Smoking-specific compensatory health beliefs and the readiness to stop smoking in adolescents

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Objective. Compensatory health beliefs (CHBs) are defined as beliefs that negative consequences of unhealthy behaviours can be compensated for by engaging in other health behaviours. CHBs have not yet been investigated in detail regarding smoking. Smoking might cause cognitive dissonance in smokers, if they are aware that smoking is unhealthy and simultaneously hold the general goal of staying healthy. Hence, CHBs are proposed as one strategy for smokers to resolve such cognitive dissonance. The aim of the present study was to develop a scale to measure smoking-specific CHBs among adolescents and to test whether CHBs are related to a lower readiness to stop smoking.

Design. For the main analyses, cross-sectional data were used. In order to investigate the retest-reliability follow-up data, 4 months later were included in the analysis.

Method. A newly developed scale for smoking-specific CHBs in adolescents was tested for its validity and reliability as well as its predictive value for the readiness to stop smoking in a sample of 244 smokers (15–21 years) drawn from different schools. Multilevel modelling was applied.

Results. Evidence was found for the reliability and validity of the smoking-specific CHB scale. Smoking-specific CHBs were significantly negatively related to an individual's readiness to stop smoking, even after controlling for other predictors such as self-efficacy or conscientiousness.

Conclusions. CHBs may provide one possible explanation for why adolescents fail to stop smoking.

Theoretical background

Smoking remains a major cause of disease and death worldwide (Doll, Peto, Boreham, & Sutherland, 2004). Despite a decline over the last few years in most high-resource countries such as Canada, smoking is still prevalent, especially among young people (Shafey, Eriksen, Ross, & Mackay, 2009). In Switzerland, for example, 14% of 15-to 19-year-olds are daily smokers (boys: 16%, girls: 11%; Keller, Radtke, Krebs, & Hornung,

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2010). Most adolescent smokers report that they want to quit smoking, but attempts at quitting have shown very low success rates (Mermelstein, 2003). Thus, smoking is still widespread, although the majority of adolescents are quite knowledgeable about the harmful effects of smoking (Bak & Piko, 2006; Pinel, Assanand, & Lehman, 2000). Results of the national and representative Tobacco Monitoring Switzerland (TMS) have also shown that there are no significant differences between adults and adolescents concerning their knowledge (Radtke, Keller, Krebs, & Hornung, 2010). In addition, there is also recent evidence from national studies that health-oriented values are relevant in adolescence (Borowsky, Ireland, & Resnick, 2009; Piko, 2005).

An explanation for smokers' difficulty to engage in smoking cessation may be provided by the compensatory health belief (CHB) model (Rabiau, Knäuper, & Miquelon, 2006).

CHB model

When smokers are faced with the temptation of smoking, a conflict between their desire to smoke and their knowledge about the maladaptive effects of smoking could arise. This mental conflict, due to non-agreeing cognitions or inconsistency in cognitions and behaviour, can be described as a negative aroused state of cognitive dissonance (Festinger, 1957). Cognitive dissonance may be experienced for various reasons: fear that the unhealthy behaviour will result in disease, conflict with a valued self-perception (e.g., being somebody who lives healthily), or discrepancy in self-expectations (e.g., to successfully stop smoking; Harmon-Jones & Harmon-Jones, 2007). Similar to adult smokers, adolescent smokers also adhere to different coping methods to relieve such discomfort (Kleinjan, van den Eijnden, & Engels, 2009). Hence, the question arises as to which strategies smokers apply to cope with such cognitive dissonance.

The CHB model (Rabiau *et al.*, 2006) proposes three self-regulatory strategies: (1) attempts to resist the desire, (2) re-evaluation of the harmfulness of the behaviour (cf. Festinger, 1957; Trope & Fishbach, 2000), and (3) CHBs. CHBs are defined as beliefs that the negative consequences of an unhealthy behaviour can be compensated for by engaging in some other healthy behaviour. Instead of resisting the desire to smoke or re-evaluating one's beliefs, smokers justify their behaviour and consequently perceive lower cognitive dissonance by planning to compensate for it later, most likely by behaviour they already engage in on a regular basis (Rabiau *et al.*, 2006). CHBs are automatically elicited by temptations or generated after indulgence (Kronick & Knäuper, 2010). According to the CHB model, the first strategy is used when the desire to smoke is not strong and when the individuals' self-efficacy to control the desire is high. The second and third strategy will be used when the desired behaviour cannot be resisted. Whereas strategies 1 and 2 require self-control, strategy 3 is the easiest to follow, because it permits the indulgence in the unhealthy behaviour without feelings of discomfort (Rabiau *et al.*, 2006). However, CHBs can be false, as for example the negative effects of smoking on one's health cannot completely be compensated for by health behaviours such as healthy eating (e.g., Sinner, Folsom, Harnack, Eberly, & Schmitz, 2006). The long-term consequence may be the pathogenesis of diseases. Moreover, holding CHBs does not necessarily mean that people actually carry out the intended compensatory behaviour. The initial dissonance may weaken over the time, causing the need to compensate for the unhealthy behaviour to fade. In this way, people wanting to give up smoking are hindered by the CHBs, because they can smoke without feeling guilty about the negative health effects (cf. Rabiau *et al.*, 2006).

CHBs in adolescence and smoking behaviour

Rabiau, Knäuper, Nguyen, Sufrategui, and Polychronakos (2009) provided first evidence for the relevance of CHBs in adolescence, because CHBs were found to be associated with lower adherence to self-care behaviours in adolescents with type 1 diabetes. A qualitative study conducted by Scheffel and Schou (2007) also pointed out that adolescent smokers rely on cognitive compensating strategies such as 'it is healthier to smoke than eat fatty food' in order to minimize their perceived health risk due to smoking. On a behavioural level, Xu (2002) provided support that smokers who regret smoking due to the related health effects try to neutralize these negative feelings by taking more exercise or making more use of medical care.

