

Evaluating smoking attitudes in response to different types of anti-smoking messages  
using a Highly Repeated Within-Person Design

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**Abstract**

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Counter-marketing of tobacco use is an important component of preventing tobacco initiation and encouraging quitting among current smokers, and has contributed to overall reduction of smoking prevalence. However, further reduction in smoking may require tailoring anti-smoking health messages for individuals and those groups among which smoking prevalence remains high in order to reduce tobacco related health disparities. This research tested a novel technique (HRWP) to explore individual differences in people's responses to various types of anti-smoking messages by identifying the "active ingredients" of messages, and assessing which types of messages are effective in changing attitudes for each individual. A sample of young adult college students, aged 18-24, was recruited to participate in 3 studies. Using the HRWP design, each

subject was exposed to a representative sample of national anti-smoking messages (from CDC, FDA and Legacy), followed by a survey to assess their responses to each of the messages. Messages that were effective in increasing anti-smoking attitudes for each participant were identified using multilevel modeling. Significant individual differences in effectiveness of different types of message were found and groups of people with similar response patterns were identified. For example, while people who never smoked were responsive to messages that portray the harmful effects of one person's smoke on others, people who have ever smoked appear not to be responsive to such messages. This study demonstrates an innovative method that can be used for tailoring effective anti-smoking messages for individuals who are both smokers and nonsmokers.

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Smoking remains the world's leading cause of preventable death (Centers for Disease Control and Prevention, 2014). An estimated 18.1% of the population in the United States smokes cigarettes and the estimates are higher among people of certain racial and ethnic backgrounds than others (CDC, 2014). Smoking costs the U.S. government close to \$289 billion dollars annually in medical costs and loss in productivity. To address this, the government uses many strategies to reduce smoking rates, including anti-smoking messages communicated through mass media. For example, last year, the Food and Drug Administration (FDA) launched a new 112 million dollar campaign, "The Real Cost" aimed at teenagers (<http://therealcost.betobaccofree.hhs.gov/>).

While anti-smoking messages have been successful in reducing smoking rates overall (Wakefield, Loken, & Hornik, 2010), disparities among different groups of people in smoking behavior and health have increased over time. For example, smoking rates and risks for smoking in the LGBT community are disproportionately high (Blosnich, Lee, & Horn, 2013), and smokers of lower socioeconomic status (SES) are more likely to smoke heavily (more than 15 cigarettes a day) and have no plan to quit smoking than people of higher SES groups (Clare, Bradford, Courtney, Martire, & Mattick, 2014).

To reduce these disparities, more targeted anti-smoking campaigns could be used, and a more nuanced study of communication is needed to explore the most effective ways to communicate to different groups. For example, Durkin, Bayly, Cotter, Mullin, & Wakefield (2013) found that to reduce smoking among lower SES samples, messages that contained personal stories and highly emotional appeals were particularly effective. However, studies like

this assume that all people of low SES tend to respond in mostly similar ways. As this is unlikely to be the case, it is difficult to identify a single ‘cure-all’ method that is equally effective for every member of a target audience.

People also vary, not only along demographic dimensions, but also on psychological variables (sometimes called “psychographics”). The tobacco industry utilizes psychological information about various market segments very effectively to increase cigarette smoking. For instance, the industry has targeted lower SES women (especially racial minorities) for years by offering discounts, coupons to this “discount susceptible” audience, along with brand images that portray smoking as luxurious or prestigious which these women found highly appealing (Brown-Johnson, England, Glantz, & Ling, 2014).

This increases the need to study the psychological characteristics of audience to better shape anti-smoking communication as countermarketing, to both help individuals to quit and as a preventative tool. Studies have demonstrated how powerful interventions can be when tailored to appeal to the psyche of the perceiver (for e.g. see Ling et al., 2014). As every individual is different along multiple demographic and psychological dimensions, I argue that the most effective approach to take is to individually tailor communication for each person.

### **Why it is important to examine the effectiveness for each person**

Anti-smoking communication research typically looks at whether exposure to a given message or type of message has produced a mean level change in quitting intention or a behavior in a given sample, as compared to a control sample. In doing so, we may overlook individual persons for whom a given message has not worked, and indeed, may have *backfired*. An analysis of tweets related to the CDC’s Tips Campaign, which featured some intensely graphic images and videos, for example, found that while the majority of responses showed acceptance of fearful

responses, about 7% of the tweets showed a backfiring of the intended effect, as evidenced by reactance, denial or a strongly stated intention to smoke upon being threatened (Emery, Szczypka, Abril, Kim, & Vera, 2014).

Research has warned that public health communication should be tested extensively before being used, to avoid a *boomerang effect* where viewers express a heightened intent to use a drug, contrary to expectations (Fishbein, Hall-Jamieson, Zimmer, Von Haefen, & Nabi, 2002). This research outlines a method to test exactly how each individual responds to anti-smoking messages using multilevel modeling. Using this method can help researchers identify individuals who respond both positively and negatively, so as to maximize efficacy of anti-smoking communication and decrease risks of unintended negative reactions. Alternatively, if a message has no impact on someone, we do not have to invest resources on that avenue.

Tailoring of anti-smoking messages is not a new idea, and is generally considered to be an effective approach (Noar, Benac, & Harris, 2007). A more important question is: how can we effectively identify which kinds of messages are effective in persuading a particular person not to smoke? This research examines the feasibility of using a method called the *Highly Repeated Within-Person (HRWP) Design* to answer these questions.

### **Tailoring using HRWP Design**

Tailoring can be particularly effective at the individual level because messages with content relevant to the self are particularly effective in shaping behavior (Bryan, Walton, Rogers, & Dweck, 2011; Hawkins, Kreuter, Resnicow, Fishbein, & Dijkstra, 2008). The current research focuses on identifying the kinds of themes and messages that will be appealing to different individuals. This is done in several stages, the first of which is to identify the “psychologically

active ingredients” or those core characteristics of anti-smoking messages that will be particularly effective in motivating people not to smoke.

This is important to find out, so that we learn that a given *type of message* is effective for a given person, and that certain types of messages can backfire or not have any effect on that person’s attitude. This will give us the ability to tailor messages for that person that captures the *themes that are effective* while avoiding those that are not. Characterizing messages along the identified active ingredients thus gives us more generalizability about what the most effective types of messages are for a given individual instead of simply telling us if a *specific message* is effective or not. This aspect of the HRWP sets this work apart from previous literature on tailoring anti-smoking messages, which has tended to concentrate on applying different theories of behavior towards tailoring, and on occasion, demographics (Noar et al., 2007).

