally, the scale has been shown to be a valuable tool to identify groups at high risk of depression. Participants are asked to indicate on a 4-point Likert scale, the frequency of their symptoms (0 = Rarely or none of the time; 3 = Most or all of the time). The total score can vary between 0 and 60, with a higher score indicating a high frequency of depressive symptoms. *Self-Esteem Scale* (SES; Rosenberg, 1965). This self-esteem measure is composed of 10 items. Its reliability and validity are well established. The convergent and discriminant validity of SES have been documented in several studies. In terms of reliability, SES has revealed satisfying internal consistency and temporal stability. A test–retest of 2 weeks and 7 months revealed coefficients of .85 and .73, respectively. Participants are asked to indicate of a 5-point Likert scale ranging from 1 (*Do not agree at all*) to 5 (*Strongly agree*) the extent to which they agree with each item. *Life Satisfaction Scale* (LSS; Diener, Emmons, Larsen, & Griffen, 1985). This scale is composed of five items assessing participants' global perception of their life satisfaction. Participants are asked to rate, on a 5-point Likert scale 1 (*Do not agree*) to 5 (*Strongly agree*), to which extent they agree with the different items. A 2-month test–retest has revealed a coefficient of .82.

General Questions About Eating Behaviors. Participants were asked to answer six questions related to eating behaviors. These questions were as follows: To what extent... 1) do you find important to regulate your eating behaviors; 2) are you trying to regulate your eating behaviors; 3) are you concerned by the quantity of food you are eating; 4) are you concerned by the quality of food you are eating; 5) do you intend to regulate your eating behaviors in the future?; and 6) do you consider yourself successful in the way you regulate your eating behaviors? Participants were asked to indicate their answer on a 7-point Likert scale.

Results and Discussion

Preliminary Analyses

Before proceeding with the main analyses of the study, preliminary analyses were conducted to verify that the basic assumptions related to the use of multivariate procedures were respected. Each of the variables was examined to assess departures from univariate and multivariate normality, linearity, and homoscedasticity. With the exception of the amotivation subscale (with a high kurtosis), the univariate distribution was deemed acceptable. A log transformation was used to correct the distribution of the amotivation scale. After transformation, the value of the kurtosis was -1.18. This value provided no reason to suspect that the distribution of the amotivation score departed significantly from normality. Also,

Table II. Descriptive Statistics for the Indicators Included in the Motivational Model of the Regulation of Eating Behaviors

	M	SD	Kurtosis	Skewness	Range
Intrinsic motivation (IM)	4.06	1.52	−0.79	−0.10	1/7
Integrated regulation (INTEG)	4.26	1.57	−0.78	−0.08	1/7
Identified regulation (IDEN)	5.27	1.18	0.53	−0.80	1/7
Introjected regulation (INTRO)	3.30	1.68	−0.95	0.33	1/7
External regulation (ER)	1.98	1.17	2.19	1.55	1/7
Amotivation (AMO)	1.47	.85	6.42	2.39	1/7
Healthy eating behaviors (HEB1)	3.71	.76	−0.48	−0.36	1/5
Healthy eating behaviors (HEB2)	3.37	.79	−0.28	−0.63	1/5
Dysfunctional eating behaviors (bulimic symptomatology)	52.60	21.07	0.81	1.21	36/180
BULIT1	18.47	7.38	−0.00	0.86	
BULIT2	16.47		6.74	1.14	1.31
BULIT3	18.04	7.97	0.83	1.26	
Depressive symptomatology	1.78	.56	0.42	0.89	1/4
Self-esteem (SE)	3.96	.78	−0.10	−0.69	1/5
Life satisfaction (LS)	3.50	.91	−0.54	−0.26	1/5

from a multivariate point of view, the distribution of standardized residuals appeared normal (see Table II). Examination of summary statistics for REBS and the hypothesized structural equation model provided no reason to suspect that the distribution of the variables departed significantly from normality. No multicollinearity or singularity was present in the sample because all correlations were below .85 (Tabachnick & Fidell, 1996).

Confirmatory Factor Analysis of REBS

A confirmatory factor analysis was performed using LISREL 8.30 (Jöreskog & Sörbom, 1996). A six-factor model was designed and assessed. The initial model included the estimation of the 24 target loadings, 6 factor variances, correlations between all 6 factors, as well as uniqueness values for all 24 items. Finally, for identification purposes, the loadings between the first indicator of each latent construct and its target factor were fixed at 1.0. Model fit was assessed by the means of multiple statistical and practical fit indices: the chi-square likelihood ratio (χ^2), the Comparative Fit Index (CFI; Bentler, 1990), the Incremental Fit Index (IFI; Bollen, 1989), the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990), and the Parsimony Comparative Fit Index (PCFI; Byrne, 1994). The use of such multiple criteria is recommended in light of the current debate concerning the assessment of model fit in covariance structure analyses.

The initial model displayed an acceptable fit, $\chi^2(237, N = 339) = 676.46$, $p < .001$, CFI = .88, IFI = .88, RMSEA = .08, and PCFI = .76. However, estimation of the model after respecifications of some parameters led to a better fit. More specifically, examination of the modification indices revealed that three

correlations between the error uniqueness values of two indicators were of sizable magnitude. Post hoc analyses were conducted whereby correlations between two items of the identified regulation subscale, two items of the introjected regulation subscale, and two items of the intrinsic motivation subscale were estimated. This last model revealed an adequate fit; $\chi^2(234, N = 339) = 531.97$ $p < .001$, CFI = .92, IFI = .92, RMSEA = .06, and PCFI = .78. All estimated parameters of the model were significant and within an acceptable range. Results of the confirmatory factor analysis are presented in Table I.