Altogether, CHBs have not been investigated in detail regarding smoking and adolescence, although Knäuper, Rabiau, Cohen, and Patriciu (2004) mentioned that CHBs should be investigated for behaviours that people are ambivalent about. Smoking in adolescence is such a behaviour (Lipkus *et al.*, 2005) because adolescent smokers are just about to start smoking on a regular basis. Before becoming regular smokers, adolescents experiment with cigarettes. Thereby, they might perceive positive sociable, pleasurable, or emotional effects of smoking. Simultaneously, they might remember their parents' advice not to smoke/to stop smoking or might experience negative effects of tobacco use (Grogan, Fry, Gough, & Conner, 2009; Lipkus *et al.*, 2005). Feelings of ambivalence arise, because of the conflict between the desire to smoke and the goal to stay healthily, stop smoking or follow the parents' advice in order to protect one's own health.

Therefore, we concluded that the use of CHBs, as one strategy to resolve a state of dissonance, results in a reduction of this discomfort. As a consequence, tobacco use might increase and the motivation to stop smoking might decline (cf. Kleinjan *et al.*, 2009) so that CHBs may be an obstructive factor for smoking interventions in adolescence.

Aims of the study

The aim of the present research was to develop a scale to measure smoking-specific CHBs among adolescents. The general CHB scale developed by Knäuper *et al.* (2004), which measure CHBs in general (e.g., eating and sleeping habits) might not be appropriate for the investigation of smoking behaviour in particular.

First, the reliability of the smoking-specific scale was examined. To test its validity, different variables were chosen based on the CHB model (Rabiau *et al.*, 2006). The selection of nearly the same variables as in Knäuper *et al.* (2004) enables a comparison of the smoking-specific CHB scale with the general scale. From a theoretical position and based on the CHB model, it is furthermore inevitable to distinguish smoking-specific CHBs from other constructs which also target self-regulation such as the Multidimensional Health Locus of Control (MHLC) scale (Muthny & Tausch, 1994) or self-efficacy (Schwarzer, 2004). Personality dimensions were assessed, with the focus on conscientiousness. This sub-dimension includes thoughtfulness, with good impulse control, and goal-directed behaviours (Rammstedt & John, 2005). In addition to Knäuper *et al.* (2004), dissonance-reducing strategies were added to distinguish CHBs from them. In order to investigate convergent validity, it was hypothesized that smoking-specific CHBs would correlate with general and smoking-specific self-efficacy, the personality sub-dimension conscientiousness, dissonance-reducing strategies, and the general CHB

scale. To examine divergent validity, it was hypothesized that scores of the smoking-specific CHBs would not be related to procrastination (Schwarzer, 2007), health-specific locus of control, and personality dimensions other than conscientiousness. Furthermore, to test the criterion-related validity, it was assumed that high scores on the smoking-specific CHB scale are associated with low readiness to quit smoking (Tabakmonitoring Schweiz, 2008) over and above the theoretically selected predictors outlined above. The incremental validity was tested of the smoking-specific CHBs over and above the general CHB scale regarding the readiness to quit smoking.

Methods

Participants

Participants were recruited from nine schools in four German-speaking cantons in Switzerland. A total of 56 classes completed the questionnaire during one 45-min lesson. Informed consent was obtained from the schools and all individuals participated voluntarily and were treated according to the American Psychological Association (APA) ethical guidelines (APA, 2002). The data collection and its analyses were done anonymously.

The total sample consists of 789 15- to 21-year-old adolescents. Cases that could not be well defined as smokers or non-smokers, because of inconsistent or missing responses of the smoking status ($n = 49$) and cases with ambiguous data were excluded ($n = 64$). Ambiguous data were considered all impossible data combinations from the stages of change, the age, the age of smoking onset, or the number of cigarettes smoked (e.g., a person who reported his/her age to be 18, but the age of smoking onset to be 23). So, the sample consists of 676 participants, but for current analyses only the smokers ($n = 244$) were taken into consideration. Only in order to investigate criterion-related validity, the non-smokers were included, which differed significantly from smokers who were older ($M = 17.1$ vs. $M = 16.9$; $t(674) = 2.17$, $p = .03$). The average participant of the 244 smokers (61.1% girls, 38.9% boys) was 17.1-year of age-old ($SD = 1.36$). One hundred and thirty-one were daily and 113 occasional smokers. Four schools also agreed that their students complete the questionnaire a second time 4 months later ($n = 384$; 15- to 21-year-old smokers $n = 91$) to investigate the retest-reliability. The dropouts did not differ significantly from the original sample in relation to socio-demographic factors and all study relevant variables (all $p > .50$) with the exception of age, which means that participants who dropped out were older ($M = 17.5$ vs. $M = 16.1$; $t(674) = 13.91$, $p \leq .001$).

Scale development

Before data collection for the main study, a pilot sample of 10 student smokers suggested examples of smoking-specific compensatory behaviours such as 'nutrition' or 'relinquishment of drugs'. Based on this input, an initial pool of 89 items was prepared. The item construction was theoretically guided (cf., Bühner, 2006), and items were generated to represent the conceptualization of different aspects of smoking-specific CHBs. After having been reviewed by health psychology experts, items were selected for the final scale. Fifty-four items were excluded for any of the following two reasons: wording and redundancy. Before items were included in the questionnaire (see Table 1 for item examples), they were tested for clarity by five adolescents using the 'Think Aloud

Table 1. Factor structure of the smoking-specific CHBs (oblique rotation)

Factor	Item	1	2	3
Exercise $\alpha = .784$	Smoking can be compensated for by physical activity.	.746	-.017	-.046
	The negative effects of smoking can be reduced by exercising.	.692	.089	.010
	The negative effects of smoking can be balanced by exercising vigorously and regularly every week.	.757	.004	.173
Food and drink $\alpha = .721$	Smoking is Ok if one drinks less alcohol in exchange.	-.020	.677	-.038
	It is alright to smoke if one takes in enough vitamins.	.064	.633	.020
	The negative effects of smoking can be made up for by eating healthy.	.242	.590	-.005
	Smoking from time to time is Ok if one eats healthy.	-.001	.683	.032
Amount of smoking $\alpha = .707$	The effects of smoking during the weekend can be compensated for by not smoking during the week.	.062	-.041	.733
	It is alright to smoke when going out as long as one smokes less or not at all the next day.	-.064	.015	.758
	It does not damage one's health if one only smokes when going out.	-.002	.045	.617

Note. Multilevel exploratory factor analysis was performed. Loadings are taken from the oblique rotated matrix provided by Mplus. Loadings $\geq .40$ are bold. Cronbach's Alpha was calculated by SPSS.

