



## UvA-DARE (Digital Academic Repository)

### Construct and predictive validity of three measures of intention to quit smoking: Findings from the International Tobacco Control (ITC) Netherlands Survey

Hummel, K.; Candel, M.J.J.M.; Nagelhout, G.E.; Brown, J.; van den Putte, B.; Kotz, D.; Willemsen, M.C.; Fong, G.T.; West, R.; de Vries, H.

**DOI**

[10.1093/ntr/ntx092](https://doi.org/10.1093/ntr/ntx092)

**Publication date**

2018

**Document Version**

Final published version

**Published in**

Nicotine & Tobacco Research

**License**

Article 25fa Dutch Copyright Act (<https://www.openaccess.nl/en/in-the-netherlands/you-share-we-take-care>)

[Link to publication](#)

**Citation for published version (APA):**

Hummel, K., Candel, M. J. J. M., Nagelhout, G. E., Brown, J., van den Putte, B., Kotz, D., Willemsen, M. C., Fong, G. T., West, R., & de Vries, H. (2018). Construct and predictive validity of three measures of intention to quit smoking: Findings from the International Tobacco Control (ITC) Netherlands Survey. *Nicotine & Tobacco Research*, 20(9), 1101-1108. <https://doi.org/10.1093/ntr/ntx092>

**General rights**

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

**Disclaimer/Complaints regulations**

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <https://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

UvA-DARE is a service provided by the Library of the University of Amsterdam (<https://dare.uva.nl>)



Original investigation

# Construct and Predictive Validity of Three Measures of Intention to Quit Smoking: Findings From the International Tobacco Control (ITC) Netherlands Survey

Karin Hummel MSc<sup>1</sup>, Math J. J. M. Candel PhD<sup>2</sup>, Gera E. Nagelhout PhD<sup>1,3</sup>,  
Jamie Brown PhD<sup>4</sup>, Bas van den Putte PhD<sup>5,6</sup>, Daniel Kotz PhD<sup>3,7,8</sup>,  
Marc C. Willemsen PhD<sup>1,9</sup>, Geoffrey T. Fong PhD<sup>10,11,12</sup>, Robert West PhD<sup>8</sup>,  
Hein de Vries PhD<sup>1</sup>

<sup>1</sup>Department of Health Promotion, Care and Public Health Research Institute, Maastricht University, Maastricht, The Netherlands; <sup>2</sup>Department of Methodology and Statistics, Care and Public Health Research Institute, Maastricht University, Maastricht, The Netherlands; <sup>3</sup>Department of Family Medicine, Care and Public Health Research Institute, Maastricht University, Maastricht, The Netherlands; <sup>4</sup>Research Department of Clinical, Educational and Health Psychology, University College London, London, United Kingdom; <sup>5</sup>Department of Communication, University of Amsterdam (ASCoR), Amsterdam, The Netherlands; <sup>6</sup>Trimbos Institute, Netherlands Institute for Mental Health and Addiction, Utrecht, The Netherlands; <sup>7</sup>Institute of General Practice, Addiction Research and Clinical Epidemiology unit, Medical Faculty of the Heinrich-Heine-University Düsseldorf, Düsseldorf, Germany; <sup>8</sup>Cancer Research UK Health Behaviour Research Centre, University College London, London, United Kingdom; <sup>9</sup>Dutch Alliance for a Smokefree Society, The Hague, The Netherlands; <sup>10</sup>Department of Psychology, University of Waterloo, Waterloo, ON, Canada; <sup>11</sup>Ontario Institute for Cancer Research, Toronto, ON, Canada; <sup>12</sup>School of Public Health and Health Systems, University of Waterloo, Waterloo, ON, Canada

Corresponding Author: Karin Hummel, MSc, P. Debyeplein 1, 6229 HA Maastricht, The Netherlands. Telephone: 31 43 388 2400; Fax: +31 43 367 1032; E-mail: [karin.hummel@maastrichtuniversity.nl](mailto:karin.hummel@maastrichtuniversity.nl)

## Abstract

**Introduction:** The aim of the study was to compare the construct validity and the predictive validity of three instruments to measure intention to quit smoking: a Stages of Change measure, the Motivation To Stop Scale (MTSS), and a Likert scale. We used the Theory of Planned Behavior as theoretical framework.

**Methods:** We used data from the International Tobacco Control Netherlands Survey. We included smokers who participated in three consecutive survey waves ( $n = 980$ ). We measured attitude, subjective norm, and perceived behavioral control in 2012, intention to quit with three instruments in 2013, and having made a quit attempt in the last year in 2014. We conducted Structural Equation Modeling with three models for the instruments of intention separately and with one model that included the three instruments simultaneously.

**Results:** All three instruments of intention were significantly and positively related to attitude and perceived behavioral control but none was related to subjective norm. All three instruments were significantly and positively related to making a quit attempt. The relation of the Likert scale with making a quit attempt ( $\beta = 0.38$ ) was somewhat stronger than that of the Stages of Change

measure ( $\beta = 0.35$ ) and the MTSS ( $\beta = 0.22$ ). When entering the three instruments together into one model, only the Likert scale was significantly related to making a quit attempt.