Correlations Among the Six REBS Subscales. Pearson correlations were computed among the six subscales. As indicated earlier, support for this self-determination continuum would be obtained through the display of a simplex pattern where adjacent subscales have the highest positive correlations and the subscales at the opposite ends of the continuum have the most negative correlations. The correlations between the subscales and among the factors (phi values) of REBS are presented in Table III. In general, the results supported the presence of a self-determination continuum. Overall, adjacent subscales generally showed higher correlations (e.g., intrinsic motivation and integrated regulation, $r = .64$) than the subscales farther apart (e.g., intrinsic motivation and identified regulation, $r = .44$, or intrinsic motivation and amotivation, $r = -.15$, $p < .01$). Finally, internal consistency of the REBS subscales appear adequate.

Correlations Between the REBS Subscales and Related Constructs. Correlations between the REBS subscales and constructs related to the regulation of eating behaviors were examined. In general, constructs with a negative valence (i.e., bulimic symptomatology and depressive symptomatology) displayed positive correlations with the non-self-determined regulatory styles (i.e., introjected regulation, external regulation, and amotivation) whereas constructs with a positive valence (i.e., self-esteem, life satisfaction, and healthy eating behaviors) displayed negative correlations with these same regulatory styles. A reverse pattern was observed for the self-determined regulatory styles. Among the non-self-determined regulatory styles, introjected regulation displayed the highest negative correlation with constructs having a negative valence (ex. depressive symptomatology). As

Table III. Internal Consistencies (Diagonal), Pearson Correlations (Above Diagonal), and Factor Correlations (Below Diagonal) Among the Regulation for Eating Behaviors Scale

	1	2	3	4	5	6
Intrinsic motivation (1)	(.87)	.78	.61	.19	.03	−.12
Integrated regulation (2)	.64	(.90)	.89	.21	.07	−.14
Identified Regulation (3)	.44	.53	(.79)	.33	.12	−.19
Introjected regulation (4)	−.19	.11	.24	(.85)	.64	.34
External regulation (5)	−.06	.01	.17	.53	(.81)	.51
Amotivation (6)	−.18	−.19	−.10	.26	.38	(.77)

Note. $r = .13$ is significant at $p < .05$ ($N = 339$).

for the self-determined regulatory styles, integrated, and identified regulation displayed the highest positive correlations with constructs having a positive valence (ex., successful regulation).

Examination of correlations between the different subscales of REBS and other constructs related to eating behaviors revealed that although the external and introjected regulatory styles were positively associated with the importance of regulating eating behaviors, only intrinsic motivation, integrated and identified regulations were positively associated with success in the regulation of their eating behaviors. Among the self-determined regulatory styles, integrated regulation displayed the strongest positive association with successful regulation. The non-self-determined regulatory styles were all negatively associated with this latter construct. Results also suggested that women with an integrated or identified regulation displayed the greatest concern for the quality of food they eat. Conversely, women with an introjected regulation displayed the strongest concern for the quantity of food they eat. Among all the regulatory styles, identified regulation presented the highest correlation with future intentions to regulate eating behaviors. Correlations between each regulatory style and constructs related to the regulation of eating behaviors are presented in Table IV. Also, correlations between the different regulatory styles of eating behaviors and BMI scores are presented in this same table. All the non-self-determined regulatory styles were found to be positively associated with BMI scores whereas none of the self-determined regulatory styles were found to be significantly associated with this latter construct.

The self-determined subscales (the intrinsic motivation, the integrated and identified regulation subscales) were grouped to form a global score of autonomous regulation. Similarly, the non-self-determined subscales (the introjected and external regulation subscales as well as the amotivation subscale) were grouped to form a global score of controlled regulation (Elliot & Sheldon, 1998; Pelletier, 2002; Sheldon & Elliott, 1998). Correlations were computed between these two types of global forms of regulation (autonomous vs. controlled) and the different constructs of Table IV. Clear distinctions were observed between the two global forms of regulation. For example, an autonomous regulation was positively associated with healthy eating behaviors, self-esteem, and life satisfaction, whereas a controlled regulation was positively associated with bulimic symptomatology and depression. Also, it was found that, although both global forms of regulation (autonomous and controlled) were related to importance, intention, and efforts to regulate eating behaviors, an autonomous regulation was more strongly associated with these constructs. An interesting finding relates to women's concern for the quality versus quantity of the food they eat. Correlations suggest that women with an autonomous regulation were mainly concerned by the quality of the foods ($r = .43$) whereas women with a controlled regulation were mainly concerned by the quantity of the foods ($r = .41$). Only women who reported an autonomous

Table IV. Correlations Between the Different Subscales of the Regulation of Eating Behaviors Scale and Related Constructs as Well as Correlations Between the Two Global Forms of Regulation of Eating Behaviors (in Bold) and Related Constructs

	IM	INTEG	IDEN	INTRO	ER	AMO	Autonomous Regulation	Controlled Regulation
To what extent women...								
find important to regulate their eating behaviors	.26	.49	.49	.32	.09	−.22	.48	.20
try to regulate their eating behaviors	.25	.47	.45	.35	.08	−.11	.46	.21
are concerned by the quantity of food they eat	−.00	.18	.33	.54	.22	.02	.18	.41
are concerned by the quality of food they eat	.28	.41	.43	.20	.08	−.08	.43	.13
intend to regulate their eating behaviors in the future	.14	.34	.49	.41	.13	−.05	.36	.28
are successful in regulating their eating behaviors	.34	.54	.27	−.20	−.13	−.32	.46	−.25
Consequences of the regulatory styles on eating behaviors								
Healthy eating behaviors	.40	.56	.34	.07	−.02	−.22	.52	−.02
Bulimic symptomatology	−.11	−.02	.12	.68	.40	.25	−.02	.63
Psychological adjustment								
Depressive symptomatology	−.14	−.09	−.06	.43	.32	.24	−.07	.47
Self-esteem	.21	.18	.04	−.45	−.34	−.25	.18	−.47
Life satisfaction	.15	.17	.01	−.27	−.21	−.15	.14	−.29
Body Mass Index	−.02	−.08	.09	.13	.14	.17	−.02	.18

Note. $r = .13$; $p < .05$ ($N = 339$).

regulation were found to be successful with the regulation of their eating behaviors ($r = .46$). A controlled regulation was negatively associated with a successful regulation of eating behaviors ($r = -.25$). Finally, BMI appears to be correlated with the regulation of eating behaviors only when a controlled form of regulation is used.

