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# COMPENSATORY HEALTH BELIEFS: SCALE DEVELOPMENT AND PSYCHOMETRIC PROPERTIES

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Compensatory Health Beliefs (CHBs) are beliefs that the negative effects of an unhealthy behavior can be compensated for, or "neutralised," by engaging in a healthy behavior. "I can eat this piece of cake now because I will exercise this evening" is an example of such beliefs. The present research describes a psychometric scale to measure CHBs (Study 1) and provides data on its reliability and validity (Studies 2 and 3). The results show that scores on the scale are uniquely associated with health-related risk behaviors and symptom reports and can be differentiated from a number of related constructs, including irrational health beliefs. Holding CHBs may hinder individuals from acquiring healthier lifestyles, for example lose weight or exercise.

*Keywords:* Compensatory health beliefs; Irrational health beliefs; Anticipated pleasure; Self-efficacy; Dissonance; Health behavior

## INTRODUCTION

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 and Foege, 1993). People are quite knowledgeable about the maladaptive effects of over-consumption of food, nicotine, alcohol, and lack of exercise (cf. Pinel *et al.*, 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 6 months (Dishman, 1991).

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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., Rogers, 1975, 1985; Ajzen, 1985) and motivational factors that may be associated with people's health choices have been relatively disregarded (Blanton and 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 reevaluation of the harmfulness of the behavior (cf. Festinger, 1957; Klein and Kunda, 1992; Baumeister and Heatherton, 1996; Trope and Fishbach, 2000; Giner-Sorolla, 2001; Klein and Goethals, 2002). 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 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 Knäuper *et al.*, 2002). 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 healthily), 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 and Turk, 1987). Christensen *et al.* (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 (i.e., the CHB is accurate) 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.[1] The goal was to receive as many suggestions

[1]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 500 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.

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 entries, 35.4% were male and 50.6% were female. Fourteen percent did not report their gender. The largest age groups to respond were 18–25 (29%) and 31–40 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. 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 five-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 4.5–5 months later, providing them with a link to a website[2] where they could 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 nonresponses 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 $p > 0.25$).

## 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 sufficient variability, 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 futher items were discarded because of unclear item wording as indicated by a higher number of missing values, leaving 26 items in the scale.

[2]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., King and Miles, 1995; Stanton, 1998; Finger and Ones, 1999; Donovan *et al*., 2000; Miller *et al*., 2002). 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.

*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 (0.86), Bartlett's test of sphericity (2131.80, $df = 325$, $p < 0.0001$), and the determinant of the matrix (0.003) all indicated that the correlation matrix was appropriate for such an analysis. Six factors with eigenvalues greater than 1.0 (Cattell, 1966) were extracted from the matrix, explaining 48.8% 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 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 $r = 0.36$ to $r = 0.60$), 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 *et al.*, 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 0.40 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 0.40 on one of the four factors. Items on the first factor (six items) are mainly concerned with compensating for the effects of substance use (alcohol, nicotine, coffee). Items on the second factor (four items) are concerned with compensating for unhealthy eating and sleeping habits. Items on the third factor (four items) are concerned with compensating for stress, and items on the final, fourth factor (three items) are concerned with regulating weight. The 17 items of the final scale as well as the factor loadings can be found in Table I and the correlations between factors can be found in Table II. 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) using the data from the retest sample ($N = 141$) to examine whether the factorial structure replicates. In specific, we compared 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 $= 0.89$, Bentler-Bonett nonnormed fit index $= 0.87$). In addition, all factor loadings were significant at the $p = 0.01$ level, suggesting that the

[3]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 *et al.*, 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 PCA often result in comparable factor solutions, and this is the case here as well: rerunning 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 I Compensatory health beliefs (CHBs): item wording and factor loadings

