Balancing Temptations and Health Goals: The Role of Compensatory Health Beliefs

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Abstract

Particularly in the health domain, humans thrive to reach an equilibrium between maximizing pleasure and minimizing harm. I propose that a cognitive strategy people employ to reach this equilibrium is the activation of Compensatory Health Beliefs (CHBs). CHBs are beliefs that the negative effects of an unhealthy behavior can be compensated for, or "neutralized," by engaging in another, healthy behavior. "I can eat this piece of cake now because I will exercise this evening" is an example of such beliefs.

This thesis presents a theoretical framework which aims at explaining why people create CHBs and how they employ CHBs to regulate their health behaviors. The model extends current health behavior models by explicitly integrating the motivational conflict that emerges from the interplay between affective states (i.e., cravings or desires) and motivation (i.e., health goals). The first study includes a psychometric scale that measures CHBs in the general population and provides data on its reliability and validity. The results showed that scores on the scale were uniquely associated with health-related risk behaviors and symptom reports and could be differentiated from a number of related constructs. Holding CHBs may hinder individuals from acquiring healthier lifestyles, for example lose weight or exercise. The second large-scale study of this thesis aimed at studying CHBs in adolescents with type 1 diabetes. It is proposed that in this population, CHBs might interfere with treatment adherence. If compensatory behaviors fail to compensate for the maladaptive behaviors, poor blood glucose control and related health problems may arise. To investigate this further, I developed and validated a CHB scale specific to type 1 diabetes. The scale was validated in a sample of adolescents with type 1 diabetes. Results showed that holding maladaptive compensatory health beliefs was
associated with poorer blood glucose control and poorer adherence to self-care behaviors while adaptive CHBs were associated with better blood glucose control and better adherence to treatment behaviors. Specifically targeting CHBs in an intervention could improve adherence to treatment and therefore the long-term health of this population. Future research as well as the implications for possible interventions are explicitly being discussed.
Résumé

Particulièrement dans le domaine de la santé, les individus tentent constamment d'atteindre un équilibre entre la satisfaction de leurs désirs et minimiser les conséquences négatives. Je propose qu’une stratégie cognitive que les gens utilisent pour atteindre un tel équilibre est l’activation des Croyances Compensatoires de Santé (CCSs). Les CCSs sont des croyances selon lesquelles les effets négatifs d’un comportement nuisible pour la santé peuvent être compensés ou « neutralisés » par le fait d’adopter un comportement sain pour la santé. "Je peux manger ce morceau de gâteau maintenant parce que je vais aller faire de l’exercice ce soir" est un exemple d’une telle croyance. Cette thèse présente un modèle théorique permettant d’expliquer pourquoi les gens forment ou entretiennent des CCSs de même que comment ils les utilisent pour réguler leurs comportements de santé. Le modèle proposé enrichit les modèles précédents sur les comportements de la santé en intégrant de façon explicite le conflit motivationnel provenant de l’interaction entre les états affectifs (désires ou envies) et la motivation (les objectifs vis-à-vis de la santé). La première étude a pour objectif de vérifier la fidélité et la validité d’une échelle psychométrique mesurant les CCS dans la population générale. Les résultats démontrent que les scores sur cette échelle sont associés de façon unique aux comportements de santé ainsi qu’aux symptômes physiques auto-rapportés. Enfin, ces résultats suggèrent que le fait d’entretenir des CCSs peut empêcher les individus d’acquérir un style de vie plus sain, comme par exemple perdre du poids ou faire de l’exercice. La deuxième étude de cette thèse a pour but d’étudier les CCSs chez les individus atteints du diabète de type 1. Il est proposé que chez cette population, les CCSs pourraient diminuer l’adhérence au traitement prescrit et que, dans la mesure où les comportements compensatoires ne
compensent pas réellement pour les comportements malsains, il pourrait s’en suivre un mauvais contrôle du taux de glucose sanguin et des problèmes de santé. En lien avec cette proposition, j’ai développé et validé une échelle de CCS auprès d’un échantillon d’adolescents atteints du diabète de type 1. Les résultats démontrent que les croyances compensatoires contre-indiquées sont associées avec un moins bon contrôle du taux de glucose sanguin et une moins grande adhérence aux activités reliées aux soins du diabète. À l'inverse, les résultats révèlent que les CCS indiquées sont associées avec un meilleur contrôle du taux de glucose sanguin et une plus grande adhérence aux comportements reliés au traitement. Ces résultats suggèrent que cibler les CCS spécifiquement lors d’interventions pourrait améliorer l’adhérence au traitement et donc la santé à long terme de cette population. Les résultats sont discutés selon leurs implications pratiques et des pistes de recherches futures sont également proposées.
Contributions of Authors

The present thesis research constitutes an original contribution to the understanding of self-regulation of health behaviors and provides tools to study the newly developed construct of Compensatory Health Beliefs (CHBs). Furthermore, I apply the theory to a specific clinical population, adolescents with type 1 diabetes, with the results having important implications both for applications and future research directions.

The first manuscript, “The Eternal Quest for Optimal Balance Between Maximizing Pleasure and Minimizing Harm: The Compensatory Health Beliefs Model”, is a theoretical paper co-authored by myself, Bärbel Knäuper, and Paule Miquelon. It has been accepted for publication in the *British Journal of Health Psychology*. The concept of Compensatory Health Beliefs (CHBs) was first described by Dr. Bärbel Knäuper. For the above mentioned article, I substantially expanded and refined the CHB model, integrated other theoretical constructs (e.g. from self-determination theory and from the theory of action control) into it and clarified the assumed mediating processes between the different components of the models. Dr. Miquelon is an expert in self-determination theory and served in an advisory role specifically for the part of the paper describing the role of self-determined motivations in the creation of CHBs.

The second manuscript “Compensatory Health Beliefs: Scale Development and Psychometric Properties”, co-authored by Bärbel Knäuper, myself, Oshra Cohen, and Nicholas Patriciu, was published in *Psychology and Health* (2004). As the second author on this paper, I have made a substantial contribution to this paper. I was importantly involved in all steps of conceptualizing and planning the reliability and validity studies, the data collection, the data analyses and the writing of the manuscript. Myself and
Bärbel Knäuper performed the statistical analyses together for both studies and worked on the manuscript, with the input of the other two co-authors. The reason I decided to include a second-author paper in my thesis package, in addition to the fact that I made substantial contributions to it, is that it constitutes an important logical step in my research program and needed to be included to follow through the thread of my graduate research career.

The third manuscript, “Metabolic Control and Self-Care in Adolescents with Type 1 Diabetes: The Role of Compensatory Health Beliefs”, co-authored by myself, Bärbel Knäuper, Thien-Kim Nguyen, Constantin Polychronakos and Maria Sufrategui, will be submitted to *Health Psychology*. For this complex study, I have undertaken the planning of the research agenda, obtained ethics approval from the hospital where the data were collected, collected the data, conducted and reported the data analyses, and wrote and revised the manuscript. Kim-Thien Nguyen was an honours student co-supervised by Dr. Knäuper and myself. She participated in the data collection, the preliminary data analyses, and reviewed the manuscript. Dr. Polychronakos is the Director of the Diabetes Clinic and Dr. Sufrategui is the Psychologist on the Diabetes Team at the Montreal Children’s Hospital. They both served in an advisory capacity during the development of the item pool, the refining of the research protocol, and for the revision of the text.
General Introduction

The main theoretical question addressed in this research program is what makes it so challenging for individuals to adhere to self-set health goals or to treatment recommendations such as in diabetes. Individuals commonly set health goals for themselves such as adhering to an exercise routine, a specific diet, or a treatment regimen. However, research shows that maintaining those health goals over time is challenging and many do not succeed. For example, after six months on a hypocaloric diet, 96% of obese individuals lost five kilograms or more, however, only 52% maintained the weight loss after a year and only 11% after five years (Toubro & Astrup, 1997). Similarly individuals often fail to maintain increased levels of physical activity over time (Perri, Martin, Leermakers, Sears, & Motelovitz, 1997). Finally, both adult and youth with type 1 diabetes show inconsistent adherence to their treatment regimen, especially to testing blood glucose and following dietary and exercise recommendations (Kovacs, Goldston, Obrosky, & Iyengar, 1992).

In trying to understand the low adherence to health goals and treatment regimens, one must consider the many daily decisions involved in these behaviors, specifically the many temptations with short-term rewards, but potential short- and long-term health effects that people face (Shah & Kruglanski, 2003). People's health goals (e.g., losing weight, being fit, and/or being healthy) are frequently incongruent with the temptations faced (Fishbach, Friedman, & Kruglanski, 2003; Trope & Fishbach, 2000), requiring the individual to activate self-regulatory processes (Metcalf & Mischel, 1999). The interplay between temptations and health goals creates a state of internal conflict or cognitive dissonance (Abraham & Sheeran, 2003; Giner-Sorolla, 2001). The Compensatory Health
Beliefs Model (Rabiau, Knäuper, & Miquelon, 2006) proposes that one way to alleviate this unpleasant state of dissonance is to create or activate Compensatory Health Beliefs (CHBs). CHBs are convictions that the negative effect of an unhealthy behavior can be compensated for by engaging in another healthy behavior. An example would be the belief that it is ok to eat a piece of cake at lunch because one will go to the gym in the evening.

The first manuscript of this thesis (Rabiau, Knäuper, & Miquelon, 2006) introduces the CHB model. It describes how and when CHBs are activated as well as their implications towards health. The model builds on previous models of health self-regulation and incorporates a number of constructs, such as self-efficacy, constructs from self-determination theory, and implementation intentions. In order to test such a model, the first step is to create a scale to measure the newly developed construct. The second manuscript (Knäuper, Rabiau, Cohen, & Patriciu, 2004) thus describes the development of a CHB scale as well as its reliability and validity.

Finally, the construct of CHBs is explored in a clinical sample of adolescents with type 1 diabetes. Compensating is an integral part of the management of diabetes because blood glucose levels depend on a balance between a number of health factors that may raise or lower it (food, stress, insulin, exercise) (Edgar & Skinner, 2003). In other words, individuals with diabetes continuously have to make decisions that involve compensation. Therefore, the construct of CHBs is particularly relevant to this disease. The third manuscript (Rabiau, Knäuper, Nguyen, Polychronakos, & Sufrategui, 2006) describes the challenges of self-regulation of diabetes in adolescence and the specific role of CHBs. Furthermore, it explains the development of a diabetes-specific CHB scale and
how well CHBs predict treatment adherence and blood glucose control in adolescents with type 1 diabetes.
Manuscript 1: The Eternal Quest for Optimal Balance Between Maximizing Pleasure and Minimizing Harm: The Compensatory Health Beliefs Model

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The Eternal Quest for Optimal Balance Between Maximizing Pleasure and Minimizing Harm: The Compensatory Health Beliefs Model

Humans struggle to reach an optimal equilibrium between fulfilling their desires and adhering to their goals (Baumeister, Bratslavsky, Muraven & Tice, 1998; Baumeister, Heatherton & Tice, 1994; Metcalfe & Mischel, 1999; Mischel, 1996; Muraven & Baumeister, 2000). In other words, they strive to find an appropriate balance between maximizing pleasure and minimizing harm, which has been referred to as the pleasure or hedonic principle (Higgins, 1997). For example, people are faced with temptations and desires such as eating delicious but unhealthy foods, smoking, or drinking alcohol, but also hold goals such as remaining healthy, being thin, or being athletic. As these examples illustrate, such struggles are particularly prominent in the health domain and the outcome is of prime importance. Being able to exert self-control over health behaviors, that is, resist temptation in the course of goal pursuit (Metcalfe & Mischel, 1999), is a key factor in maintaining one’s health. Therefore enhancing people’s self-control could have great impact on the prevention of disease.

As of now, much of the work attempting to explain and predict health behavior has implicitly assumed that health behavior choices are primarily the product of reasoned cognitive processes. For example, Rogers’ (1975, 1983, 1985) Protection Motivation Theory assumes that people’s health behavior is a function of perceived severity, vulnerability, response effectiveness, and self-efficacy. Ajzen’s Theory of Planned Behavior (1985, 1991) regards health behavior as being primarily determined by the individual’s intention to perform the behavior in combination with perceived behavioral control. In turn, intention to perform the behavior is predicted by three factors: positive
and/or negative attitudes towards the behavior, perceived behavioral control and subjective norms. Even though these well-validated models address affective states and motivation, they do not specifically address the interplay between the two. The model proposed here, in contrast, focuses on the motivational conflict that arises from the interplay between affective states (e.g., cravings, anticipated pleasure, and desires) and motivation (e.g., goals). The model is grounded in previous theories of health self-regulation but further integrates an affective component (desires or anticipated pleasure) as well as a motivational component (health goals) and the motivational conflict resulting from the interplay between the two.

Self-Regulation towards Resisting Temptations: Compensatory Health Beliefs

When individuals are faced with a temptation, the conflict between their wish for the desired object or activity and their other goals (e.g., stay healthy) may create a motivational conflict or anticipatory guilt (Giner-Sorolla, 2001). This motivational conflict can be described as the perception of a discrepancy among cognitions generating a negative intrapersonal state of cognitive dissonance (Festinger, 1957), which in turn motivates the individual to seek and implement a strategy to alleviate this unpleasant state. We propose that one of the strategies used to alleviate that state of discomfort is to activate compensatory health beliefs (CHBs). CHBs are beliefs that the negative effects of a volitional unhealthy behavior can be compensated for, or “neutralized,” by engaging in another, volitional healthy behavior. The concept of volition is highlighted in the definition to emphasize that this construct is relevant to behaviors requiring self-control. These are situations in which short-term outcomes are in opposition to long-term outcomes (Trope & Fishbach, 2000). Specifically, in order to experience conflict upon
performing an unhealthy behavior, this behavior cannot be one that the person has no control over (environment) or one that is performed through automatic processes (Bargh & Chartrand, 1999). If a person does not have, or does not perceive having control over a situation, he or she will not experience a self-regulation conflict (Ajzen, 1991).

The nature of CHBs can best be illustrated with examples: Being faced with a temptation such as an enticing piece of cake, a cigarette, or a drink, a person may be torn between the pleasure that would be obtained by fulfilling the desire and the knowledge that it will be bad for one’s health. To resolve the conflict, the person might escape to the belief that eating the cake, smoking the cigarette, or having the drink is fine because he or she will go to the gym later that day thus annihilating negative effects by making up for the consumed calories, the decrease in lung capacity, or the consumed alcohol. In other words, the person may believe that the negative effects of the indulgence can be compensated or “neutralized” by exercising later. Thus, the compensatory behavior is used to justify the indulgence (see Hart, 1993, for a similar reasoning). In sum, CHBs are defined as beliefs that certain volitional, unhealthy (but pleasurable) behaviors can be compensated for by engaging in healthy behaviors. We propose that they are motivated justifications of maladaptive health-related behaviors. It is important to emphasize that the constructs of CHBs can be applied to a wide array of health behaviors such as illicit drug use, adherence to treatments, etc., and that scales can be developed to measure domain-specific CHBs.

CHBs can be scientifically accurate, partially accurate, or inaccurate. However, in line with our proposition that CHBs are motivated justifications of maladaptive health-behavior choices, we suggest that people are motivated not to question the validity of the
Distinguishing between accurate or inaccurate CHBs can be difficult because unhealthy behaviors can have, and in the majority do have, multiple negative effects on health and the compensatory behavior can potentially compensates for some, but not all of these negative effects. As we will outline in more detail below, the overall effects on health of holding a lot of these beliefs can be expected to be negative.

In this paper, we introduce a theoretical framework that aims at explaining why people develop CHBs and how they employ and maintain CHBs to resolve “guilty pleasure”-dilemmas (Giner-Sorolla, 2001).

Compensatory Health Beliefs Model

In a quest towards understanding affective and motivational influences on human health choices and subsequent health goals and behaviors, we developed a theoretical framework based upon the Protection Motivation Theory (Rogers, 1975; 1983), the Theory of Planned Behavior (Ajzen, 1985), Schwarzer’s (1992, 1999) integration of these two models (the Health Action Process Approach, HAPA), and the Self-Concordance Model (Sheldon, 2002; Sheldon & Elliot, 1999), which is based on the concepts of Self-Determination Theory (SDT; Deci & Ryan, 1985; 2000). The Self-Concordance Model extends SDT research by focusing on people’s personal goal statements rather than focusing on domain-specific motivation. We have termed the health behavior framework emerging from the integration of these models the compensatory health belief (CHB) model. The CHB model presents an attempt at explaining why people develop CHBs and how they employ CHBs to self-regulate resisting temptations, and their power in predicting health choices and future health outcomes. Major components of the CHB model include motivational conflict between desire and goal, or cognitive dissonance.
(Festinger, 1957; Mischel, 1996), goal self-concordance or the extent to which people pursue their set of personal goals out of self-determination (Sheldon, 2002; Sheldon & Elliot, 1999), self-efficacy (Bandura, 1977; Schwarzer & Renner, 2000), intentions (Ajzen, 1991), and implementation intentions or plans (Gollwitzer, 1999; Gollwitzer & Brandstätter, 1997). The processes described in the model start out with the motivational conflict between desires and health goals (i.e., cognitive dissonance) when having the opportunity to engage in a pleasurable, but unhealthy activity or, alternatively, after having engaged in a behavior believed to be unhealthy. It ends with either the implementation of the compensatory behavior or with a suspension of the intention to engage in it. The model will be described in detail below and is illustrated in Figure 1.

Conflict Resolution Attempts

As mentioned earlier, the interaction between the temptation to engage in an unhealthy behavior and one’s health goals creates a motivational conflict (i.e., cognitive dissonance). An example would be the desire or craving to smoke but the awareness that it is not good for one’s health. We propose that the conflict between the desire to indulge in a tempting behavior and the cognitive reasoning of its maladaptive consequences can mainly be alleviated by the following three strategies (see Figure 1): (1) deciding to resist the desire (i.e., resist to smoke), (2) adapting the perception of the degree of risk or harm caused by the behavior and/or re-evaluating outcomes expectancies, and (3) creating or activating compensatory health beliefs. The first strategy, not giving into the temptation, is a behavioral strategy whereas the other two are cognitive strategies. The behavioral strategy involves making the decision that one will not indulge in the temptation and therefore alleviates the motivational conflict, as one did not engage in an unhealthy
behavior. The first cognitive strategy is to adapt the outcome expectancies about the temptation (i.e. to change one’s belief that the behavior is indeed unhealthy or interfering with one’s goals) (cf. Baumeister & Heatherton, 1996; Giner-Sorolla, 2001; Stroebe, 2002; Trope & Fishbach, 2000). For example, a person might think that not exercising will not harm their cardiovascular health. In addition, people might adapt their risk perception such that they are, after all, not that much at risk for heart disease. It has been shown that risk perception and outcome expectancy are two of the major cognitions operating in the formation of goals (Schwarzer, 1999). This suggests that modifying either one of these cognitions or both will alleviate the motivational conflict by reducing the importance of the goal, if only temporarily. Once individuals no longer believe that the behavior is harmful or once they are less concerned about the negative health effects impacting them in particular, they may engage in the desired behavior freely. Note that both strategies, (1) resisting the desire and (2) changing health beliefs, are quite effortful and require substantial self-control (Baumeister et al., 1994).