Test of the Hypothesized Motivational Model of the Regulation of Eating Behaviors

A model incorporating the two autonomous and controlled forms of regulation of eating behaviors, the healthy and dysfunctional eating behaviors, and psychological adjustment index was assessed using structural equation modeling (LISREL 8.30; Jöreskog & Sörbom, 1996). The estimation procedure was performed using Maximum Likelihood (ML) fitting function. The proposed model is presented in Fig. 1. It is composed of 5 latent variables, 14 measured variables serving as indicators, 4 standardized structural regression coefficients showing the

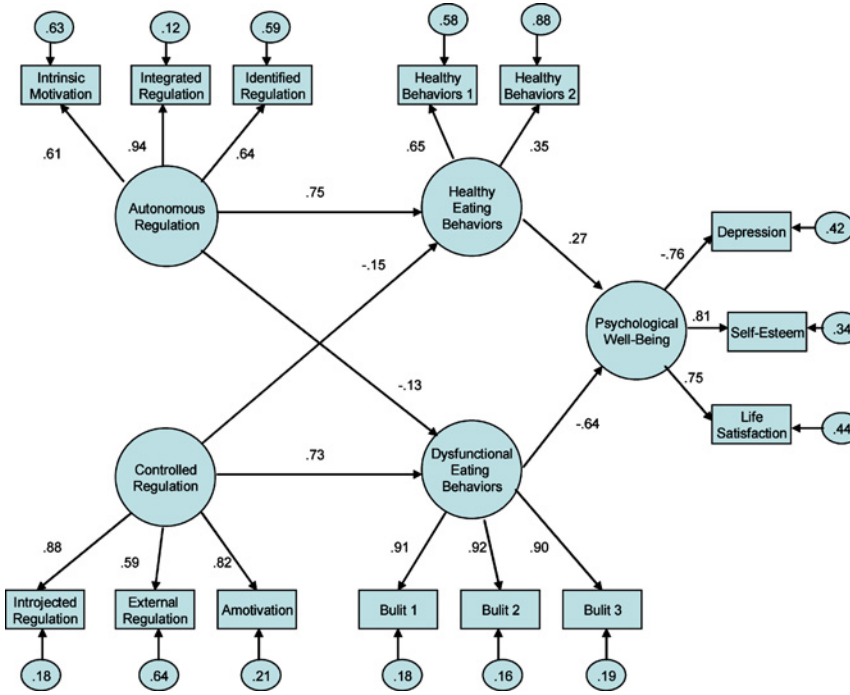

Fig. 1. Relationships between forms of regulation, eating behaviors, and psychological well-being. All estimates are significant at the level of .05.

hypothesized directional influences among the latent variables, 14 factor loadings from the factors onto the indicators, and 14 error variances associated with the observed variables.

With the exception of the likelihood ratio chi-square, the fit indices revealed that the correspondence between the estimated model and the sample covariance was satisfactory; $\chi^2(71, N = 339) = 229.25$, $p < .001$; RMSEA = .037; CFI = .93; IFI = .93; and PCFI = 78. As predicted, autonomous regulation was positively associated with healthy eating behaviors ($\beta = .75$) and healthy eating behaviors, in turn, was positively associated with psychological well-being ($\beta = .27$). Controlled regulation was positively associated with bulimic symptomatology ($\beta = .77$), which, in turn, was negatively associated with psychological well-being ($\beta = -.64$). Also, autonomous regulation was associated negatively with bulimic symptomatology ($\beta = -.13$), and controlled regulation was negatively associated with healthy eating behaviors ($\beta = -.15$). The amount of variance explained in healthy eating behaviors, bulimic symptomatology, and psychological well-being was 55, 57, and 49% respectively.

Overall, the results of Study 2 support the factorial structure and the construct validity of REBS. The motivational model of the regulation of eating behaviors suggest that individuals regulate their eating behaviors for different reasons and these reasons are associated with success or failure at the regulation of eating behaviors. Despite the interesting findings obtained in the first two studies, some limitations should be underlined. First, the studies relied exclusively on self-report measures. It would be important to substantiate our findings with objective or behavioral measures. Second, as with the vast majority of studies in the area of eating pathology, the investigation focused on a sample that was mainly composed of undergraduate university females. Replication with people selected from different communities and from various socioeconomic backgrounds could increase the generalization of our findings. Third, even though sophisticated statistical procedures were used to evaluate the motivational model, the design involved measurement of the variables at one point in time. It would be important to use a longitudinal design to validate the presumed direction of effects found in these studies, to examine the behavior change process and the maintenance of eating behaviors over time. Finally, we used bulimic symptomatology as a measure of dysfunctional eating and a representation of repeated failures at self-regulation. It would also be important to examine if the different forms of regulation of eating behaviors could be useful to predict actual dietary behavior change. The purpose of Study 3 was to address these shortcomings.