In the next stage of the study, individuals are exposed to a variety of anti-smoking messages that vary in these “psychologically active ingredients” and their attitude toward smoking upon viewing each of these messages is recorded. Multilevel modeling is then used to see if effectiveness of each of these active ingredients in changing smoking attitudes is the same across individuals or different. If individuals respond to different anti-smoking messages in significantly different ways from each other, it is a good indication that tailoring to individuals will be beneficial. This research can also be used to build a theory about which kinds of messages are particularly effective for different individuals.

### **Study 1. Identifying the active ingredients of anti-smoking messages.**

Following the steps (see Figure 1) outlined in the Highly Repeated Within-Person Design (Whitsett & Shoda, 2014), the behavior of interest is first identified (in the present research, smoking attitude in response to persuasive anti-smoking messages). Ideally, the actual behavior

of smoking would be assessed, but as the paradigm is a highly repeated one, it was most practical to assess smoking attitude, which is an important determinant of behavior (Kraus, 1995). Next, a large body of stimuli was assembled. 46 anti-smoking messages were selected from extensive online searches using keywords and key phrases such as “anti-smoking messages” or “anti-smoking ads”. Selected stimuli were all still-images with text from previously or currently run anti-smoking campaigns by Government or non-governmental agencies and organizations in the US (for e.g., the Truth campaign from the Legacy Foundation and some from the CDC’s Tips from Former Smokers Campaign).

## **Method**

### **Characterizing the stimulus set**

The next step in the HRWP Design is to identify the *active ingredients* or those features of the situation that influence smoking attitude. This was done taking a bottom-up approach. Participants ( $N = 82$ ) were recruited from an introduction to psychology class and asked to view the selected 46 messages in random order. After viewing each anti-smoking message, they responded on an open ended question “Do you think this message is effective as an anti-smoking message? What aspect of this message has the greatest impact on you?” A team of research assistants read through all the responses and extracted all key phrases that occurred repeatedly in the responses. After extended discussion on the key phrases, the list was reduced to 49 characteristics. These included items such as “this message shows that smoking makes people look less youthful” and “this message shows how smoking affects a specific part of the body”.

### **Identifying active ingredients of anti-smoking message**

New raters ( $N = 156$ ) rated each of the stimuli on the extent to which the different characteristics applied to each message using a Likert scale of 1(not at all) - 7(very much). This

was to determine the extent to which each of the characteristics was present in each stimulus. Each participant rated all stimuli on 3 randomly selected characteristics. Inter-rater reliabilities were computed for items and items with high inter-rater correlations (over .7) were retained for further analysis.

All the remaining rated characteristics were submitted to a Principal Components Analysis with Varimax rotation to reduce the number of variables characterizing anti-smoking message stimuli. A scree plot indicated that 3 factors (accounting for 61% of variance) presented a reasonable solution. The items and loadings on each factor are presented in Table 1. The first factor is labeled “Graphic Evidence”, which includes evidence for the negative consequences of smoking, that can be shocking, disgusting and communicates with some urgency the permanent, typically anatomical damage done to smokers. The second factor that emerged from this analysis is “source credibility”, which includes whether the message appears to be from an official source, whether it looks fake or employs real humans or cartoon-like images (as in infographics) and suggests a course of action (such as providing links to visit a website with more information). The final factor is “Other-Focus” which includes information on how one person’s smoke affects others, such as messages on secondhand smoke, pregnant mothers, children of parents who smoke, etc.

### **Definitional Categories and Ratings**

**Procedure.** Using the three factors that have been identified, a short rating measure was developed for repeated administration in the next phase of the study. Since the HRWP design requires repeated administration of questions, a short scale to rate each of the stimuli was developed using the definitional approach (adapted from Ptacek, Smith, Espe, & Raffety, 1994; Stone & Neale, 1984). First, factors are labeled and then defined with a list of component items

(see table 2). One these definitional categories were randomly chosen for each rater, who rated all stimuli on the extent to which it fits that category. Every rater is provided with example stimuli to rate to familiarize them before the task, and they rated for only one category. The first factor “Graphic evidence” was distinguished into 2 separate theoretical constructs, “Graphic Nature” and “Evidence” in order to make it easy for raters to evaluate the features of messages,. That is, they were provided with 2 separate questions. The “graphic” component includes the shocking and disgusting nature of stimuli, and the “evidence” component simply includes facts, statistics or any kind of evidence. As it happens, these happened to covary very highly among the 46 messages examined in this study, although there are examples of messages that contain one but not the other. In all analyses, the two ratings were averaged to get one rating for graphic evidence for all the stimuli.

## **Results**

With this the characterization of the stimuli is complete. As expected, the “graphic” and “evidence” ratings were highly positively correlated at  $r = .77, p < .001$  and were averaged to make a single factor. The stimuli selected in the study had a range of ratings for “graphic evidence” ( $M = 4.28, SD = 1.11$ ), “source credibility” ( $M = 4.47, SD = 1.03$ ) and “other-focus” ( $M = 3.51, SD = 1.58$ ). Source credibility was also positively correlated with graphic evidence ( $r = .58, p < .001$ ). Other focus was not correlated with any other factor.

## **Discussion**

Following the steps outlined by the HRWP Design, a set of anti-smoking message stimuli were gathered and analyzed in a bottom-up fashion to reveal 3 underlying “psychologically active ingredients”. These items were labeled “Graphic Evidence”, “Source Credibility” and “Other-focus” and condensed into factors presented in Table 2. The stimuli were rated along

each of these dimensions. The average of these independent ratings for each factor was used in study 2, while participants in study 3 provided their own ratings of the described factors.

It is worth noting that while the results of the factor analysis provide three convenient factors to test, there are many dimensions of messages (humor or gender-specificity for example) that participants pointed out to be effective, that did not load on to any of these 3 factors, and that might still influence attitude and behavior. The results of the factor analysis also depend on the type of stimuli used in the study. I used a range of stimuli from anti-smoking campaigns from various agencies (CDC, Legacy, etc.). Since many sets of stimuli were from the same campaign, there is a good chance they already follow a formula considered effective by these organizations. In the next study, responses to each of these active ingredients are assessed using multilevel modeling.

## **Study 2: Pilot study**

### **Method**

#### **Participants**

Participants ( $N = 56$ ; age = 18-24 years ( $M = 19.4$ ), 73% female, 29% White, 50% Asian, 21% other races, 57% never-smokers) participated in exchange for psychology extra credit. 12 participants were excluded due to computer errors and for providing incomplete data. 2 participants were excluded for reporting only 0s in their smoking attitude measures. They self-reported a previously established extremely negative attitude towards smoking that anti-smoking messages were unlikely to move. Data was analyzed for the remaining 42 participants.