Technique' (Fowler, 1995). Each item was scored on a scale of 1 (*strongly disagree*) to 5 (*strongly agree*).

After data collection for the main study, a further examination of the items was conducted to consider the development of a short scale. Due to the large number of items for each facet (e.g., nutrition), all items were excluded that had a poorer distribution in comparison with the other items belonging to the same facet. In addition, items that were misunderstood, because of unclear wording, were not introduced in the shortened scale. In consequence, 13 items remained, whereas it was guaranteed that these items cover all different aspects of smoking-specific CHBs and that no psychological relevant information got lost.

Measures

Other instruments were included in the questionnaire to investigate the construct and criterion validity based on the proceeding of the study conducted by Knäuper *et al.* (2004). In Table 2, the means, standard deviations, and the internal consistencies are shown.

General CHB scale (Knäuper *et al.*, 2004)

The Canadian CHB scale consists of 17 items divided into four subscales labelled 'substance use', 'eating/sleeping', 'stress', and 'weight regulation'. The presented study

Table 2. Scale characteristics (mean, SD, range, Cronbach's Alpha = α) and correlations with general CHBs and smoking-specific CHBs

Scale	M	SD	Range	α	GCHB	SCHB	SCHBe	SCHBf	SCHBa
GCHB	48.94	8.65	1–5	.72	–	.43**	.35**	.31**	.29**
SCHB	21.91	6.61	1–5	.80	.43**	–	.77**	.75**	.78**
SCHBe	7.21	2.98	1–5	.78	.35**	.77**	–	.39**	.33**
SCHBf	6.82	2.79	1–5	.72	.32**	.75**	.39**	–	.44**
SCHBa	7.89	2.89	1–5	.71	.32**	.78**	.33**	.44**	–
BFI-K:									
N	2.90	0.88	1–5	.71	–.09	–.01	.05	–.04	–.02
E	3.72	0.79	1–5	.72	–.03	–.27**	–.21**	–.13*	–.17**
O	3.77	0.89	1–5	.61	–.07	–.07	–.01	–.06	–.09
C	3.27	0.70	1–5	.61	–.22**	–.23**	–.17**	–.21**	–.16*
A	3.06	0.72	1–5	.46	–.02	–.11	–.09	–.08	–.09
MHLC:									
CH	15.65	4.53	1–6	.60	.03	.06	–.01	.11	.06
IC	26.52	4.38	1–6	.67	.12	.05	.03	.05	.04
PO	15.94	4.83	1–6	.69	.02	.24**	.15*	.14*	.14*
Self-efficacy:									
G	28.64	4.18	1–4	.82	–.01	–.01	–.03	–.01	–.03
S	28.21	8.77	1–4	.92	–.11	–.27**	–.20**	–.20**	–.21**
Procrastination	25.37	4.32	1–4	.69	–.10	–.04	–.05	–.04	–.01
DRS	8.25	2.59	0–4	.46	.10	.24**	.15*	.18**	.21**
Readiness to stop smoking	1.92	1.62	0–4	.74	–.09	–.23**	–.21**	–.17**	–.16*

Note. GCHB, General Compensatory Health Beliefs (CHBs); SCHB, Smoking-specific CHBs; SCHBe, subscale smoking-specific CHBs “exercise”; SCHBf, subscale smoking-specific CHBs “food and drink”; SCHBa, subscale smoking-specific CHBs “amount of smoking”; BFI-K, Big Five Inventory; N, neuroticism; E, extraversion; O, openness; C, conscientiousness; A, agreeableness; MHLC, Multidimensional Health Locus of Control; CH, chance; IC, internal control; PO, powerful others; G, general self-efficacy; S, smoking-specific self-efficacy; DRS, dissonance reducing strategies. Results provided by Mplus for level 1 variables. Cronbach's Alpha was calculated by SPSS.

* $p < .05$. ** $p < .01$.

used a German translation of the general CHB scale (Lippke, Hohmann, Kalusche, & Knäuper, 2007). An example of an item with a five-point Likert-scale of 1 (*strongly disagree*) to 5 (*strongly agree*) is ‘Sleep compensates for stress’.

Big five inventory

The German short version of the BFI-K (BFI-K; Rammstedt & John, 2005) consists of 21 items (e.g., ‘I worry about things’) with a five-point Likert-scale of 1 (*strongly disagree*) to 5 (*strongly agree*).

Procrastination

The procrastination scale (Schwarzer, 2007) was used to measure a tendency towards dilatory behaviour across a variety of daily tasks (e.g., ‘I often take on things which I then end up not doing’). The 10 items are scored on a four-point Likert-scale ranging from 1 (*for not at all true*) to 4 (*exactly true*).

Multidimensional health locus of control

The internality, powerful others, and chance health locus of control subscales from the German version of the MHLC scale (Muthny & Tausch, 1994) were used to measure participants' beliefs regarding control over their health outcomes. Each of these subscales contains six items with a six-point Likert-scale ranging from '*strongly disagree*' to '*strongly agree*' (e.g., 'If I become sick, I have the power to make myself well again'). In compliance with Muthny and Tausch (1994), the item 'Luck plays a big part in determining how soon I will recover from an illness' was eliminated to enhance the internal consistency.

Generalized self-efficacy scale

Self-efficacy was measured using a 10-item scale (Jerusalem & Schwarzer, 1999) (e.g., 'I can usually handle whatever comes my way'). Participants are required to rate their feelings of competency regarding their ability to overcome barriers in everyday life on a four-point Likert-scale of 1 (*for not at all true*) to 4 (*exactly true*).

Smoking-specific self-efficacy scale

Respondents rated the extent to which each statement applies to them on a four-point Likert-scale (Schwarzer, 2004). Of the 16 items only 11 items were chosen due to non compatible item-phrasing concerning adolescents. The item stem 'I can manage to carry out my smoking cessation intention . . .' was followed by items, such as, 'even if I feel depressed'.