The third conflict resolution strategy, creating or activating CHBs is, we suggest, the easiest path an individual can follow because it permits “the best of both worlds.” Specifically, a belief is activated that one can compensate for giving in to the temptation by executing another health behavior that one believes to “neutralize” or compensate for the ill effects of this behavior. By activating these beliefs it becomes possible to indulge in the desired behavior without the accompanying negative affect (e.g., guilt). Or, if one already indulged in it, CHBs can relieve arising feelings of discomfort. Instead of changing the desire to eat (strategy 1) or revising one’s beliefs (strategy 2), the person justifies the behavior by planning to compensate for it later.
What determines which conflict resolution strategy will be used? We predict that it is determined by two main factors and that both play a crucial role in determining the level of motivational conflict: (1) the degree of desirability of the tempting behavior and (2) a person's health goals self-concordance. The first option, resisting the desire, is particularly likely to be used when the desire is not strong, when one's health goals is pursued out of self-determined motivation, and when the individuals' self-efficacy to control their desire is high (cf. Kuhl, 1984; 1994). In contrast, the second and third strategy, changing a belief related to the desire or using a CHB, will be used when the outcome of the desired behavior is greatly satisfying and cannot be resisted (Marlatt, Baer, Donovan, & Kivlahan, 1988; Newcomb & Harlow, 1986; Norman, Conner, & Bell, 1999).

Motivational Conflict

As outlined in Figure 1, a motivational conflict is created when the desire to engage in a tempting behavior diverges from a health goal such as staying healthy or losing weight. According to our theory, this conflict is the motivational catalyst that leads to the activation of a CHB. We assume that CHBs only become activated when a motivational conflict arises because the individual believes that the desired behavior may come at a cost to his or her goals. Such conflicts can arise in a variety of situations, as temptations can vary widely in their form and strength. For example, temptations can be as far ranging as food, drugs or simply taking the car rather than walking. The effect of the degree of desire on the activation of CHBs is, probably, non-monotonic: When the behavior is not very desirable and the person has high health-related self-efficacy, people should be capable of resisting the desire and CHBs are unnecessary and therefore will not
be activated (cf. Giner-Sorolla, 2001). High health-related self-efficacy should be associated with a low tendency to hold and use CHBs. When the temptation is extremely desirable and people are unable to resist, they may not be able to use CHBs because they feel the strength of the desire justifies the behavior. Again, CHBs would not get activated. Thus, an inverted U-shaped function of the desirability of the temptation, and the exertion of CHBs can be expected with CHBs being most likely activated for medium-desirable behaviors (see Trope & Fishbach, 2000, for similar reasoning).

The value of one's goals, in other words how important the outcome is to the person, will also have an impact on the amount of conflict (Fishbach, Friedman, & Kruglanski, 2003; Trope & Fishbach, 2000). According to goal system theory, goals are construed as knowledge structures, defined as cognitive representations which can be activated (Shah & Kruglanski, 2003). Therefore, the importance of a goal can be enhanced if it is primed or activated, which Shah and Kruglanski (2003) argue can be done by presentation of means towards achieving that goal (behaviors or situations). For example, being primed with the words “reading” and “studying” activates the goal of academic achievement, and therefore will make the goal more likely to be attained.

One's health goals (e.g., exercising regularly, eating healthy, quitting smoking) can also be pursued out of self-determined motivation (i.e., goals are pursued because of strong interest or self-identified personal convictions; self-concordant goals) or out of non self-determined motivation (i.e., goals are pursued because of external pushes or rewards, or introjected sanctions characterized by anxiety and guilt; non self-concordant goals) (for details, see the Self-Concordance Model; Sheldon, 2002; Sheldon & Elliot, 1999). Because self-concordant goals express developing interests and deep-seated
values, they are relatively enduring facets of personality. Therefore, these goals are more likely to receive sustained effort and to be attained over time (Sheldon & Elliot, 1999; Sheldon & Houser-Marko, 2001). Consequently, we predict that the self-concordance of one's health goals will influence whether CHBs will be activated or not. Specific predictions are thoroughly detailed in the following section.

Health Goal Self-concordance and CHBs

We propose that self-concordance will predict the most likely route that individuals will take in attempting to reduce the motivational conflict they experience between a specific desire and their health goals. The Self-Concordance Model proposes that different types of motivation are associated with the pursuit of personal goals. According to SDT (Deci & Ryan, 1985; 2000), these types of motivation represent a self-determination continuum, along which intrinsic motivation corresponds to the more self-determined form of motivation, and is observed when one engages in a behavior for the pleasure and satisfaction inherent to it. Unlike intrinsic motivation, identified (i.e., one engages in a behavior out of choice and personal values or convictions), introjected (i.e., one performs a behavior in order to avoid guilt or anxiety or to attain ego enhancements, such as pride) and external (i.e., ones engages in a behavior to satisfy an external demand or reward contingency) regulation are extrinsic forms of motivation (i.e., ones engage in a behavior or an activity in order to attain some separable outcome, rather than for its inherent satisfaction). Identified, introjected and external regulation, respectively, range from the more to the less self-determined forms of motivation along the continuum and
reflect differing degrees to which the regulation of a requested behavior have been internalized and integrated (Deci & Ryan, 2000; Ryan & Deci, 2000). Internalization refers to people's "taking in" a regulation, and integration refers to the further transformation of that regulation into their own so that, subsequently, their behavior will be more self-determined. Deci and Ryan (2000) further suggest that feelings of autonomy (i.e., feeling that one's behavior is self-chosen and meaningful), competence (i.e., feeling that one is effective and able in one's behavior) and relatedness (i.e., feeling that one is connected to or in harmony with important others) will facilitate the internalization of extrinsically motivated behaviors, while only autonomy will allow the integration of these behaviors into the self.

Since several aspects of health behaviors (e.g., eating healthy, taking medication, exercising regularly, seeing a doctor or quitting smoking) are unlikely to be perceived as very exciting or interesting (i.e., purely intrinsic), we believe that most health goals will rather be pursued through one or more of the three types of extrinsic motivation described above. Consequently, we do not consider the role of intrinsic motivation in our predictions regarding the relation between health goals self-concordance and the activation of CHBs. Therefore, the next section primarily introduces hypotheses regarding the relationship between extrinsic motivations and the activation of CHBs.

External regulation. External regulation includes the classic instance of being motivated to obtain rewards or avoid punishments. For example, one might try to stop smoking simply to win a prize in a contest. Because it hampers autonomy and is dependent on the contingency, external regulation shows the poorest behavior maintenance (Deci & Ryan, 2000). In the CHB model, we hypothesize that health goals
which are externally regulated will most likely result in people not resisting the
temptation (e.g., eating sweets) and changing their outcome expectancies and/or risk
perception beliefs (e.g., changing the belief that the behavior is unhealthy, strategy 2).
The basis of this hypothesis stems from the fact that in externally motivated health goals,
the value of being healthy (or fit, thin, etc.) is not yet part of the self. Therefore, the
volitional strength behind these goals is more likely to fade when obstacles are
encountered, and therefore, they are less likely to be attained (e.g., Sheldon & Elliot,
1999). We can infer from this that the threshold for the degree of desirability of the
temptation does not need to be very high to outweigh the importance of externally
regulated goals.

*Introjected regulation.* Unlike external regulation, introjected regulation involves
an external regulation having been internalized, but not truly accepted as one’s own.
Introjection-based behaviors are performed to avoid guilt and shame or to attain feelings
of worth. We suggest that people holding introjected regulation toward their health goals
will most often use CHBs as a way to reduce the conflict because their motivation is
strong enough to prevent them from changing their beliefs but not potent enough to
permit them to resist the temptation. Therefore, resorting to CHBs is a likely alternative.
In addition, introjected regulators have been found to be most sensitive to feelings of
guilt or pride (Deci & Ryan, 2000). We reason that CHBs are effective and efficient in
alleviating such feelings.

*Identified regulation.* Identified regulation involves a conscious valuing of a
behavioral goal or regulation, an acceptance of the behavior as personally important. For
example, people might realize the importance of eating well and not smoking for their
health, and make these values a prominent part of their identity. According to Deci and Ryan (2000), behaviors under identified regulation are better maintained, and associated with higher commitment and performance. We hypothesize that people who have identified regulation regarding health goals will most often be able to resist their temptation and only rarely use CHBs as a way to reduce their dissonance.

Compensatory Behavior: Intention, Plan, and Implementation

Once the compensatory health belief has been activated, for it to successfully reduce the motivational conflict, it requires the creation of an intention to actually perform the compensatory health behavior (see Figure 1). In Schwarzer’s HAPA model, action plan refers to the individual’s intended action towards the achievement of a desired health behavior (see also Bagozzi, 1992; Gollwitzer, 1993). In Ajzen’s theory of planned behavior (1985, 1991), intention is the central factor in predicting behavior. In our model, intention would be equivalent to Gollwitzer’s concept of goal intention, which he describes as a feeling of commitment to achieve the sub-goal (e.g., I intend to exercise to make up for eating the piece of cake) (Gollwitzer, 1999; Gollwitzer & Brandstätter, 1997). Goal intentions are to be differentiated from implementation intentions, which are a self-regulatory strategy that involves linking an anticipated future situation to a certain goal-directed behavior, i.e., to make a detailed plan (e.g., I intend to exercise at the gym when I leave work at 6 p.m. for the aerobics class). Accordingly, the compensatory behavior plan or implementation intention is a stage where individuals create and visualize a concrete and detailed outline of how they will compensate for the unhealthy behavior. It involves self-efficacy in an attempt to imagine viable routes to goal attainment (cf. Schwarzer, 1992). Without an execution plan for the compensatory
behavior, an individual is likely to lose sight of the way to perform the action, and would fail to initiate the behavior. Extensive research has shown the benefits of implementation intentions toward goal completion (Gollwitzer, 1999; Gollwitzer & Brandstätter, 1997; Verplanken & Faes, 1999; Webb & Sheeran, 2003). Through the process of maintenance, "competing intentions" that serve to undermine the action in progress are kept under control. As such, the person must continue foreseeing successful outcomes in order to keep all other distracting intentions at bay. When applied to the present model, maintenance consists of imagining to successfully carrying out the behavior that compensates for the unhealthy behavior (e.g., eating more at lunch after having skipped breakfast).

After developing a plan, individuals face the choice of carrying out the compensatory behavior or not. Individuals who conclude that they are, indeed, capable of carrying out the compensatory health behavior specified in the CHB plan, then initiate it and execute it successfully. The execution of the compensatory behavior results in an effective reduction of the motivational conflict and any negative affect attached to it because the individuals believe that they have "erased" or "neutralized" the maladaptive effects of the satiation behavior by carrying out the compensatory behavior.

The other possibility is to not complete the compensatory behavior, which will result in the continued existence of a state of conflict. The added level of discomfort caused by the failure to engage in the compensatory behavior can persist until (1) individuals re-evaluate their self-efficacy concerning the compensatory behavior and carry it out, (2) individuals seek relief in the other possibility for resolving the conflict as described earlier, specifically change their beliefs of risk perception and outcome
expectancy, or (3) the discomfort simply abates with the passage of time. As mentioned above, execution of the compensatory behavior is facilitated by a clear action plan but also depends on one’s level of self-efficacy.

Influence of Self-Efficacy on Compensatory Behaviors

As described in Schwarzer’s (1992; 1999) HAPA model, self-efficacy is paramount for action to occur. The importance of self-efficacy has been demonstrated for initiating and persistence in general behavior (Bandura, 1977) and health behavior specifically (e.g., Block & Keller, 1998; Hevey, Smith, & McGee, 1998; O’Leary, 1985). Hevey et al. (1998) reviewed the use of self-efficacy in health-promoting behaviors in areas as diverse as exercise, smoking, and drug use. As in prior models (HAPA), it is hypothesized that self-efficacy will have an impact at different stages in our model. First of all, as mentioned earlier, self-efficacy will have an impact on the goals that people set for themselves (this part is not represented in the depiction of the model) (Schwarzer, 1999). Once the motivation conflict is in motion, self-efficacy will impact whether the person will be able to resist the desire or instead, give in and resort to a cognitive strategy.

Given the importance of self-efficacy in practicing health behaviors, there is reason to believe that an evaluation of self-efficacy will be necessary in the process of generating a compensatory action that individuals believe they can execute. If self-efficacy is low concerning the compensatory behavior, there is little chance individuals will perform the behavior as they lack the conviction necessary to be able to carry it through. Not performing the compensatory behavior will deflate individuals’ self-efficacy, reinforcing the negative cycle between low self-efficacy and not carrying out
the behavior. However, when self-efficacy is high, it is predicted that individuals will perform the compensatory behavior. Moreover, once the compensatory behavior is achieved, it will in turn strengthen the individuals’ sense of self-efficacy.

*Predicted Effects on Health Outcomes*

When the compensatory behavior does in fact compensate for the negative effects of indulging in the temptation, and if one actually performs the compensatory behavior, the overall health outcome of holding CHBs would be positive. However, to the extent that (1) the compensatory health behavior does not, in fact, compensate for the negative effects, and (2) individuals fail to follow through with the compensatory behavior, CHBs can be expected to result in negative health outcomes. That is, individuals might erroneously believe a certain compensatory behavior indeed eliminates the negative effects of a certain unhealthy behavior. Continuously engaging in an unhealthy behavior, falsely assuming that the subsequent compensatory behavior “makes up” for it can lead to poor health in the long term. Moreover, as outlined earlier, it is difficult for most CHBs to distinguish whether they are accurate or not because the unhealthy behaviors with which CHBs are concerned can have multiple negative effects on health and the compensatory behavior can potentially compensate for some, but not all of these negative effects. Second, even if the compensatory behavior is mostly effective, people often do not manage to follow through with their plans. They may procrastinate regarding the compensatory behavior and, while time passes, the initially felt discomfort may weaken until the need for the compensatory behavior is no longer felt. It can therefore be assumed that, overall the tendency to engage in CHBs is associated with negative health outcomes over time.
Empirical Support for the Model

Knäuper et al. (Knäuper, Rabiau, Cohen, & Patriciu, 2004) developed and validated a psychometric scale to measure individual differences in using CHBs. Factor analysis yielded a scale of 17 items with four subscales (substance use, eating/sleeping habits, stress, and weight regulation) explaining 51.02% of the total variance. The scale demonstrated strong psychometric properties with good internal consistency (\(\alpha = .80\)), and high stability as measured by test-retest reliability at 4.5 to 5 month interval (\(r_u = .75, p < .0001, N = 141\)). The CHB scale showed convergent validity with health self-efficacy (\(r = -.20, p = .04\)) and the personality factor “conscientiousness” measured with the NEO Five-Factor Inventory (NEO-FFI) (\(r = -.19, p = .04\)), and discriminant validity with all other measure of personality, health locus of control, and importantly with social desirability. Moreover, higher CHB scores were significantly related to more health-related risk behaviors (\(r = .29, p = .002\)) and more illness symptoms reported (\(r = .28, p = .003\)). Interestingly, specific CHB subscales were significantly related to the corresponding specific health-related risk behaviors (substance use \(r = .41, p < .0001\), eating/sleeping habits \(r = .21, p = .02\), and weight regulation \(r = -.25, p = .009\)).

Furthermore, individuals with a BMI of 27 or greater (indicating being overweight or obese) were found to hold more CHBs. Rabiau et al. (Rabiau, Knäuper, Miquelon, & Grouzet, 2005) showed in a sample of female dieters that scores on the scale are predictive of self-regulatory success or failure. The extent to which dieters adhered to the rules over the course of their diet was examined by comparing the degree to which they reported the same rules at T1 and T2. Dieters who scored higher on eating and dieting-related compensatory beliefs showed lower adherence to self-set dieting rules (\(r = .21, p\)}
= .02) and were more likely to have a history of unsuccessful dieting as measured by Herman and Polivy’s (1980) Restraint Scale\(^1\) \((r = .34, p < .001)\).

Dispositional variables that were found in these two studies to negatively moderate the use of compensatory health beliefs were eating-related self-efficacy, self-determined motivation and conscientiousness (Knäuper et al., 2004; Rabiau et al., 2005). These findings suggest that a chronic use of compensatory beliefs results in lower goal attainment, particularly among individuals who lack the self-regulatory abilities and resources necessary for implementing the compensatory behavior, as the model predicts.

**Future Research**

The CHB model can be used to derive predictions for explaining health behavior choices. For example, health goals self-concordance is hypothesized to predict the type of conflict resolution strategy that will be employed. Similarly, we predict a moderating role of self-efficacy on the type of conflict resolution strategy used and on the probability to carry out the compensatory behavior. Moreover, we predict that the compensatory behavior is more likely to be implemented when an implementation intention was clearly outlined. Also, as explained previously, the strength of the temptation plays an important role: CHBs should be more prevalent when a person has been primed with or is in presence of a temptation. Therefore, different environments can be created to test "diathesis-stress" types of predictions in which the strength of temptations is manipulated. This has been done in past studies, for example by presenting people with either chocolate cookies or their fat-reduced alternatives (Baumeister et al., 1998). These

\(^1\) That the Restraint Scale (RS) measures unsuccessful dieting was suggested by a number of authors (Heatherton & Baumeister, 1991; Lowe, 1993; Lowe & Timkio, 2004; Ruderman, 1986) based on the notion that it contains items that assess the tendency to overeat, the frequency of past dieting attempts, and the degree of weight cycling.
hypotheses would best be studied in a prospective design in order to uncover the causal mechanisms and the capacity of CHBs to predict health behavior and health outcomes. Experimental and prospective studies are needed to examine whether the predicted desire-goal conflict, CHB activation, intentions and behaviors actually occur in the sequence and manner specified in our model. We are currently preparing a study using experience-sampling methodology (ESM) that is aimed at testing the model’s predictions in naturalistic conditions of actual eating situations among dieters. The study assesses prospectively how individual dispositions combine with internal (physiological) and external (environmental) factors to elicit CHBs and when the use of CHBs results in self-regulation failure and thereby lower goal-attainment. ESM (DeVries, 1992) is a measurement technique where individuals are signaled at random or fixed intervals and instructed to record responses to questions. Participants will receive a palmtop computer to carry with them for seven consecutive days and will be signaled at random seven times per day. At each signal, participants complete a short questionnaire on the palmtop related to the last eating or temptation episode, whichever they experienced last. To provide the reader with an idea how the various concepts in the model can be empirically operationalised, we are providing an overview of the measures of the planned study in Table 1. This study will allow assessing how CHBs predict goal attainment in interaction with other signal-level and person-level variables.

**Applied Implications**

With the aim of limiting risk behaviors and reinforcing positive health behaviors, the model is very helpful in highlighting areas for potential interventions. Following through the model, a noteworthy area of intervention pertains to the internalization and
integration of extrinsically motivated health behaviors (e.g., eating healthy, exercising, not smoking, etc.) into an individuals' sense of self. This could be accomplished by providing individuals with experiences in which they would: (1) obtain a meaningful rationale of why a certain health behavior is important, feel they have opportunities for choice and be encouraged to accept more responsibility for the health behavior, (2) feel they have control over carrying out this behavior and (3) have a sense of being related to other people (Deci & Ryan, 2000; Ryan & Deci, 2000; Williams, 2002).

Secondly, one could intervene at the stage of CHB activation. CHBs are not necessarily detrimental to one's health as long as the compensatory behavior does in fact compensate for the unhealthy behavior. This generates two separate issues: First of all, wrong beliefs about one's health and inappropriate compensatory behaviors are very detrimental for one's health, whether or not one is self-efficacious. The first step is thus to raise awareness about the process associated with CHBs as well as the frequency of usage of CHBs. Furthermore, cognitive restructuring can be employed to modify dysfunctional beliefs into more adaptive beliefs. Many studies have demonstrated the efficacy of cognitive behavior therapy (CBT) at improving symptoms through adapting dysfunctional beliefs (Butler & Beck, 2000). Moreover, CBT has now being applied to the domain of health behavior change with success in areas such as obesity (Cooper & Fairburn, 2001) and smoking cessation (Sykes & Marks, 2001, Perkins et al., 2001). We believe that incorporating the construct of CHBs into a behavior change intervention based on cognitive behavioral techniques would increase its efficacy. Making people aware of their tendency to use CHBs as a mechanism to carry on with their unhealthy habits and teaching them tools such as cognitive restructuring to alter both the beliefs and
the process through which they are used would facilitate behavior change. Another area of possible intervention is to help people carry out the compensatory behavior by enhancing their perceived self-efficacy (Schwarzer & Renner, 2000) or by helping them to translate their intentions into actions by designing implementation intentions (Gollwitzer, 1999; Gollwitzer & Brandstätter, 1997; Verplanken & Faes, 1999; Webb & Sheeran, 2003). This would involve teaching people to develop specific plans of when, where, and how they will implement the compensatory behaviors. The ultimate goal of creating implementation intentions is to render the intended behavior automatic in the presence of the specified situational cues, or in other words to create a new habit (Gollwitzer, 1999).