#### **Procedure**

Participants were shown each anti-smoking message presented in randomized order on a computer screen. After viewing each message, participants reported its effectiveness (e.g. “this

message would prevent you from smoking”) as well as their smoking attitude on feeling thermometer (“how favorable or unfavorable do you feel towards smoking” on a 0-extremely cold or unfavorable – 100 extremely warm or favorable scale) after viewing each message. Participants were instructed to report less favorable attitudes after viewing messages that they considered particularly effective.<sup>1</sup> Participants also filled out questionnaires indicating demographic information (age, gender, race, and ethnicity) and their smoking history.

## Results

This dataset contains nested data of multiple observations within individuals and individuals within groups. Multilevel modeling was used to analyze how smoking attitude covaries with these active ingredients for each individual. More specifically, Hierarchical Linear Modeling (Raudenbush & Bryk, 2002) was used to predict how strongly each of the active ingredients of anti-smoking messages predicts smoking attitudes for each individual (level 1, or intra-individual, slope).

### Level 1 – the individual level

At level-1, every individual’s smoking attitude (responses on the feeling thermometer) is modeled from exposure to anti-smoking messages that contain different active ingredients. In the case of graphic evidence, most people's attitude toward smoking was reduced as the amount of graphic evidence increased ( $\beta = -4.99, p < .001$ ). Figure 2 illustrates 42 regression lines, each one corresponding to each of the 42 participants, predicting smoking attitude from the extent of graphic evidence in the message. However, some people (as lines with upward slopes in Figure 2 show) responded more positively, suggesting that these messages are not effective uniformly for

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<sup>1</sup> The feeling thermometer was selected as it is a single item measure that can be used repeatedly in the HRWP method without fatiguing participants. It correlates highly with the semantic differential scale that many others use to measure smoking attitudes, with implicit smoking attitude measures and with smoking behavior (Swanson et al., 2001).

everyone. There are significant individual differences in the slopes of individuals ( $SD = 3.66, p < .001$ ). This demonstrates that graphic is not equally effective for all individuals. Indeed, there are individuals for whom increasing graphic evidence results in more positive self-reported attitudes. For example, figure 3 shows a participant for whom graphic evidence was significantly associated with decreasing smoking attitude ( $r = -.84, p < .001$ ), while figure 4 shows another participant with a contrasting pattern ( $r = .34, p < .01$ ).

Results are obtained for the other 2 active ingredients and are captured in Table 3. With regard to the general trend seen among all participants, source credibility did not significantly impact smoking attitudes overall ( $\beta = -.79, p = .14$ ), and other-focus was negatively related with smoking attitude ( $\beta = -1.02, p = .003$ ). However, there were significant individual differences in slopes of individuals for all three active ingredients. Similar analyses are conducted for the participants' reports of how effective each message was. The effectiveness measure was moderately correlated with the feeling thermometer ( $r = -.42, p < .001$ ) and results are fairly similar to the attitude results. As messages were increasingly characterized by each feature, participants reports of the message's effectiveness increased significantly (all  $p$ 's  $< .01$ ). There are significant individual differences in individual slopes, such that increasing graphic evidence ( $SD = 0.16$ ) and other-focus ( $SD = .10$ ) don't result in uniform evaluations of effectiveness from all participants ( $p$ 's  $< .001$ ).

## **Level 2 – group level**

It is possible to test whether group-level variables can predict sensitivity to different active ingredients (level-1 slope). For example, we can test if smokers are more resistant to messages containing a specific active ingredient, such that their level-1 slope is different from non-smokers. This was tested with all the active ingredients as level 1 predictors and smoking

experience as a level-2 predictor. Smoking experience was coded (0- never smoked, 1- any experience smoking). Results are summarized in Table 4 and illustrated in figures 5 and 6.

As a message increasingly included information on how smoking affects others, non-smokers reported more negative attitudes ( $\beta = -2.55, p < .001$ ). However, smokers' attitude toward smoking are hardly affected by this active ingredient ( $\beta = -0.4, p = .02$ ). With regard to another active ingredient, source credibility (i.e., messages citing a more credible source of information) led to greater, rather than lower, positive smoking attitude in ever-smokers ( $\beta = .83, p = .002$ ) while source credibility was negatively associated with non-smokers' smoking attitude ( $\beta = -1.94, p = .002$ ).

In the case of reported message effectiveness, never-smokers reported increasing effectiveness as messages increasingly featured graphic evidence ( $\beta = .45$ ), source credibility ( $\beta = .07$ ) and other-focus ( $\beta = .07$ , all  $p$ 's $<.05$ ). However, for people with smoking experience, this effect was either reversed (in the case of graphic evidence) or removed by having any smoking experience (see Table 4). These results could be worrying, as messages particularly designed to get smokers to quit may have no effect or even an opposite effect.

## Discussion

This study tested the effects of viewing different kinds of anti-smoking messages on individual smoking attitudes and explored which kinds of messages were most highly related to a negative smoking attitude in different individuals using a HRWP Design. It was found that in general, graphic evidence, source credibility and other focus were associated with a more negative smoking attitude. There were significant individual differences in these effects such that not everyone was equally affected by each of these. There were individuals for whom some of the factors had no impact on their attitude at all and some for whom the intended effect

“backfired” so to speak. They reported more positive smoking attitudes as messages increased in that factor. The second active ingredient, “source credibility” was not a significant predictor overall. This may be because it is effective for some people and has the opposite effect for others, with the result that they cancelled out, revealing no overall trend.

Though all 3 active ingredients were important predictors of smoking attitude, smoking experience significantly moderated these effects, sometimes attenuating them considerably. However, this study still has a modest sample size and this effect needs to be replicated with a bigger sample. The next study attempted to replicate this study with more stimuli as well as a bigger sample to increase the power to detect effects. The next study also attempts to explain individual differences in response to the “other-focus” factor as a function of cultural self-construal.

### **Study 3**

Study 3 was conducted to replicate the effects of study 2 and also add a new dimension to the study. In study 2, the messages were pre-rated by different participants on the extent to which they were characterized by each of the active ingredients, so we only had the average or nomothetic ratings of the stimuli on each of the active ingredients. In study 3, participants were also asked to rate each of the messages on the active ingredients, aside from reporting how effective the messages were. Thus, this data contained each individual’s perceptions or *idiographic ratings* of how the messages were characterized along with their responses to each message. More stimuli were also added to create a total pool of 64 stimuli.

In study 3, cultural self-construal was also investigated as a potential individual difference that moderates the effects of the “other-focus” factor. Individuals operating from an interdependent framework often see the self as interconnected with close others, and are more

attentive to the needs and wellbeing of close others (Cross, Bacon, & Morris, 2000; Markus & Kitayama, 1991). I predicted that people who score high in interdependence might be more responsive to the messages that focus on how other people may be harmed by someone's smoke (rated high on other-focus) than people low in interdependent self-construal.