**Conclusions:** All three instruments showed reasonable construct validity and comparable predictive validity. Under the studied conditions, the Likert scale performed slightly better than the Stages of Change measure and the MTSS.

**Implications:** An assessment of the Stages of Change, the Motivation To Stop Scale, and a Likert scale showed comparable predictive and construct validity as measures for intention to quit smoking. All three instruments can be used in future research; however, under the studied theoretical framework, that is, the Theory of Planned Behavior, the Likert scale performed slightly better than the other two instruments.

## Introduction

According to the Theory of Planned Behavior (TPB), if smokers evaluate smoking cessation as positive (attitude), if they think that important others want them to quit smoking (subjective norm), and if they are convinced that they can quit (perceived behavioral control), this results in high intention to quit, leading to a higher likelihood of actually quitting.<sup>1,2</sup> Previous research has confirmed that intention to quit is the strongest predictor of making a future quit attempt.<sup>3,4</sup> It is important for researchers to use the most valid instruments to assess these theoretical concepts. The aim of our study was to determine and compare the construct validity and the predictive validity of three different instruments that were used to measure intention to quit smoking in previous research: (1) an assessment of the Stages of Change, (2) the Motivation To Stop Scale (MTSS), and (3) intention measured by a Likert scale.

The Stages of Change concept is part of the Transtheoretical Model,<sup>5</sup> which distinguishes three stages before behavior change: precontemplation (not planning to quit), contemplation (planning to quit within the next 6 months), and preparation (planning to quit within the next month). In the present study, we used a slightly modified algorithm and subdivided the precontemplators by adding a group of smokers who plan to quit smoking beyond the next 6 months because previous research has shown that the group of precontemplators often is not homogenous.<sup>6–11</sup> The MTSS was developed for use in large-scale tracking surveys by West et al. in collaboration with the English Department of Health, and is based on the PRIME Theory of motivation.<sup>12</sup> The instrument incorporates intention (eg, “I intend to stop smoking in the next month”), desire (eg, “I want to stop smoking”), and belief (eg, “I think I should stop smoking”) to quit.<sup>13,14</sup> Another frequently used method to measure intention to quit smoking is by means of a Likert scale, for example, by asking how likely it is that smokers would quit within a specific time frame.<sup>15–18</sup>

Previous studies assessing the validity of measures of intention to quit smoking have been conducted for the Stages of Change, and these have found mixed results.<sup>19–23</sup> Studies about the validity of the MTSS have found a good predictive validity of the instrument.<sup>13,14</sup> We are not aware of any studies about the validity of Likert intention scales in tobacco control research. To the best of our knowledge, this is the first study that analyzes and compares three different measures of intention to quit smoking regarding their construct and predictive validity. Construct validity refers to the extent to which an instrument adequately assesses the theoretical construct it is intended to and was designed to measure.<sup>24</sup> In particular, hypothesized relations of a construct with other constructs should then be reflected by the empirical relations between measurements of these constructs. In the

present study, an instrument of intention has good construct validity if it is positively related to measurements of attitude, subjective norm, perceived behavioral control, and making a quit attempt. Predictive validity refers to the extent to which an instrument can predict a certain outcome that is measured later in time.<sup>25</sup> In the current study, a strong association between the instruments for intention and making a quit attempt would be indicative of good predictive validity.

In the present study, we addressed the following research questions: (1) which of the three instruments has the best construct validity? (2) which of the three instruments has the best predictive validity? and (3) do the different instruments have added value when used together in one model?

## Methods

### Design and Sample

We used data from three consecutive survey waves from the International Tobacco Control (ITC) Netherlands Survey, which is part of the global ITC Project.<sup>26–28</sup> The ITC Netherlands Survey follows a prospective cohort design with annual surveys. Data for Wave 6 were collected in May–June 2012, for Wave 7 in May–June 2013, and for Wave 8 in May–June 2014. The ITC Netherlands Surveys were conducted using computer-assisted web interviews among a probability sample of Dutch smokers and quitters.<sup>29</sup> Respondents who were lost to follow-up between survey waves were replenished by recruiting new respondents from the same sampling frame.<sup>30</sup>

For the current study, we included respondents aged 15 years and older who participated in Waves 6–8 ( $n = 1210$ ) and who were smoking in Waves 6 and 7. This resulted in an analysis sample size of  $n = 980$ . Respondents were classified as smoker if they had smoked at least 100 cigarettes in their lifetime and were currently smoking cigarettes at least monthly.

## Measurements

### Covariates (2012)

An overview of the measured variables is given in [Table 1](#). We included sex, age, monthly gross household income, level of completed education, the Heaviness of Smoking Index (HSI), daily versus occasional smoking status, and whether or not respondents had made a quit attempt in the previous year (measured in 2012) as covariates into the analyses. Age was categorized into: 15–24 years, 25–39 years, 40–54 years, and 55 years and older. Monthly household income was categorized into three levels: low (<2000 Euros), moderate (2000–3000 Euros), and high (>3000 Euros). Completed education was also categorized into three groups: low (primary education and lower prevocational secondary education), moderate

(middle prevocational secondary education and secondary vocational education), and high (senior general secondary education, [pre] university education, and higher professional education). The HSI was used as indicator of the level of nicotine dependence. This index is the sum of the categorized number of cigarettes smoked per day and the time to the first cigarette of the day. The HSI ranges from 0 to 6, with a higher score indicating higher nicotine dependence.<sup>31</sup>

#### TPB Determinants of Intention to Quit (2012)

Smokers' attitude toward quitting smoking was measured by asking: "If you quit smoking within the next 6 months, this would be..." Respondents used a five-point Likert scale to indicate their responses on three continua: unwise to wise, unpleasant to pleasant, and negative to positive.<sup>32</sup> Cronbach's alpha for these items was 0.84.