Dissonance-reducing strategies

Four items that serve as rationalizations for smokers in a state of dissonance were measured with a five-point Likert-scale (adapted from Hornung, 1986). Item examples are: 'Many old persons, who have smoked most of their life, yet are fine in health' or 'Too much attention is given to the harmful effects of smoking'.

Smoking status and readiness to stop

The questions were extracted from 'Tobacco Monitoring Switzerland'. The presented study classifies smoking status of the respondents in two categories: smokers, who smoke daily or occasionally and non-smokers. In addition, respondents' readiness to stop smoking was assessed based on stages of change measured related to Prochaska, DiClemente, and Norcross (1992). Adolescents could rate their readiness to quit within a certain time frame using the following scale (Tabakmonitoring Schweiz, 2008): 'general readiness to quit smoking', 'within the next 30 days', 'within 6 months', 'within 1 year', and 'within 2 years'. The items were summed up to form an index, which means that an adolescents' agreement to an item was coded with one, so that a higher score on this scale represented a greater and more proximal level of readiness to quit.

Data analysis

Due to the fact, that the adolescents in this study are nested within school classes, the statistic programs Mplus 5.01 (Muthén & Muthén, 2007) and HLM 6.04 (Raudenbush & Bryk, 2002) were used in addition to SPSS 15.0. With the use of SPSS 15.0, sample and scale characteristics were assessed: for example, missing values were

replaced by the Expectation Maximization imputation method (cf. Tabachnik & Fidell, 2007). Exploratory factor analyses (EFA) and confirmatory factor analyses (CFA) were performed by Mplus to determine the structure of smoking-specific CHBs considering the hierarchical data structure. The sample was randomly divided into two samples and with these two samples the analyses were conducted. Furthermore, to determine the validity of the new scale, correlations were performed between the smoking-specific CHBs and the measures described above. To test the predictive power of smoking-specific CHBs, hierarchical regressions were computed. Based on the principle of parsimony (Tabachnik & Fidell, 2007), all variables that are significantly associated in the bivariate analyses with smoking-specific CHBs and the outcome variable (cf. Table 2) were entered in the regression model as predictors for the readiness to stop smoking. In this study, random slope models were estimated in the HLM analyses. All variables were grand-mean centred (Raudenbush & Bryk, 2002). The equation can be written like this:

$$\text{Level 1 (individual level): } y_{ij} \text{ (readiness to stop smoking)} = \beta_{0j} + \beta_{1j} \text{ (powerful others)} \\ + \beta_{2j} \text{ (extraversion)} + \beta_{3j} \text{ (conscientiousness)} + \beta_{4j} \text{ (smoking-specific self-efficacy)} \\ + \beta_{5j} \text{ (dissonance-reducing strategies)} + \beta_{6j} \text{ (smoking-specific CHBs)} + r_{ij},$$

where y_{ij} is defined as individuals (i) readiness to stop smoking (y) across different school classes (j). β_{0j} is the intercept term and represent the mean level of the readiness to stop smoking in the school class context j . The slopes representing the association between the readiness to stop smoking and the predictors mentioned above are denoted by β_{1j} – β_{6j} for every group j . The term r_{ij} is a level 1 residual. Accordingly, the equation on level 2 looks as follows:

$$\text{Level 2 (school class level): } \beta_{0j} = \gamma_{00} + u_{0j}, \beta_{1j} = \gamma_{10} + u_{1j}; \\ \beta_{2j} = \gamma_{20} + u_{2j}; \beta_{3j} = \gamma_{30} + u_{3j}; \beta_{4j} = \gamma_{40} + u_{4j}; \beta_{5j} = \gamma_{50} + u_{5j}; \\ \beta_{6j} = \gamma_{60} + u_{6j}$$

γ_{00} is the average of all the β_{0j} 's and γ_{10} – γ_{60} represent the mean slopes of the different predictor variables. The effect of the only variable (slope) at level 2 (school class) was specified as random (error terms: u_{1j} – u_{6j}), indicating possible differences between classes in these mean effects. To estimate effect sizes, Pseudo- R^2 (McFadden, 1979) was calculated. However, Pseudo- R^2 acts only as a descriptive measure and could not be computed for non-significant effects. In addition, Pseudo- R^2 might not be exactly determined for models with random intercept and random slopes. For these reasons, interpretations should be treated cautiously and it should be taken into consideration that the b -coefficients are unstandardized. Furthermore, it should be noted, that the aim of all reported multilevel analyses (factor analysis and regression) was to obtain correct test statistics by controlling for class effects and not to specify a model to analyze differences between classes.

Results

Multilevel exploratory factor analysis

With one sub-samples, the 13 items of the smoking-specific CHBs were entered into a multilevel EFA with oblique rotation to reach a psychologically interpretable position. By reason that in Mplus the variance explained by a factor is not given for oblique rotation,

the variance was calculated based on the varimax solution (cf., Muthén & Muthén, 2007). Items with component weights of more than .40 were grouped, but three items, which pertained to habits of deep breathing or the use of light cigarettes, failed to load on any factor. Therefore, the factor analysis was subsequently repeated with the remaining 10 items, which resulted in three factors. The structure of the factors is listed in Table 1. Based on the meaningfulness of the emerging factors and the Kaiser-rule (eigenvalues: 3.9, 1.4, 1.3), it was decided that three factors were an accurate representation of the final solution. The first factor, which accounted for 18% of the common variance after rotation, was labelled 'exercise'. Agreement with these items means respondents perceived physical exercise as one strategy to compensate for the negative health effects of smoking. The second factor, accounting for 18% of the variance, was labelled 'food and drink'. The four items connote the respondent's belief that negative health effects may be neutralized by eating healthily or by reducing alcohol consumption. The third factor, accounting for 15% of the variance, was labelled 'amount of smoking'. Its three items reflected the belief that a reduction of the number of cigarettes smoked would compensate for health consequences of smoking.