| *Factor and item* | *1* | *2* | *3* | *4* |
|---|---|---|---|---|
| Factor I: substance use ($\alpha = 0.74$) | | | | |
| 1. The effects of regularly drinking alcohol can be made up for by eating healthy | **0.735** | −0.043 | 0.096 | −0.133 |
| 2. It is alright to drink a lot of alcohol as long as one drinks lots of water to flush it | **0.581** | 0.242 | −0.092 | 0.007 |
| 3. Smoking from time to time is OK if one eats healthy | **0.534** | 0.077 | 0.029 | −0.119 |
| 4. The effects of drinking coffee can be balanced by drinking equal amounts of water | **0.520** | −0.160 | 0.036 | 0.136 |
| 5. The effects of drinking too much alcohol during the weekend can be made up for by not drinking during the week | **0.489** | 0.053 | 0.156 | 0.019 |
| 6. Smoking can be compensated for by exercising | **0.405** | −0.041 | −0.061 | 0.235 |
| Factor II: eating/sleeping habits ($\alpha = 0.66$) | | | | |
| 1. Too little sleep during the week can be compensated for by sleeping in on the weekends | −0.012 | **0.704** | 0.060 | −0.038 |
| 2. It is OK to go to bed late if one can sleep longer the next morning (only the number of hours count) | −0.034 | **0.591** | 0.044 | −0.054 |
| 3. It is OK to skip breakfast if one eats more during lunch or dinner | 0.052 | **0.520** | −0.007 | 0.038 |
| 4. Eating whatever one wants in the evening is OK if one did not eat during the entire day | 0.108 | **0.425** | −0.188 | 0.297 |
| Factor III: stress ($\alpha = 0.63$) | | | | |
| 1. Stress during the week can be made up for by relaxing on the weekend | −0.106 | 0.338 | **0.557** | 0.045 |
| 2. A stressful day can be compensated for by relaxing in front of the T.V. | 0.141 | −0.257 | **0.543** | 0.056 |
| 3. The bad effects of stress can be made up for by exercising | −0.019 | 0.181 | **0.494** | 0.005 |
| 4. Sleep compensates for stress | 0.102 | 0.033 | **0.417** | 0.018 |
| Factor IV: weight regulation ($\alpha = 0.57$) | | | | |
| 1. Eating dessert can be made up for by skipping the main dish | −0.014 | 0.051 | −0.118 | **0.661** |
| 2. Using artificial sweeteners compensates for extra calories | −0.054 | −0.061 | 0.217 | **0.563** |
| 3. Breaking a diet today may be compensated for by starting a new diet tomorrow | 0.001 | 0.029 | 0.174 | **0.456** |

*Note*: Loadings are taken from the pattern matrix. Loadings in bold are values above 0.40. 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 II Intercorrelations of CHB factors

| *Factor* | *1* | *2* | *3* |
|---|---|---|---|
| 1. Substance use | – | | |
| 2. Eating/sleeping habits | 0.45 | – | |
| 3. Stress | 0.28 | 0.35 | – |
| 4. Weight regulation | 0.48 | 0.54 | 0.23 |

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 $\Delta \chi^2 > 121$, $p < 0.001$).

## Reliability

### *Internal Consistency*

An analysis conducted on the 17-item scale demonstrated good internal consistency ($\alpha = 0.80$). The highest inter-item correlation was $r = 0.46$, and the great majority of the inter-item correlations clustered around $r = 0.20$–$0.25$, 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 $\alpha = 0.63$ and $\alpha = 0.74$ (see Table I), except for the weight regulation dimension ($\alpha = 0.57$), which is 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 4.5–5-month interval. A test–retest correlation of $r_{tt} = 0.75$ ($p < 0.0001$, $N = 141$) 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 2–15 people (median group size $= 7$). The questionnaire booklet included the CHB scale and the measures described below and took about 45 min to be filled out.

### *Measures*

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

*Irrational Health Belief Scale* (IHBS; Christensen *et al.*, 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, its 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 ($\alpha = 0.84$), test–retest reliability ($r_{tt} = 0.57$, $p = 0.0001$), 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 *et al.*, 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 six-point response scale with only the end points labeled to a five-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 *et al.*, 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 0.84 and 0.75, respectively, in two samples of 288 and 254 persons (Schwarzer, 2000). The items were presented with a four-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 and 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 and Renner, 2000).

*NEO-Short Form* The NEO Five-Factor Inventory Short Form (NEO-FFI; Costa and 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 five subscales of the NEO–FFI Short Form consists of 12 items with respondents endorsing the items on a five-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 and 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 *et al.* (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 nonmedical 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 built by summarising 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 comprising 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 four-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. Missing values on measures with subscales (CHB, MHLC, self-efficacy) were replaced by the respondent's mean for the rest of the items of the respective subscale. Missing data for the NEO-FFI were replaced by the scale mean ("neutral").

*Divergent and Convergent Validity* Table III presents the means, standard deviations, and alpha reliabilities for all measures, as well as the bivariate correlations[4] with the CHB and the 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 0.76.

Our first goal was to examine how the CHB measure is related to the IHBS. As can be seen in Table III, a significant positive correlation between scores on the CHB scale and scores on the IHBS was found ($r = 0.31$, $p = 0.001$). 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 III) 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 III shows that, as expected, CHB scores are negatively correlated with health-related

[4]Table II 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.