## **Method**

### **Participants**

Participants ( $N = 109$ , age=18-24 years ( $M = 19$ ), 66.3% female; 42.6% White, 46.5% Asian, 10.9% other races, 75% never-smoker) were recruited from undergraduate psychology classes at the University of Washington in exchange for extra credit. Many participants were excluded on the basis of partial or incomplete data, leaving a total sample of 87 submitted to analysis.

### **Procedure**

Participants came into the lab and informed consent was obtained. They were then asked to provide 2 sets of measures. In one part, participants viewed 60 anti-smoking messages in random order and rated each on the different active ingredients (graphic, evidence, source credibility and other-focus) one by one. The order of the questions was randomized. They were also shown the same 60 anti-smoking messages and provided measures of smoking attitude and message effectiveness similar to study 2. Participants were instructed to report their baseline smoking attitude before the study began, and instructed to report less favorable attitudes after viewing messages that they considered particularly effective. Half the participants (randomly selected) rated the messages on active ingredients before providing smoking attitude measures and the other half did it in reverse order. All participants also filled out the Cross Relational Interdependence Scale.

## Results

### Ratings of Anti-smoking stimuli

This set of ratings was collected ideographically, by having each individual rate the stimuli for each of the active ingredients. This collection of stimuli consisted of a set of images that had a range of graphic content ( $M = 3.27$ ,  $SD = 2.04$ ), evidence ( $M = 2.86$ ,  $SD = 2.12$ ), “source credibility” ( $M = 4.13$ ,  $SD = 2.13$ ) and “other-focus” ( $M = 3.03$ ,  $SD = 2.31$ ). Graphic and evidence ratings had a small positive correlation ( $r = .27$ ,  $p < .001$ ) and were not averaged to create one rating for graphic evidence in the following analysis (unlike the previous study). Graphic ratings also correlated positively with source credibility ( $r = .21$ ,  $p < .001$ ). All the ratings were also averaged to create an overall nomothetic rating of all stimuli. The averaged ratings contained similar, but stronger correlations between graphic and evidence ( $r = .40$ ,  $p < .01$ ) and between graphic and source credibility ( $r = .32$ ,  $p < .01$ ). The effects of positive correlation between predictors on the model are discussed in the level 1 result.

### Level 1

Here, the participant has both rated the stimuli for their perception of extent to which the messages are characterized by the active ingredients and provided their smoking attitude after viewing each of the stimuli. This data was analyzed using Hierarchical Linear Modeling. All the active ingredients were entered simultaneously and proved to significantly predict smoking attitudes except source credibility. The results are summarized in table 5. This might have been because ratings of source credibility in the stimuli in the study were correlated with ratings of graphic evidence. When entered simultaneously in the prediction model, graphic evidence might have accounted for the shared variance between the 2 predictors. When entered alone in the

prediction equation, source credibility was found to be a significant predictor of smoking attitude ( $\beta = -.71, p < .001$ )

The standard deviations of the slopes were significantly large, suggesting that people do not respond uniformly to messages characterized by these active ingredients. This replicates the effects found in the pilot study. This is also replicated when the analyses are run using averaged nomothetic ratings as predictors (which is identical to Study 2).

**Effectiveness assessment.** None the predictors with the exception of “Evidence” predict changes in the ratings of how effective each message was perceived to be. On average, increasing the amount of statistics, facts and evidence for negative consequences of smoking was reported to be more effective in convincing participants not to smoke ( $\beta = 1.00, p < .001$ ). There were significant individual differences in participants’ reports of effectiveness of messages for each of the predictors. All the random effects were significant (all  $p$ ’s  $< .001$ ).

**Order effects.** The data was divided into 2 groups based on whether the participants did the ratings task first or filled out the outcome measures first. In general, when participants rated the messages on the extent to which they were characterized by each of the active ingredients before they reported on smoking attitude and effectiveness, there was a stronger association between the two. This was true for graphic evidence ( $\beta = -2.44$  vs.  $-1.97$ ), other-focus ( $\beta = -.96$  vs.  $-.5$ ) and source credibility ( $\beta = .2$  vs.  $.3$  when entered simultaneously and  $\beta = -.7$  vs.  $-.5$  when entered alone in the model).

## Level 2

**Smoking experience.** Smoking experience (0-never smoker, 1-ever smoker) was entered as a level 2 variable in the multilevel model. Smoking experience did not predict changes in attitude differentially for messages that contained graphic evidence and source credibility. It was

however, found to have an effect on messages that varied in other-focus. Specifically, as a message increasingly talked about how smoking affects others, never-smokers showed an increasingly negative attitude ( $\beta = -.87, p < .001$ ) while ever-smokers showed a negligible decrease in attitude ( $\beta = -.07, p < .01$ ). This effect is replicated from the pilot study when using nomothetic ratings of the messages, but not when using the idiographic ratings. There are no effects of smoking experience on self-reported effectiveness of messages in convincing participants not to smoke. The results are summarized in table 6.

**Cross' Relational Interdependence Scale.** If people are more relationally interdependent, they might be more receptive to the other-focus factor in the messages. When relational interdependence was entered into the multilevel model, it did not predict differences in smoking attitude on viewing messages with other-focus. However, there was an effect such that people low in relational interdependence showed a stronger negative attitude ( $\beta = -2.25, p < .001$ ) towards smoking than people high in interdependence ( $\beta = -1.69, p < .05$ ) on viewing messages high in graphic evidence. Relational interdependence does not account for the individual differences in how people respond to the Other-Focus factor.

## Discussion

Study 3 replicated some effects of study 2 with more stimuli and idiographic ratings of the anti-smoking messages. All three active ingredients were associated with more negative smoking attitudes. There are also significant individual differences in the effects of each of the active ingredients, such that for some people the messages actually backfired. Source credibility has been come up with mixed results across multiple analyses (only sometimes associated significantly with more negative attitudes). This might either be because there was wide variation in the responses, such that the effect averaged out or it might be because source credibility was

correlated with graphic evidence. When source credibility was tested separately, it was found to be significantly negatively associated with smoking attitudes.

The order in which the participants did the study appears to have affected the results such that participants who rated the messages for the extent to which they were characterized by the active ingredients before evaluating the message responded with stronger negative evaluations of the messages. This may be because rating the message (on graphicness for example) may make participants think more deeply about the messages and formulate (possibly implicit) theories on what impacts them, or because repeated exposure to the message makes it more effective over time (Sly, Trapido, & Ray, 2002).

Relational interdependent self-construal did not predict differences in responses to other-focus as predicted. This may be because the stimuli used showed people or messages that might not have resembled actual close-others. It can be retested for example, by asking participants to imagine effects on others who are close to them (family or friends, for example) as they read the messages varying in other-focus. Alternatively, a large set of our participants were never-smokers and do not have children and might not have related to the messages in the same way as parents do. This needs to be tested with an older, adult population with both smokers and non-smokers.