Multilevel confirmatory factor analysis

The multilevel CFA was conducted with the other random sub-sample to confirm the factor structure. For the described model above, the chi-square value indicated that the model fit the data well ($\chi^2(32, N = 122) = 36.38; p = .27$). Furthermore, the goodness of fit was assessed with the Comparative Fit Index (CFI = .98), the Tucker Lewis Index (TLI = .98), the root means square error for approximation (RMSEA = .03), and the standardized root mean square residual (SRMR = .05). All values meet the criteria for acceptable model fit (Hu & Bentler, 1999). Likewise, all factor loadings were significant $p \leq .001$.

Reliability

The alpha coefficient for the total scale was $\alpha = .80$. The internal consistency of the subscales ranged from .71 to .78 (see Table 2). The majority of the corrected inter-item correlations clustered around $r = .29$ (.11–.55). After the data had been collected twice, resulting retest-reliability coefficient for smokers was $r_{tt} = .71$ ($n = 91$).

Validity

The results of testing for construct validity are shown in Table 2 for the total smoking-specific CHB scale, as well for the subscales.

Convergent validity

The results of the correlation analysis (conducted in Mplus) indicated similar relationships of the total smoking-specific CHB scale and the three subscales with all other scales. As can be seen, there was a significant positive relationship between the general CHB scale and the smoking-specific CHBs. As expected, smoking-specific CHBs showed a significant negative relationship with the smoking-specific self-efficacy. The higher the smoking-specific self-efficacy was the lower the smoking-specific CHBs. As hypothesized, the smoking-specific CHBs as well as the general CHB scale were negatively correlated

with the personality dimension conscientiousness. Adolescents with higher scores on the smoking-specific CHBs or the general CHB scale were less conscientious. A positive correlation was found between the smoking-specific CHBs and the dissonance-reducing strategies, which indicated a small overlap, but both constructs are assumedly different types of beliefs.

Divergent validity

Table 2 shows that the personality dimensions neuroticism, openness, and agreeableness did not correlate with the smoking-specific CHBs and the general CHBs. Against our expectations, the personality dimension extraversion was found to be significantly negatively related to the smoking-specific CHBs. Furthermore, no relation with the MHLC subscale chance and internal control was found. Contrary to the assumption of no relationship, smoking-specific CHB scores were significantly positively related to the MHLC subscale powerful others. Also, as expected, the smoking-specific CHBs and the general CHBs were not correlated with procrastination.

Association with the smoking status

A comparison between smokers and non-smokers regarding the total smoking-specific CHB scale score and the general CHB scale score was carried out (conducted with HLM). The results indicated that smokers have higher smoking-specific CHB scores than non-smokers ($M = 2.19$ vs. $M = 1.80$; $b = .22$, $p \leq .001$). In contrast, smokers and non-smokers did not differ with regard to the general CHBs ($M = 2.87$ vs. $M = 2.78$; $b = .11$, $p = .10$). Furthermore, for the smoking-specific CHBs, no gender difference was found between male and female smokers ($M = 2.24$ vs. $M = 2.16$; $b = .04$, $p = .32$).

Association with the readiness to stop smoking

The results of correlation analysis for assessing criterion-related validity indicated a significant negative relationship between smoking-specific CHBs and a smoker's readiness to stop smoking. The general CHBs failed to reach statistical significance relating to the readiness to stop smoking (cf. Table 2).

As already noted, multilevel regression analyses were conducted. The model specifies the prediction of the readiness to stop smoking with random effects of the intercept of the readiness to stop smoking and of the slopes of MHLC powerful others, extraversion, conscientiousness, smoking-specific self-efficacy, dissonance-reducing strategies, and smoking-specific CHBs. Table 3 presents the intercorrelations among the scales without the control variables gender ($b = -.05$; $p = .83$) and age ($b = -.07$; $p = .34$), because they were no significant predictors for the readiness to stop smoking.

The estimated intra-class correlation (ICC) for readiness to stop smoking was $ICC = .03$. This indicates low clustering effects, which is the same for the predictors (see Table 4). As shown in Table 4, the total smoking-specific CHB scale was significantly negatively related to the intercept of the readiness to stop smoking, with adolescent smokers holding higher smoking-specific CHBs having a lower readiness to stop smoking as adolescent smokers with lower smoking-specific CHBs. The same analyses with nearly the same results were conducted with the three subscales of the smoking-specific CHB scale: the subscales 'exercise' and 'food and drink' were both significantly negatively related and the subscale 'amount of smoking' was marginally significantly related to

Table 3. Correlations of the scales used in the regression model, except for the smoking-specific CHBs

	1	2	3	4	5	6
1. BFI-K <i>extraversion</i>	–	.13*	–.11	.19**	–.01	.16*
2. BFI-K <i>conscientiousness</i>		–	–.16*	.15*	–.10	.11
3. MHLC <i>powerful others</i>			–	.01	–.02	.05
4. Smoking-specific self-efficacy				–	–.10	.17**
5. Dissonance-reducing strategies					–	–.04
6. Readiness to stop						–

Note. CHBs, Compensatory Health Beliefs; BFI-K, Big Five Inventory; MHLC, Multidimensional Health Locus of Control. Results provided by Mplus for Level 1 variables.

* $p < .05$; ** $p < .01$.

the readiness to stop smoking. All other variables, except for the personality dimension extraversion, failed to reach statistical significance.

Discussion

The main purpose of this study was to construct a scale for assessing smoking-specific CHBs. Multilevel EFA resulted in three different subscales labelled 'exercise', 'food and drink', and 'amount of smoking'. Based on the comparable results for the total smoking-specific CHB scale and the subscales, we suggest that both have their utility. The subscales are especially important for the investigation of content-specific CHBs, whereas the total smoking-specific CHB scale enable the use of an aggregated score. The factor analysis showed that the three factors are correlated to a large extent. This factor structure was confirmed by a multilevel CFA. The use of the total smoking-specific CHB score is also feasible, because of the good internal consistency of the whole scale. Furthermore, the total scale and the subscales showed a good convergent and divergent validity. Although the negative relationship between the BFI-K sub-dimension extraversion and the smoking-specific CHBs was unexpected, it is still consistent with other studies, in which introverts experienced more discomfort than extraverts as a consequence of cognitive dissonance (e.g., Matz, Hofstedt, & Wood, 2008). In light of the assumption that CHBs are one strategy to resolve a cognitive dissonance, it might be a comprehensible explanation why there is a significant negative association between these scales. Another unexpected result was the positive correlation between the smoking-specific CHBs and the MHLC sub-dimension powerful others. High scores on the sub-dimension powerful others reflect the belief that health status is subject to external control (e.g., physicians, or medication; Muthny & Tausch, 1994). Therefore, it is tenable that this belief serves as one strategy for smokers to reduce a possible cognitive dissonance by placing the responsibility for their health on powerful others. This assumption is supported by studies that focus on health locus of control in smokers, which have shown that recidivists were associated with an external locus of control (e.g., Segall & Wynd, 1990). This is in line with the smoking-specific CHBs, because both scales serve as justifications for smoking behaviour.