TABLE III Description of scale characteristics and intercorrelations with CHB and IHBS

| *Scale* | *M* | *SD* | $\alpha$ | *CHB* | *IHBS* | *t-test* (*df* = *108*) |
|---|---|---|---|---|---|---|
| 1. CHB | 20.15 | 7.88 | 0.76 | – | | – |
| 2. Irrational Health Beliefs (IHBS) | 37.18 | 11.62 | 0.89 | 0.31** (0.38***) | – | – |
| 3. Internal control (MHLC) | 22.75 | 3.39 | 0.70 | 0.09 (0.12) | −0.18* (−0.23*) | $p = 0.007$ (0.008) |
| 4. Powerful others (MHLC) | 13.16 | 3.63 | 0.60 | 0.11 (0.16) | 0.26** (0.36***) | $p = 0.08$ (0.05) |
| 5. Chance (MHLC) | 14.00 | 4.11 | 0.66 | 0.15 (0.21*) | 0.34*** (0.44***) | $p = 0.04$ (0.02) |
| 6. Procrastination | 25.70 | 4.72 | 0.72 | 0.10 (0.14) | 0.07 (0.09) | *ns* (*ns*) |
| 7. Self-efficacy–nutrition | 14.36 | 3.32 | 0.82 | −0.19* (−0.24*) | −0.18 (−0.21*) | *ns* (*ns*) |
| 8. Self-efficacy–exercise | 12.32 | 3.71 | 0.86 | −0.11 (−0.14) | −0.10 (−0.11) | *ns* (*ns*) |
| 9. Self-efficacy–alcohol | 9.65 | 2.69 | 0.82 | −0.20** (−0.25**) | 0.04 (0.05) | $p = 0.02$ (0.004) |
| 10. NEO – N | 3.04 | 0.62 | 0.81 | 0.03 (0.04) | 0.17 (0.20*) | $p = 0.097$ (0.07) |
| 11. NEO – E | 3.38 | 0.51 | 0.77 | −0.02 (−0.03) | −0.24** (−0.29**) | $p = 0.03$ (0.01) |
| 12. NEO – O | 3.66 | 0.56 | 0.78 | 0.13 (0.17) | −0.26** (−0.31**) | $p = 0.0002$ (0.0001) |
| 13. NEO – A | 3.61 | 0.47 | 0.71 | −0.15 (−0.20*) | −0.36*** (−0.45***) | $p = 0.02$ (0.01) |
| 14. NEO – C | 3.40 | 0.58 | 0.83 | −0.19* (−0.24*) | −0.21* (−0.24**) | *ns* (*ns*) |
| 15. Social desirability (MCSD) | 14.25 | 5.50 | 0.75 | −0.06 (−0.08) | −0.25** (−0.31**) | $p = 0.04$ (0.03) |
| 16. Risk behavior score | 10.88 | 0.65 | 0.57 | 0.29** (0.44***) | 0.04 (0.06) | $p = 0.01$ (0.0001) |
| 17. Symptom checklist | 20.17 | 11.46 | 0.89 | 0.28** (0.34***) | 0.36*** (0.41***) | *ns* (*ns*) |

*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.
*$p < 0.05$; **$p < 0.01$; *** $p < 0.001$.

self-efficacy. Participants with high scores on the CHB scale show lower self-efficacy toward preventive nutrition ($r = -0.19$, $p = 0.05$) and alcohol resistance ($r = -0.20$, $p = 0.04$). 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 ($r = -0.19$, $p = 0.04$). 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 ($r = 0.10$, *ns*).

Also, the CHB scale's sensitivity to social desirable responding and relations to socio-demographic characteristics were examined (see Table III). Unlike scores on the IHBS, scores on the CHB scale were not related to the tendency to respond in a socially desirable way ($r = -0.06$, *ns*) and CHB scores did not show a correlation with race/ethnicity, age, or major in university (all $p > 0.30$). However, a gender difference was found such that males had higher CHB scores than females ($M = 21.62$ and $M = 18.59$, respectively, $t(109) = 2.06$, $p = 0.04$).

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: $r = 0.29$, $p = 0.002$, symptoms: $r = 0.28$, $p = 0.003$). 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 than or equal to 27 (indicating being overweight or obese) have higher CHB scores than individuals with BMIs below 27 ($M = 23.74$ vs. $M = 19.54$, $t(109) = -2.00$, $p = 0.048$).