### **General Discussion.**

Using the Highly Repeated Within-Person Design, the “active ingredients” of anti-smoking messages were identified and individual differences in how people react to anti-smoking messages (that differ in these active ingredients) were explored. The psychologically *active ingredients* of anti-smoking messages, or those characteristics that are important factors that facilitate inducing a negative attitude towards smoking, were identified as “Graphic

Evidence”, “Source Credibility” and “Other-focus” using a bottom-up approach. This is consistent with some research showing that these are essential features of anti-smoking messages and are generally considered effective tools of persuasion (Hammond, 2011; Latimer et al., 2012). However, while most research draws on literature to study any single feature (such as graphicness) of anti-smoking messages, there has been no comprehensive test to identify all the dominant characteristics that are effective in changing attitudes. This research can serve as a stepping stone for developing theory and creating a more unified approach to understanding and applying persuasive methods to reduce smoking.

Across two studies, it was shown that each of the active ingredients was effective in reducing smoking attitudes on average, and was generally considered effective in convincing participants not to smoke. However, it was also found that individuals differ significantly in the extent to which they are impacted by messages that contain varying levels of these active ingredients. For example, it was found that not everyone responds with more negative attitudes when faced with graphic anti-smoking messages. A closer examination of the individual data showed that some individuals can show no change in attitude when exposed to graphic messages, and some others can even show a more positive attitude towards smoking. These differences were not random, but were statistically significant differences indicating that people can respond very differently to the same message.

This data supports research that suggests that fear-inducing messages can backfire in some instances (Emery et al., 2014). For example, people who smoke may feel threatened upon viewing graphic messages and may actually smoke more out of defiance or to quell the increasing anxiety they experience. Others may be angry, or simply deny the evidence presented in the message with available knowledge of their own, often contrary, experiences so far (for

e.g., “my grandfather smoked all his life and is still fine at seventy”) (Emery et al., 2014). For such people, showing graphic images may hinder the goal of motivating non-smoking behavior. The same can happen with the other active ingredients. Research has shown that people often push back against messages issued by official agencies as a sign of rebelling against a threat to freedom of choice (Invernizzi, Falomir-Pichastor, Munoz-Rojas, & Mugny, 2003). Individual motivation can be increased by examining their responses to a variety of active ingredients, to see what kinds of messages would be maximally effective in motivating them.

Previous experience with smoking may be an important factor affecting the way in which people view and respond to anti-smoking messages. Although this sample did not have sufficient number of respondents who reported smoking every day, there was a sample of people who had attempted to smoke at least once. On examining this data, it was found that people who had ever smoked (including the handful of people who smoked weekly or daily) were not persuaded by messages that communicated how smoking affects *other people*, such as when secondhand smoke affects children. Experience with smoking was not found to moderate the effects of the other active ingredients. Ever-smokers were on average, also influenced by messages that contained graphic evidence, for example. This research demonstrated how to test for such level-2 effects, so that we can identify groups of people who respond in similar ways.

### **Implications for tailoring communication**

This research provides important contributions to the literature of tailoring communication. While the current view on tailoring is that it is generally considered effective (Kreuter, Strecher, & Glassman, 1999; Noar et al., 2007), no studies have so far directly tested to find out if individual responses are different enough to warrant tailoring communications or interventions. This work shows quantitative support for the existence of significant individual

differences in what is maximally effective for changing smoking attitude. Studies on tailoring also focus heavily on applying theories of behavioral change and rely less on the actual features of the messages that are being used, and relatively few studies tailor to distinct demographic groups (Noar et al., 2007).

In this work, the extensive study on the characteristics of anti-smoking messages produced the package of “active ingredients” of anti-smoking messages, which can be utilized for creating specific messages that is shown to be a best fit for each individual. Using the HRWP method, it is not only possible to identify the active ingredients of anti-smoking messages that are effective in motivating individuals not to smoke, it is also possible to identify those elements that have *no effect* on one’s attitude or which backfire and have the opposite of the intended effect. Though the literature shows that this is important to keep in mind while tailoring (Kreuter et al., 1999), relatively few studies take care to point out *what does not work*. This kind of information is also usually lost in between-subject studies which focus on the average effect of different types of messages.

Tailoring work can also be perceived to be complicated and cumbersome, going into a level of detail that takes a lot of time, effort and resources (Hawkins et al., 2008). This work creates a framework along which tailoring can be done, with lots of options to tailor as precisely to the individual as required, or to tailor to groups of individuals with common characteristics. People commonly fill out surveys online and provide data which is being collected and analyzed for multiple uses. It is becoming increasingly feasible to research and advertise, or provide communication that is more effective in changing behavior for individuals with increased electronic communication, or online data collection.

Knowing an individual's profile of responses can be helpful in deciding which antismoking messages or public health communication should be displayed on their webpages, or by email, for example. For ease of carrying out interventions, a set of predetermined stimuli rated for active ingredients can be created and appropriate messages selected for circulation to a specific individual. Alternatively, the HRWP framework can yield theory and suggestions for communicating with groups of individuals with similar response patterns. If we know for example, that extroverts are more responsive to a certain kind of message, we can communicate with them in particular ways.

### **Strengths and Limitations of the study**

One of the limitations of the study is that the repeated measure design limits the collection of behavioral measures (in this case, the number of cigarettes smoked, for example) in the lab. Further, due to time constraints, long surveys and questionnaires that assess attitudes are generally not used. Instead, 1 item measures are repeatedly filled out, and the selected question has to be a good predictor of the behavioral outcome. In this case, the feeling thermometer has been known to be correlated with smoking behavior in previous research, and serves as the outcome measure (Swanson, Rudman, & Greenwald, 2001). While attitude is known to influence behavior, we do not have a long term record of whether the self-reported attitude ties in with an outcome and that serves as a question for future research. The HRWP design can be carried out over days using more elaborate measures than in a single session lab study (for e.g., see Smith et al., 2011), so this work can serve as a stepping stone for building a new research that analyzes individual smoking behavior over time after exposure to different anti-smoking messages.

The selection of the stimuli also significantly influences the HRWP design's outcomes. For this study, a wide range of stimuli from multiple professionally run campaigns was selected

for exposure to young adult college students, but the results may be different with a different set of stimuli or a different sample. Different anti-smoking message campaigns are often created with specific themes in mind for the audience (Ling et al., 2014; Sly et al., 2002). To know about how to tailor for a certain demographic such as young children, both the stimuli and the sample assessing the stimuli need to be carefully selected, as the active ingredients that motivate children not to smoke are unlikely to be the same as for adults. In this sense, while we must be careful in generalizing the results from the level-2 data, it is also reassuring that the HRWP design can be used to find people with similar thought processes and response patterns, providing a basis for generalization that is supported by evidence.