STUDY 3

Eating habits in general are hard to change. Recent reviews and studies confirm that initial and especially sustained adherence are difficult to achieve in the

dietary management of hyperlypidemia (McCann & Bovbjerg, 1998), hypertension (Elmer, Grimm, Flack, & Laing, 1991), and obesity (Wadden, 1993) among other chronic diseases. Although desired, dieting is a difficult behavior because it demands much self-control in resisting temptation and delaying gratification (Rosenbaum, 1993). People who are faced with life-threatening choices may find it easier to implement dietary changes because they are desperately trying to meet their basic need for survival. Yet when dietary change is a preventive health measure, such as reduction of blood lipids to reduce risk of heart disease, achievement of healthier eating patterns appears to be more difficult.

In the third study, our goal was to examine these issues. More specifically, we examined the relationships between individuals' general level of self-determined motivation, their level of contextual self-determined motivation for regulation of dietary behaviors and subsequent modifications in self-reported eating behaviors that would be reflected in an improved blood lipid profile and thereby lead to reduced risk for CAD. In particular, we sought to evaluate the predictive value of the self-determination construct in long-term adherence to healthier dietary behavior change. We considered motivation at two different levels, a general more dispositional level and a contextual level (i.e., the regulation of eating behaviors). General motivation was also assessed as the relationship between motivation within different life contexts and situations, especially when one faces important changes in his or her life, is expected to be influenced by one's general motivational orientation (Vallerand, 1997). Contextual motivation, as it is more subject to variations than is general motivation, is therefore likely to be more useful in explaining and predicting changes in outcomes that occur within specific contexts, such as dietary habits.

Accordingly, this study was designed to test a motivational model of the regulation of dietary behaviors of candidates for dietary changes on the basis of recent blood lipid results and other risk factors for CAD. Consistent with the longitudinal nature of this study, the model assesses the relationship between motivational, behavioral, and physiological variables across three time points—baseline (Time 1), 13 weeks (Time 2), and 26 weeks (Time 3). This model incorporates general motivation at Time 1 to predict contextual motivation (within dietary behavior domain) at Time 2, which in turn is used to predict dietary behaviors (dietary fat and saturated fat intake) at Time 3. Furthermore, the model posits that changes in dietary behaviors will be related to corresponding changes in physiological parameters (body weight, LDL-cholesterol, HDL-cholesterol and triglycerides).

The main hypothesis guiding this research was that level of general motivation assessed at baseline would predict the level of self-determined (i.e., autonomous) motivation within the context of dietary behavior regulation assessed at 13 weeks after baseline, which in turn would be a reliable predictor of adoption and long-term maintenance of healthier dietary changes assessed at 26 weeks after baseline. The dependent variables of primary interest were changes in percent calories

from fat and percent calories from saturated fat between baseline assessment and 26-week follow-up. Contextual motivation was measured at 13 weeks to ensure that by being provided with relevant health and nutritional information as well as practical dietary skills participants had time to absorb what it meant to implement dietary changes into their habitual eating patterns. Participants who would be regulating their dietary behaviors for self-determined reasons are expected to report consuming lower proportions of dietary fat and saturated fat. Conversely, participants who were non-self-determined in the regulation of their dietary behaviors were not expected to sustain their regulatory efforts, they were not expected to adhere to healthier eating patterns over the 26-week period, and they were not likely to show such positive changes in dietary habits. Furthermore, we expected that changes in dietary behaviors would be linked to favorable physiological outcomes (reduction in weight and improved blood lipid parameters). Specifically, reduced consumption of fat, including saturated fat, is expected to result in some weight loss and improvements in LDL-cholesterol, HDL-cholesterol, and TG levels. Assessment of changes in blood lipid parameters over the 26-week treatment period will provide an objective measure of self-reported dietary behaviors.

Method

Participants and Procedure

Study participants were 111 volunteers recruited from the practices of 18 primary care physicians. The mean age of these participants was 53.89 (SD = 7.8), 40.5% were female, 30.6% were daily smokers; 27.9% exercised more than three times per week; and the mean 10-year risk of CVD was 11.53% (SD = 6.47%). The sample size was calculated to detect an absolute difference in LDL-C of 0.4 mmol/l (approximately 10%) between groups ($a = 0.05$, $b = 0.20$), assuming a common standard deviation of 0.5 mmol/l (Bristol, 1989). Physicians approached patients they thought would be candidates for dietary change on the basis of recent blood lipid results and other risk factors for CAD, as per Canadian recommendations (Fodor, Frohlich, Genest, & McPherson, 2000). Patients were eligible to participate in the study if they were free of CVD and for men if they were 40–70 years of age and for women if they were 50–70 years of age. People with LDL-C $>$ 6 mmol/l, TG $>$ 4 mmol/l, and/or diabetes mellitus, and those using lipid lowering medications were excluded.

At a baseline screening session, potential participants were provided with information pertaining to the nature of the dietary change. A detailed medical and lifestyle history was taken, a fasting blood sample was drawn to determine a baseline lipid profile, and body weight was measured. They completed the General Self-Determination Scale (GSDS) and baseline eating behaviors were assessed using a 24-hr dietary recall questionnaire and a 3-day food record (from two

weekdays and one weekend day). The dietary instruments were administered by a dietitian and completed in groups of 5–10 participants. After the screening session, a research assistant contacted each participant by telephone to review his/her blood lipid profile and to instruct the individual with regards to the information that they would receive. One week after baseline measures, all participants received dietary counseling with a dietitian and step-by-step information on healthy eating. At 13 weeks after the counseling session participants completed the Regulation of Eating Behaviors Scale. At 26 weeks after the initial session body weight was measured and eating behaviors were again assessed by a 24-hr dietary recall questionnaire and a 3-day food record; a fasting blood sample was drawn for determination of the lipid profile. Participants received assistance from a registered dietitian in completing these forms.