In conclusion, the CHB model is valuable not only in furthering the theoretical knowledge of health behaviors but also at the practical level in terms of highlighting clear testable hypotheses as well as ways of intervening and ultimately improving people’s health.
Table 1: Measuring the constructs of the CHB model in an experience-sampling study.

<table>
<thead>
<tr>
<th>Name of the construct</th>
<th>Measurement of the construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desire</td>
<td>How <strong>pleasant</strong> did you expect the food to taste? <em>(not at all pleasant to very pleasant)</em> How much did you crave this food before you ate it? <em>(not at all to very much)</em></td>
</tr>
<tr>
<td>Health goals</td>
<td>How <strong>important</strong> is it at this moment for you to maintain your weight or lose weight? <em>(not at all important to very important)</em></td>
</tr>
<tr>
<td>Motivational conflict</td>
<td>To what extent did you <strong>feel</strong> the following way right before you ate? guilty, nervous, happy [etc.] To what extent did you feel the following way after eating? guilty, nervous, happy [etc.] <em>(not at all to very much)</em></td>
</tr>
<tr>
<td>Temptation regulation</td>
<td>How <strong>confident</strong> did you feel that you would be <strong>able to</strong> resist eating the food? <em>(not at all confident to very confident)</em></td>
</tr>
<tr>
<td>self-efficacy</td>
<td></td>
</tr>
<tr>
<td>Adaptation of outcome</td>
<td>To what extent do you think that eating the food will <strong>interfere with your goal</strong> to maintain or lose weight?</td>
</tr>
<tr>
<td>expectancies</td>
<td></td>
</tr>
<tr>
<td>CHB activation</td>
<td>To what extent did you <strong>think that you would make up</strong> for eating the food, for example by exercising later or by eating less at the next meal? <em>(not at all to very much)</em></td>
</tr>
<tr>
<td>Compensatory behavior</td>
<td>To what extent do you <strong>intend to make up</strong> for eating the food, for example by exercising later or by eating less at the next meal? <em>(not at all to very much)</em></td>
</tr>
<tr>
<td><strong>Compensatory behavior</strong></td>
<td>How <strong>confident</strong> are you that you will be <strong>able to make up</strong> for the food eaten, for example by exercising later or by eating less at the next meal? (<em>not at all confident to very confident</em>)</td>
</tr>
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<td>---------------------------</td>
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</tr>
<tr>
<td><strong>self-efficacy</strong></td>
<td>实施意图：如何具体地设想补偿吃掉的食物，例如通过以后做运动或下顿饭少吃？(<em>not at all concretely to very concretely</em>)</td>
</tr>
<tr>
<td><strong>Implementation intention</strong></td>
<td>How <strong>concretely</strong> do you <strong>envision</strong> to make up for eating the food, for example by exercising later or by eating less at the next meal? (<em>not at all concretely to very concretely</em>)</td>
</tr>
<tr>
<td>Implementation of</td>
<td>The last time you had made a plan to compensate for giving compensatory behavior in to the temptation, did you actually <strong>follow through</strong> with your intention? (yes/no)</td>
</tr>
<tr>
<td>compensatory behavior</td>
<td>------------------------------------------------------------------------------------------------------------------</td>
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</tbody>
</table>

Note. All constructs, except for the last one, are being assessed on 7-point Likert-type rating scales
Figure 1: Compensatory Health Beliefs Model

Desire

Self-efficacy

Motivational conflict

Health goals

Resist desire

Activate compensatory health beliefs

Compensatory behaviour intention

Implementation of compensatory behaviour

Adapt risk perception/outcome expectancy

Implementation intention
Transition to Manuscript 2

Manuscript 1 (Rabiau, Knäuper, & Miquelon, 2006) introduced the construct of compensatory health beliefs (CHBs) and presented an elaborate model of CHBs and health self-regulation. Namely, it described that the interplay between temptations and health goals creates a state of conflict or cognitive dissonance that can be alleviated by activating CHBs. CHBs are the conviction that the detrimental effects of a negative health behavior can be compensated for or neutralized by performing a positive behavior (e.g., “I can have this piece of cake now because I will go to the gym later.”). The model integrates a number of self-regulation constructs such as self-determination, self-efficacy, and implementation intentions. Moreover, important predictions were explicitly stated concerning health outcomes based on the model. One important prediction is that the more frequently people employ CHBs the poorer their health should be. Firstly, many of the beliefs are inaccurate in that the compensatory behavior will not in fact compensate for the negative health behavior, and I argue that individuals are not motivated to question the accuracy of the beliefs they hold. Secondly, even if the belief is accurate, individuals may often not follow through with their compensatory plan (e.g., they do not go to the gym), thereby the negative effects of the unhealthy behavior are not (fully) compensated for.

In order to test these predictions, the first step is the development of a scale to measure the new construct. This next paper thus describes the development and reliability and validity studies for a CHB scale. Items include a wide range of health behaviors such as nutrition, exercise, stress relief, alcohol consumption, and smoking. The item pool was developed based on input from a wide population. The scale’s reliability and validity
were tested in a sample of University students. Both the psychometric properties of the scale and the predictions for health outcomes are discussed.
Manuscript 2: Compensatory Health Beliefs: Scale Development and Psychometric Properties

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Compensatory Health Beliefs: Scale Development and Psychometric Properties

In the past few decades, much attention has been focused on health behaviors and their consequences for health outcomes. Ample empirical evidence demonstrates that behavioral and life-style factors such as smoking, being overweight or obese, and lack of exercise are major determinants of morbidity and mortality (see McGinnis & Foege, 1993). People are quite knowledgeable about the maladaptive effects of over-consumption of food, nicotine, alcohol, and lack of exercise (cf. Pinel, Assanand, & Lehman, 2000) and attempt to adopt a healthier life style. Many of these attempts, however, remain unsuccessful. Within five years the majority of dieters will regain the weight they originally lost (National Institutes of Health, Technology Assessment Conference Panel, 1992) and after five years often exceed their initial weight (National Task Force on the Prevention and Treatment of Obesity, 1993). The picture is similar for exercising, where almost half of those who begin an exercise regime quit within the first six months (Dishman, 1991).

Thus the question arises as to what makes it so difficult for people to consistently engage in healthy behaviors and adhere to their health behavior choices. As of now, much of the work attempting to explain and predict health behaviors has implicitly assumed that health behavior choices are the product of rational appraisal processes (e.g., Ajzen, 1985; Rogers, 1975, 1985) and motivational factors that may be associated with people's health choices have been relatively disregarded (Blanton & Gerrard, 1997). We focus here on a specific motivational state as a determinant of health and risk behaviors: The cognitive dissonance, or mental conflict, that arises when the pleasure of indulging in a desired behavior stands in conflict with the potentially negative (long-term) health
effects. The resolution of this mental conflict requires self-regulatory processes such as attempts to resist the desire or a re-evaluation of the harmfulness of the behavior (cf. Baumeister & Heatherton, 1996; Festinger, 1957; Giner-Sorolla, 2001; Klein & Goethals, 2002; Klein & Kunda, 1992; Trope & Fishbach, 2000). We propose that people may use certain types of beliefs to resolve such “guilty pleasure”-dilemmas (Giner-Sorolla, 2001). 

Compensatory Health Beliefs, it is proposed, enable individuals to keep the best of both worlds: eating the cake, but not feeling guilty about it.

Compensatory Health Beliefs

The present research focuses on beliefs that people use to justify unhealthy behavior choices. We will call these beliefs Compensatory Health Beliefs (CHBs). The nature of CHBs can best be illustrated with an example: Being faced with an enticing piece of cake a person may, on the one hand, know that it is high in saturated fats, cholesterol, and sugar and therefore, bad for one’s health. On the other hand, the person may have a craving for the cake and imagines how good it will taste. Being torn between these two conflicting cognitions the person might escape to the belief that eating the cake is fine because he or she is planning on going to the gym later that day where the consumed calories will be burned off and the heart will be protected from the harmful effects of high-cholesterol food. In other words, the person may believe that the negative effects of the indulgence in unhealthy food can be compensated or “neutralized” by subsequent exercising. The planned future caloric expenditure is used to “justify” the current indulgence in unhealthy food (see Hart, 1993, for a similar reasoning).

In general terms, CHBs are defined as accurate or inaccurate beliefs that certain unhealthy (but pleasurable) behaviors can be compensated for by engaging in healthy
behaviors. CHBs can be activated in anticipation or subsequently to fulfilling a desire. In the former case, dissonance is created by the mere anticipation of engaging in a pleasurable activity that might be harmful. In the latter case, dissonance is created as a consequence of having engaged in an unhealthy behavior (e.g., eating a piece of cake; see Rabiau, Knäuper, & Miquelon, 2006). Cognitive dissonance may be perceived because of a variety of reasons, including that the unhealthy behavior is feared to result in disease, that it violates a valued self-perception (e.g., being somebody who eats healthy), or that it is discrepant with self-expectations (e.g., losing weight) (cf. Aronson, 1968; Steele, 1988). Activating CHBs resolves the cognitive dissonance generated by such cognitions. Using CHBs is conceived as a strategy individuals use when they fail to resist temptations. It is thus an automatic motivated regulatory process that functions to reduce cognitive dissonance by justifying unhealthy behavior choices with the plan to engage in healthy behaviors.

CHBs should be distinguished from irrational health beliefs, which can also undermine health behaviors (cf. Meichenbaum & Turk, 1987). Christensen et al. (Christensen, Moran, & Wiebe, 1999) developed the concept of irrational health beliefs and presented a scale to measure such cognitive distortions. An example of an irrational health belief is the belief that a medication becomes unnecessary as soon as one ceases to feel sick. High scores on the scale were found to be associated with a negative pattern of health behaviors, e.g. poor adherence to medical regimens. They are different from CHBs in two ways. First, CHBs are not necessarily “irrational”, but may partly be valid (see discussion section for a comment on the distinction between accurate and inaccurate CHBs). Secondly, they are a different type of cognition. While irrational health beliefs
are (inaccurate) outcome expectancies, CHBs are motivated justifications of maladaptive health-related behaviors.

Effects on Health

Importantly, holding CHBs does not necessarily lead to negative effects on health. It will not affect a person’s health negatively if (1) the compensatory behavior effectively neutralizes the effects of the unhealthy behavior and if (2) the person indeed follows through with the compensatory behavior. However, many compensatory health behaviors may not, in fact, effectively compensate for all negative effects of the satiation behavior. Continuously engaging in an unhealthy behavior, falsely assuming that the subsequent compensatory behavior “makes up” for it, can lead to ill health in the long run. Also, people often do not manage to carry out the planned compensatory behavior (e.g., go to the gym). They may procrastinate and, while time passes, the initially felt dissonance may weaken until the initially felt need to compensate for the unhealthy behavior fades away.

Research Aims

The aims of the present research are to develop a scale to measure CHBs (Study 1), to test the reliability of the scale (Study 2) and to provide initial evidence for its validity by examining its relationship with other related constructs, and the concurrent validity for risk behaviors and symptom reports (Study 3).

Study 1: Generation of an initial item pool

Study 1 served to generate an initial item pool from which a draft of the CHB scale could be created. To reach a large and diverse population we collected ideas for items through a survey on the Internet\. The goal was to receive as many suggestions of
CHBs as possible. In order to maximize the number of visitors to the website, various search engines were contacted and asked to post the survey on their listings. The survey was also posted on a number of online research websites. Participants were provided with a definition of CHBs, and were asked to write down in an open response format any CHBs that come to mind.

Participants

Of the 142 individuals who submitted multiple entries, 35.4% were male and 50.6% were female. Fourteen percent did not report their gender. The largest age groups to respond were 18 to 25 (29%) and 31 to 40 years old (26%). Most participants came from North America (49.4%) and Europe (36.3%). The remaining participants were quite equally distributed over Africa (3.0%), Asia (5.1%), and Australia (5.2%).

CHB Submissions

Participants submitted 523 entries altogether. All responses were first evaluated by our research group regarding compliance with the CHB definition and all entries that did not conform to the definition were eliminated. Eliminated entries included outcome expectancy beliefs like “Lemon juice, honey and hot water are a drink that soothes a sore throat” and “An apple a day keeps the doctor away.” After discussion of all original items, 237 items remained in the pool.

Creation of Initial Scale

The 237 entries were then reviewed for (1) redundancy and (2) broad applicability in order to reduce the item pool to a manageable size. In discussion, the researchers were able to reduce the item pool further to 67 items based on these two criteria. Many of these entries were edited in order to create simple, straightforward language that could be
readily understood by individuals with diverse educational backgrounds. Finally a 5-point Likert-type response format was chosen. Respondents are asked to indicate the degree to which they hold a certain belief using the response options “not at all” (0), “a little” (1), “somewhat” (2), “quite a bit” (3) and “very much” (4). The 67-item scale draft was then sent to a group of 12 experts in the field of health psychology and psychometrics. The experts were provided with the background and definition of CHBs and asked for each item (1) whether it is a reflection of the CHB construct, (2) whether the wording is clear, (3) whether and why an item should be deleted from the item pool, and (4) whether the response format was clear and feasible. The scale was modified according to the expert feedback and reduced to 40 items.

Study 2: Reliability

The objective of Study 2 was to demonstrate that the scale provides an internally consistent and temporally stable assessment of the tendency to engage in CHBs.

Method

Participants

A sample of 381 undergraduate students from McGill University was recruited to participate in the study. Participants volunteered in exchange for a lottery ticket for a chance to win 100 Canadian dollars. The sample consisted of 314 females (82.4%) and 66 males (17.3%; one person did not reveal the gender) with a mean age of 20.9 years ($SD = 3.43$, range $= 18 - 50$). The majority of the sample was Caucasian (84%) and was enrolled as Psychology Majors (69.8%). Other areas of study included biology (12.1%) and nursing (10.8%).

Procedure
The 40-item scale was administered in group-sessions following class time. Before completing the scale, participants were asked whether they would be willing to be contacted to complete the scale once more at a later time. If they agreed, they were sent an email 4.5 to 5 months later, providing them with a link to a website where they may fill out the questionnaire a second time. Of the 371 participants who had agreed to be surveyed again, 141 participated in the retest assessment (38%). Hereby, a large proportion of the non-responses is due to invalid email addresses: Of the 371 emails sent out, 98 (26.4%) were returned as undeliverable. Of the 273 students with valid email addresses, 141 (51.7%) filled out the questionnaire. The test and retest samples did not differ in any of the demographic variables (age, gender, race/ethnicity, university major, all \( p > .25 \)).

**Results and Discussion**

**Item Analysis**

In the following, we describe the decision processes leading to the retention or elimination of items. Seventeen items were retained from the initial item pool of 40 items.

*Analysis of item distribution.* The first criterion for item elimination was a skewed or unbalanced item distribution. The goal here was to retain only items that show a sufficient range of distribution, or in other words would not elicit a limited range of responses. Ten items were marked as candidates for elimination because of their skewed or unbalanced distribution. Four further items were discarded because of unclear item wording as indicated by a higher number of missing values, leaving 26 items in the scale.
Principal axis factor analysis. The 26 items were then subjected to a principal axis factor analysis (PFA) for the full sample of \( N = 381 \) participants in order to explore the factor structure of the CHB measure.\(^3\) Missing values were treated pairwise. The Kaiser-Meyer-Olkin measure of sampling adequacy (.86), Bartlett's test of sphericity (2131.80, \( df = 325, p = .000 \)), and the determinant of the matrix (.003) all indicated that the correlation matrix was appropriate for such an analysis. Six factors with eigenvalues greater than 1.0 (Cattell, 1965) were extracted from the matrix, explaining 48.80% of the variance. However, the eigenvalues for the fifth and sixth factor were only 1.09 and 1.06, respectively, and an inspection of the scree plot clearly indicated a drop and then leveling off of the eigenvalues after the first four factors (eigenvalues 5.88, 1.75, 1.61, 1.31), suggesting that only these should be retained. An oblique rotation (promax) was then performed on these four factors to increase their interpretability. The factor correlation matrix of the factor solutions showed that the four factors were substantially correlated (correlations ranging from \( r = .36 \) to \( r = .60 \)), suggesting considerable overlap in variance between the factors. Oblique rotation provides a better simple structure and more stable factor solutions in such cases and is therefore used as the basis for factor interpretation (Fabrigar, 1999). Based on the analysis of the loadings of the rotated factors (pattern matrix), nine items were dropped from the item pool because they failed to load above .40 on either of the four factors. We repeated the factor analysis with the remaining 17 items and examined the factor loadings of the new promax rotated factor solution. Four factors emerged, explaining together 51.02% of the total variance. Inspection of the pattern matrix showed that all items now loaded above .40 on one of the four factors. Items on the first factor (6 items) are mainly concerned with compensating for the effects
of substance use (alcohol, nicotine, coffee). Items on the second factor (4 items) are concerned with compensating for unhealthy eating and sleeping habits. Items on the third factor (4 items) are concerned with compensating for stress, and items on the final, fourth factor (3 items) are concerned with regulating weight. The 17 items of the final scale as well as the factor loadings can be found in Table 1 and the correlations between factors can be found in Table 2. The scale has an 8th grade reading level as determined by the Flesch Kincaid Grade Index (7.7), suggesting that it is feasible to use in a wide range of populations.

Confirmatory factor analysis. We conducted confirmatory factor analyses (CFAs) to compare the fit of a one-, two-, three- and four-factor model by using EQS software with maximum likelihood estimation. Evaluation of fit indices indicated that the four-factor model fit the data well ($\chi^2(113, N = 141) = 248.42; \chi^2/df$-ratio = 1.76; CFI = .89; Bentler-Bonett nonnormed fit index = .87). In addition, all factor loadings were significant at the $p = .01$ level, suggesting that the four factors were well constructed. Fit of the one-, two-, and three-factor models was much lower with $\chi^2$ difference tests indicating that the four-factor model has a significantly better fit than any of the other three models (all $\Delta \chi^2 > 121, p < .001$).

Reliability

Internal consistency. An analysis conducted on the 17-item scale demonstrated good internal consistency ($\alpha = .80$). The highest inter-item correlation was $r = .46$, and the great majority of the inter-item correlations clustered around $r = .20$ to $r = .25$, indicating that the retained items are sufficiently differentiating and not redundant with one another. There were no negative inter-item correlations. The internal consistency
values of the four subscales were between $\alpha = .63$ and $\alpha = .74$ (see Table 1), except for the weight regulation dimension ($\alpha = .57$), which was probably due to the modest number of only three items in this subscale.

*Test-retest reliability.* CHB total scores were correlated with retest scores collected after a 4.5 to 5-month interval. A test-retest correlation of $r = .75$ ($p = .000, N = 141$) was obtained. It indicates high stability over the comparably long time period.

**Study 3: Validity**

The objective of Study 3 was to provide initial data on the construct and criterion-related validity of the measure. One goal was to establish that CHBs can be distinguished from irrational health beliefs and have discriminant validity with respect to various personality dimensions. Another goal was to examine the convergent validity of the CHB scale with respect to health control beliefs, procrastination, and health-related self-efficacy and to examine the concurrent validity of the measure with respect to people’s health-related risk behaviors and symptom reports. It was assumed that higher scores on the CHB scale are associated with lower health-related self-efficacy, more risk behaviors, and more illness symptoms. Finally, the study served to examine the scale’s sensitivity toward socially desirable responding.