Subjective norm about quitting was measured by asking smokers: "How do you think that most of the people who are important to you would feel about your quitting smoking within the next 6 months?" Respondents answered this question on a five-point Likert scale (1 = strongly disapprove, 5 = strongly approve).<sup>18</sup>

Perceived behavioral control to quit smoking was measured by asking smokers: "Suppose you want to quit smoking within the next 6 months, will you be able to resist smoking when: ...you just woke up?", "...you have experienced something annoying?", "...you are having a cup of coffee or tea?", "...you are drinking alcohol?", and "... you are offered a cigarette?" Response options for these questions were "I will certainly be able" (5), "I will probably be able" (4), "Maybe I will be able, maybe not" (3), "I will probably not be able" (2), and "I will certainly not be able" (1).<sup>33</sup> Cronbach's alpha for these items was 0.84.

#### Intention to Quit (2013)

The first measure of intention was an assessment based on the Stages of Change. Smokers were asked: "Are you planning to quit smoking: ...within the next month?" (4), "...within the next 6 months?" (3), "...sometime in the future, beyond 6 months?" (2), and "...or are you not planning to quit?" (1).<sup>6-8</sup> Respondents also had the opportunity to answer with "don't know". Those respondents were subsequently asked: "If you had to choose, what would you answer to this question be: Are you planning to quit smoking..." with the same response options as used in the first question.

The second measure was the MTSS. Smokers were asked: "Which of the following best describes you?" Response options were: "I don't want to stop smoking" (1), "I think I should stop smoking but don't really want to" (2), "I want to stop smoking but haven't thought about when" (3), "I really want to stop smoking but don't know when I will" (4), "I want to stop smoking and hope to soon" (5), "I really want to stop smoking and intend to in the next 3 months" (6), and "I really want to stop smoking and intend to in the next month" (7).<sup>13</sup>

For the third measure, we used the question: "Are you planning to quit smoking within the next 6 months?" Respondents answered this question on a five-point Likert scale (1 = very unlikely, 2 = unlikely, 3 = maybe, maybe not, 4 = likely, 5 = very likely).<sup>18</sup>

#### Quit Attempts (2014)

To measure whether respondents had attempted to quit, we asked all respondents: "Have you made any attempts to stop smoking in the last year?" (yes/no).<sup>3</sup>

#### Ethics

The ITC Netherlands Surveys received clearance by the University of Waterloo's Office of Research Ethics.

#### Statistical Analyses

Respondents had the opportunity to refuse to answer the included survey questions or to answer with "don't know". These response options were recoded into missing values. The variable with most missing values was income (30.4%,  $n=298$ ). The missing values of all variables were filled using multiple imputation. This procedure saves persons for the analysis and thus yields more power for statistical testing. Analysis based on multiple imputation is a valid procedure in case the data are missing at random, that is, the missingness only depends on variables included in the analysis.<sup>34</sup> Because the percentage of incomplete cases was 47%, following guidelines on the number of imputations,<sup>35</sup> analysis results are presented that are based on 50 imputed data sets.

We conducted attrition analyses, sample description, and correlation analyses using SPSS 21.0. To examine the construct and predictive validities of the three instruments for intention, we performed Structural Equation Modeling using Mplus 7.3.<sup>36</sup> The Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Root-Mean-Square Error of Approximation (RMSEA) were used to determine the model fits. A good model fit was indicated if the CFI and the TLI were more than 0.90 and the RMSEA was less than 0.05.<sup>37</sup> We entered attitude and perceived behavioral control as latent constructs into the analyses. All other concepts were measured with single items and therefore entered as observed variables. The three measures of intention were not normally distributed and therefore specified as categorical variables. We adjusted all analyses for the previously described covariates. We furthermore applied sampling weights for age and gender to make the data representative for the population of Dutch smokers. To answer the first two research questions, we tested the model three times, with one model for each measure of intention. To answer research question three, we tested the model with all three instruments entered simultaneously. We calculated the degree of multicollinearity for all models, and this turned out to be low. The variance inflation factors ranged from 2.47 to 2.76 for the three intention instruments. The cutoff points for these values vary, but in general, variance inflation factors smaller than 10 indicate that the degree of multicollinearity is not problematic.<sup>38,39</sup>

#### Results

##### Attrition Analyses

We compared respondents who were included in the analysis sample ( $n = 980$ ) with respondents who were excluded, either because they quit smoking in Wave 7 or dropped out of the cohort ( $n = 624$ ). The mean age of smokers who were included (40.8 years) was higher than the mean age of smokers who were excluded (36.1 years) ( $t = 5.97$ ,  $p < .001$ ). Smokers who were included had a higher level of nicotine dependence ( $t = 2.29$ ,  $p < .05$ ). The proportion of daily smokers compared to occasional smokers was higher in the analysis sample than in the group that was excluded ( $\chi^2 = 10.1$ ,  $p < .01$ ). Smokers who were included into the analysis sample and smokers who were excluded did not differ regarding the sex distribution, their income, education, attitude toward quitting, perceived behavioral control to quit, subjective norm about quitting, and any of the three intention instruments.