Blood samples were analyzed in the Department of Laboratory Medicine at the Ottawa Hospital. Serum TG (triglycerides), TC (total cholesterol), and HDL-C (high-density lipoprotein cholesterol) concentrations were determined using standard laboratory procedures. LDL-C (low-density lipoprotein) concentrations were calculated from the measured values of TG, TC, and HDL-C. The 3-day food record and 24-hr dietary recall data were analyzed using the Elizabeth Stewart Hands & Associates (ESHA) Food Processor with the Canadian Nutrient Data File Data System, version 7.3. Three-day averages were generated for intake of selected dietary components at baseline and at the 26-week follow-up point.

Completion rates for scheduled contact sessions were monitored for all participants. Dependent variables of primary interest were changes in total dietary fat and saturated fat consumption between baseline assessment and 26-week follow-up; from these reports percent calories from fat and percent calories from saturated fat were calculated and used as behavioral outcomes. Serum TG, TC, and HDL-C concentrations and weight were used as physiological indicators of the self-reported dietary behavior changes.

Measures

The General Self-Determination Scale. Participants completed an 18-item GSDS at baseline (Pelletier et al., 2003). GSDS represents a broad orientation to be intrinsically or extrinsically regulated, or amotivated in general. GSDS is composed of six subscales assessing independently the six constructs of intrinsic motivation, as well as integrated regulation, identified regulation, introjected regulation, external regulation, and amotivation. Each subscale contains three items. Participants are presented with the statement "In general, I do things . . ." and are asked to indicate on a 7-point Likert-type scale, ranging from 1 (*Does not correspond at all*) to 7 (*Corresponds completely*) the extent to which each of the 18 items corresponds to their own motives for behavior in general. The following are sample items from each of the six subscales of the global motivation scale:

(1) . . . for the pleasure of learning new, interesting things (intrinsic motivation); (2) . . . because they reflect what I value most in life (integrated regulation); (3) . . . because I choose to invest myself in what is important to me (identified regulation); (4) . . . because I force myself to do them (introjected regulation); (5) . . . in order to show others what I am capable of (external regulation); (6) . . . even though I believe they are not worth the trouble (amotivation). Results of five studies support the six-factor structure of the construct validity of the scale. To simplify the analysis and to illustrate how the GSDS subscales could be combined, a general self-determination index (SDI), rather than an autonomous and a controlled regulation score, was computed for each participant. This was done by multiplying the participant's score on each subscale by a weight assigned as a function of the position of the subscales on the self-determination continuum (see Blais, Sabourin, Boucher, & Vallerand, 1990; Green-Demers, Pelletier, & Menard, 1997; Vallerand, 1997, for more information on SDI). Accordingly, the global SDI was derived from the following formula: SDI = 3(average score of intrinsic items) + 2(average score of integrated items) + 1(average score of identified items) −1(average score of introjected items) − 2(average score of extrinsic items) − 3(average score of amotivation items). The general SDI reflects the relative level of self-determination experienced by the participants when engaging in general behaviors.

The Regulation of Eating Behaviors Scale. Participants completed REBS (Study 1), which assessed their motivational orientation toward dietary regulation, at baseline, and 13 weeks. The contextual SDI reflects the relative level of self-determination experienced by the participants when engaging in healthful dietary behaviors. Once again, to simplify the analysis and to illustrate how REBS subscales could be combined, an SDI, rather than an autonomous and a controlled regulation score, was computed for each participant. This was done by multiplying the participant's score on each subscale by a weight assigned as a function of the position of the subscales on the self-determination continuum as described for the General Self-Determination Scale.

Eating Behavior Measures. Eating behaviors were assessed at baseline, and 26 weeks using a 24-hr dietary recall questionnaire and a 3-day food record. The 24-hr recall provides data for 1 day and is used to obtain estimates of the typical food intakes of a population (Cataldo, DeBruyne, & Whitney, 1995). The assessor, in this case a dietitian, asks the client to recount everything eaten or drunk in the past 24 hr. The dietitian describes what a serving size of different foods would consist of and how it should be measured and recorded, and prompts participants to recall in as much detail as possible their food intake.

A food record is an extensive, accurate log of all food eaten over a period of several days. In this study participants were instructed to record a detailed description (including brand names) of everything they ate or drank for two consecutive weekdays and one weekend day (i.e., Thursday, Friday, Saturday or

Sunday, Monday, Tuesday). They were asked to write down, immediately after each meal, the times foods were eaten, all foods and beverages consumed, the amounts consumed, and method of preparation.

Physiological Measures. Blood lipid parameters (LDL-C, TC/HDL ratio, and TG) and weight were assessed at baseline and 26 weeks after initial counseling session.

Results and Discussion

Changes in Outcome Measures

A comparison of baseline and 26 weeks dietary and blood lipid measures for all participants are presented in Table V. Mean percent energy obtained from fat and saturated fat was significantly reduced over the 26-week period, as was mean intake of dietary cholesterol. Blood lipid parameters decreased over the 26-week period, with the mean LDL-cholesterol and total cholesterol/HDL-cholesterol levels being statistically lower at Time 3. Mean body weight was also statistically lower by Time 3.