**Method**

**Participants and procedure**

A sample of 111 university students was recruited for the validity study. The study was conducted in a student population based on the theoretical assumption that CHBs are common cognitions that should be present in any sample. Most participants were recruited through flyers on campus and ad postings on a university website.
Participants who were recruited through these means were compensated for their time with 10 Canadian dollars whereas others participated in exchange for extra-credit in their courses. Gender was equally distributed in the sample as 51.4% were male and 48.6% were female. The mean age of the sample was 21.83 years (SD = 4.48, range = 18 - 47). The majority of the sample reported their race or ethnicity as White or Caucasian (66.7%) or as Asian (14.4%). Students were enrolled in a variety of majors with about a quarter each in health sciences (23.4%), psychology (21.6%), arts/literature (20.7%), as well as some in science (12.6%). Participants filled out a comprehensive battery of questionnaires alone or in groups of 2 to 15 people (median group size = 7). The questionnaire booklet included the CHB scale and the measures described below and took about 45 minutes to be filled out.

**Measures**

In addition to the CHB scale the following measures were administered:

*Irrational Health Belief Scale* (IHBS; Christensen, Moran, & Wiebe, 1999). The IHBS is a 20-item scale aimed at measuring health-related cognitive distortions. We administered the IHBS to examine to which extent our CHB scale measures a different type of health beliefs than those measured by the IHBS. Each IHBS item is composed of a brief vignette describing a person in a health-related situation (e.g., Your doctor recommends a new medication for an ongoing health problem and indicates that about 10% of patients experience unpleasant side effects from the medicine. You think to yourself, ‘If anyone is going to have side effects, it’s going to be me.’). Respondents are asked to read each vignette and to imagine that it is happening to them. They are then asked to indicate for each situation on a scale from 1 (not at all what I think) to 5 (almost
exactly what I think) how similar the thought is to how they would think in that situation. Internal consistency ($\alpha = .84$), test-retest reliability ($r = .57$, $p = .0001$), and construct validity have been demonstrated for this scale (Christensen et al., 1999). Good psychometric properties were also found in the present sample (see below).

_Multidimensional Health Locus of Control scales_ (MHLC; Wallston, Wallston, & DeVellis, 1978). The MHLC measures whether “the source of reinforcements for health-related behaviors is primarily internal, a matter of chance, or under the control of powerful others” (Wallston et al., 1978; p. 160). The response format was slightly changed from the original 6-point response scale with only the end points labeled to a 5-point, Likert-type response scale with options strongly disagree (1), somewhat disagree (2), neither agree nor disagree (3), somewhat agree (4), and strongly agree (5). Scores on the three subscales (internal, powerful others, chance) are calculated by summing across the respective items. The measure is widely used in the health-behavior area and reliability and construct validity have been previously documented (e.g., Wallston et al., 1978).

_Procrastination Scale_ (Schwarzer, Schmitz, & Diehl, 2000). To measure procrastination a scale developed by Schwarzer et al. (2000) was used. It consists of 10-items describing common ways in which people might procrastinate in their everyday life. The German version of this scale yielded a Cronbach's coefficient alpha of .84 and .75, respectively, in two samples of 288 and 254 persons (Schwarzer, 2000). The items were presented with a 4-point Likert-type response format with options not at all true (1), barely true (2), moderately true (3), and exactly true (4).
Health Self-Efficacy Scales. (Schwarzer & Renner, 2000). High scores on the CHB scale were assumed to be correlated with low health-related self-efficacy. Self-efficacy in three areas of health (preventive nutrition, physical exercise, alcohol resistance) was measured using an instrument developed by Schwarzer and Renner (2000). For each area, respondents are asked how certain they are that they would carry out the healthy behavior even if they would have to overcome certain barriers (e.g., “I can manage to carry out my exercise intentions even when I am tired.”). The response format is very uncertain (1), rather uncertain (2), rather certain (3), and very certain (4). Reliability and concurrent validity (correlations with behavioral intentions) have been demonstrated for the German version of the scale (Schwarzer & Renner, 2000).

NEO-short form. The NEO Five Factor Inventory Short-Form (NEO-FFI; Costa & McCrae, 1992) was used to assess the association of CHB scores with higher-order personality dimensions as conceptualized in the Five Factor Model of personality. Each of the 5 subscales of the NEO-FFI Short-Form consists of 12 items with respondents endorsing the items on a 5-point, Likert-type scale. Scores for each subscale are calculated by summing across items after reverse scoring appropriate items. The scale’s psychometric properties are well documented.

Marlowe-Crowne Social Desirability scale (MCSD; Crowne & Marlowe, 1960). The MCSD was designed to measure people’s need to present themselves in a favorable light. The measure is commonly used to assess a self-report measure’s tendency to be answered in a socially desirable way.

Assessment of risk behaviors. A series of questions assessing health-related risk behaviors was developed based on an instrument presented by Thompson, Nelson,
Caldwell, and Harris (1999). For the present study, a sample of the questions was extracted from the survey. Specifically, an index was formed by summing across 13 variables: lifetime smoking, current smoking, number of fruits consumed per day, number of servings of vegetables consumed per day, amount of physical exercise per day, amount of alcohol consumed per day, number of drinks consumed when having alcohol, use of drugs for non-medical purposes, use of vitamin supplements, time since last general health check-up, time since last dental check-up, sunscreen use, sun protection factor used when exposed to the sun. Items were coded such that a higher score on each of the behaviors would indicate higher risk (e.g., the number of fruits eaten per day was reverse-coded to indicate lack of fruit intake), then z-transformed and summed up to form an index of risk behavior.

Specific risk behavior indices corresponding with the subscales of the CHB scale were also built by summarizing responses to the respective questions: An index of smoking/alcohol related risk behavior, an index of (un)healthy eating behaviors (fruit and vegetable intake, use of vitamin supplements), and an index for risk behavior related to weight regulation (fruit and vegetable intake, exercising). An index of stress related risk behaviors could not be built because stress-related risk behavior questions were not included in the series of questions asking about risk behaviors.

*Body Mass Index.* Height and weight were assessed to calculate participants’ Body Mass Index (BMI) as an indicator of caloric intake and risk factor for disease.

*Assessment of illness symptoms.* Illness symptoms were assessed using a symptom checklist consisting of 34 items which was adapted from an instrument developed by Berne (1995). The list was chosen because of its comprehensive collection of broad
symptoms in a wide variety of areas ranging from "general" (e.g., flu-like symptoms, shortness of breath), "pain" (e.g., headaches, muscle pain), "sleep" (e.g., difficulty falling asleep), "sensitivities" (e.g., to food, to medications), "gastrointestinal" (e.g., stomach ache, bloating) to "skin" (e.g., eczema, sores). Participants were asked how often they experience the symptoms in a typical month. Responses were given on a 4-point, Likert-type scale with the response options none of the time (0), a few times (1), often (2), and all the time (3). Scores on the symptom checklist were calculated by summing up across items, resulting in a range of possible scores from 0 to 102.

**Results**

*Construct validity*

*Missing values.* Overall there were only few missing values with the maximum percentage being 1.44% on any measure. Missing values on measures without subscales (IHBS, procrastination, subjective health, MCSD, symptom checklist) were replaced by the respondent’s mean for the rest of the items (cf. Snedecor & Cochra, 1980). Missing values on measures with subscales were replaced by the respondent’s mean for the rest of the items of the respective subscale (CHB, MHLC, self-efficacy). Missing data for the NEO-FFI were replaced by the scale mean ("neutral").

*Divergent and convergent validity.* Table 3 presents the means, standard deviations, and alpha reliabilities for all measures, as well as the bivariate correlations with the CHB and the Irrational Health Belief Scale (IHBS). For the CHB scale, a mean of 20.15 ($SD = 7.88$, range $= 3 – 40$, $N = 111$) was obtained in this sample. Cronbach’s coefficient alpha as indicator of internal consistency was .76 in this sample.
Our first goal was to examine how the CHB measure is related to the Irrational Health Belief Scale (IHBS). As can be seen in Table 3, a significant positive correlation between scores on the CHB scale and scores on the IHBS was found ($r = .31, p = .001$). Thus it appears that the two scales have some overlap in the type of health beliefs they assess, maybe in the way that both are types of beliefs that reduce cognitive dissonance generated by engaging in unhealthy behaviors. A closer examination of the bivariate correlations of both scales with the other measures shows, however, that the patterns of associations are quite different, supporting the notion that they do not assess the same type of health beliefs. T-tests for comparisons of dependent (single sample) correlations (see last column of Table 3) reveal that scores on the IHBS tend to be more strongly related to health locus of control beliefs (internal control, powerful others, chance), four of the five personality dimensions of the NEO (neuroticism, extraversion, openness to experience, agreeableness) and social desirability. CHB scores, on the other hand, are more strongly related to alcohol self-efficacy and to risk behaviors. Both measures are significantly related to the number of reported symptoms, stressing the relevance of both types of beliefs for self-reported health. We will return to these issues in the hierarchical regression analyses reported below.

Focusing further on the CHB scale's association with other measures, Table 3 shows that, as expected, CHB scores are negatively correlated with health-related self-efficacy. Participants with high scores on the CHB scale show lower self-efficacy towards preventive nutrition ($r = -.19, p = .05$) and alcohol resistance ($r = -.20, p = .04$). In terms of personality it is noteworthy that CHB scores were, as would be expected, only related to conscientiousness. Less conscientious participants had higher CHB scores ($r =$
-.19, p = .04). No relation with neuroticism or any other personality dimension was found, demonstrating the divergent validity of the measure with regard to personality. CHB scores were found not to be related to the tendency to procrastinate \( r = .10, \text{ns} \).

Also, the CHB scale’s sensitivity to social desirable responding and relations to socio-demographic characteristics were examined (see Table 3). Unlike scores on the IHBS, scores on the CHB scale were not related to the tendency to respond in a socially desirable way \( r = -.06, \text{ns} \) and CHB scores did not show a correlation with race, age, or major in university (all \( p > .30 \)). However, a gender difference was found such that males had higher CHB scores than females \( M = 21.62 \) and \( M = 18.59 \), respectively, \( t(109) = 2.06, p = .04 \).

Altogether, these results indicate that the CHB scale has high convergent validity with health self-efficacy measures and conscientiousness. It has high discriminant validity with all other NEO-FFI measures of personality, with health locus of control and with social desirability. Even though CHB scores overlap to a certain degree with scores on the IHBS, their pattern of association with other variables is different, suggesting that they capture different types of health beliefs.

*Relation to risk behaviors and symptom reports*

The correlation of scores on the CHB scale with the risk behavior index as well as symptom reports as indicator of health were both significant (risk behaviors: \( r = .29, p = .002 \), symptoms: \( r = .28, p = .003 \)). The higher a person’s CHB score, the more likely the person is to engage in health-related risk behaviors and the more illness symptoms the person reports. Furthermore, CHB scores are significantly related to an individual’s BMI: Individuals with BMIs greater or equal 27 (indicating being overweight or obese) have
higher CHB scores than individuals with BMIs below 27 ($M = 23.74$ vs. $M = 19.54$, $t(109) = -2.00$, $p = .048$).

In terms of the sub-dimensions of the CHB scale, significant correlations were found, as one would expect, between the substance use CHB dimension and alcohol/nicotine related risk behavior ($r = .41$, $p = .000$), between the eating/sleeping habits CHB dimension and eating related risk behavior ($r = .21$, $p = .02$) and between the weight regulation CHB dimension and weight regulation risk behavior ($r = -.25$, $p = .009$). The latter negative correlation suggests that individuals who hold CHBs related to weight regulation indeed engage in weight regulating behaviors (self-report to eat more fruits and vegetables and exercise more). None of the CHB subscales were related to irrational health beliefs (all $p > .30$).

To test which proportion of the variance in risk behaviors and symptom reports can be uniquely attributed to variance in CHB scores, we conducted two sets of hierarchical regression analyses. We controlled for gender and race/ethnicity in both analyses. For the regression of risk behaviors, we entered all psychological measures found to be significantly associated with the CHB scores in the bivariate analyses on the first step of the regression. These variables are nutrition self-efficacy, alcohol self-efficacy, and the NEO-conscientiousness scores. Next, we entered the scores of the Irrational Health Beliefs Scale (IHBS) to determine the unique proportion of variance they share with risk behaviors. CHB scores were entered on the third and final step of the regression in order to test whether CHBs have any additional unique shared variance with risk behaviors beyond all variables already in the equation. Table 4 presents the intercorrelations among all measures included in the regression models, and Table 5
presents the results of the regression analyses. As can be seen in the upper part of Table 5, CHB scores share a significant proportion of variance with risk behaviors above and beyond all other variables with which CHB scores are directly associated, including irrational health beliefs (IHBS). In fact, IHBS scores did not share a significant proportion of variance with risk behaviors.

An identical hierarchical regression model was also built for symptom reports, with the exception of risk behaviors being entered into the equation before any other variable (i.e. on step 1) to control for the direct effects that risk behaviors can have on health. The bottom part of Table 5 presents the results of this analysis. In contrast to risk behaviors, irrational health beliefs share a significant unique proportion of variance with symptoms reports (step 3). However, as can be seen, CHB scores also share a unique proportion of variance with illness symptoms, beyond all other variables associated with it ($p = .04$).

We also ran three separate regression analyses (results not reported in Table 5) to examine to which extent specific CHBs predict specific risk behaviors. The regression models were identical to the one described above, with the only difference being that for these three regression models substance use, eating habit, and weight regulation risk behaviors, respectively, were the criterion variables and the respective CHB subscale (i.e. substance use, eating/sleeping habits, weight regulation) was entered instead of the total CHB sum score in the last step of each of the three regression analysis. Results show that the substance use CHB subscale is a significant predictor of alcohol risk behavior beyond and above alcohol related self-efficacy and the other variables in the equation ($R^2$-change: 5.1%, $beta = .26$, $F(1, 103) = 8.58$, $p = .004$). Similarly, there is a tendency for
the eating/sleeping CHB subscale to uniquely predict eating risk behaviors ($R^2$-change: 2.4%, $\beta = .16, F(1, 103) = 2.79, p = .098$), and CHBs related to weight regulation predict dieting risk behavior beyond and above all other variables in the equation ($R^2$-change: 7.4%, $\beta = -.28, F(1, 103) = 8.71, p = .004$).

In sum, the results of the regression analyses show that CHBs are related to risk behaviors and symptom reports.

Discussion
This paper describes the development and psychometric properties of the Compensatory Health Beliefs Scale. The results show that the scale is a reliable and valid instrument to measure CHBs. Scores on the scale showed substantial convergent validity with health self-efficacy and the conscientiousness dimension of the NEO. Holding CHBs was not related to the tendency to procrastinate. This is not surprising as procrastination should mostly matter for carrying through with the planned compensatory behavior but not for holding CHBs. Scores on the scale shared unique variance with health-related risk behaviors and symptom reports. Furthermore, higher CHB scores are related to a higher BMI. Concerning a related measure of health beliefs, the Irrational Health Belief Scale (IHBS), our scale demonstrated some overlap but differences in the patterns of association with other constructs. While the CHB scale seems to capture health beliefs that are relevant for the self-regulation of health-related behavior, the IHBS seems to be a measure of beliefs and attributions concerning health events.

Both, the total CHB scale score as well as the specific subscale scores appear to be useful, depending on the research question: First and importantly, the factor analysis showed that the four content-specific facets of the CHB scale are substantially correlated.
Thus, individuals who tend to use CHBs to regulate health behaviors in one content area tend to do the same in another content area, supporting the notion that the tendency to hold CHBs indeed represents a more general health behavior-regulating tendency and that the different areas of behavior are specific manifestations of the more general construct of CHBs. We suggest that the aggregate score and the specific subscale scores both have their utility. Specifically, the total CHB scale score should provide optimal prediction of more complex health outcomes, whereas the more narrow, content-specific subscale-scores, in line with our results, are most efficacious in predicting a content-specific criterion (for example, risk behavior related to substance use).

We did not distinguish in our analyses between accurate or inaccurate CHBs. Such a classification is difficult because the unhealthy behaviors with which CHBs are concerned (see Table 1) have multiple negative effects on health and the compensatory behavior potentially compensates for some, but not all of these negative effects. For example, Item 6 states that "Lack of exercise can be compensated for by eating less." Eating less may well compensate for the calories that one misses to burn when not exercising and may thereby help avoiding the negative health effects of putting on weight. However, exercising also protects against heart disease and has other health protective functions. Eating less cannot compensate for these additional functions of exercising. An inspection of Table 1 suggests that all listed unhealthy behaviors have such multiple effects on health and that the respective compensatory behavior does not compensate for all of these effects. Future research might identify criteria for distinguishing more accurate
from less accurate CHBs and investigate their respective role in the regulation of health behaviors.

Future Research and Implications for Health Behavior Change Programs

While the present paper introduced an instrument to assess CHBs, future research now has to examine the role of CHBs for health behavior and health behavior change in more detail and in different samples, as the present studies were primarily conducted among college students. If the number of submissions to the Internet CHB search is any indication, people from diverse socio-demographic backgrounds can relate to the idea of CHBs, emphasizing the likely utility of the CHB measure in the general population as well as in specific samples.