### **Conclusion**

This work demonstrates the application of a Highly Repeated Within-Person Design to examine how individuals respond to a variety of anti-smoking messages. This research contributes to the literature on tailoring communication in anti-smoking messages and has important implications for how we think about and design messages for each person. This work adds to current knowledge on tailoring by identifying the factors and themes in anti-smoking messages as dimensions to tailor on, as well as demonstrating the use of demographic and psychological variables in conjunction with message characteristics. Taken together, the studies in this paper demonstrate an overarching methodology which can be used for developing theory and interventions to reduce smoking, which will benefit the health and wellbeing of millions of people across the world.

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Table 1. Loadings of different message characteristics on three visible factors.

Item	Graphic Evidence	Source Credibility	Other-Focus
The message shows the future consequences of smoking	.929	.171	.099
This message talks about the negative consequences of smoking	.918	.019	.052
The message shows that smoking is as bad or worse than using other drugs	.879	.025	-.085
The message provides evidence for the negative consequences of smoking	.871	.139	.149
The message shows that smokers will regret taking up smoking.	.858	.167	.183
The message shows that the damage from smoking is permanent	.854	.153	-.047
The message is shocking	.809	.221	.002
It presents facts related to smoking	.736	-.125	.161
The message emphasizes the need to quit smoking immediately.	.733	.265	.174
There is an emphasis on how certain part(s) of the body is affected by smoking	.667	.510	-.242
The message depicts a medical setting (for e.g. a hospital).	.637	.590	.053
Statistics related to smoking behavior are shown.	.583	-.235	.198
The message is from an official source.	-.004	.914	.112
The message shows real people	.172	.909	.005
The message has a cartoon-like drawing	-.162	-.908	-.013
It contains information about specific actions that people can take to quit smoking	.181	.840	.019
The message looks fake (e.g. it looks photoshopped)	-.206	-.691	.033
The message shows that smoking can lead to the death of children	.166	-.035	.840
The message shows that cigarette smoke can be harmful to non-smokers who are exposed to it	.139	.254	.838
The message shows that smoking by pregnant women causes prenatal harm	.135	-.071	.809
The message shows the harmful effects of secondhand smoke on others.	-.020	.348	.791
It is only relevant to people with children	-.042	-.295	.630

Table 2. Definitional Categories of different active ingredients of anti-smoking messages.

<b>Category Label</b>	<b>Definition</b>
<b>Graphic Nature</b>	This message contains disgusting or shocking material and shows that smoking has negative consequences on the body which maybe permanent or that smokers will eventually regret smoking because of lasting damage.
<b>Evidence</b>	This message contains facts, statistics or evidence that smoking has negative consequences.
<b>Source Credibility</b>	This message is of high quality, it is from an official or credible source such as a Government organization or employs real people, not cartoon-like images or does not look fake or photo-shopped.
<b>Other-focus</b>	This message contains information about the harmful effects of one person's smoke on others such as when people are affected by secondhand smoke, or when parents' smoke affects children or when pregnant mothers' smoke affects a fetus.

Table 2. Summary of results of multi-level model predicting individuals' smoking attitude from each of the active ingredients of anti-smoking messages from Study 2.

<b>Level 1 predictor</b>	Average level-1 slope coefficient	<i>P</i>	<i>SD</i> of slopes across participants	<i>p</i>
Predicting smoking attitude				
<b>Graphic Evidence</b>	-4.99	<.001	3.66	<.001
<b>Source Credibility</b>	-0.79*	0.14*	2.47	<.001
<b>Other-focus</b>	-1.02	.003	1.61	<.001
Predicting effectiveness report				
<b>Graphic Evidence</b>	0.39	<.001	0.16	<.001
<b>Source Credibility</b>	0.09	.001	0.09	.11
<b>Other-focus</b>	0.07	<.001	0.10	<.001

Table 4. Summary of results from multilevel model testing for differences between ever-smokers and never-smokers on level-1 effects from Study 2.

Level 1 predictor	Average level-1 slope coefficient	Level-2 moderator coefficient			
		Smoking attitude		Effectiveness Ratings	
		<i>Smoking experience (0-never smoker)</i>	<i>Smoking experience (1-ever smoker)</i>	<i>Smoking experience (0-never smoker)</i>	<i>Smoking experience (1-ever smoker)</i>
<b>Graphic Evidence Source Credibility Other-focus</b>	-4.99***	-5.76***	1.81	.45***	-.13*
	-0.79	-2.10***	3.06**	.07**	.03
	-1.02**	-1.70***	1.61**	.07*	.003

Table 5. Summary of results of multi-level model predicting individuals' smoking attitude from each of the active ingredients of anti-smoking messages from Study 3.

<b>Level 1 predictor of smoking attitude</b>	Average level-1 slope coefficient	<i>p</i>	<i>SD</i> of slopes across participants	<i>p</i>
<b>Graphic</b>	-1.78	<.001	1.80	<.001
<b>Evidence</b>	-.95	<.001	1.15	<.001
<b>Source Credibility</b>	.03	.81	.77	<.001
<b>Other-focus</b>	-.49	<.001	.90	<.001

Table 6. Summary of results from multilevel model testing for differences between ever-smokers and never-smokers on level-1 effects from Study 3.

Level 1 predictor	Average level-1 slope coefficient	Level-2 moderator coefficient	
		Smoking attitude	
		<i>Smoking experience (0-never smoker)</i>	<i>Smoking experience (1-ever smoker)</i>
<b>Graphic Evidence Source Credibility Other-focus</b>	-1.78*** -.95*** .03 -.49***	-2.10*** -1.66*** .44** -.87***	-2.79 -2.0 -.06 -.07**