General Motivation as Predictor of Contextual Motivation

Hierarchical linear regression analysis was used to evaluate the relationship between general motivation and motivation within the context of dietary behavior regulation. On the first regression step, Time 2 motivation scores for dietary regulation were regressed on contextual motivation scores assessed at baseline to adjust for any variance introduced by uninformed baseline motives for dietary behavior

Table V. Self-Reported Dietary Behavior, Lipid Parameters, and Body Weight Measures for Participants at Baseline and at 26 Weeks (Time 3)

Measure	Baseline mean (95% CI), $n = 111$	Time 3 mean (95% CI), $n = 111$	% Change	Paired t test p value
Dietary behavior				
% Calories from fat	32.49 (30.64, 34.33)	28.45 (26.55, 30.35)	−12.4	<.01
% Calories from saturated fat	10.50 (9.72, 11.28)	8.37 (7.66, 9.08)	−20.3	<.01
Physiological				
LDL-C (SD), mmol/l	4.38 (4.26, 4.50)	4.13 (4.00, 4.26)	−5.7	<.01
TC/HDL-C (SD), mmol/l	5.02 (4.82, 5.22)	4.78 (4.58, 4.99)	−4.9	<.01
TG (SD), mmol/l	1.68 (1.54, 1.81)	1.59 (1.46, 1.73)	−5.4	.08
Body weight (SD), kg	82.21 (79.34, 85.07)	80.69 (77.82, 83.57)	−1.8	<.01

Note. HDL-C denotes high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; TG, triglycerides.

change. On the second step, the general motivation scores were entered into the regression equation. General motivation was found to be a reliable predictor of contextual motivation 13 weeks later; $r = .49$; semipartial correlation, $sr^2 = .06$, $F(2, 109) = 3.07$, $p < .06$. Overall, general motivation explained an additional 7% of the variance in contextual motivation after controlling for the contextual motivation at baseline. Individuals who were assessed as more self-determined generally at baseline were also more likely to regulate their dietary behaviors for self-determined reasons at Time 2.

Self-Determination as Predictor of Dietary Behaviors

The predictive value of the self-determination construct in the regulation of dietary behaviors was tested using hierarchical multiple regression analyses. A separate analysis was conducted for each dietary measure (i.e., percent calories from total dietary fat and percent calories from saturated fat); the dietary variable assessed at Time 3 was regressed on SDI derived from the scores on REBS at Time 2. On the first regression step the dietary outcome was regressed on its baseline score after controlling for age, gender, smoking status, exercise frequency, and the baseline general SDI score. On the second step the Time 2 SDI score was entered. With this procedure variance due to baseline values of dietary behavior measures and self-determination were removed on the first regression step, so that on the second step only the variance explained by the predictor of interest (i.e., SDI score for dietary self-determination) remained.

The path analysis depicting the relationships among motivational, behavioral, and physiological variables of the hypothesized model are presented in Fig. 2. Regression analyses revealed that self-determined regulation of dietary behaviors at Time 2 was a significant predictor of Time 3 measures of percent calories from total dietary fat, $r = -.32$; $sr^2 = .09$, $F(6, 109) = 3.19$, $p < .01$, and from saturated fat, $r = -.18$; $sr^2 = .04$, $F(6, 109) = 2.69$, $p < .05$. Contextual motivation explained an additional 17 and 7% of the variance in calories from total dietary fat and calories from saturated fat respectively after controlling for each construct at baseline. The more self-determined participants' motives for regulating their dietary behaviors were, the more successful they were at reducing their fat and saturated fat intake in their diets over the 26-week period.

Relationship Between Dietary Behavior Change and Physiological Outcomes

Finally, regression analyses were used to confirm that a reliable relationship exists between dietary behavior changes and physiological outcomes (i.e., weight and blood lipid parameters). These analyses served to provide an objective measure for adherence to a healthier dietary regimen, thereby supporting the self-reported dietary behavior outcome measures with objective data and strengthening the

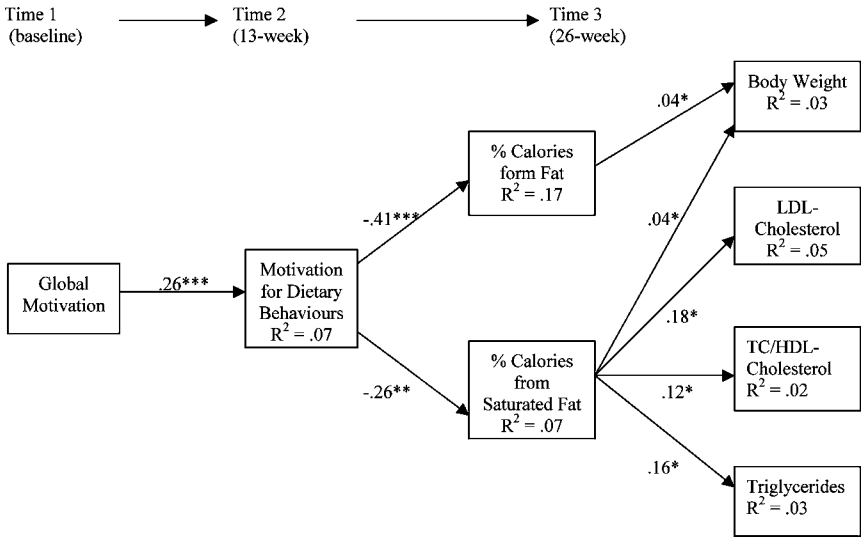

Fig. 2. Path analysis modeling the relationships between the motivational, behavioral, and physiological variables. Variables controlled for (entered on first regression step): age, gender, smoking status, exercise frequency, and baseline measure of predictor variable. HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; TG, triglycerides. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$. Numbers above the arrows represent beta weights.