Furthermore, the general and the newly developed smoking-specific CHB scales (total scale and subscales) were found to be positively correlated. This result indicates

Table 4. Hierarchical regression analysis by HLM with the readiness to stop smoking as outcome

Predictors	<i>b</i>	<i>SE</i>	<i>df</i>	<i>p</i> -value	Pseudo- <i>R</i> ²	ICC
Smoking-specific CHB scale – <i>total</i>						
MHLC <i>powerful others</i>	.23	.13	52	.10	.04	.07
BFI-K <i>extraversion</i>	.21	.14	52	.15	–	.05
BFI-K <i>conscientiousness</i>	.09	.14	52	.51	–	.03
Smoking-specific self-efficacy	.18	.16	52	.25	–	.04
Dissonance-reducing strategies	–.03	.16	52	.87	–	.01
Smoking-specific CHBs <i>total</i>	–.46	.16	52	.01	.04	.03
Smoking-specific CHB scale – <i>exercise</i>						
MHLC <i>powerful others</i>	.22	.14	52	.12	–	.07
BFI-K <i>extraversion</i>	.22	.14	52	.13	–	.05
BFI-K <i>conscientiousness</i>	.13	.14	52	.36	–	.03
Smoking-specific self-efficacy	.22	.16	52	.18	–	.04
Dissonance-reducing strategies	–.01	.16	52	.96	–	.01
Smoking-specific CHBs <i>exercise</i>	–.29	.11	52	.01	.06	.09
Smoking-specific CHB scale – <i>food and drink</i>						
MHLC <i>powerful others</i>	.23	.14	52	.12	–	.07
BFI-K <i>extraversion</i>	.29	.14	52	.04	.07	.05
BFI-K <i>conscientiousness</i>	.08	.14	52	.58	–	.03
Smoking-specific self-efficacy	.23	.16	52	.15	–	.04
Dissonance-reducing strategies	–.03	.15	52	.83	–	.01
Smoking-specific CHBs <i>food/drink</i>	–.34	.15	52	.03	.07	.07
Smoking-specific CHB scale – <i>amount of smoking</i>						
MHLC <i>powerful others</i>	.19	.14	52	.16	–	.07
BFI-K <i>extraversion</i>	.26	.15	52	.09	.13	.05
BFI-K <i>conscientiousness</i>	.13	.13	52	.33	–	.03
Smoking-specific self-efficacy	.22	.16	52	.17	–	.04
Dissonance-reducing strategies	–.01	.16	52	.95	–	.01
Smoking-specific CHBs <i>amount</i>	–.20	.12	52	.09	.08	.03

Note. Analysis by HLM controls for classes. The intercept is the mean level of the readiness to stop smoking in the school class context. MHLC, Multidimensional Health Locus of Control; BFI-K, Big Five Inventory. Coefficients are unstandardized *b* coefficients. Pseudo-*R*² could not be computed for non-significant effects. ICC, intra-class correlations.

that the items of both kinds of scales were similarly understood and that the scales share the underlying factor of CHBs. Nevertheless, smoking-specific CHBs (total scale and subscales) are negatively associated with the readiness to stop smoking, while the general CHB scale is not. Moreover, unlike the general CHB scale, smoking-specific CHBs distinguished between smokers and non-smokers. As indicated by these results, smoking-specific CHBs appear to be more useful for examining smoking behaviour than the general CHB scale, because it deals with very specific compensating beliefs for smoking. In line with this, the multilevel regression analysis demonstrates that all scales of the smoking-specific CHBs are significantly negatively related to the readiness to stop smoking, even in comparison with other scales. Accordingly, smoking-specific CHBs may provide one possible explanation for why adolescents often fail to change their smoking behaviour.

Overall, the correlations between smoking-specific CHBs and the readiness to stop smoking are not high. In terms of effect size, Pseudo- R^2 can be interpreted cautiously as very small-to-small for the smoking-specific CHBs. This might be due to the different specificity of the items concerning the readiness to stop smoking and the smoking-specific CHBs. The items to measure readiness to stop smoking are worded in first-person format, whereas adolescents had to evaluate the smoking-specific CHBs in general, instead of answering the items with respect to their own personal smoking behaviour. This was by reason that the non-smokers also had to answer the questions.

Limitations

First, the sample size of adolescent smokers in the study is expandable. However, it is not always possible to determine the number of smokers at the beginning of studies in school settings, because there is a wide variation of smokers in each school class, so that the sample size is finally acceptable. Second, the mean of the smoking-specific CHBs is rather low. A possible explanation regards the formulation of the questions, concerning smoking-specific CHBs as already mentioned above. Possibly, adolescent smokers would agree upon smoking-specific CHBs to a greater extent if the items were worded in first-person format. As a consequence, future studies should vary the answering format in order to account for this explanation. A third limitation lies in the assessment of smoking status. Although self-reports of smoking status are accurate, biochemical assessment should be considered in future studies to improve accuracy (e.g., by assessing saliva cotinine; Patrick *et al.*, 1994).