Figure 1. Steps of the Highly Repeated Within Person Design

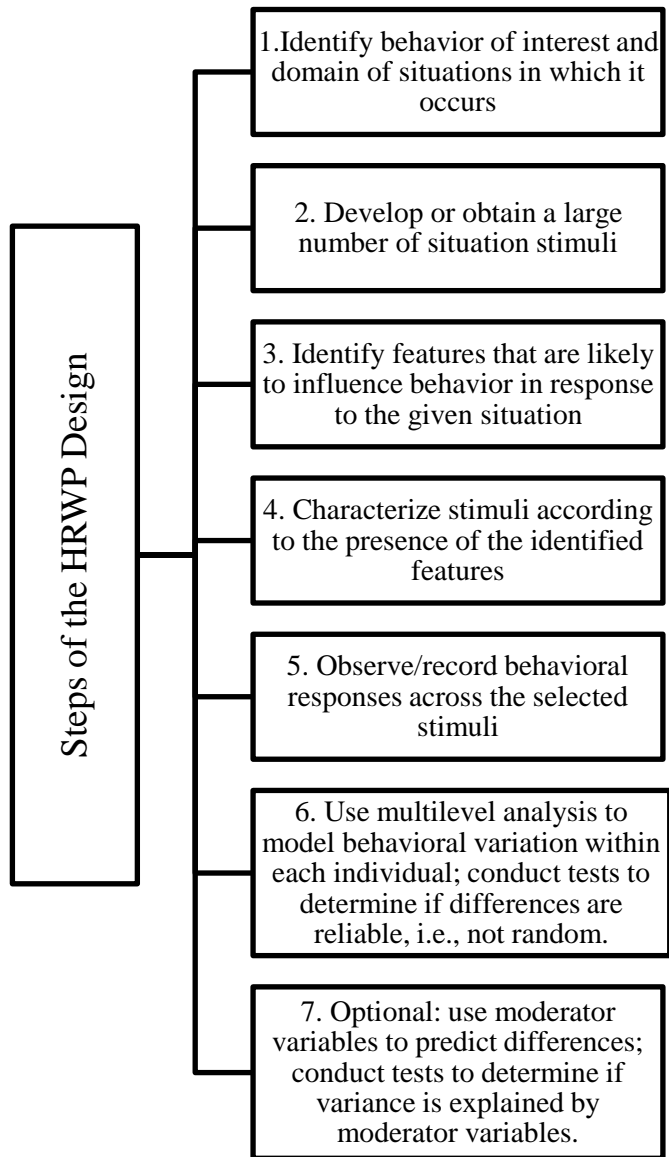


Figure 2. Multilevel model predicting smoking attitudes as a function of “Graphic Evidence” for 46 participants

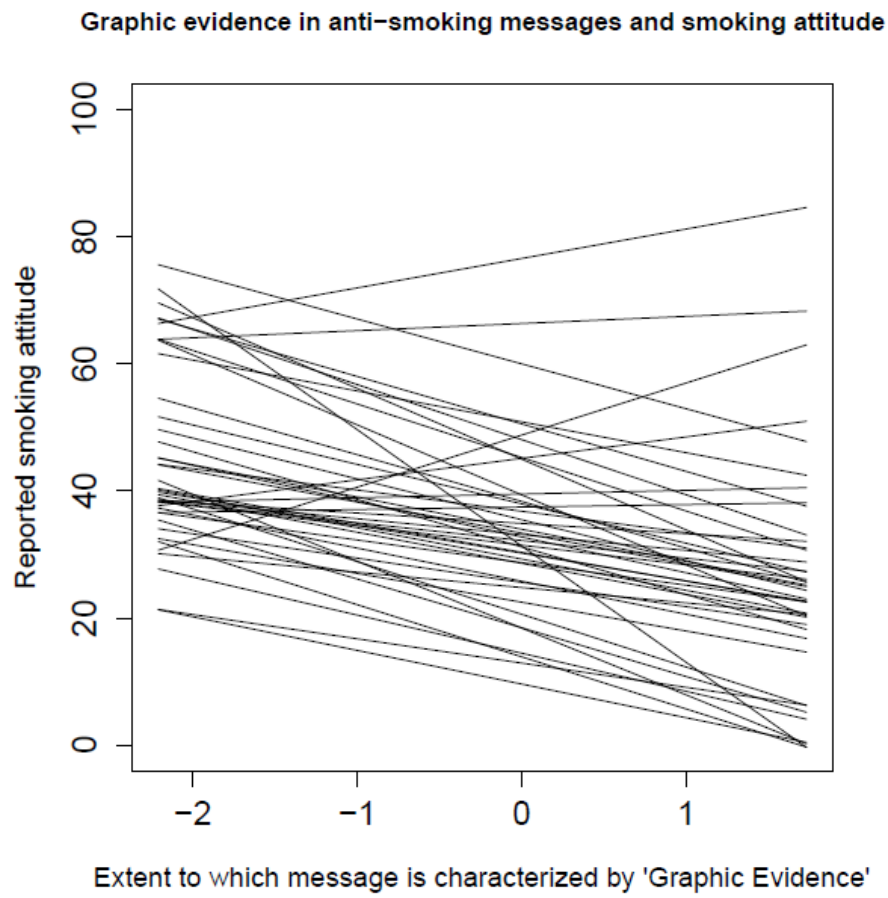


Figure 3. Example of a participant for whom graphic evidence is associated with an increasingly anti-smoking attitude.

Example of negative correlation between graphic evidence and smoking attitude

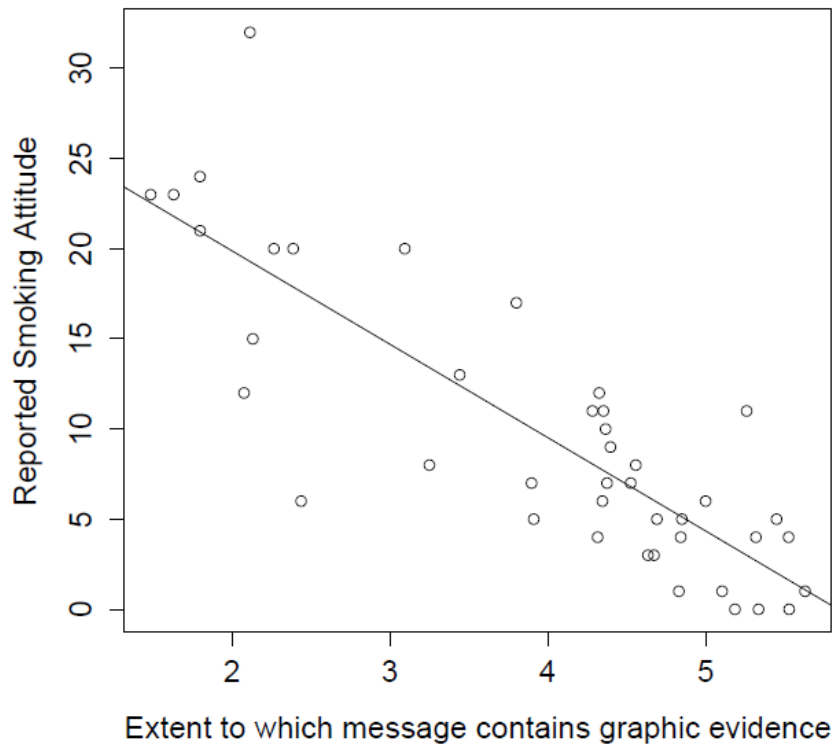


Figure 4. Example of a participant for whom graphic evidence is associated with an increasingly pro-smoking attitude.