validity of the self-determination construct as a determinant of maintained dietary behavior change. Time 3 blood lipid parameters (LDL-C, TC/HDL-C ratio, and TG) and body weight were regressed on Time 3 dietary behavior measures; a separate analysis was conducted for each physiological outcome. On the first regression step the physiological outcome was regressed on its baseline score and all baseline dietary behavior values, age, gender, smoking status, and frequency of exercise; on the second step the Time 3 dietary behavior score of interest was entered. This ensured that on the second regression step only the variance explained by the predictor of interest (i.e., Time 3 dietary behavior score) remained. Relationships between behavioral and physiological variables were in the expected direction; measures of total dietary fat and saturated fat intake were positively related to weight and blood lipid parameters. Decreases in percent calories from total dietary fat and saturated fat were significant predictors of reduced body weight at Time 3, $r = .20$; $\mathrm{sr}^2 = .01$, $F(7, 109) = 4.12$, $p < .01$, $R^2 = .03$. Reduction in percent calories from saturated fat was a significant predictor of lower LDL-cholesterol levels, $r = .23$; $\mathrm{sr}^2 = .02$, $F(6, 109) = 2.76$, $p < .05$; $R^2 = .05$; lower TC/HDL ratio, $r = .17$; $\mathrm{sr}^2 = .01$, $F(6, 109) = 2.83$, $p < .05$, $R^2 = .02$; and lower TG levels, $r = .15$; $\mathrm{sr}^2 = .02$, $F(6, 106) = 2.89$, $p < .05$, $R^2 = .03$, at Time 3. These significant relationships between the self-reported behavioral and objective physiological measures confirmed the reliability of the dietary behavior data.

In sum, this study examined the role of general and contextual self-determination as a potential modifiable determinants of successful dietary behavior change. We proposed a model not only to examine the strength of the relationship between general motivation and contextual motivation within the domain of dietary regulation, but more importantly to test the value of self-determination at the contextual level in predicting long-term dietary behavior change and associated health benefits. Our intent was to evaluate the significance of these relationships to inform the design of future interventions with respect to facilitating management of dyslipidemia through dietary means. The hypothesized model spanned across three time points to propose that general self-determination is a reliable indicator of self-determination within the context of dietary behavior regulation; that more self-determined reasons for dietary behavior change would be associated with sustained regulatory efforts and thereby maintained heart-healthy dietary changes, namely reductions in total dietary fat and saturated fat intake; and thirdly that these healthful dietary changes would be evidenced in improved blood lipid profiles and reduced body weight.

Findings demonstrated that over the 26-week period participants did on average modify their dietary patterns in a healthful direction. Participants reduced their consumption of total dietary fat by 12.4% and their saturated fat intake by 20.3%. These were relevant improvements that were also reflected in significant decreases in mean LDL-cholesterol and TC/HDL-cholesterol levels as well as a drop in mean body weight. Path analyses provided support for the relationships proposed in our model designed to gain insight into the prediction of these dietary behavior and physiological changes. Specifically, the SDT construct was found to be a valuable determinant of adherence to desired dietary patterns change. In support of the hierarchy of motivation proposed by SDT (Deci & Ryan, 1985; Vallerand, 1997), we found that individuals' motives for regulating their dietary behaviors were reliably related ($r = .49$) to their general motivation reflected in their personalities at large. This suggests that although broad measures of personality and adjustment may not be informative with respect to functioning in specific contexts and/or situations, they can be used to reliably predict motivational orientation within specific domains.

The level of self-determined motivation within a specific context was useful in predicting functioning and adjustment within those domains of human activity. The more self-determined participants' motives for healthy dietary regulation were, the more they persisted in their efforts to reduce their intake of total dietary fat and saturated fat. Correspondingly, the more self-determined that individuals were in this behavioral domain, the greater their reported reductions in percent calories from total fat and from saturated fat were even 26 weeks after the initiation of intervention. The magnitude of the relationships between the contextual measure of self-determination and each dietary behavior measure ($\beta = -.41$ for total fat; $\beta = -.26$ for saturated fat) was meaningful, especially given that self-reported behavior was supported by objective physiological measures toward dietary change. As

expected, reported reductions in percent calories from total dietary fat at Time 3 were directly associated with reductions in body weight. Similarly, reductions in percent calories from saturated fat over the course of the 26-week period were reflected in lower body weight at Time 3, as well as significant reductions in LDL-cholesterol, TC/HDL-cholesterol, and triglycerides.

GENERAL DISCUSSION

In this article, we examined why some people may be successful at regulating their eating behaviors whereas others may be at greater risk of experiencing failures at self-regulation. The bulimic symptomatology and sustained dietary change were used as measures of chronic failure at self-regulation of eating behaviors. In a first study, a new instrument was developed to measure different motives underlying women's regulation of eating behaviors namely, REBS. REBS was based on the different behavioral regulatory styles identified by Deci and Ryan in their Self-Determination Theory (1985; Ryan & Deci, 2000). In a second study, the factorial structure of REBS and its psychometric properties were assessed, and a motivational model was proposed and tested to examine the relationships between an autonomous form and a controlled form of regulation of eating behaviors, healthy and dysfunctional eating behaviors and psychological adjustment. The results of *exploratory* and confirmatory factor analyses supported the six different types of reasons postulated to explain why women may regulate their eating behaviors. Globally, the experimental version of REBS revealed an adequate structure and very acceptable internal consistency. Results of Study 2 provided additional support for the validity of REBS. Correlations between the REBS subscales globally supported the presence of the self-determination continuum. In terms of the correlations between the REBS subscales and different constructs related to eating behaviors, some correlations deserve particular attention. An interesting finding concerns the preoccupation of women for the quantity versus the quality of the food they eat. Women with a self-determined regulatory style indicated that they were concerned by the quality of the foods they ate whereas women who reported a non-self-determined indicated that they were concerned by the quantity of food they ate. Considering that women who reported a non-self-determined regulatory style were found to be unsuccessful in the regulation of their eating behaviors and because these women were also found to be mostly concerned by the quantity of foods, it would be interesting to examine if an emphasis on the quantity of food instead of on the quality could put someone at greater risk for self-regulation failure of eating behaviors.