Outlook and conclusions

This study presents first evidence of the usefulness of smoking-specific CHBs in adolescents. First, the scale needs repeated validation and the predictive validity of the new scale for smoking-specific outcomes should be confirmed in advance. Further research is also recommended to examine the smoking-specific CHBs as well as the German version of the general CHB scale in different samples (e.g., in adults). In order to test long-term effects of smoking-specific CHBs on smoking cessation, a longitudinal design would be needed. Within the TMS (Keller *et al.*, 2010), this is currently being developed. In addition, it is intended to integrate smoking-specific CHBs into an existing theoretical model of behaviour change (such as the Health Action Process Approach, cf. Schwarzer, 2008), because so far, CHBs have not been investigated within the framework of such a behaviour change model. The CHB model (Rabiau *et al.*, 2006) explains the generation of CHBs as well as the implementation of compensatory health behaviour, but not the relevance of CHBs for a behavioural change. In addition, it is required to test the smoking-specific CHBs in relation to other concepts such as risk perceptions, outcome expectancies, attitudes, or descriptive norms (cf. Manning, 2009) to analyze their contribution to health behaviour change in more detail.

Until now, research on predictors of smoking cessation among adolescents found that amongst others, self-efficacy, knowledge, and beliefs about smoking are important predictors of smoking cessation (e.g., Dijk, Reubsaet, de Nooijer, & de Vries, 2007). Because our results indicate that smoking-specific CHBs are important predictors of smoking cessation, CHBs should be targeted in interventions. For example, an intervention could focus on unmasking CHBs and to inform adolescents that smoking

cannot be compensated for by any other healthy behaviour. This should raise adolescents' awareness for these maladaptive beliefs and thereby limit CHBs' potential to reduce cognitive dissonance. A second strategy could be to reduce the automatic activation of CHBs. Because CHBs are often activated after indulgence, interventions might want to strengthen adolescents' capabilities to resist temptations to smoke. Thus, interventions could for example address adolescents' resistance self-efficacy to deal successfully with high-risk situations that provoke temptations (cf. Marlatt, Baer, & Quigley, 1995). Regarding smoking-specific CHBs, more studies are needed to enhance our knowledge about their role for smoking outcomes as well as how to deal with them in interventions. Thus, smoking-specific CHBs can promote appropriate interventions for adolescent smokers and better assist in smoking cessation.

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References

- American Psychological Association. (2002). Ethical principles of psychologists and code of conduct. *American Psychologist*, 57, 1060–1073. doi:10.1037/0003-066X.57.12.1060
- Bak, J., & Piko, B. (2006). Smoke-free world for children's welfare: Perceptions of smoking in preadolescence. *Children and Youth Services Review*, 29, 283–293. doi:10.1016/j.childyouth.2006.07.007
- Borowsky, I., Ireland, M., & Resnick, M. D. (2009). Health status and behavioral outcomes for youth who anticipate a high likelihood of early death. *Pediatrics*, 124, 81–88. doi:10.1542/peds.2008-3425
- Bühner, M. (2006). *Einführung in die Test- und Fragebogenkonstruktion* [Introduction to tests and measurement]. Munich, DE: Pearson Education.
- Dijk, F., Reubsaet, A., de Nooijer, J., & de Vries, H. (2007). Smoking status and peer support as the main predictors of smoking cessation in adolescents from six European countries. *Nicotine & Tobacco Research*, 9, 495–504. doi:10.1080/14622200701587060
- Doll, R., Peto, R., Boreham, J., & Sutherland, I. (2004). Mortality in relation to smoking: 50 years' observations on male British doctors. *British Medical Journal*, 328, 1519. doi:10.1136/bmj.38142.554479.AE
- Festinger, L. A. (1957). *A theory of cognitive dissonance*. Stanford: Stanford University Press.
- Fowler, F. J. (1995). *Improving survey questions: design and evaluation*. Thousand Oaks, CA: Sage Publications.
- Grogan, S., Fry, G., Gough, B., & Conner, M. (2009). Smoking to stay thin or giving up to save face? Young men and women talk about appearance concerns and smoking. *British Journal of Health Psychology*, 14, 175–186. doi:10.1348/135910708 × 327617
- Harmon-Jones, E., & Harmon-Jones, C. (2007). Cognitive dissonance theory after 50 years of development. *Zeitschrift für Sozialpsychologie*, 38, 7–16. doi:10.1024/0044-3514.38.1.7
- Hornung, R. (1986). *Krebs: Wissen, Einstellungen und präventives Verhalten der Bevölkerung* [Cancer: Public's knowledge, attitudes and preventive behaviour]. Bern, CH: Hans Huber Verlag.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6(1), 1–55.
- Jerusalem, M., & Schwarzer, R. (1999). *Allgemeine Selbstwirksamkeit* [General self-efficacy] (online publication). Retrieved from http://web.fuberlin.de/gesund/skalen/Allgemeine_Selbstwirksamkeit/allgemeine_selbstwirksamkeit.htm