In terms of the subdimensions of the CHB scale, significant correlations were found, as one would expect, between the substance use CHB dimension and alcohol/nicotine-related risk behavior ($r = 0.41$, $p < 0.0001$), between the eating/sleeping habits CHB dimension and eating-related risk behavior ($r = 0.21$, $p = 0.02$) and between the weight regulation CHB dimension and weight regulation risk behavior ($r = -0.25$, $p = 0.009$). The latter negative correlation suggests that individuals who hold CHBs related to weight regulation indeed engage in weight-regulating behaviors (report eating more exercising and a higher fruit and vegetable consumption). None of the CHB subscales were related to irrational health beliefs (all $p > 0.30$).

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 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 IV presents the intercorrelations among all measures included in the regression models, and Table V presents the results of the regression analyses. As can be seen in the upper part of Table V, 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 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 of risk behaviors on health.

TABLE IV Intercorrelations among variables used in the regression models

| | *1* | *2* | *3* | *4* | *5* | *6* | *7* |
|---|---|---|---|---|---|---|---|
| 1. CHB | – | −0.31** | −0.19* | −0.20* | −0.19* | 0.29** | 0.28** |
| 2. IHBS | | – | −0.18 | 0.04 | −0.20* | 0.04 | 0.36*** |
| 3. Nutrition self-efficacy | | | – | 0.37*** | 0.07 | −0.15 | −0.16 |
| 4. Alcohol self-efficacy | | | | – | 0.14 | −0.45*** | −0.10 |
| 5. Conscientiousness | | | | | – | −0.21*** | −0.05 |
| 6. Risk behavior | | | | | | – | 0.05 |
| 7. Symptoms | | | | | | | – |

*Note*: $N = 111$. CHB = Compensatory Health Beliefs Scale; IHBS = Irrational Health Belief Scale.
*$p < 0.05$; **$p < 0.01$; *** $p < 0.001$.

TABLE V Summary of hierarchical regression analyses on risk behavior and symptom reports

| *Predictor* | $\beta$ | $R^2$ *Change* | *Significance of step* |
|---|---|---|---|
| Risk Behavior | | | |
| Step 1 | | 0.23 | $F(3, 105) = 10.82$, $p < 0.0001$ |
| Nutrition self-efficacy | 0.02 | | |
| Alcohol self-efficacy | −0.37*** | | |
| Conscientiousness | −0.22* | | |
| Step 2 | | 0.00 | $F < 1$ |
| IHBS | −0.03 | | |
| Step 3 | | 0.03 | $F(1, 103) = 4.20$, $p = 0.04$ |
| CHB | 0.19* | | |
| Overall model | | 0.29 | $F(7, 103) = 6.04$, $p < 0.0001$ |
| Symptoms | | | |
| Step 1 | | 0.002 | $F < 1$ |
| Risk behavior | −0.06 | | |
| Step 2 | | 0.04 | $F(3, 103) = 1.36$, $p = 0.26$ |
| Nutrition self-efficacy | −0.09 | | |
| Alcohol self-efficacy | −0.08 | | |
| Conscientiousness | 0.01 | | |
| Step 3 | | 0.16 | $F(1, 102) = 21.12$, $p < 0.0001$ |
| IHBS | 0.38 | | |
| Step 4 | | 0.03 | $F(1, 101) = 4.19$, $p = 0.04$ |
| CHB | 0.20 | | |
| Overall model | | 0.27 | $F(9, 101) = 4.15$, $p < 0.0001$ |

*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.
*$p < 0.05$; **$p < 0.01$; *** $p < 0.001$.

The bottom part of Table V 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 ($p = 0.04$).

We also ran three separate regression analyses (results not reported in Table V) to examine to which extent specific CHBs predict specific risk behaviors. The regression models were identical to the ones described above, with the only difference being that substance use, eating habits, 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 analyses. 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%, $\beta = 0.26$, $F(1, 103) = 8.58$, $p = 0.004$). Similarly, there is a tendency for the eating/sleeping CHB subscale to uniquely predict eating risk behaviors ($R^2$-change: 2.4%, $\beta = 0.16$, $F(1, 103) = 2.79$, $p = 0.098$), and CHBs related to weight regulation predict dieting risk behavior beyond and above all other variables in the equation ($R^2$ change: 7.4%, $\beta = -0.28$, $F(1, 103) = 8.71$, $p = 0.004$).

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

## DISCUSSION

This paper described the development and psychometric properties of the CHB 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 per se. Scores on the scale shared unique variance with health-related risk behaviors and symptom reports. Furthermore, higher CHB scores were related to a higher BMI. Concerning a related measure of health beliefs, the IHBS, our scale demonstrated some overlap. However, the two scales show clear 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 behaviors, 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 I) 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 I 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 Knäuper *et al.*, 2002). 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 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 psychoeducational 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. Schwarzer, 1992; Gollwitzer, 1993).

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