We have developed a comprehensive model outlining how CHBs can be incorporated into a conceptual framework of health behavior (see Rabiau, Knäuper, & Miquelon, 2006). The model integrates CHBs into the fundamental theory of cognitive dissonance (Festinger, 1957) and promises to extend current health behavior models by explicitly addressing the role of desires and anticipated pleasure and guilt. Experimental and prospective studies are needed to examine whether the predicted cognitions, emotions (e.g., guilt) and behaviors actually occur in the sequence and manner specified in our model. In studies currently under way, we investigate whether the scale can predict objective outcomes such as weight loss among dieters or metabolic control in patients with diabetes. These studies may also enlighten the mechanisms mediating the relationship between CHBs and outcomes. Finally, one could also speculate that CHBs should be particularly likely to be formed for health behaviors that people are particularly ambivalent about, and ambivalence should be assessed in future studies.
Implications for Health Promotion and Prevention Programs

The present findings may have implications for the design of psycho-educational approaches to health behavior change. As described earlier, CHBs can have negative health effects through two means. First, the compensatory behavior may not, in fact, compensate for the negative effects of the satiation behavior. Second, even if the compensatory behavior is effective, people often do not manage to carry it out. Health programs thus need to educate people to identify the maladaptive aspects of CHBs (e.g., that exercise cannot “erase” all negative consequences of eating high saturated fats) and to distinguish them from the correct aspects of CHBs (e.g., that exercise can burn off the calories consumed in food). Failure to carry through with an intended compensatory behavior is most likely a contributing factor to high failure rates of diets and weight loss attempts. Health programs therefore may want to (1) stress that it is easier to avoid the negative health behavior in the first place than to compensate for it later, and (2) motivate people to follow through with planned compensatory behaviors by helping them develop concrete action plans (cf. Gollwitzer, 1993; Schwarzer, 1992).
### Table 1

**Compensatory Health Beliefs (CHBs): Item Wording and Factor Loadings**

<table>
<thead>
<tr>
<th>Factor and item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factor 1: Substance Use (α = .74)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. The effects of regularly drinking alcohol can be made up for by eating healthy.</td>
<td>0.735</td>
<td>-0.043</td>
<td>0.096</td>
<td>-0.133</td>
</tr>
<tr>
<td>2. It is alright to drink a lot of alcohol as long as one drinks lots of water to flush it.</td>
<td>0.581</td>
<td>242</td>
<td>-0.092</td>
<td>0.007</td>
</tr>
<tr>
<td>3. Smoking from time to time is OK if one eats healthy.</td>
<td>0.534</td>
<td>0.077</td>
<td>0.029</td>
<td>-0.119</td>
</tr>
<tr>
<td>4. The effects of drinking coffee can be balanced by drinking equal amounts of water.</td>
<td>0.520</td>
<td>-0.160</td>
<td>0.036</td>
<td>0.136</td>
</tr>
<tr>
<td>5. The effects of drinking too much alcohol during the weekend can be made up for by not drinking during the week.</td>
<td>0.489</td>
<td>0.053</td>
<td>0.156</td>
<td>0.019</td>
</tr>
<tr>
<td>6. Smoking can be compensated for by exercising.</td>
<td>0.405</td>
<td>-0.041</td>
<td>-0.061</td>
<td>0.235</td>
</tr>
<tr>
<td>Factor and item</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>-------------------------------------------------------------------------------</td>
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<tr>
<td><strong>Factor II: Eating/Sleeping Habits (α = .66)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Too little sleep during the week can be compensated for by sleeping in on</td>
<td>-.012</td>
<td>.704</td>
<td>.060</td>
<td>-.038</td>
</tr>
<tr>
<td>the weekends.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. It is OK to go to bed late if one can sleep longer the next morning (only</td>
<td>-.034</td>
<td>.591</td>
<td>.044</td>
<td>-.054</td>
</tr>
<tr>
<td>the number of hours count).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. It is OK to skip breakfast if one eats more during lunch or dinner.</td>
<td>.052</td>
<td>.520</td>
<td>-.007</td>
<td>.038</td>
</tr>
<tr>
<td>4. Eating whatever one wants in the evening is OK if one did not eat during</td>
<td>.108</td>
<td>.425</td>
<td>-.188</td>
<td>.297</td>
</tr>
<tr>
<td>the entire day.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Factor III: Stress (α = .63)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Stress during the week can be made up for by relaxing on the weekend.</td>
<td>-.106</td>
<td>.338</td>
<td>.557</td>
<td>.045</td>
</tr>
<tr>
<td>2. A stressful day can be compensated for by relaxing in front of the T.V.</td>
<td>.141</td>
<td>-.257</td>
<td>.543</td>
<td>.056</td>
</tr>
<tr>
<td>3. The bad effects of stress can be made up for by exercising.</td>
<td>-.019</td>
<td>.181</td>
<td>.494</td>
<td>.005</td>
</tr>
<tr>
<td>4. Sleep compensates for stress.</td>
<td>.102</td>
<td>.033</td>
<td>.417</td>
<td>.018</td>
</tr>
</tbody>
</table>
Factor and item

Factor IV: Weight Regulation ($\alpha = .57$)

1. Eating dessert can be made up for by skipping the main dish. - .014  .051  -.118  .661
2. Using artificial sweeteners compensates for extra calories. - .054  -.061  .217  .563
3. Breaking a diet today may be compensated for by starting a new diet tomorrow. .001  -.029  .174  .456

Note. Loadings are taken from the pattern matrix. Loadings in bold are values above .40. Response format used was 0 (not at all), 1 (a little), 2 (somewhat), 3 (quite a bit), 4 (very much). The following instruction was given: “Different people believe different things regarding their health. Below is a list of beliefs that everyone may hold to some degree. Please read each sentence carefully and rate how closely the idea matches your own belief by marking the appropriate number. Since we all believe different things, there are no correct or incorrect choices. As well, most of these beliefs have not been scientifically tested. How closely does each of the following ideas match your own belief?”
Table 2

Intercorrelations of CHB Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Substance Use</td>
<td></td>
<td></td>
<td></td>
<td>----</td>
</tr>
<tr>
<td>2. Eating/Sleeping Habits</td>
<td>.45</td>
<td></td>
<td></td>
<td>----</td>
</tr>
<tr>
<td>3. Stress</td>
<td>.28</td>
<td>.35</td>
<td></td>
<td>----</td>
</tr>
<tr>
<td>4. Weight Regulation</td>
<td>.48</td>
<td>.54</td>
<td>.23</td>
<td>----</td>
</tr>
</tbody>
</table>
Table 3  

*Description of Scale Characteristics and Intercorrelations with CHB and IHBS*

<table>
<thead>
<tr>
<th>Scale</th>
<th>M</th>
<th>SD</th>
<th>A</th>
<th>CHB</th>
<th>IHBS</th>
<th>t-test (df = 108)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CHB</td>
<td>20.15</td>
<td>7.88</td>
<td>.76</td>
<td>---</td>
<td></td>
<td>---</td>
</tr>
<tr>
<td>2. Irrational Health Beliefs</td>
<td>37.18</td>
<td>11.62</td>
<td>.89</td>
<td>.31** (.38***)</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>(IHBS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Internal Control (MHLC)</td>
<td>22.75</td>
<td>3.39</td>
<td>.70</td>
<td>.09 (.12)</td>
<td>-.18* (-.23*)</td>
<td>( p = .007 (.008) )</td>
</tr>
<tr>
<td>4. Powerful Others (MHLC)</td>
<td>13.16</td>
<td>3.63</td>
<td>.60</td>
<td>.11 (.16)</td>
<td>.26** (.36***)</td>
<td>( p = .08 (.05) )</td>
</tr>
<tr>
<td>5. Chance (MHLC)</td>
<td>14.00</td>
<td>4.11</td>
<td>.66</td>
<td>.15 (.21*)</td>
<td>.34*** (.44***)</td>
<td>( p = .04 (.02) )</td>
</tr>
<tr>
<td>6. Procrastination</td>
<td>25.70</td>
<td>4.72</td>
<td>.72</td>
<td>.10 (.14)</td>
<td>.07 (.09)</td>
<td>( ns (ns) )</td>
</tr>
<tr>
<td>7. Self-Efficacy –Nutrition</td>
<td>14.36</td>
<td>3.32</td>
<td>.82</td>
<td>-.19* (-.24*)</td>
<td>-.18 (-.21*)</td>
<td>( ns (ns) )</td>
</tr>
<tr>
<td>8. Self-Efficacy –Exercise</td>
<td>12.32</td>
<td>3.71</td>
<td>.86</td>
<td>-.11 (-.14)</td>
<td>-.10 (-.11)</td>
<td>( ns (ns) )</td>
</tr>
<tr>
<td>9. Self-Efficacy –Alcohol</td>
<td>9.65</td>
<td>2.69</td>
<td>.82</td>
<td>-.20** (-.25**)</td>
<td>.04 (.05)</td>
<td>( p = .02 (.004) )</td>
</tr>
<tr>
<td>10. NEO – N</td>
<td>3.04</td>
<td>0.62</td>
<td>.81</td>
<td>.03 (0.04)</td>
<td>.17 (.20*)</td>
<td>( p = .097 (.07) )</td>
</tr>
<tr>
<td>11. NEO – E</td>
<td>3.38</td>
<td>0.51</td>
<td>.77</td>
<td>-.02 (-.03)</td>
<td>-.24** (-.29**)</td>
<td>( p = .03 (.01) )</td>
</tr>
<tr>
<td>Scale</td>
<td>( M )</td>
<td>( SD )</td>
<td>( A )</td>
<td>CHB</td>
<td>IHBS</td>
<td>( t )-test ((df = 108))</td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>-----</td>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td>12. NEO - O</td>
<td>3.66</td>
<td>.56</td>
<td>.78</td>
<td>.13 (.17)</td>
<td>-.26** (-.31**)</td>
<td>( p = .0002 (.000) )</td>
</tr>
<tr>
<td>13. NEO - A</td>
<td>3.61</td>
<td>.47</td>
<td>.71</td>
<td>-.15 (-.20*)</td>
<td>-.36*** (-.45*** )</td>
<td>( p = .02 (.01) )</td>
</tr>
<tr>
<td>14. NEO - C</td>
<td>3.40</td>
<td>.58</td>
<td>.83</td>
<td>-.19* (-.24*)</td>
<td>-.21* (-.24**)</td>
<td>ns (ns)</td>
</tr>
<tr>
<td>15. Social Desirability (MCSD)</td>
<td>14.25</td>
<td>5.50</td>
<td>.75</td>
<td>-.06 (-.08)</td>
<td>-.25** (-.31**)</td>
<td>( p = .04 (.03) )</td>
</tr>
<tr>
<td>16. Risk Behavior Score</td>
<td>10.88</td>
<td>.65</td>
<td>.57</td>
<td>.29** (.44*** )</td>
<td>.04 (.06) .36***</td>
<td>( p = .01 (.0001) )</td>
</tr>
<tr>
<td>17. Symptom Checklist</td>
<td>20.17</td>
<td>11.46</td>
<td>.89</td>
<td>.28** (.34*** )</td>
<td>.36*** (.41*** )</td>
<td>ns (ns)</td>
</tr>
</tbody>
</table>

*Note. \( N = 111 \). Disattenuated correlations and \( p \)-levels are provided in parentheses. CHB = Compensatory Health Beliefs Scale; IHBS = Irrational Health Belief Scale; MHLC = Multiple Health Locus of Control scale; NEO = NEO Five Factor Inventory Short Form; NEO-N = Neuroticism; NEO-E = Extraversion; NEO-O = Openness to experience; NEO-A = Agreeableness; NEO-C = Conscientiousness; MCSD = Marlowe-Crowe Social Desirability scale; \( \alpha \) = Cronbach’s coefficient alpha.

*\( p < .05 \). **\( p < .01 \). ***\( p < .001 \).
Table 4

*Intercorrelations among Variables Used in the Regression Models*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CHB</td>
<td>---</td>
<td>.31**</td>
<td>-.19*</td>
<td>-.20*</td>
<td>-.19*</td>
<td>.29**</td>
<td>.28**</td>
</tr>
<tr>
<td>2. IHBS</td>
<td></td>
<td>---</td>
<td>-.18</td>
<td>.04</td>
<td>-.20*</td>
<td>.04</td>
<td>.36***</td>
</tr>
<tr>
<td>3. Nutrition self-efficacy</td>
<td></td>
<td></td>
<td>---</td>
<td>.37***</td>
<td>.07</td>
<td>-.15</td>
<td>-.16</td>
</tr>
<tr>
<td>4. Alcohol self-efficacy</td>
<td></td>
<td></td>
<td></td>
<td>---</td>
<td>.14</td>
<td>-.45***</td>
<td>-.10</td>
</tr>
<tr>
<td>5. Conscientiousness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>---</td>
<td>-.21***</td>
<td>.05</td>
</tr>
<tr>
<td>6. Risk behavior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>---</td>
<td>.05</td>
</tr>
<tr>
<td>7. Symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>---</td>
</tr>
</tbody>
</table>

*Note.* *N* = 111. CHB = Compensatory Health Beliefs Scale; IHBS = Irrational Health Belief Scale.

*p < .05. **p < .01. ***p < .001*
Table 5

Summary of Hierarchical Regression Analyses on Risk Behavior and Symptom Reports

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Beta</th>
<th>$R^2$ change</th>
<th>Significance of step</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk Behavior</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition self-efficacy</td>
<td>.02</td>
<td>.23</td>
<td>$F(3, 105) = 10.82, p = .000$</td>
</tr>
<tr>
<td>Alcohol self-efficacy</td>
<td>-.37***</td>
<td>.00</td>
<td>$F &lt; 1$</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>-.22*</td>
<td>.03</td>
<td>$F(1, 103) = 4.20, p = .04$</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IHBS</td>
<td>-.03</td>
<td>.19*</td>
<td>$F(7, 103) = 6.04, p = .000$</td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHB</td>
<td>.19*</td>
<td>.29</td>
<td></td>
</tr>
</tbody>
</table>

**Symptoms**

<p>| Step 1          |      |              |                      |
| Risk behavior   | -.06  | .002         | $F &lt; 1$              |</p>
<table>
<thead>
<tr>
<th>Predictor</th>
<th>Beta</th>
<th>$R^2$ change</th>
<th>Significance of step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2</td>
<td></td>
<td>.04</td>
<td>$F(3, 103) = 1.36, p = .26$</td>
</tr>
<tr>
<td>Nutrition self-efficacy</td>
<td>-.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol self-efficacy</td>
<td>-.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td>.16</td>
<td>$F(1, 102) = 21.12, p = .000$</td>
</tr>
<tr>
<td>IHBS</td>
<td>.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td></td>
<td>.03</td>
<td>$F(1, 101) = 4.19, p = .04$</td>
</tr>
<tr>
<td>CHB</td>
<td>.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall model</td>
<td></td>
<td>.27</td>
<td>$F(9, 101) = 4.15, p = .000$</td>
</tr>
</tbody>
</table>

*Note.* Displayed are the betas (standardized regression coefficients) for the final equation. $R^2$ change is the incremental change in accounted variance for each step of the analysis.

* $p < .05$  
** $p < .01$  
*** $p < .001$.
Concerns have been brought forward in the past that Internet users do not present a representative sample of the general population (see Couper, 2000). This was less of an issue here, though, because the goal was not to reach a sample in which all socio-demographic groups are proportionally represented. It was sufficient to reach some members of all groups, which is realistic given that a certain proportion of members from all socio-demographic groups have Internet access. We received more than five hundred entries from people varying in gender, age and country of origin. In terms of the major socio-demographic variables, all groups were represented in the sample, though, the recruitment strategy certainly restricted the sample to English-speaking respondents. A large number of the submissions were highly redundant, suggesting that the existing pool of CHBs has been exhausted. To further rule out the possibility that important domains of CHBs were missed, we asked the health psychology experts who reviewed the item pool whether they could contribute additional item ideas. No additional items were suggested by the experts beyond those already in the pool.

A computer-based approach was chosen as a cost-efficient method for collecting the retest data. A large amount of research has demonstrated measurement equivalency between paper-pencil and web- or computer-administered questionnaires. Specifically, measurement equivalency has been found regarding variance, factor structures and factors loadings, covariance structures, internal consistency and test-retest reliability (e.g., Donovan, Drasgow, & Probst, 2000; Finger & Ones, 1999; King & Miles, 1995; Miller et al., 2002; Stanton, 1998). For the present data, the variance, factor structure, factor loadings, and internal consistency values were comparable for the time 1 and time 2 assessments, supporting the notion of measurement equivalency of the paper-pencil and computer-based version of the CHB scale.

PFA is generally recommended over principal components analysis (PCA) when the goal is to find a parsimonious representation of the relationships between assessed variables (Fabrigar, Wegener, MacCallum, & Strahan, 1999). PFA more realistically estimates factor loadings and factor correlations than PCA because it recognizes the existence of random error in the measured variables and therefore less likely results in inflated factor loadings and an underestimation of factor correlations (Fabrigar et al., 1999, Russell, 2002). When the number of variables and the communalities are sufficiently high, PFA and principal components analysis (PCA) often result in comparable factor solutions, and this is the case here as well: Re-running the analyses using principal components analysis resulted in the same number of factors with the same variables loading on each of the four factors. The only emerging difference were higher factor loadings when PCA was used.

Table 2 shows the uncorrected as well as disattenuated correlations. Because disattenuation does not change the overall pattern of correlations substantially, we discuss the uncorrected correlations in the text.
Transition to Manuscript 3

Manuscript 2 (Knäuper, Rabiau, Cohen, & Patriciu, 2004) describes a scale to measure CHBs in the general population and demonstrates that CHBs are negatively related to health outcomes. The subsequent goal of this research program was to study the construct of CHBs in a clinical population in which the concept of compensation would be particularly relevant. Compensating is an integral part of the management of diabetes because blood glucose levels depend on an equilibrium between factors that raise or lower it (food, stress, insulin, exercise). In other words, individuals with diabetes continuously have to make decisions that involve compensation. Therefore the construct of CHB is particularly relevant to this disease. Also, upon inspection of the literature, it became clear that adolescence is a period of risk for adherence to treatment of type 1 diabetes with a decline in metabolic control (Edgar & Skinner, 2003; Frey, Guthrie, Loveland-Cherry, Park, & Foster, 1997; Kovacs, Goldston, Obrosky, & Iyengar, 1992; Law, Kelly, Huey, Summerbell, 2002). I therefore decided to focus on the role of compensatory health beliefs in adolescents with type 1 diabetes. Research has shown that diabetes-specific measures (e.g., locus of control or family functioning) may be more strongly related to metabolic control and adherence to treatment than general measures (Peyrot & Rubin, 1994). I therefore designed a scale specific to adolescents with type 1 diabetes. The following manuscript presents the development and psychometric properties of a diabetes-specific CHB scale as well as its relationship with adherence to treatment and metabolic control.
Manuscript 3: Metabolic Control and Self-Care in Adolescents with Type 1 Diabetes: The Role of Compensatory Health Beliefs

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1. McGill University
2. Montreal Children’s Hospital
Metabolic Control and Self-Care in Adolescents with Type 1 Diabetes: The Role of Compensatory Health Beliefs

In patients with type 1 diabetes, insulin production, which controls blood glucose levels, has ceased. Thus, insulin has to be administered exogenously. However, many other factors such as diet, exercise, illness, and stress, also affect blood glucose levels. Therefore, only injecting insulin regularly is not sufficient to properly manage blood glucose level. In order to prevent short- and long-term health complications, the patient has to monitor and regulate blood glucose levels, food intake, activity and stress levels (Guttmann-Bauman, Flaherty, Strugger, & McEvoy, 1998).

Type 1 diabetes is typically diagnosed in childhood. Once diagnosed, the young patients and their parents are educated about the disorder and given a treatment regimen to follow. However, research shows that many patients, especially during adolescence, do not fully adhere to the treatment and, as a result, suffer adverse health consequences (Kovacs, Goldston, Obrosky, & Iyengar, 1992; Law, Kelly, Huey, & Summerbell, 2002). A tight metabolic control is critical, as it has been shown to prevent or at least delay diabetes complications (DCCT, 1994). Adolescents have particular difficulty achieving glucose control, as they usually attain higher average glycohaemoglobin levels than adults, despite similar treatments (Brink, 1997). This is, in part, due to increasing insulin resistance during puberty (Amiel, Sherwin, Simonson, Lauritano, & Tamborlane, 1986) and in part due to a lack of adherence to the multifaceted treatment regimen (Toobert, Hampson, & Glasgow, 2000). Lack of knowledge about the disease and its management is usually not the most crucial factor in non-adherence as the adolescents are usually well informed about their disease (Johnson, 1998; Wolanski, Sigman, & Polychronakos,
Rather, a number of psychosocial factors seem to play a central role: family cohesion, social support, peer pressure, self-efficacy, self-esteem, autonomy, locus of control, health beliefs, and illness representation have been found to influence adherence in adolescents with diabetes (Johnston-Brooks, Lewis, & Garg, 2002; La Greca, Auslander, Greco, Spetter, Fisher, & Santiago, 1995; Rubin & Peyrot, 1989; Williams, Freedman, & Deci, 1998). We propose that a certain type of health beliefs — so called compensatory health beliefs (CHBs) — may be another important factor that hinders adolescents in fully adhering to their treatment regimen.

Compensatory Health Beliefs

Compensatory health beliefs, CHBs, are convictions that the negative effects of an unhealthy behavior can be compensated for by engaging in another, healthy behavior. For example, dieters may say to themselves: “I can eat this piece of cake now because I will be exercising this evening.” According to the compensatory health beliefs model (Rabiau, Knäuper, & Miquelon, 2006), when being faced with a temptation at odds with one’s health goals (e.g., stay healthy, or lose weight), activating CHBs is one way to alleviate the conflict or cognitive dissonance by providing a prescription for how the unhealthy behavior may be compensated for. People may thus engage in the unhealthy behavior without feeling guilty about it. Knäuper, Rabiau, Cohen, and Patriciu (2004) developed a Compensatory Health Beliefs Scale, which shows good psychometric properties. The authors found higher CHB scores to be associated with more health risk behaviors and more symptoms reported. CHBs are believed to be unhealthy because (1) many are inaccurate and the compensatory behavior does not make up for the negative effects of the unhealthy behavior, and (2) even if they are accurate, many times
individuals will not actually carry through and perform the compensatory behavior (i.e., not go exercise later).