- Keller, R., Radtke, T., Krebs, H., & Hornung, R. (2010). *Der Tabakkonsum der Schweizer Wohnbevölkerung in den Jahren 2001 bis 2009. Tabakmonitoring - Schweizerische Umfrage zum Tabakkonsum* [Tobacco consumption of the Swiss Population between 2001 – 2009. Tobacco Monitoring Switzerland]. Zürich, CH: Psychologisches Institut der Universität Zürich, Sozial- und Gesundheitspsychologie.
- Kleinjan, M., Van Den Eijnden, R. J. J. M., & Engels, R. C. M. E. (2009). Adolescents' rationalizations to continue smoking: The role of disengagement beliefs and nicotine dependence in smoking cessation. *Addictive Behaviors*, 34, 440–445. doi:10.1016/j.addbeh.2008.12.010
- Knäuper, B., Rabiau, M., Cohen, O., & Patriciu, N. (2004). Compensatory health beliefs scale development and psychometric properties. *Psychology and Health*, 19, 607–624. doi:10.1080/0887044042000196737
- Kronick I., & Knäuper, B. (2010). Temptations elicit compensatory intentions. *Appetite*, 54, 398–401. doi:10.1016/j.appet.2009.12.011
- Lippke, S., Hohmann, C., Kalusche, A., & Knäuper, B. (2007). *Compensatory beliefs scale - general and diet (German)*. Retrieved from <http://www.psych.mcgill.ca/perpg/fac/knaeuper/GermanCHB.doc>
- Lipkus, I. M., Pollak, K. I., McBride, C. M., Schwartz-Bloom, R., Lyna, P., & Bloom, P. N. (2005). Assessing attitudinal ambivalence towards smoking and its association with desire to quit among teen smokers. *Psychology and Health*, 20, 373–387. doi:10.1080/08870440512331333988
- Manning, M. (2009). The effect of subjective norms on behaviour in the theory of planned behaviour: A meta-analysis. *British Journal of Social Psychology*, 48, 649–705. doi:10.1348/014466608x393136
- Marlatt, G. A., Baer, J. S., & Quigley, L. A. (1995). Self-efficacy and addictive behavior. In A. Bandura (Ed.), *Self-efficacy in changing societies* (pp. 289–315). New York: Cambridge University Press.
- Matz, D. C., Hofstedt, P. M., & Wood, W. (2008). Extraversion as a moderator of the cognitive dissonance associated with disagreement. *Personality and Individual Differences*, 45, 401–405. doi:10.1016/j.paid.2008.05.014
- McFadden, D. (1979). Quantitative methods for analyzing travel behavior of individuals: Some recent developments. In D. Hensher & P. Stopher (Eds.), *Behavioral travel modeling* (pp. 279–318). London: Croom Helm.
- Mermelstein, R. (2003). Teen smoking cessation. *Tobacco Control*, 12(Suppl. 1), i25–i35.
- Muthén, L. K., & Muthén, B. O. (2007). *Mplus. User's Guide* (5th ed.). Los Angeles, CA: Muthén & Muthén.
- Muthny, F. A., & Tausch, B. (1994). Adaption der Multidimensionalen Health Locus of Control Scales (MHLC) für den deutschsprachigen Raum [The adaptation of the MHLC scale for German speaking regions]. *Zeitschrift für Psychologie*, 15, 3–15.
- Patrick, D. L., Chéadle, A., Thompson, D. C., Diehr, P., Koepsell, T., & Kinne, S. (1994). The validity of self-reported smoking: A review and meta-analysis. *American Journal of Public Health*, 84, 1086–1093.
- Piko, B. (2005). Adolescents' health-related behaviors in the light of their value orientations. *Substance Use & Misuse*, 40, 735–742. doi:10.1081/ja-200030528
- Pinel, J. P. J., Assanand, S., & Lehman, D. R. (2000). Hunger, eating, and ill health. *American Psychologist*, 55, 1105–1116.
- Prochaska, J. O., DiClemente, C. C., & Norcross, J. C. (1992). In search of how people change. Applications to addictive behaviors. *American Psychologist*, 47, 1102–1114.
- Rabiau, M., Knäuper, B., & Miquelon, P. (2006). The external quest for optimal balance between maximizing pleasure and minimizing harm: The compensatory health beliefs model. *British Journal of Health Psychology*, 11, 139–153. doi:10.1093/her/cyp032
- Rabiau, M., Knäuper, B., Nguyen, T.-K., Sufrategui, M., & Polychronakos, C. (2009). Compensatory beliefs about glucose testing are associated with low adherence to treatment and poor metabolic control in adolescents with type 1 diabetes. *Health Education Research*, 24, 890–896. doi:10.1093/her/cyp032

- Radtke, T., Keller, R., Krebs, H., & Hornung, R. (2010). *Passivrauchen in der Schweizer Bevölkerung 2009. Tabakmonitoring - Schweizerische Umfrage zum Tabakkonsum*. [Second-hand smoke in Switzerland. Tobacco Monitoring Switzerland]. Zürich, CH: Psychologisches Institut der Universität Zürich, Sozial- und Gesundheitspsychologie.
- Rammstedt, B., & John, O. P. (2005). Kurzversion: Des Big Five Inventory (BFI-K): Entwicklung und Validierung eines ökonomischen Inventars zur Erfassung der fünf Faktoren der Persönlichkeit [Short-version of the Big Five Inventory (BFI-K): Development and validation of a brief inventory to assess the five factors of personality]. *Diagnostica*, 51, 195-206. doi:10.1026/0012-1924.51.4.195
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Newbury Park, CA: Sage.
- Scheffel, J., & Schou, K. C. (2007). To be one who continues to smoke: Construction of legitimacy and meaning in young adult's accounts of smoking. *Addiction Research and Theory*, 15, 161-176. doi:10.1080/1606650601179464
- Schwarzer, R. (2004). *Psychologie des Gesundheitsverhaltens. Einführung in die Gesundheitspsychologie* [Introduction to Health Psychology] (3rd ed., revised, pp. 23). Göttingen, DE: Hogrefe.
- Schwarzer, R. (2007). *Procrastination* (online publication). Retrieved from <http://web.fu-berlin.de/gesund/skalen/Prokrastination/prokrastination.htm>
- Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology: An International Review*, 57, 1-29.
- Segall, M. E., & Wynd, C. A. (1990). Health conception, health locus of control, and power as predictors of smoking behaviour change. *American Journal of Health Promotion*, 4, 338-344.
- Shafey, O., Eriksen, M., Ross, H., & Mackay, J. (2009). *The tobacco atlas* (3rd ed.). Atlanta, GA: American Cancer Society.
- Sinner, P., Folsom, A. R., Harnack, L., Eberly, L. E., & Schmitz, K. H. (2006). The association of physical activity with lung cancer incidence in a cohort of older women: The Iowa Women's Health Study. *Cancer Epidemiology, Biomarkers & Prevention*, 15, 2359-1364.
- Tabachnik, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston: Pearson.
- Tabakmonitoring Schweiz. (2008). *Catalogue of questions in the basic module - de*. Zurich, CH: University of Zurich, Department of Psychology. Retrieved from http://www.tabakmonitoring.ch/Fragenkatalog/Fragenkatalog_Basismodul_de.pdf
- Trope, Y., & Fishbach, A. (2000). Counteractive self-control in overcoming temptation. *Journal of Personality and Social Psychology*, 78, 493-506. doi:10.1037/70022-3514.79.4.493
- Xu, K. T. (2002). Compensating behaviors, regret, and heterogeneity in the dynamics of smoking behavior. *Social Science & Medicine*, 54, 133-146.