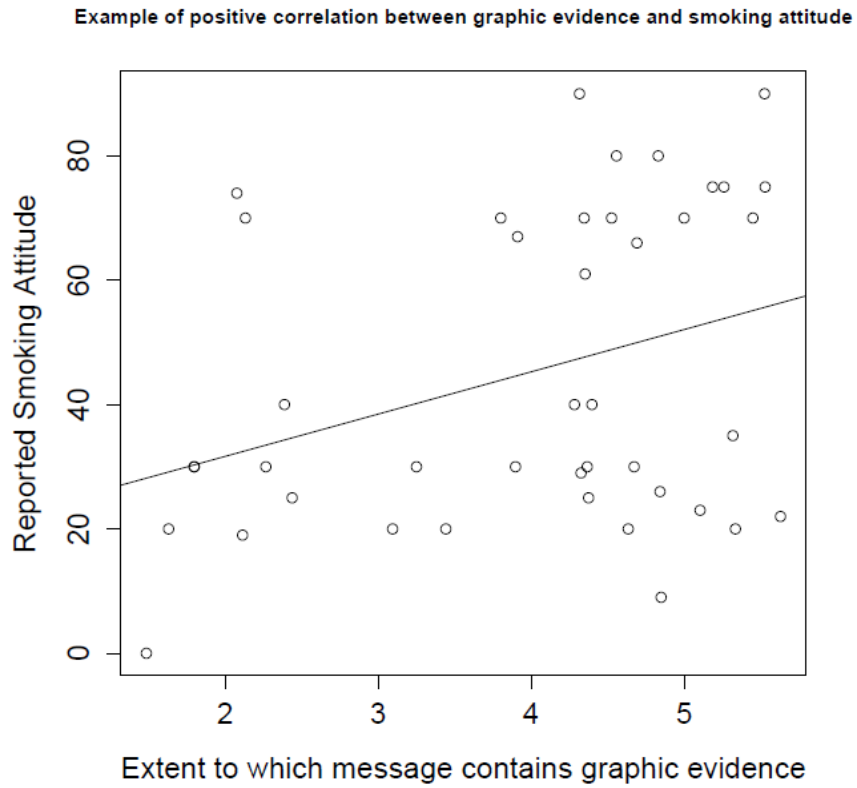


Figure 5. Differences in effects of “other-focus” on smoking attitude for ever-smokers and never-smokers

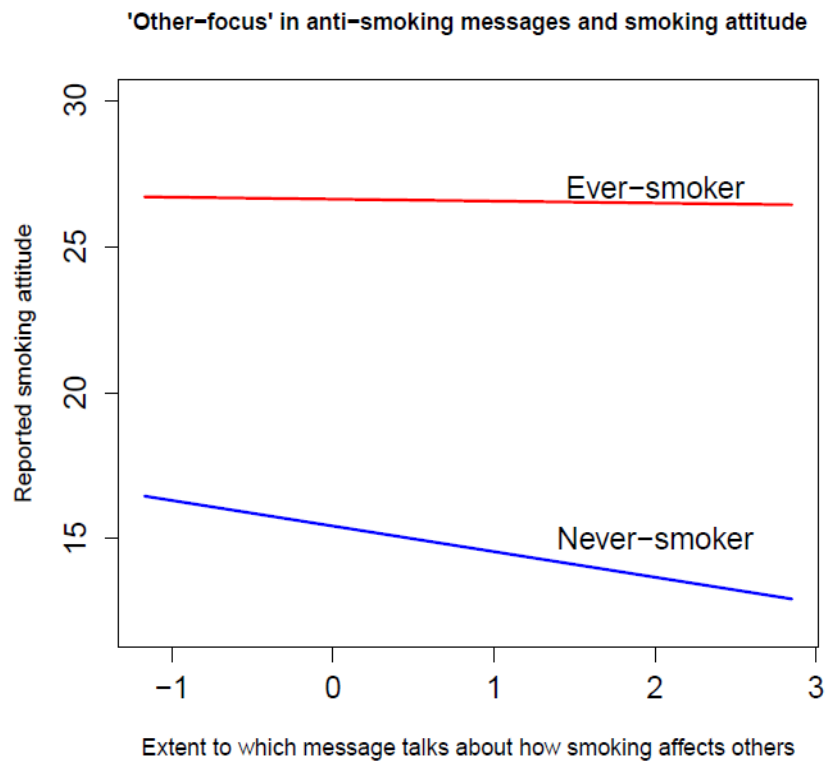


Figure 6. Differences in effects of “credibility” on smoking attitude for ever-smokers and never-smokers

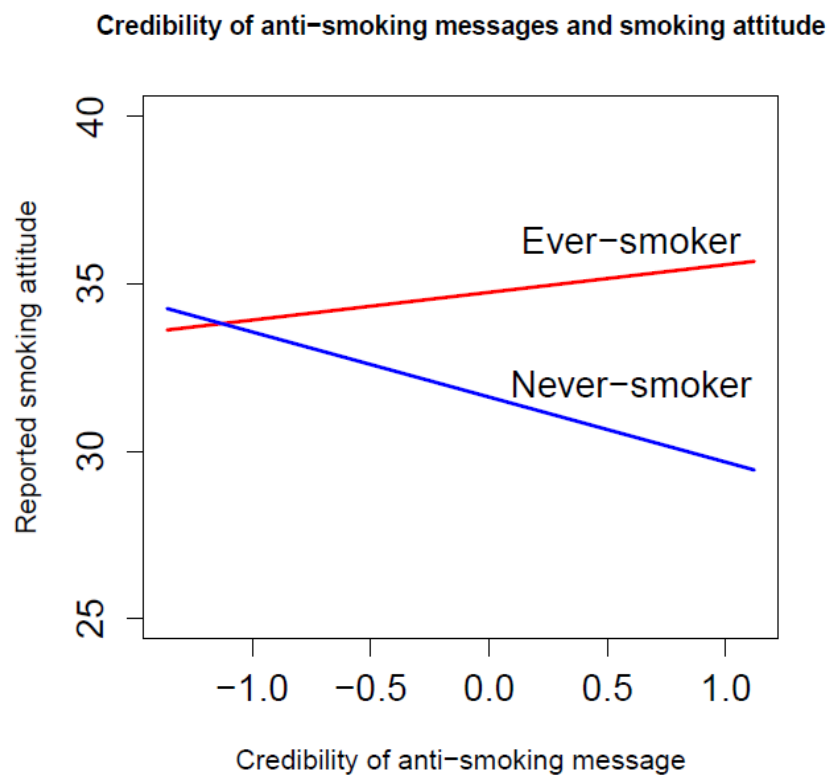


Figure 7. Multilevel model predicting smoking attitudes as a function of “Other-focus” for 87 participants. Black lines highlight variation and represent the five highest and lowest slopes.