Compensating is an integral part of the management of diabetes because blood glucose levels depend on a balance between factors that raise it (food, stress) and those that lower it (insulin, exercise). In other words, individuals with diabetes continuously have to make decisions that involve compensation. Adolescence is a particularly challenging period for diabetes care, as the responsibility of diabetes care shifts from the parent to the adolescent (Palmer et al., 2004), leaving the adolescents with many choices leading to frequent opportunities to experience the cognitive dissonance between feeling tempted and wanting to prevent health complications. We hypothesize that adolescents with diabetes use CHBs as a means to resolve these mental conflicts in their efforts to maximize pleasure while believing to minimize harm. For example, an adolescent knows testing blood glucose at bedtime is mandatory but because of sleeping at a friend's house, he or she prefers not to test. The CHB “Testing my glucose twice tomorrow morning will make up for not doing it tonight” will resolve the cognitive dissonance as the adolescent may skip testing without feeling guilty or uneasy about it.

Frequent deviations from the optimal blood glucose level are associated with long-term health complications (DCCT, 1994) and can, in extreme cases, acutely cause life-threatening ketoacidosis. Therefore, distinguishing between adaptive CHBs and maladaptive CHBs is crucial to prevent these health complications. For the present research, diabetes-specific CHBs were divided based on theoretical grounds into two categories: (1) adaptive CHBs, in other words CHBs that are in accordance with treatment recommendations and (2) maladaptive CHBs, CHBs in contradiction with
treatment recommendations. Examples for adaptive CHBs are “Drinking a juice before exercising can make up for the decrease in blood glucose caused by exercising” or “Taking extra insulin can make up for the increase in blood glucose caused by eating an extra snack.” If the compensatory behaviors are in fact carried out, then these CHBs will contribute to a successful regulation of the adolescent’s blood glucose. Maladaptive CHBs, in contrast, have a detrimental impact on blood glucose regulation and may result in negative short- and long-term health consequences. Examples of maladaptive CHBs are “Not taking my insulin can make up for skipping breakfast” or “Not eating snacks can make up for not exercising”. Acting upon such CHBs should have adverse medical effects and put adolescents with diabetes at risk for hypoglycemia or hyperglycemia. CHBs might best be thought of as fitting along a continuum from “strictly maladaptive” to “very adaptive”, but for the purpose of research the beliefs are separated into dichotomous categories.

Research Aims

The goals of this research were (1) to create a psychometric scale to measure CHBs specific to adolescents with type 1 diabetes, (2) to measure the scale’s feasibility, reliability and validity, and (3) to examine the relationship between CHBs and treatment adherence for concurrent validity. The ultimate goal of the research was to create a tool that can be used both by care providers and researchers to improve adherence to treatment and consequently improve the health status of adolescents with diabetes. Identifying the use of maladaptive compensatory health beliefs and changing them as part of the continued education process of patients with diabetes could result in better adherence to treatment regimens and, thereby, better health outcomes.
Method

The first phase of this project was to gather a pool of potential items for the development of a CHB scale specific to type 1 diabetes. The researchers drafted a pool of items based on the treatment guidelines of the Canadian Diabetes Association (Canadian Diabetes Association, 1998 and 2000) and consulted with members of the Diabetes Team of the Montreal Children’s Hospital (doctors, nurses, nutritionists, psychologist, social workers, etc.) concerning the accuracy, wording and completeness of the item pool. The second phase consisted of the administration of the Diabetes CHB item pool to a sample of adolescents to evaluate the scale’s reliability and validity and its relationship with treatment adherence.

Participants

The CHB item pool and other measures were administered to 152 adolescents between 12 and 18 years of age who had been diagnosed with type 1 diabetes for at least one year. The participants were recruited from the outpatient population of the Diabetes Clinic at the Montreal Children’s Hospital. Age of onset, disease duration, and present age have been shown to be associated with treatment adherence (Johnson & Meltzer, 2002) and were therefore recorded as control variables. The sample was composed of 43.9% males (68) and 54.2% female (84) and 59.4% (92) filled out the questionnaires in English and 40.6% (63) filled them out in French. Out of the 152 participants who agreed to participate in the study, 116 fully completed the questionnaires (74.8%). Participants who did not return the questionnaires (28) or for whom 5% or more of the data were missing (8) were excluded form the analyses. Out of the 116 completed questionnaires, two more participants were excluded from the analysis because of response styles.
choosing the same response options on many questions in a row) or because their responses were not interpretable (e.g., checking several response options for one question). Participants who did not return the questionnaires or did not fully complete them did not differ from those who did in terms of age, gender, or disease duration. The non-respondent group showed poorer metabolic control with a mean glycosylated hemoglobin of 9.58% compared to 8.85% in the respondent group ($t(139) = -2.67, p = .009$). Also, the parental level of education was lower in the non-respondent group, with 21% of the mothers being university graduates in the non-respondent group versus 40% in the respondent group. Similarly, 59.1% of the fathers in the non-respondent group had a high-school degree or less compared to 34.6% in the respondent group.

Retest reliability data are based on 86 participants who returned the retest questionnaire at time 2 (75.4% of the 114 participants for whom we had complete data).

Measures

Conducting the project in a bilingual hospital required having both English and French versions of the questionnaires. All measures were therefore translated into French by a native French speaker and then back translated into English by a native English speaker, both of whom had prior experience with translation to ensure quality. Discrepancies were discussed and the translations modified based on consensus by a bilingual team.

Diabetes-specific compensatory health beliefs. The item pool of 44 items was developed by the authors as described above, to measure individual differences in diabetes-specific CHBs in adolescents with type 1 diabetes. Participants were asked how much they agreed or disagreed with the particular beliefs using a 5-point bipolar response
format ranging from “totally disagree” to “totally agree.” The 44 items consisted of both adaptive and maladaptive beliefs, as described above.

Convergent and Divergent Validity

Diabetes knowledge. Knowledge was assessed with the Diabetes Knowledge Scale (Fitzgerald, Anderson, Funnell, Hiss, Hess, Davis and Barr, 1998). Diabetes knowledge was measured to ensure that the CHB scale did not simply measure knowledge about diabetes. Because the two concepts overlap to some extent, we expected medium-sized correlations. Moreover, we expected different patterns of prediction between diabetes knowledge and CHBs towards adherence, namely that CHBs scores would be able to predict adherence better than knowledge. The scale contains 23 items divided into a general test subscale (14 items) and an insulin-use subscale (9 items). The alpha coefficients for both subscales have been found to be above .70 (Fitzgerald et al., 1998). The scores on the scale increased after receiving diabetes specific education, supporting the content validity of the measure. Even though the psychometrics of this scale were tested on a sample of adults, each item was found to be at a grade 6 reading level making it appropriate for use with adolescents.

Diabetes self-regulation. The Treatment Self-Regulation Questionnaire (TSRQ) was used to measure the motivation to engage in health behaviors such as following a treatment regimen. The diabetes specific version was developed and used by Williams, Freedman, and Deci (1998). Autonomous regulation reflects internal motivation, i.e. one engages in a behavior out of choice and personal convictions, whereas controlled regulation reflects extrinsic motivation, i.e., one performs a behavior in order to avoid guilt or anxiety or to satisfy an external demand. According to our theoretical model,
participants with more autonomous and less controlled regulation should develop less CHBs, particularly less maladaptive CHBs. The TSRQ has two subscales: autonomous regulation (8 items) and controlled regulation (11 items) for a total of 19 items. Internal reliability for the scale was found to be very good ($\alpha$ between .81 and .85 for autonomous regulation, and between .80 and .86 for controlled regulation) (Williams et al., 1998). It was found in past research that better glycemic control was associated with autonomous regulation (Williams et al., 1998).

_Diabetes self-efficacy._ The Self-Efficacy Questionnaire (SED) originally developed by Grossman, Brink, and Hauser (1987) and later modified by Rubin and Peyrot (1989) was used to assess the conviction of being able to manage one’s diabetes. Less self-efficacious adolescents were expected to develop more maladaptive CHBs. The original SED Scale (Grossman et al., 1987) consisted of 3 subscales (35 items) and was validated in a sample of adolescents aged 12 to 18 years. Internal consistency has been found to be good for the total score ($\alpha = .90$) and for the diabetes specific scale ($\alpha = .92$), and acceptable for the medical situations scale ($\alpha = .70$), and the general subscale ($\alpha = .60$) (Grossman et al., 1987). The total score and the diabetes-specific subscale score were significantly positively associated with metabolic control. Rubin and Peyrot (1989) adapted the Grossman SED Scale and reduced it to 25 items. Rubin and Peyrot (1989) shortened version was used in the present study using Grossman original wording for adolescents.

_Illness representation – treatment effectiveness._ Perceived treatment effectiveness was assessed using a subscale of the Illness Representations Questionnaire (IRQ; Skinner, Howells, Greene, Edgar, McEvilly, & Johansson, 2003). The IRQ is based on
the Personal Model of Diabetes Interview (Hampson, Glasgow, & Toobert, 1990) and the Illness Perception Questionnaire (Weinman, Petrie, Moss-Morris, & Horne, 1996). It measures five areas of illness representation: Identity, Cause, Timeline, Consequences, and Treatment Effectiveness. Only the Treatment Effectiveness subscales were used in this particular study. Participants with higher perceived treatment effectiveness and low adherence were expected to have more CHBs as they would feel more dissonance. In other words, the more a person feels that the treatment is effective, the more guilty or uncomfortable he/she would feel about not adhering to the treatment, and the more likely he/she would be to develop CHBs to alleviate the feelings of guilt or unease. The Treatment Effectiveness subscale is divided into control of glucose and prevention of complications subscales. The instrument has a reading grade of seven, its subscales have good internal consistency (treatment effectiveness to control \( \alpha = .67 \); treatment effectiveness to prevent \( \alpha = .82 \)) (Skinner et al., 2003), and have demonstrated validity in predicting self-care and emotional well-being in adolescents.

*Perceived competence.* A general sense of perceived competence was measured using an unpublished brief version (4 items) of the Generalized Perceived Competence Scale (K. Wallston, personal communication, August 12, 2003). The construct is the same as the Perceived Health Competence Scale developed by Smith, Wallston, and Smith (1995), but more general. It was expected that adolescents with a higher score on perceived competence would develop less maladaptive CHBs and more adaptive CHBs. The alpha in the present sample was .61, which is respectable given the small number of items.
Social desirability. The Children’s Social Desirability Questionnaire, developed by Crandall, Crandall, and Katkovsky (1965) was used to measure the adolescents’ tendency to respond in ways that they perceive to be socially appropriate. The authors found high internal consistency for the scale with split-half reliabilities ranging from .82 to .95 (Crandall et al., 1965).

Concurrent Validity: Relationship to Treatment Adherence

Physiological marker of treatment adherence. Glycosylated hemoglobin (HbA1c) levels were used as indicators of glycemic control, which is considered to be a physiological proxy to treatment adherence. HbA1c is widely accepted as the best measure of intermediate term glycemic control (Dougherty et al., 1999) as it reflects the average glycemic control over the preceding two to three months. The goal of the treatment regimen is to keep glucose levels within a normal range, and therefore as people better adhere to their treatment, it is expected that their average glucose level should approach the optimal range (below 7%). A single HbA1c measure provides a measure of how stable glucose levels were in the past two to three months. In addition, we used a measure of metabolic stability over a longer time period as another outcome variable. Metabolic stability was calculated in the present study as the standard deviation of five HbA1c glucose measures (time 1 measure and up to four prior measures).

Self-reported measures of treatment adherence. Self-care behaviors, which are a self-report measure of adherence to treatment, was assessed using the Summary of Diabetes Self-Care Activities Questionnaire. This scale was designed by Toobert, Hampson and Glasgow (2000) and consists of eleven items that assess areas of diabetes self-management such as general diet, specific diet, exercise, blood-glucose testing, foot
care, and smoking. Adolescents with high levels of maladaptive CHBs are expected to have lower self-care scores. The internal consistency assessed by the coefficient alpha was .79 (Toobert et al., 2000). The scale was developed with adults, but has been previously adapted for adolescents with type 1 diabetes (Palardy, Greening, Ott, Holderby, & Atchison, 1998) which was the version used in the present study.

Control variables. Demographic information about the adolescent and the parents were assessed in short questionnaires. Questions answered by the adolescents included grade level, average grades, first language, insulin pump usage, number of recommended injections per day, number of siblings, and birth position within the siblings. Parents provided information on their education level, occupation, employment status, living arrangements, their child’s diabetes-related hospitalizations, emergency room visits, doctor’s visits, number of days missed at school in the past twelve months because of diabetes-related problems, and doctor’s treatment recommendations. Additional demographic information was obtained from the adolescent’s medical file, such as date of birth, gender, age at diagnosis, weight, and height.

Procedure

Potential participants and their families were approached at the Diabetes Clinic at the Montreal Children’s Hospital when they came for their regular appointments. Assent was obtained from the adolescents and consent from a parent for all participants. Of all the families approached, only five refused to participate. Both the parent and the participants filled out their respective questionnaires while waiting at the clinic. If the participant did not have time to finish, they were given a stamped return envelop and asked to fill it out and send it back as soon as possible. Once the participants finished
filling out the questionnaires they were given a debriefing explaining the concept of
CHBs as well as a movie pass in appreciation for their time. In order to assess test-retest
reliability of the scale, the participants were asked whether they agreed to be sent the
Diabetes CHB questionnaire at home two weeks later. Following the retest, participants
received an in-depth debriefing for each of the CHBs from the item pool followed by a
phone call in case of any questions. This was done to prevent the formation of erroneous
beliefs following the participation in the study.

Medical records were reviewed in order to access the glycosylated hemoglobin
(HbA1c) test results as well as the information mentioned above.

Results

Item Analysis

Analysis of Item Distribution

None of the items were eliminated based on the item distribution analysis. In a
clinical sample, skewed items might provide valuable information on participant with
more extreme responding and therefore be of particular interest.

Principal Axis Factor Analysis

The 44 item pool was subjected to a principal axis factor analysis (PFA) for the
full sample of N = 116 participants in order to explore the factor structure of the Diabetes
CHB scale. Missing values were treated listwise. The Kaiser-Meyer-Olkin measure of
sampling adequacy (.65), Bartlett's test of sphericity (1660.87, df = 946, p = .00), and the
determinant of the matrix (.00) all indicated that the correlation matrix was appropriate
for such an analysis. Upon examination of the scree plot, a clear drop of the eigenvalues
was followed by a plateau subsequent to the first three factors (eigenvalues 6.87, 3.90,
2.26, then 1.90, 1.83, 1.70), suggesting that only these three should be retained. The factor correlation matrix showed that factors 1 and 3 were not correlated (r = .05). However, factors 1 and 2, and factors 2 and 3 were substantially correlated (r = .32 and r = .39, respectively), suggesting overlap in variance between the factors. In case of correlated factors, an oblique rotation provides a better simple structure and more stable factor solutions and was therefore used to enhance factor interpretation (Fabrigar, 1999). The three-factor solution was replicated after rotation (eigenvalues 7.05, 4.11, 2.33, then 2.01, 1.83, 1.78). Based on the analysis of the loadings of the rotated factors (pattern matrix), we first deleted items loading above .35 on two factors and then items not loading on either of the factors (below .35 on all three factors). In total, 24 items were eliminated from the item pool. We repeated the factor analysis with the remaining 20 items and examined the factor loadings of the new promax rotated factor solution. Once again, three factors emerged (eigenvalues 4.60, 2.53, 1.53), explaining 33.8% of the total variance. Inspection of the pattern matrix showed that all items now loaded above .35 on one of the three factors (see Table 1 for factor loadings). The 6 items loading on the first factor were maladaptive CHBs about glucose testing (e.g., “It is Ok not to test my glucose level if I did not eat sweets beforehand”). All of these items are especially maladaptive because not testing glucose cannot be compensated for. Factor 1 accounts for 19.91% of the variance. The 8 items loading on the second factor are general maladaptive CHBs. These beliefs relate to eating behavior as well as stress management (e.g., “Eating much more at lunch can make up for skipping breakfast”) and refer to beliefs for which the compensatory behavior fails to compensate for the unhealthy behavior. Factor 2 accounts for 9.78% of the variance. The 6 items loading on the third
factor are adaptive CHBs (e.g., “Eating large portions makes up for low glucose”) and account for 4.14% of the variance. The 20 items of the final scale as well as the factor loadings can be found in Table 1. The final CHB scale has three subscales, two containing maladaptive CHBs (glucose-testing maladaptive CHBs and general maladaptive CHBs) and one containing adaptive CHBs. Because the predictions for the first two subscales and the third are opposing, a total score of the three subscales would not be appropriate. Instead, we calculated a ratio index. Schwartz (1997) states that a ratio reflecting the balance of positive and negative elements adds important theoretical information beyond reporting each dimension separately. In specific, when looking at outcomes, this ratio index allows examining the question whether adaptive beliefs buffer the effects of maladaptive beliefs. Based on a similar reasoning from Schwartz who developed the State of Mind (SOM) measure (Schwartz, 1997), which is a ratio of positive cognitions compared to both positive and negative cognitions, we developed the adaptive CHB ratio. For the Adaptive CHBs ratio, the mean score for adaptive CHBs was divided by the sum of the mean scores of the adaptive CHBs and the mean score of the two maladaptive CHB subscales. The higher the adaptive CHB ratio, the more respondents endorsed adaptive CHBs relative to maladaptive CHBs. Regarding the validity measures, hypotheses are similar to the ones stated for adaptive CHBs. In other words, we hypothesize that better knowledge will be associated with a higher adaptive CHB index and the more self-efficacious one feels about following recommendations the more likely these recommendations are integrated within one’s repertoire and to be followed through. Therefore, more adaptive CHBs will be incorporated into the self. Because more knowledge and higher self-efficacy are hypothesized to be related to less
maladaptive CHBs, the adaptive CHB ratio would be higher. Moreover, being successful at managing one’s blood glucose will feedback into self-efficacy and reinforce the adaptive beliefs. Based on an analogous logic, comparable expectations were made for the other validity measures.

**Confirmatory Factor Analysis**

We conducted confirmatory factor analyses (CFAs) with the retest questionnaires to examine the fit of the three-factor model as well as to examine whether the three-factor model fits the data better than a one-factor or a two-factor model. AMOS software with maximum likelihood estimation was used. For our three-factor model, the $\chi^2$ was significant ($\chi^2 (df = 168, N = 84) = 245.01, p < .000$). However, this is not surprising because already very small differences between expected and observed correlations can lead to a significant $\chi^2$ in large samples (Cole, 1987). Examination of the fit indices indicated that the three-factor model fit the data well ($\chi^2/df$-ratio = 1.46; CFI = .86, NNFI = .82, RMSEA=.075, AIC= 369.01). In addition, all factor loadings were significant at the $p = .003$ level, suggesting that the three factors were well constructed. Fit of the one- and two-factor models was much lower. Specifically, all fit indices of the two-factor model ($\chi^2/df$-ratio = 1.74; CFI = .76, NNFI = .71, RMSEA=.094, AIC= 415.7) were worse than those of the 3-factor model. The one-factor model fit the data very poorly ($\chi^2/df$-ratio = 2.58; CFI = .49, NNFI = .38, RMSEA=.138, AIC= 557.77). Given that indices such as RMSEA and AIC penalize for the complexity of the model and nevertheless the indices for the three-factor model were better than those of the one- and two-factor models, one can conclude that the three-factor model is the best fit for the data.
Reliability

Internal Consistency

The internal consistency of the initial 44-item pool was $\alpha = .87$. An analysis conducted on the 20-item scale demonstrated good internal consistency ($\alpha = .81$). The highest inter-item correlation was $r = .55$, and the great majority of the inter-item correlations clustered between $r = .10$ and $r = .30$, indicating that the retained items are sufficiently differentiating and not redundant with one another. There were no negative inter-item correlations. The internal consistency values of the three subscales were $\alpha = .81$ for the glucose testing maladaptive CHBs (6 items), $\alpha = .73$ for the general maladaptive CHBs, and $\alpha = .69$ for the adaptive CHBs (see Table 1).