## Sample Description

In 2012, most respondents of the analysis sample ( $n = 980$ ) were daily smokers (93.1%) and had made no quit attempt in the previous year (70.7%) (see Table 1). Furthermore, most respondents had quite a low intention to quit smoking in 2013. Regarding the Stages of Change measure, most smokers (58.9%) planned to quit sometime in the future, beyond 6 months. Almost one-third of the smokers (32.6%) scored level 2 of the MTSS, indicating that they thought they should stop smoking but did not really want to. Most smokers (39.1%) scored level 3 of the Likert scale, indicating that they “maybe or maybe not” would quit smoking within the next 6 months. In 2014, 33.5% of the respondents had made a quit attempt in the previous year.

## Correlations

Table 2 shows the correlations between the TPB determinants (measured in 2012), the three intention measures (in 2013), and making a quit attempt (in 2014). Attitude, subjective norm, and perceived behavioral control were significantly correlated with all three intention instruments. Attitude correlated more strongly (range from  $r = 0.35$  to  $r = 0.39$ ) with all three instruments than subjective norm (range from  $r = 0.15$  to  $r = 0.24$ ) and perceived behavioral control (range from  $r = 0.19$  to  $r = 0.24$ ). Furthermore, attitude was highly correlated with subjective norm ( $r = 0.48$ ,  $p < .001$ ). All three measures of intention correlated significantly with making a quit attempt (the Likert scale:  $r = 0.35$ ,  $p < .001$ ; the Stages of Change measure:  $r = 0.32$ ,  $p < .001$ ; and the MTSS:  $r = 0.31$ ,  $p < .001$ ).

## Structural Equation Models

### Models with Separate Instruments of Intention

The model fit indicators of the three models were reasonable (CFI = 0.93–0.94, TLI = 0.88–0.89, RMSEA = 0.03–0.04). The factor loadings of attitude and perceived behavioral control were all significant.

The model that included the Stages of Change measure explained 25% of the variance in making a quit attempt. Attitude ( $\beta = 0.37$ ,  $p < .001$ ) and perceived behavioral control ( $\beta = 0.16$ ,  $p < .01$ ) were significantly and positively related to the Stages of Change measure, but subjective norm was not significantly related ( $\beta = 0.04$ ,  $p = .43$ ) (see Figure 1A). Furthermore, the Stages of Change measure was significantly and positively related to making a quit attempt ( $\beta = 0.35$ ,  $p < .001$ ).

The model that included the MTSS explained 20% of the variance in making a quit attempt. Attitude was significantly and positively related to the MTSS ( $\beta = 0.43$ ,  $p < .001$ ), as was perceived behavioral control ( $\beta = 0.09$ ,  $p < .05$ ) (see Figure 1B). In contrast, subjective norm was not related to the MTSS ( $\beta = -0.01$ ,  $p = .77$ ). Moreover, the MTSS was significantly and positively related to making a quit attempt ( $\beta = 0.22$ ,  $p < .001$ ).

The model that included the Likert scale explained 27% of the variance in making a quit attempt. Attitude ( $\beta = 0.32$ ,  $p < .001$ ) and perceived behavioral control ( $\beta = 0.18$ ,  $p < .001$ ) were significantly and positively related to the Likert scale, but subjective norm was not ( $\beta = -0.04$ ,  $p = .38$ ) (see Figure 1C). The Likert scale was also significantly and positively related to making a quit attempt ( $\beta = 0.38$ ,  $p < .001$ ).

### Model With All Three Instruments of Intention

Figure 2 shows the results of the model with all three instruments of intention entered at once. All three instruments were related to attitude. The Stages of Change measure and the Likert scale were also