Consistent with SDT (Deci & Ryan, 1985), women's reasons for regulating their eating behaviors were found to be differentially related to various consequences. Women who indicated regulating their eating behaviors for

self-determined motives reported more positive consequences such as healthy eating behaviors, higher self-esteem, and greater life satisfaction. Conversely, women who indicated regulating their eating behaviors for non-self-determined motives reported more bulimic and depressive symptoms, lower self-esteem, and lower satisfaction with life. These relationships were also supported in the structural equation model. It was found that women who reported an autonomous regulation also reported healthy eating behaviors. Conversely, women who reported a controlled regulation reported bulimic symptoms reflecting an eating disturbance. It is interesting to note that controlled regulation was also negatively associated with healthy eating behaviors whereas autonomous regulation was not related to bulimic symptomatology. Finally, it appears that healthy eating could have a positive impact on the overall psychological well-being on the individual whereas having dysfunctional eating behaviors could affect negatively the overall psychological adjustment. Although we believe that good eating behaviors are not sufficient for psychological adjustment, our results suggest that it may be necessary to experience psychological adjustment.

Overall, the path analyses provided empirical support for the relationships proposed in our model. In line with the self-determination theory (Deci & Ryan, 1985; Ryan, Sheldon, Kasser, & Deci, 1996; Sheldon & Kasser, 1995; Vallerand & Reid, 1988), our results showed that people who were more self-determined generally were predisposed to adopt a more self-determined orientation toward regulation of dietary behaviors that, in turn, was associated with more persistent regulatory efforts toward achievement of positive health outcomes. These research findings are encouraging for the health behavior field at large because they demonstrate that not only is complex behavior change possible, but that it can be sustained over a 3-month period if its regulation is more self-determined. Thus, when promoting health behavior change and maintenance, one needs to look beyond the intensity of initial motivation (i.e., readiness to change) and consider individuals' source of motivation for goal pursuit to predict sustained effort toward behavior change and its long-term maintenance.

Apart from the direct positive relationship between a self-determined regulatory style and adherence to healthful behaviors, motivational orientation shapes how individuals approach a task even prior to initiation of regulation. In accordance with findings from other studies that more self-determined regulatory styles lead to enhanced learning, greater interest, greater effort, greater persistence, and better performance (see Vallerand, 1997, for a review), it can be deduced that the general tendency of more self-determined individuals to be more proactive inclined them to make better use of the information provided to them at the onset of our study. Because of its predictive value within the context of dietary behavior regulation, the self-determination construct can be utilized as a factor according to which interventions can be tailored to facilitate management of dyslipidemia, as well as other diet-related disorders, through dietary means. Whereas individuals

who are more self-determined are prone to effective self-regulatory strategies, less self-determined individuals would benefit from more intervention strategies specifically designed to enhance level of self-determined motivation.

This line of reasoning leads to next steps for this area of research; namely, the application of the theory of self-determined motivation to intervention designs. As any benefit from dietary modification entails sustained behavioral change, a dietary change program is effective only to the extent that it assists individuals in making long-lasting changes. Previous research has shown that social contexts that support individuals' autonomy (by providing choice, minimizing control, providing a meaningful rational, and encouraging self-initiation and acknowledging feelings) facilitate self-determined actions, whereas contexts that hinder autonomy (i.e., controlling contexts) undermine self-determined motivation. This implies that behavioral interventions (e.g., autonomy-supportive contexts) can be employed to strengthen self-regulatory systems that foster capacity for self-protective action and thereby harvest greater persistence resulting in long-term behavior change. Accordingly, the effectiveness of a controlling versus an autonomy-supportive style of intervention delivery on people with different motivational orientations needs to be examined. Moreover, the findings of this study needs to be extended to dietary behaviors other than fat intake, and more broadly to other health behaviors such as promotion of physical activity and smoking cessation.

In sum, our findings clearly suggest that individuals are motivated to regulate their eating behaviors for different reasons, and that these reasons reflect different degrees of internalization of the regulatory processes of eating behaviors. Unlike most studies in the domain of eating behaviors, our research examined predictors of dysfunctional eating behaviors as well as sustained healthy eating behaviors in one integrative model. Findings suggest that the more individuals display a self-determined regulatory style toward their eating behaviors, the more they have healthy eating behaviors. Finally, our findings suggest that the regulatory processes underlying eating behaviors can have an impact on one's global psychological adjustment.

Although preliminary in nature, these findings hold some important implications for health professionals concerned with understanding why some people may be more successful than others at regulating their eating behaviors. One possible way of addressing this issue would be to inquire about the different reasons as to *why* people regulate their eating behaviors. Results of the present studies suggest that it is important to distinguish between autonomous and controlled motives, given the different associations that these two global categories of motives present with eating behaviors (healthy vs. pathological). Our results suggest that although people may be motivated to regulate their eating behaviors, successful regulation is less likely to occur if the motivation is non-self-determined. It is important for people to develop a genuine willingness for the activity so that they can personally endorse the regulation of the behavior. Therefore, health

professionals' effort should not be confined merely at encouraging people to regulate their eating behaviors but at promoting a self-determined regulatory style toward eating behaviors. The contextual factors that foster the development of self-determined motives for an activity have been the focus of extensive studies (see Deci & Ryan, 1987, for a review). Globally, autonomy-supportive, informative, and caring contexts were found to affect the quality of the self-regulatory process. Thus, having a partner who displays a caring attitude and who provides information about the regulation of healthy eating by supporting one's autonomy and competence may help the person develop a self-determined style of regulation. Although, contemporary research has acknowledged the negative impact of pressures (sociocultural influences, partner, friends, and families' pressures) on eating behaviors, it has neglected to examine how positive interpersonal behaviors (e.g., autonomy support, competence support, and caring) could facilitate the adoption of a self-determined regulatory style toward eating, which in turn could lead to positive eating behaviors. Future studies could specifically examine this question.

In sum, as briefly described above, REBS may prove useful for many researchers interested in better understanding determinants as well as consequences of people's motivation for regulating their eating behaviors. It is our hope that the present research has laid the foundation for such type of work.

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