Test-retest Reliability

CHB total scores were correlated with retest scores collected about a month later. A test-retest correlation of $r = .70$ ($p < .001$, $N = 83$) was obtained. It indicates high stability over the comparably long time period.

Validity

One goal of the present research was to establish that the DCHB Scale can be distinguished from scores on the Diabetes Knowledge scale and in addition to have discriminant validity with respect to social desirability. Another goal was to examine the convergent validity of the DCHB scale with respect to diabetes self-efficacy, diabetes self-regulation, and treatment effectiveness and to examine the concurrent validity of the measure with respect to treatment adherence. It was assumed that higher scores on the maladaptive CHB subscales would be associated with lower diabetes-specific self-efficacy, less adherence to self-care behaviors, and lower glucose control.
Divergent and Convergent Validity

Table 2 present the means, standard deviations and ranges of all DCHB subscales. Table 3 presents the means, standard deviations, and alpha reliabilities for all measures, as well as the bivariate correlations with the DCHB subscales.

Diabetes knowledge. As anticipated, adolescents had a relatively good knowledge of diabetes and diabetes care as measured by the DCHB with a mean of 76.78 % (SD = 14.21). The alpha coefficient of the DCHB was high (α = .74) in our sample. Similar findings were observed with total knowledge scores and the subscale scores. Therefore, only total knowledge is reported. In accordance with our previsions, higher diabetes knowledge was related to less maladaptive CHBs (r = -.26, p = .006 for glucose-testing maladaptive CHBs, and r = -.19, p = .048 for general maladaptive CHBs). Moreover, higher knowledge was related to a higher adaptive CHB ratio (r = .25, p = .007). In other words, the more knowledgeable the adolescents, the more adaptive relative to maladaptive CHBs they held. That the DCHB scale does not primarily measure knowledge is evidenced by the size of the correlations, which are moderate (i.e. in the .2 range), showing that the CHB scale does measure something in addition to knowledge. Furthermore, contrary to glucose testing CHBs and the adaptive CHB ratio, knowledge is not related to metabolic control (statistical analyses showing CHBs relations with metabolic control will be discussed later). This implies that the two scales provide different information and that only CHBs have implications for metabolic control.

Self-regulation. Expected results were observed with self-regulation towards diet and exercise: A higher self-regulation index (i.e., more autonomous and less controlled) was associated with a higher adaptive CHB ratio (r = .22, p = .02). In specific, the more
intrinsically motivated the participants were towards following their diets and doing exercise, the more adaptive compared to maladaptive CHBs they reported. Also, the negative relationship between the self-regulation index and the general maladaptive CHBs was significant at the .1 level ($r = -.16, p = .087$). The more externally motivated participants were to follow their diets and do exercise the more general maladaptive CHBs they endorsed. However, no relation was found between the Self-Regulation index specific to medication and glucose testing and the DCHB subscales. The alpha for the autonomous regulation to take medication and test glucose was quite low ($\alpha = .47$) while the alphas for the other subscales were above .72. One hypothesis is that the wording "I take my medication for diabetes and/or check my glucose because..." was not optimal for our sample of adolescents with Type 1 Diabetes who do not usually take medication for diabetes but rather inject insulin and check their glucose. In hindsight, the wording could have been better tailored to our population.

Diabetes self-efficacy. The self-efficacy scores were very high in this sample with a mean of 4.32 and a range between 3.00 and 5.00 on a 1 to 5 scale. In other words, adolescents in this sample felt highly capable of taking care of their diabetes. For example, 98.2% of adolescents answered 5 (very sure I can) when asked about taking insulin. Even though we seem to encounter a ceiling effect with this scale, expected correlations with CHBs still appeared at the .10 level of significance. Participants with high self-efficacy reported less overall maladaptive CHBs ($r = -.16, p = .097$), and had a higher adaptive CHB ratio ($r = .18, p = .061$).

Treatment effectiveness. A strong negative correlation was observed between perceived treatment effectiveness to control glucose and maladaptive glucose testing.
CHBs \( (r = -0.40, p < 0.001) \). The less effective participants perceived the treatment to be for controlling their glucose level, the more likely they were to endorse maladaptive glucose-testing CHBs, which is congruent with our theoretical assumptions. Similar findings were observed for treatment effectiveness to prevent complications \( (r = -0.19, p = 0.040) \). We hypothesized that these relations would be stronger when metabolic control was lower, because it would create more dissonance. When controlling for metabolic control, the correlations did in fact get stronger \( (r = -0.45, p < 0.001 \) and \( r = -0.28, p = 0.004 \) respectively).

**General perceived competence.** As it was for diabetes self-efficacy, general perceived competence was high in this sample (mean of 4.1 out of 5). It showed strong relationships with CHBs. As expected, higher generalized perceived competence was associated with less maladaptive glucose testing CHBs \( (r = -0.24, p = 0.009) \) and a higher adaptive CHB ratio \( (r = 0.31, p = 0.001) \).

**Social desirability.** A higher tendency to respond in a socially desirable way was related to fewer CHBs reported, whether adaptive or maladaptive \( (r = -0.28, p = 0.003) \) for adaptive CHBs, \( r = -0.20, p = 0.034 \) for glucose-testing maladaptive CHBs, and \( r = -0.190, p = 0.045 \) for general maladaptive CHBs). Social desirability is the only measure for which both adaptive and maladaptive CHBs have a relation in the same direction, i.e., negative. Moreover, social desirability is the only scale, other than the DCHB scale, to be related to metabolic control, for which there is no possible responding bias as it is a blood test. The higher the tendency to reply in a socially desirable manner, the lower the HbA\(_{1c}\) result and therefore the higher the metabolic control \( (r = -0.24, p = 0.015) \). This seems to imply that the Social Desirability scale measures a character trait that also impacts behavior.
Relation to Treatment Adherence

**Metabolic control.** According to the Canadian Diabetes Association guidelines (1998, 2000), the recommended HbA1c target for people with diabetes is below 7%. On average, metabolic control in our sample was 8.85% (see Table 4 for descriptives as well as correlations). As predicted, there was a positive correlation between glucose-testing CHBs and HbA1c test results \( (r = .20, p = .036) \). Higher scores on glucose testing CHBs was related to higher HbA1c tests results meaning poorer metabolic control. On the other hand, a negative correlation was found between the adaptive CHB ratio and HbA1c test results \( (r = -.20, p = .043) \). That is to say, the higher the relative number of adaptive CHBs versus maladaptive ones, the lower the HbA1c results and therefore the better the metabolic control. These results are perfectly in accordance with our expectations that adaptive CHBs buffer the effects of maladaptive CHBs.

To assess the relationship between the stability of metabolic control and CHBs, we used the standard deviation of the past five HbA1c measures for each participant. More variability within a participant’s blood glucose measures was associated with more maladaptive glucose-testing CHBs \( (r = .18, p = .058) \), and more general maladaptive CHBs \( (r = .26, p = .006) \). In other words, adolescents with unstable metabolic control reported more maladaptive CHBs, which once again corroborates with our hypotheses.

**Diabetes self-care activities.** Results from the Diabetes Self-Care Activities scale show good concurrent validity, with more maladaptive CHBs associated with less reported adherence to diabetes self-care activities and a higher adaptive CHB ratio with better adherence (see Table 4 for descriptives and correlations). More precisely, higher scores on maladaptive glucose-testing CHBs and general maladaptive CHBs were
associated with lower adherence to general diet ($r = -23, p = .014$; and $r = -.17, p = .080$, respectively). In addition, a higher adaptive CHB ratio was related to higher adherence to general diet ($r = .23, p = .014$). For fruit consumption, higher maladaptive glucose testing CHBs were associated with lower fruit consumption ($r = -.30, p = .002$). In terms of reported exercise outside of school, higher adaptive CHBs were related to higher levels of exercise reported ($r = .21, p = .029$), and a higher adaptive CHB ratio was related to more exercise reported ($r = .25, p = .007$). Adherence to testing one’s glucose was high with a mean of 6.37 out of 7 days. The strongest relation obtained in adherence is between maladaptive glucose testing CHBs and adherence to glucose testing ($r = -.49, p < .001$), which strongly validates the glucose CHB subscale. The more CHBs related to glucose testing participants held, the lower their adherence to glucose testing.

*Other measures.* Higher levels of adaptive CHBs were associated with less reported hospitalizations due to diabetes at the .10 level ($r = -.17, p = .079$). Moreover, a higher adaptive CHB ratio was associated with less diabetes-related hospitalizations ($r = -.18, p = .070$). Another trend emerged wherein more general maladaptive CHBs was associated with more reported diabetes-related doctor visits other than routine checks ($r = .17, p = .085$). Finally, the more maladaptive glucose-testing CHBs a participant held, the more missed school days due to diabetes complications he or she reported ($r = .38, p < .001$).

*Age, age at diagnosis, and disease duration.* The interdependence of the variables age, age at diagnosis and disease duration is reflected in their high intercorrelations. Especially age at diagnosis and disease duration were highly correlated ($r = -.89, p < .001$). Age was not related to HbA1c results. However both age at diagnosis ($r = -.28, p = .
.005) and disease duration ($r = .29, p = .003$) were. Earlier diagnosis and longer disease duration were related to higher HbA1c results and therefore poorer metabolic control.

There was no correlation between age and DCHB scores. However, there was a positive correlation between adaptive CHBs and age at diagnosis ($r = .19, p < .05$). The older the participants were at the time of diagnosis, the more adaptive CHBs they report. The correlation of better glucose control with more adaptive CHBs disappeared when controlling for either age at diagnosis or disease duration. Age, age at diagnosis, and disease duration were not related to any of the adherence measure of the self-care activities.

**Gender.** No gender differences were found both for the CHBs subscales and for the adherence measures except for exercising outside of school. Girls reported less exercising outside of school than boys ($t(112) = 2.23, p = .028$).

**Predicting Treatment Adherence**

To test which proportion of the variance in metabolic control and diabetes self-care activities can be uniquely attributed to variance in the different DCHB subscores, we conducted a series of hierarchical regression analyses. We controlled for gender, age, and age of diagnosis or disease duration in all analyses. Because of the interdependence between current age, onset age and disease duration, one cannot use all three variables in the same regression model. Johnson and Meltzer (2002) propose the solution of looking at pairs of models, searching for a consistent pattern in the results. For example, if testing for the effects of current age, one would run two models, one controlling for onset age and a second model controlling for disease duration. Only those current age effects that
remained significant in both models would be considered true current age effects independent of the other variables. This is how we proceeded for the results listed below.

Maladaptive glucose-testing CHBs and the adaptive CHB ratio were the two DCHB subscores related to metabolic control. Two regressions models with metabolic control as the criterion variable were ran, one with maladaptive glucose-testing CHBs and one with the adaptive CHB ratio as predictors. For both models, the demographic variables (gender, age, and either age at diagnosis or disease duration) were entered in the first step. The second step entailed entering all psychological measures found to be significantly associated with (1) the glucose-testing CHB score and (2) the adaptive CHB ratio. In the first model, the results were virtually identical when using age at diagnosis or disease duration, therefore only results with age at diagnosis are reported. In the first model, the variables associated with glucose-testing CHBs included social desirability, treatment effectiveness to control glucose, treatment effectiveness to prevent complications, diabetes knowledge, and general perceived competence. In the final step, glucose-testing CHBs were entered to test whether the CHBs had any additional unique shared variance with metabolic control beyond all variables already in the equation. As can be seen in Table 5, maladaptive glucose-testing CHBs share a significant proportion of variance with metabolic control above and beyond all other variables with which they are directly associated. The other variables that did share a significant proportion of variance of metabolic control were age at diagnosis (or disease duration), social desirability, and treatment effectiveness to prevent complications.

For the second model with the adaptive CHB ratio as the predictor, the variables entered in Step 2 of the regression analysis included the self-regulation index for diet and
exercise, diabetes self-efficacy, and perceived competence. The adaptive CHB ratio was not a significant predictor of metabolic control. The only significant predictor in the model was age at diagnosis (or disease duration). Therefore, the results are not reported in the table.

We also ran separate regression analyses to examine to which extent specific CHB subscores predict specific diabetes self-care activities. The regression models were similar to the ones described above, with the only difference being that general diet, fruit consumption, exercising outside of school and glucose testing, respectively, were the criterion variables and the CHB subscale found to be correlated with each respective self-care activity were used as the predictors. For general diet, the first model was with glucose-testing CHBs as the proximal predictor. Only perceived treatment effectiveness to control diabetes was a significant predictor in that model ($\beta = .33, p = .04$) and therefore is not reported. In the model with the adaptive CHB ratio as the proximal predictor, the only significant predictor of general diet was the adaptive CHB ratio (see Table 5). The maladaptive glucose-testing CHBs score was the only significant predictor of fruit consumption. Aside from gender, the only other predictor of exercising outside of school was the adaptive CHB ratio (see Table 5). For glucose testing (see bottom of Table 5), significant predictors included general perceived competence, treatment effectiveness to control glucose and to prevent complications, and glucose testing CHBs. Glucose testing CHBs had predictive value over and above the other variables.

In sum, the results of the regression analyses show that glucose-related CHBs and the adaptive CHB ratio are significant predictors both of metabolic control and of several diabetes self-care activities, above and beyond the other predictor variables.
Discussion

Altogether, the results indicate that the DCHB subscales have high convergent validity with self-efficacy, self-regulation, perceived treatment effectiveness, and perceived competence. Furthermore, the subscales show discriminant validity with the Diabetes Knowledge Scale. Even though DCHB scores overlap to a certain degree with scores on the Diabetes Knowledge Scale, the correlations are only moderate in size and their pattern of association with other variables, particularly with metabolic control, is different, suggesting that they capture distinct constructs. Even though our scale is not completely independent of social desirability, it is important to note that adolescents with higher scores on the social desirability scale also had better metabolic control. This suggests that the social desirability scale might have been measuring a trait characteristic that also positively affects people’s adherence to their treatment.

We also observed expected relationships in terms of adherence. Less maladaptive and more adaptive CHBs were related to better adherence to treatment, both for metabolic control and self-care activities. Maladaptive glucose-testing CHBs were particularly important in predicting metabolic control and regular glucose testing. Adolescents who believe that one can compensate for not testing glucose levels seem to be particularly at risk for not actually testing their glucose regularly and show worst metabolic control. More glucose-testing CHBs were also found to be the only predictor of lower fruit consumption. Adolescents endorsing more maladaptive glucose-testing CHBs seem to be at particular risk for blood glucose management. These beliefs should therefore be assessed and addressed directly in diabetes education.
It is interesting that the adaptive CHB ratio shows such consistent results, both with the adherence measures and with the validity measures. It means that it is not only the level of maladaptive CHBs that are important for predicting adherence but also the relation of adaptive to maladaptive CHBs. In other words, the positive effects of adaptive CHBs may buffer the negative effects of maladaptive CHBs in terms of blood glucose level. In terms of intervention, it means that one should not only concentrate on changing maladaptive beliefs, but also foster adaptive health beliefs.

The younger the adolescents were at time of diagnosis, and therefore the longer they had diabetes, the poorer was their metabolic control. One possible explanation is that when diagnosed young, diabetes care education is more likely to be targeted at the parents, and therefore the knowledge and responsibility have to be transferred from the parents to the adolescents later on. Palmer et al. (2004) report that such a transfer of responsibility can be problematic if not done according to the child’s maturity level. They found that parents based their decision to withdraw parental involvement during adolescence on pubertal status (physical signs such as menarche or voice changes) more than level of autonomy, which was related to poorer metabolic control. So the older the adolescents at the time of diagnosis, the least transfer of responsibility will be necessary and therefore the less difficulties they will have controlling their blood glucose. In the present study, we also found that adolescents who were older at the time of diagnosis held more adaptive CHBs. This corroborates the previous hypothesis that the older at diagnosis, the more the diabetes care education is directly targeted at them and the more opportunities they have to form adaptive CHBs.
A limitation of this study and this type of research in general (e.g., Riekert & Drotar, 1999) is the fact that nonresponders had a significantly worse metabolic control than responders. The sample may therefore be skewed in favor of adolescents who manage their diabetes better. Possible explanations are that both adherence to treatment and successful participation in the study require similar organizational skills (e.g., planning to test glucose and planning to fill out questionnaire and send it back) (Riekert & Drotar, 1999). Another possibility is that adolescents who have difficulties controlling their glucose might feel less inclined to confront themselves with questions regarding their diabetes self-management (Riekert & Drotar, 1999).

As a long-term perspective, our goal is to improve the adherence of adolescents with diabetes, recognizing the challenges in their everyday lives that may interfere with their intentions to conform to treatment recommendations. We propose that holding CHBs contributes to the predicament of these adolescents. In depth follow-up of low adherent adolescents concerning their coping with daily temptations to act contrary to recommendations may shed light on the issues at hand and guide new interventions. We propose that experience sampling methodology (ESM) would be a good methodology to use for such a purpose. In ESM, participants are given small handheld computers, and are prompted several times a day to answer a few questions. Adolescents could be asked to report on social situations in which they were faced with temptations (e.g., skipping the blood glucose testing because the friends were waiting at the door) and record what they thought and how they coped with the problem. We know that social pressure and peer pressure are important determinants of adherence to diabetes treatment regimens in
adolescence. However, they might act differently depending on the degree of CHBs held by the adolescent.

To conclude, diabetes type 1 is a disease requiring close management and a rigorous life-style. This is especially difficult for adolescents who experience peer pressure (e.g., to use alcohol or drugs), as well as physical changes. Noncompliance with treatment has detrimental, sometimes life-threatening consequences on the person’s health. Because of complications, it is reported that the life expectancy of an individual with type 1 is 75% of that of a person who does not have diabetes (Johnson, 1998). Therefore, it is important to further our knowledge on how to improve adherence to the treatment and consequently long-term health of this population. The reported research highlights that CHBs, particularly maladaptive CHBs, are an important predictor of treatment adherence in adolescents.
Table 1

*Item Description and Factor Loadings (20 items, $\alpha = 0.81$)*

<table>
<thead>
<tr>
<th>Factor I: Glucose-Testing Maladaptive CHBs ($\alpha = 0.81$)</th>
<th>FI</th>
<th>FII</th>
<th>FIII</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I do not have to test my glucose regularly if my meals are carefully planned by my parents.</td>
<td><strong>0.688</strong></td>
<td>-0.117</td>
<td>0.027</td>
</tr>
<tr>
<td>2. Being able to feel my glucose level can make up for not testing it regularly.</td>
<td><strong>0.468</strong></td>
<td>0.174</td>
<td>-0.025</td>
</tr>
<tr>
<td>3. It is OK not to test my glucose if I did not eat any sweets beforehand.</td>
<td><strong>0.752</strong></td>
<td>-0.093</td>
<td>-0.059</td>
</tr>
<tr>
<td>4. Testing my glucose regularly is not that important if I eat the same things every day.</td>
<td><strong>0.841</strong></td>
<td>-0.093</td>
<td>-0.059</td>
</tr>
<tr>
<td>5. Following a meal plan can make up for not testing my glucose regularly.</td>
<td><strong>0.636</strong></td>
<td>0.130</td>
<td>0.095</td>
</tr>
<tr>
<td>6. It is OK not to test my glucose as long as I do not eat any sweets afterwards.</td>
<td><strong>0.655</strong></td>
<td>0.044</td>
<td>-0.092</td>
</tr>
</tbody>
</table>

Factor II: General Maladaptive CHBs ($\alpha = 0.73$)

1. Watching TV or listening to music can make up for the change in blood glucose caused by stress. | -0.053 | **0.457** | -0.029 |
2. Eating low carbohydrate (carb) snacks can make up for the change in blood glucose caused by stress (for example before an exam).