**Table 1.** Sample Characteristics for 2012, 2013, and 2014 (Weighted Data)

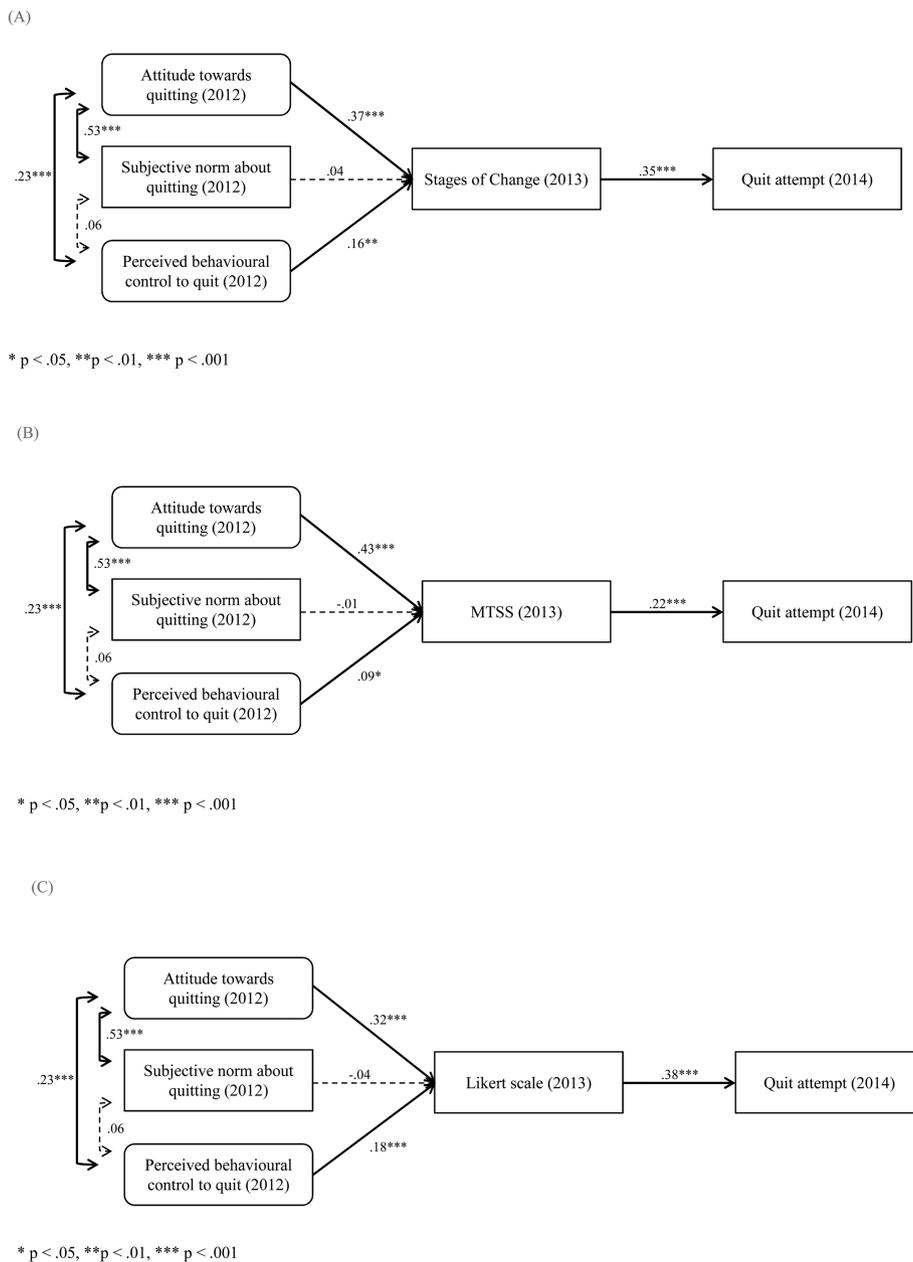
Included measures	Analysis sample ( $n = 980$ )
2012	
Sex	
Male, %	50.3
Age	
15–24 years, %	21.4
25–39 years, %	25.2
40–54 years, %	30.0
55 years and older, %	23.4
Income	
Low, %	44.4
Moderate, %	31.5
High, %	24.0
Education	
Low, %	31.8
Moderate, %	47.3
High, %	20.9
Heaviness of Smoking Index (HIS), mean (SD)*	2.36 (1.50)
Smoking status	
Daily smoker, %	93.1
Occasional smoker, %	6.9
Quit attempt made in the last year	
Yes, %	29.3
Attitude toward quitting, mean (SD)**	3.98 (0.76)
Subjective norm about quitting, mean (SD)**	4.22 (0.79)
Perceived behavioral control to quit, mean, (SD)**	3.26 (0.92)
2013	
Stages of change, % (n)	
Not planning to quit	17.9 (159)
Beyond 6 months,	58.9 (524)
Within the next 6 months	18.6 (165)
Within the next month	4.6 (41)
Motivation To Stop Scale (MTSS), % (n)	
I don't want to stop smoking	18.6 (177)
I think I should stop smoking but don't really want to	32.6 (311)
I want to stop smoking but haven't thought about when	17.8 (170)
I really want to stop smoking but I don't know when I will	16.9 (161)
I want to stop smoking and hope to soon	8.3 (79)
I really want to stop smoking and intend to in the next 3 months,	3.4 (32)
I really want to stop smoking and intend to in the next month	2.4 (23)
Likert scale (“Are you planning to quit within the next 6 months?”), % (n)	
Very unlikely	20.3 (195)
Unlikely	24.6 (237)
Maybe, maybe not	39.1 (376)
Likely	8.8 (85)
Very likely	7.2 (69)
2014	
Quit attempt made in the last year	
Yes, %	33.5

\*On a scale from 0 to 6, \*\*on a scale from 1 to 5.

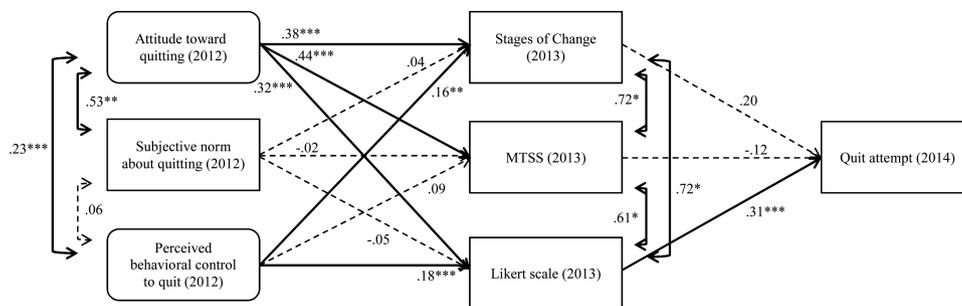
**Table 2.** Pearson Correlations Between the TPB Determinants (2012), Intention to Quit Measures (2013), and Making a Quit Attempt (2014)

Included measures	1	2	3	4	5	6	7
1. Attitude toward quitting (2012)	1.00						
2. Subjective norm about quitting (2012)	.48***	1.00					
3. Perceived behavioural control to quit (2012)	.19***	.05	1.00				
4. Stages of Change (2013)	.39***	.24***	.22**	1.00			
5. Motivation to Stop Scale (MTSS) (2013)	.39***	.20***	.19**	.71***	1.00		
6. Likert scale (2013)	.35***	.15***	.24***	.69***	.67***	1.00	
7. Quit attempt (2014)	.17***	.11**	.10**	.32***	.31***	.35***	1.00

\*\* $p < .01$ , \*\*\* $p < .001$ .



**Figure 1.** Structural Equation Models assessing the pathways between the TPB determinants (2012), (A) the Stages of Change measure (2013), (B) the MTSS (2013), (C) the Likert scale (2013) and making a quit attempt (2014). To simplify the presentation, the covariates and factor loadings were left out, and only pathways and estimates of interest are depicted. Dashed arrows indicate nonsignificant estimates. The reported results are for standardized variables. MTSS = Motivation to Stop Scale; TPB = Theory of Planned Behavior.



\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Figure 2.** Structural equation model assessing the pathways between the TPB determinants (2012), the three instruments for intention to quit (2013) and making a quit attempt (2014). To simplify the presentation, the covariates and factor loadings were left out, and only pathways and estimates of interest are depicted. Dashed arrows indicate nonsignificant estimates. The reported results are for standardized variables. MTSS = Motivation To Stop Scale; TPB = Theory of Planned Behavior.

related to perceived behavioral control. However, in this model, only the Likert scale was significantly related to making a quit attempt ( $\beta = 0.31$ ,  $p < .001$ ). The other two instruments did not have a significant contribution in addition to the Likert scale in explaining the variation in quit attempts.

## Discussion

The aim of the current study was to determine the construct as well as the predictive validity of three measures of intention to quit smoking in the context of the TPB.<sup>1</sup> We compared a measure of the Stages of Change, the MTSS, and a Likert scale.

Our first research question was which of the three instruments had the best construct validity. None of the tested instruments was positively related to subjective norm about quitting, but all of them were positively related to attitude about quitting, perceived behavioral control to quit, and attempts to quit. This indicates that all three instruments had comparable and reasonable construct validity in our study. Previous research has also found a weak relation between subjective norm and quit intention.<sup>6,40,41</sup> Therefore, it is possible that our results are not an indicator for low validity of the instruments for quit intention but that subjective norm is actually weakly related to intention to quit smoking.

The second research question was which instrument had the best predictive validity. The model that included the Likert scale had the highest explained variance in making a quit attempt. Furthermore, the relation of the Likert scale with making a quit attempt was slightly stronger than the relation of the Stages of Change measure and the MTSS. Therefore, the predictive validity of the Likert scale was somewhat better than that of the Stages of Change measure and the MTSS. It should be noted that all three instruments were significantly positively related to making a quit attempt.

We also entered all three instruments together in one model to examine whether they would have added value to each other (third research question). Only the Likert scale was significantly and positively related to making a quit attempt in that model. The other two instruments seemed to add no extra information to the prediction of making a quit attempt. This means that in future studies, under conditions that are similar to those of the present study, it is not necessary to add more than one instrument of intention to a model that aims to explain quit attempts.

The three instruments used different response options and labels which led to different categorizations of intention, and smokers were allocated into subgroups in a different way. The Stages of Change measure uses four response options, and all of them include fixed time frames of when a smoker plans to quit. The MTSS is more sensitive by using seven response options of which some use fixed timeframes. The Likert scale only asks about the intention to quit in the next 6 months and uses no further timeframes. Researchers of future studies should be aware of those differences between the instruments. If one wants to use an instrument with the highest predictive validity and relatively high construct validity under the TPB, the Likert scale seems to be a good choice. However, if one wants to have more information about when exactly a respondent plans to quit and, for example, wants to tailor an intervention based on the moment a smoker intends to quit, a researcher might prefer using the Stages of Change measure or the MTSS.