3. Eating extra free foods in the afternoon can make up for the increase in glucose caused by eating extra cookies in the morning.

4. Not eating snacks can make up for not exercising.

5. Eating more at lunch can make up for the decrease in glucose caused by skipping breakfast.

6. Eating a mostly protein meal can make up for the increase in glucose caused by drinking a regular soft drink or eating candies.

7. Eating only protein foods for supper can make up for the increase in glucose caused by eating extra carbs at lunch.

8. Sleeping in after a stressful day can make up for the change in glucose caused by the stress.
Factor III: Adaptive CHBs ($\alpha = .69$)

1. Taking extra insulin can make up for the increase in blood glucose caused by eating an extra snack. 
   - .060  -.094  .623

2. Eating larger portions than usual at a meal can make up for low glucose before the meal. 
   - .021  .116  .424

3. Taking extra insulin at supper can make up for the increase in glucose caused by eating too much at lunch. 
   - -.043  -.074  .564

4. Eating a larger desert than is in my meal plan is OK if I drink a diet soft drink instead of a regular soft drink with the meal. 
   - -.038  .050  .407

5. Eating carbs can make up for the decrease in glucose caused by drinking alcohol. 
   - .118  .016  .545

6. Taking extra insulin can make up for the increase in glucose caused by eating too many sweets. 
   - -.011  .066  .567
Table 2

*Descriptives of CHB Subscales and Indexes*

<table>
<thead>
<tr>
<th></th>
<th>$M$</th>
<th>$SD$</th>
<th>Min.</th>
<th>Max.</th>
<th>$N$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose-testing maladaptive CHBs</td>
<td>1.42</td>
<td>0.62</td>
<td>1.00</td>
<td>4.67</td>
<td>114</td>
</tr>
<tr>
<td>General maladaptive CHBs</td>
<td>2.45</td>
<td>0.74</td>
<td>1.00</td>
<td>4.13</td>
<td>114</td>
</tr>
<tr>
<td>Adaptive CHBs</td>
<td>3.34</td>
<td>0.88</td>
<td>1.00</td>
<td>5.00</td>
<td>114</td>
</tr>
<tr>
<td>Adaptive CHB ratio</td>
<td>0.46</td>
<td>0.08</td>
<td>0.30</td>
<td>0.65</td>
<td>114</td>
</tr>
</tbody>
</table>
Table 3

Description of Scale Characteristics and Intercorrelations of Validity Scales with DCHB Scores

<table>
<thead>
<tr>
<th>Scales</th>
<th>Mean (SD)</th>
<th>Alpha</th>
<th>Glucose-testing maladapt. CHBs</th>
<th>General maladapt.</th>
<th>Adaptive CHBs</th>
<th>Adaptive CHB ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes knowledge</td>
<td>76.78% (14.21)</td>
<td>.74</td>
<td>-.26**</td>
<td>-.19**</td>
<td>.04</td>
<td>.25**</td>
</tr>
<tr>
<td>Self-regulation diet/exercise</td>
<td></td>
<td></td>
<td>-.04</td>
<td>-.16*</td>
<td>.11</td>
<td>.22**</td>
</tr>
<tr>
<td>Diabetes self-efficacy</td>
<td>4.32 (0.37)</td>
<td>.77</td>
<td>-.12</td>
<td>-.13</td>
<td>.07</td>
<td>.18*</td>
</tr>
<tr>
<td>Treatment effectiveness Control glucose</td>
<td>3.07 (0.55)</td>
<td>.68</td>
<td>-.39**</td>
<td>-.09</td>
<td>-.12</td>
<td>.10</td>
</tr>
<tr>
<td>Prevent complications</td>
<td>3.23 (0.52)</td>
<td>.70</td>
<td>-.19**</td>
<td>.06</td>
<td>-.01</td>
<td>.12</td>
</tr>
<tr>
<td>Perceived competence</td>
<td>4.1 (0.72)</td>
<td>.61</td>
<td>-.24**</td>
<td>-.08</td>
<td>.16*</td>
<td>.31**</td>
</tr>
<tr>
<td>Social desirability</td>
<td>0.39 (0.16)</td>
<td>.86</td>
<td>-.20**</td>
<td>-.19**</td>
<td>-.28**</td>
<td>-.08</td>
</tr>
</tbody>
</table>
### Table 4

**Description and Intercorrelations of Adherence Measures with DCHB Scores**

<table>
<thead>
<tr>
<th>Measures</th>
<th>Mean (SD)</th>
<th>Glucose-testing maladapt.</th>
<th>General maladapt.</th>
<th>Adaptive CHBs</th>
<th>Adaptive CHB ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic control (%)</td>
<td>8.85 (1.29)</td>
<td>.20**</td>
<td>-.03</td>
<td>-.17*</td>
<td>-.20**</td>
</tr>
<tr>
<td>Metabolic instability</td>
<td>2.12 (0.66)</td>
<td>.18*</td>
<td>.26**</td>
<td>.13</td>
<td>-.11</td>
</tr>
<tr>
<td>General diet</td>
<td>4.21 (2.35)</td>
<td>-.23**</td>
<td>-.17*</td>
<td>.06</td>
<td>.28**</td>
</tr>
<tr>
<td>Fruit consumption</td>
<td>4.25 (2.33)</td>
<td>-.30**</td>
<td>-.13</td>
<td>-.17*</td>
<td>.07</td>
</tr>
<tr>
<td>Exercise outside school</td>
<td>3.71 (2.21)</td>
<td>.10</td>
<td>-.12</td>
<td>.21**</td>
<td>.25**</td>
</tr>
<tr>
<td>Glucose testing</td>
<td>6.37 (1.24)</td>
<td>-.49**</td>
<td>-.11</td>
<td>.09</td>
<td>.21**</td>
</tr>
</tbody>
</table>
Table 5

*Summary of Hierarchical Regression Analyses to Predict Metabolic Control and Glucose Testing*

<table>
<thead>
<tr>
<th>Criterion: Metabolic control</th>
<th>β</th>
<th>R² Change</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictor: Glucose-testing CHBs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>.04</td>
<td>.04</td>
<td>F(3, 93) = 2.78, p = .046</td>
</tr>
<tr>
<td>Age</td>
<td>.09</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Age at diagnosis</td>
<td>-.33**</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td>.19</td>
<td>F(5, 88) = 4.57, p = .001</td>
</tr>
<tr>
<td>Diabetes knowledge</td>
<td>-.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment effectiveness to control glucose</td>
<td>-.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment effectiveness to prevent complications</td>
<td>.30*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>β</td>
<td>R² Change</td>
<td>Significance</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----</td>
<td>-----------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Perceived Competence</td>
<td>-.13</td>
<td>.03</td>
<td>F(1, 87) = 4.05, p = .047</td>
</tr>
<tr>
<td>Social Desirability</td>
<td>-.27**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td>.03</td>
<td></td>
</tr>
<tr>
<td>Maladaptive glucose-testing CHBs</td>
<td>.23**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Criterion: General Diet**

**Predictor: Adaptive CHB Ratio**

<table>
<thead>
<tr>
<th>Step 1</th>
<th>β</th>
<th>R² Change</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>.06</td>
<td>.02</td>
<td>F(3, 104) = .744, p = .53</td>
</tr>
<tr>
<td>Age</td>
<td>-.02</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>Age at diagnosis</td>
<td>-</td>
<td>-.02</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>β</td>
<td>R² Change</td>
<td>Significance</td>
</tr>
<tr>
<td>--------</td>
<td>----</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td>Diabetes knowledge</td>
<td>.05</td>
<td>.06</td>
<td>$F(4, 100) = 1.64, p = .17$</td>
</tr>
<tr>
<td>Perceived competence</td>
<td>.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-regulation index, diet and exercise</td>
<td>-.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td>.05</td>
<td>$F(1, 99) = 5.41, p = .022$</td>
</tr>
<tr>
<td>Adaptive CHB ratio</td>
<td></td>
<td>.24**</td>
<td></td>
</tr>
</tbody>
</table>

**Criterion: Fruit Consumption**

Predictor: Glucose-testing CHBs

<table>
<thead>
<tr>
<th>Step 1</th>
<th>β</th>
<th>R² Change</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>.01</td>
<td>$F(3, 98) = .28, p = .84$</td>
</tr>
<tr>
<td>Variable</td>
<td>β</td>
<td>R² Change</td>
<td>Significance</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------</td>
<td>-----------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Gender</td>
<td>-.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at diagnosis</td>
<td>.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td>.06</td>
<td><em>F</em>(5, 93) = 1.17, <em>p</em> = .33</td>
</tr>
<tr>
<td>Diabetes knowledge</td>
<td>-.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment effectiveness to control glucose</td>
<td>-.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment effectiveness to prevent complications</td>
<td>.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived competence</td>
<td>-.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social desirability</td>
<td>.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td>.05</td>
<td><em>F</em>(1, 92) = 4.62, <em>p</em> = .034</td>
</tr>
<tr>
<td>Maladaptive glucose-testing CHBs</td>
<td>-.27**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predictor: Adaptive CHB ratio</td>
<td>β</td>
<td>R² Change</td>
<td>Significance</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>Criterion: Exercise Outside of School</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>-.24**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at diagnosis</td>
<td>.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
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</tr>
<tr>
<td>Diabetes knowledge</td>
<td>-.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived competence</td>
<td>-.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-regulation index, diet and exercise</td>
<td>.18*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>.11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F(3, 104) = 2.10, p = .105
F(4, 100) = 1.66, p = .166
<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>R² Change</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptive CHB ratio</td>
<td>.24**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Criterion: Glucose Testing**

Predictor: Glucose-testing CHBs

<table>
<thead>
<tr>
<th>Step 1</th>
<th>β</th>
<th>R² Change</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at diagnosis</td>
<td>.09</td>
<td></td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>β</th>
<th>R² Change</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes knowledge</td>
<td>.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>β</th>
<th>R² Change</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>.05</td>
<td>(F(1, 99) = 5.53, p = .021)</td>
</tr>
<tr>
<td></td>
<td>β</td>
<td>R^2 Change</td>
<td>Significance</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>--------</td>
<td>------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Treatment effectiveness to control glucose</td>
<td>.30*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment effectiveness to prevent complications</td>
<td>-.29**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived competence</td>
<td>.26**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social desirability</td>
<td>-.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>.10</td>
<td></td>
<td>F(1, 95) = 15.14, p &lt; .000</td>
</tr>
<tr>
<td>Maladaptive glucose-testing CHBs</td>
<td>-.40**</td>
<td></td>
<td></td>
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</table>
General Discussion

This thesis represents an important original contribution with detailed theory, measurement tools, health outcomes predictions, avenues for applications, and a fertile ground for future research. The first manuscript introduces a thorough theoretical model for the construct of CHBs and the processes involved in using CHBs to regulate temptations. The second manuscript describes the development of a general CHB scale with strong psychometric properties. Finally, the last manuscript applies the construct to a clinical population as well as offers a tool specialized to diabetes. Moreover, it establishes a new predictor of metabolic control and adherence to treatment in adolescents with type 1 diabetes. It also explicitly develops potential interventions to improve health outcomes, which is the ultimate goal of this research domain.

Many research directions can spring from this thesis as this construct is relevant in any area of health research and potentially beyond (e.g., interpersonal relationships, parenting). The construct is particularly relevant to many chronic health issues that are at the forefront of major concerns worldwide such as obesity, diabetes, cardiovascular health, smoking, etc.

Future Research Directions

Now that the relationship between CHBs and health outcomes has been established, the next step in the research is to specifically test predictions from the CHB model including the proposed processes involving self-determination, self-efficacy, implementation intentions, etc. Based on the diabetes data and data collected with female dieters, I am currently preparing models to be tested with structural equation modeling. The goal is to refine and further develop the theoretical model.
Also, our research team is in the process of developing a new CHB scale for adults with type 2 diabetes. Sharing many features with type 1 diabetes, the construct of CHBs is similarly relevant in the self-management of type 2 diabetes. Improving the treatment of type 2 diabetes is of particularly relevance because of the current surge in obesity in many countries, and the accompanying increase in diabetes.

In the future, we would like to test interventions designed to change maladaptive CHBs or decrease their use and therefore increase people’s health.

These are some of the research directions that are presently pursued in our research group. As alluded to earlier, the CHB construct is applicable to a wide range of areas and therefore future research directions are endless.

Applications

The scales presented in this thesis could be used in practical clinical settings by members of diabetes teams as an assessment tool to measure the maladaptive use of CHBs. The scores on the scales could help guide treatment plans in therapy by psychologists, nutritionists, social workers, nurses, or physicians. In other words, the scores, if high, could suggest targeting maladaptive CHBs in treatment and in conversation with the patient.

It awaits future testing to uncover the optimal type of effective intervention to change CHB use, but I will list below a few ideas. Firstly, making people aware of the CHB process and the potentially detrimental health effect could already have positive effects in terms of lowering the use of maladaptive CHBs and fostering the use of adaptive CHBs. Secondly, specifically targeting maladaptive CHBs in therapy and promoting adaptive CHBs through cognitive restructuring could be very helpful.
Cognitive restructuring involves identifying irrational beliefs and attitudes and modifying them to more adaptive ones through a number of techniques such as examining the evidence for the beliefs, having the client conduct behavioral experiments, monitoring, problem solving, etc. (Beck, 1995).

For example, some of the most detrimental maladaptive beliefs found in the diabetes population were beliefs related to glucose testing. In specific, some of the adolescents falsely believed that not testing their blood glucose level could be compensated for by either testing later or not eating sweets. One of the assumptions in cognitive therapy is that people tend to only consider evidence that is congruent with their particular beliefs and fail to notice contradictory evidence. Therefore, one cognitive technique is to encourage the patient to examine all the evidence both in accordance and in contradiction with the belief, and not simply focus on concurring evidence (Beck, 1995).

Glucose-testing maladaptive CHBs could be challenged by encouraging the adolescents to examine all the evidence from the information given to them and to monitor what happens when they act according to the belief (CHB). Together with the therapist, the individuals would then re-evaluate the belief based on all the gathered information in a similar fashion as it is done for depressive thoughts in cognitive behavioral therapy (Beck, 1995). Wysocki, Greco, Harris, Bubb, and White (2001) studied the impact on Behavioral-Family Systems Therapy (BFST), which includes cognitive restructuring training, on adherence to treatment in adolescents with type 1 diabetes. They found that BFST improved parent-adolescent relationship and reduced diabetes specific conflicts. Although there were no immediate effects on metabolic
control, they found improvements in treatment adherence at the 6- and 12-month follow-ups. Thus, CBT has already shown some promise in improving adherence in adolescents with diabetes.

To conclude, compensatory health beliefs have been found to be related to poorer adherence to health goals and treatment regimen. We propose that compensatory thinking hinders self-regulatory processes to maintain health behaviors by allowing individuals to indulge in temptations without regret. This leads to negative health outcomes in the long-term, especially when the CHBs are maladaptive.
References


Williams, G. C. (2002). Improving patients' health through supporting the autonomy of patients and providers. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-


Appendix E: General CHB scale

Instructions
Different people believe different things regarding their health. Below is a list of beliefs that everyone may hold to some degree. Please read each sentence carefully and rate how closely the idea matches your own belief. Since we all believe different things, there are no correct or incorrect choices. As well, most of these beliefs have not been scientifically tested. Since your responses will be confidential, please respond to each item honestly.

How much do you believe each of the following?

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>A Little</th>
<th>Somewhat</th>
<th>Quite a bit</th>
<th>Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sleep compensates for stress.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. The effects of drinking coffee can be balanced by drinking equal amounts of water.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. The bad effects of stress can be made up for by exercising.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. A stressful day can be compensated for by relaxing in front of the TV.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. The effects of regularly drinking alcohol can be made up for by eating healthy.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. It is OK to skip breakfast if one eats more during lunch or dinner.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Using artificial sweeteners compensates for extra calories.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. The effects of drinking too much alcohol during the weekend can be made up for by not drinking during the week.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
<td>A Little</td>
<td>Somewhat</td>
<td>Quite a bit</td>
<td>Very much</td>
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<tr>
<td>---</td>
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</tr>
<tr>
<td>9. Eating dessert can be made up for by skipping the main dish.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Smoking can be compensated by exercising.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. Stress during the week can be made up for by relaxing on the weekend.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. Smoking from time to time is OK if one eats healthy.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. It is OK to go to bed late if one can sleep longer the next morning (only the number of hours count).</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. Breaking a diet today may be compensated for by starting a new diet tomorrow.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. It is alright to drink a lot of alcohol as long as one drinks lots of water to flush it.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16. Eating whatever one wants in the evening is OK if one did not eat during the entire day.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. Too little sleep during the week can be compensated for by sleeping in on weekends.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Appendix F: Diabetes CHB scale

**Instructions:** Different people believe different things about their health and the best way to take care of their diabetes. Below is a list of beliefs that someone with diabetes might have. Some of these beliefs might help in controlling glucose but others might not. **Please read each belief carefully and tell us how much you agree or disagree with it** by filling in the bubble for one of the following responses: Totally disagree; Somewhat disagree; Neither agree nor disagree; Somewhat agree; or Totally agree.

<table>
<thead>
<tr>
<th>Beliefs</th>
<th>Totally Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither agree nor disagree</th>
<th>Somewhat agree</th>
<th>Totally agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Taking extra insulin can make up for the increase in blood glucose caused by eating an extra snack.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Watching TV or listening to music can make up for the change in blood glucose caused by stress.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. I do not have to test my glucose regularly if my meals are carefully planned by my parents.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Eating low carbohydrate (carb) snacks can make up for the change in blood glucose caused by stress (for example before an exam).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Eating larger portions than usual at a meal can make up for low glucose before the meal.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Beliefs:</td>
<td>Totally Disagree</td>
<td>Somewhat Disagree</td>
<td>Neither Agree nor Disagree</td>
<td>Somewhat Agree</td>
<td>Totally Agree</td>
</tr>
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</tr>
<tr>
<td>6. Taking extra insulin at supper can make up for the increase in glucose caused by eating too much at lunch.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Eating a larger desert than is in my meal plan is OK if I drink a diet soft drink instead of a regular soft drink with the meal.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. Being able to feel my glucose level can make up for not testing it regularly.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Eating extra free foods in the afternoon can make up for the increase in glucose caused by eating extra cookies in the morning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. Not eating snacks can make up for not exercising.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. It is OK not to test my glucose if I did not eat any sweets beforehand.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12. Testing my glucose regularly is not that important if I eat the same things every day.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Beliefs:</td>
<td>Totally Disagree</td>
<td>Somewhat Disagree</td>
<td>Neither Agree nor Disagree</td>
<td>Somewhat Agree</td>
<td>Totally Agree</td>
</tr>
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</tr>
<tr>
<td>13. Eating more at lunch can make up for the decrease in glucose caused by skipping breakfast.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>14. Eating carbs can make up for the decrease in glucose caused by drinking alcohol.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>15. Eating a mostly protein meal can make up for the increase in glucose caused by drinking a regular soft drink or eating candies.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>16. Following a meal plan can make up for not testing my glucose regularly.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>17. Eating only protein foods for supper can make up for the increase in glucose caused by eating extra carbs at lunch.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>18. It is OK not to test my glucose as long as I do not eat any sweets afterwards.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>19. Sleeping in after a stressful day can make up for the change in glucose caused by the stress.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
20. Taking extra insulin can make up for the increase in glucose caused by eating too many sweets.