## Limitations

The current study has several limitations. First of all, we only investigated whether attitude, subjective norm, and perceived behavioral control would be related to the three measures of intention to quit. It is possible that other constructs are related to intention as well, such as the “processes of change” of the Transtheoretical Model.<sup>42</sup> However, these variables were not included in the ITC Netherlands Survey. Second, we used mainly observed variables in the current study. It would be important to compare our results with models that solely use latent variables, in particular, for subjective norm because subjective norm was not related to any of the intention instruments. It is possible that full construct validity could not be shown due to the single item measure that we used for subjective norm, making correlations with this measure prone to attenuation effects because of its moderate reliability. Third, there was 1 year between the measurements of the TPB determinants, the measurements for intention to quit, and making a quit attempt. It is possible that a different time interval might produce different results. Fourth, we could not adjust our analyses for respondents’ baseline intention to quit because the MTSS was only since 2013 included into the ITC Netherlands Survey. Finally, our results may not be fully generalizable to the whole population of Dutch smokers. Smokers who were less addicted and occasional smokers were more likely to be

excluded from the analyses. In particular, we found higher dropout of young respondents, which has been reported in a previous publication about attrition in the ITC Netherlands Survey.<sup>30</sup>

## Conclusion

In this study of smokers in the Netherlands, a measure of the Stages of Change, the MTSS, and a Likert scale showed comparable and reasonable construct validity as well as comparable predictive validity as instruments of intention to quit. The conditions of construct validity and predictive validity were slightly better met by the Likert scale in comparison with the other two instruments in our study.

## Funding

The ITC Netherlands Surveys were supported by a grant from the Netherlands Organisation for Health Research and Development (ZonMw) (200130002). JB's post is funded by a fellowship from the Society for the Study of Addiction and Cancer Research UK also provide support (C1417/A14135). DK is funded by the Ministry for Innovation, Science and Research of the German Federal State of North Rhine-Westphalia ("NRW-Rückkehrprogramm"). Additional support was provided to GTF from a Senior Investigator Award from the Ontario Institute for Cancer Research and a Prevention Scientist Award from the Canadian Cancer Society Research Institute. RW is funded by Cancer Research UK (C1417/A14135).

## Declaration of Interests

JB has received unrestricted research grants relating to smoking cessation from Pfizer. RW undertakes research and consultancy and receives fees for speaking from companies that develop and manufacture smoking cessation medications (Pfizer, J&J, McNeil, GSK, Nabi, Novartis, and Sanofi-Aventis).

## Acknowledgments

Several members of the ITC Project team at the University of Waterloo have assisted in all stages of conducting the ITC Netherlands Survey, which we gratefully acknowledge. In particular, we thank Thomas Agar, the Project Manager of the ITC Europe Project, and Anne Quah, the Project Manager of the ITC Project.

## References

1. Ajzen I. The theory of planned behavior. *Organizational Behavior and Human Decision Processes* 50. Vol 21991:179–211.
2. De Vries H, Mudde A. Predicting stage transitions for smoking cessation applying the attitude – social influence – efficacy model. *Psychology & Health*. 1998;13(2):369–385.
3. Hyland A, Borland R, Li Q, et al. Individual-level predictors of cessation behaviours among participants in the International Tobacco Control (ITC) Four Country Survey. *Tob Control*. 2006;15(Suppl 3):iii83–iii94.
4. Vangeli E, Stapleton J, Smit ES, Borland R, West R. Predictors of attempts to stop smoking and their success in adult general population samples: a systematic review. *Addiction*. 2011;106(12):2110–2121.
5. Prochaska JO, DiClemente CC. The transtheoretical approach. In: Norcross JC, Goldfried MR, eds. *Handbook of Psychotherapy Integration*. 2nd ed. New York: Oxford University Press; 2005:147–171.
6. Nagelhout GE, de Vries H, Fong GT, et al. Pathways of change explaining the effect of smoke-free legislation on smoking cessation in The Netherlands. An application of the international tobacco control conceptual model. *Nicotine Tob Res*. 2012;14(12):1474–1482.
7. Hall PA, Fong GT, Yong HH, Sansone G, Borland R, Siahpush M. Do time perspective and sensation-seeking predict quitting activity among smokers? Findings from the International Tobacco Control (ITC) Four Country survey. *Addict Behav*. 2012;37(12):1307–1313.
8. Borland R, Partos TR, Yong HH, Cummings KM, Hyland A. How much unsuccessful quitting activity is going on among adult smokers? Data from the International Tobacco Control Four Country cohort survey. *Addiction*. 2012;107(3):673–682.
9. Dijkstra A, Bakker M, De Vries H. Subtypes within a sample of precontemplating smokers: a preliminary extension of the stages of change. *Addict Behav*. 1997;22(3):327–337.
10. Balmford J, Borland R, Burney S. Exploring discontinuity in prediction of smoking cessation within the precontemplation stage of change. *Int J Behav Med*. 2008;15(2):133–140.
11. Herzog TA, Blagg CO. Are most precontemplators contemplating smoking cessation? Assessing the validity of the stages of change. *Health Psychol*. 2007;26(2):222–231.
12. West R, Brown J. *Theory of Addiction*. 2nd ed. Oxford: John Wiley & Sons, Ltd.; 2013.
13. Kotz D, Brown J, West R. Predictive validity of the Motivation To Stop Scale (MTSS): a single-item measure of motivation to stop smoking. *Drug Alcohol Depend*. 2013;128(1-2):15–19.
14. Hummel K, Brown J, Willemsen MC, West R, Kotz D. External validation of the Motivation To Stop Scale (MTSS): findings from the International Tobacco Control (ITC) Netherlands Survey. *Eur J Public Health*. 2017;27(1):129–134.
15. Wong NC, Cappella JN. Antismoking threat and efficacy appeals: effects on smoking cessation intentions for smokers with low and high readiness to quit. *J Appl Commun Res*. 2009;37(1):1–20.
16. Smit ES, De Vries H, De Munter L, Hoving C. Depressive symptoms' association with smoking-related cognitions and their influence on smoking cessation behaviour. *OA Epidemiology*. 2013;1(2).
17. Bakker EC, Nijkamp MD, Sloot C, Berndt NC, Bolman CA. Intention to abstain from smoking among cardiac rehabilitation patients: the role of attitude, self-efficacy, and craving. *J Cardiovasc Nurs*. 2015;30(2):172–179.
18. Van den Putte B, Yzer MC, Brunsting S. Social influences on smoking cessation: a comparison of the effect of six social influence variables. *Prev Med*. 2005;41(1):186–193.
19. Bondy SJ, Victor JC, O'Connor S, McDonald PW, Diemert LM, Cohen JE. Predictive validity and measurement issues in documenting quit intentions in population surveillance studies. *Nicotine Tob Res*. 2010;12(1):43–52.
20. Herzog TA. Analyzing the transtheoretical model using the framework of Weinstein, Rothman, and Sutton (1998): the example of smoking cessation. *Health Psychol*. 2008;27(5):548–556.
21. Velicer WF, Norman GJ, Fava JL, Prochaska JO. Testing 40 predictions from the transtheoretical model. *Addict Behav*. 1999;24(4):455–469.
22. Kraft P, Sutton SR, McCreath Reynolds H. The transtheoretical model of behaviour change: are the stages qualitatively different? *Psychology & Health*. 1999;14(3):433–450.
23. Dijkstra A, Conijn B, De Vries H. A match-mismatch test of a stage model of behaviour change in tobacco smoking. *Addiction*. 2006;101(7):1035–1043.
24. Nunnally JC, Bernstein IH. *Psychometric Theory*. 3rd ed. New York: McGraw-Hill; 1994.
25. Cronbach LJ, Meehl PE. Construct validity in psychological tests. *Psychol Bull*. 1955;52(4):281–302.
26. ITC Project. International Tobacco Control Policy Evaluation Project. 2016; [www.itcproject.org](http://www.itcproject.org). Accessed 9.6.2015.
27. Fong GT, Cummings KM, Borland R, et al. The conceptual framework of the International Tobacco Control (ITC) Policy Evaluation Project. *Tob Control*. 2006;15 Suppl 3:iii3–11.
28. Thompson ME, Fong GT, Hammond D, et al. Methods of the International Tobacco Control (ITC) Four Country survey. *Tob Control*. 2006;15 Suppl 3:iii12–18.
29. Nagelhout GE, Willemsen MC, Thompson ME, Fong GT, van den Putte B, de Vries H. Is web interviewing a good alternative to telephone interviewing?

- Findings from the International Tobacco Control (ITC) Netherlands survey. *BMC Public Health*. 2010;10(351): DOI:10.1186/1471-2458-10-351.
30. Zethof D, Nagelhout GE, de Rooij M, et al. Attrition analysed in five waves of a longitudinal yearly survey of smokers: findings from the ITC Netherlands survey. *Eur J Public Health*. 2016;26(4):693–699.
  31. Heatherton TF, Kozlowski LT, Frecker RC, Rickert W, Robinson J. Measuring the heaviness of smoking: using self-reported time to the first cigarette of the day and number of cigarettes smoked per day. *Br J Addict*. 1989;84(7):791–799.
  32. Van den Putte B, Yzer MC, Brunsting S, Willemsen MC. Sociale invloeden op stoppen met roken. *Tijdschrift voor Communicatiewetenschap*. 2005;33:262–272.
  33. Hoving EF, Mudde AN, de Vries H. Smoking and the  $\emptyset$  pattern; predictors of transitions through the stages of change. *Health Educ Res*. 2006;21(3):305–314.
  34. Enders CK. *Applied Missing Data Analysis*. New York, NY: Guilford Press; 2010.
  35. White IR, Royston P, Wood AM. Multiple imputation using chained equations: issues and guidance for practice. *Stat Med*. 2011;30(4):377–399.
  36. Muthén LK, Muthén BO. *Mplus User's Guide*. Los Angeles, CA: Muthén & Muthén 2007.
  37. Hox JJ, Bechger TM. An introduction to Structural Equation Modeling. *Family Science Review*. 1998;11:354–373.
  38. Menard S. Applied logistic regression analysis. *Sage University Paper Series on Quantitative Applications in the Social Sciences*. Thousand Oaks, CA: Sage; 1995:07-106.
  39. Myers R. *Classical and Modern Regression with Applications*. 2nd ed. Boston, MA: Duxbury; 1990.
  40. Godin G, Valois P, Lepage L, Desharnais R. Predictors of smoking behaviour: an application of Ajzen's theory of planned behaviour. *Br J Addict*. 1992;87(9):1335–1343.
  41. Armitage CJ, Conner M. Efficacy of the Theory of Planned Behaviour: a meta-analytic review. *Br J Soc Psychol*. 2001;40(Pt 4):471–499.
  42. Velicer WF, Prochaska JO, Fava JL, Norman GJ, Redding CA. Smoking cessation and stress management: Applications of the Transtheoretical Model of behavior change. *Homeostasis*. 1998;38(5–6):216–233.