Motivational content features improve tailoring of anti-smoking advertisements

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Abstract

Mass communication campaigns are among the most effective population-level tobacco control policies, yet their impact varies widely across individuals, suggesting substantial scope for optimization. Message tailoring is known to increase persuasion, but a central question remains unresolved: which recipient characteristics should be used for tailoring, which message features matter most, and how should they be matched? In a large pre-registered study, 2,622 daily smokers in France viewed three anti-smoking video advertisements randomly drawn from a library of 38 advertisements (N = 7,866 ad evaluations). Advertisements were independently coded for two complementary dimensions of content: (i) 19 arguments commonly used in tobacco prevention and (ii) 17 motivational content features defined as cues that activate motivational systems (e.g., disgust or parental care). We examined which arguments and content features most effectively increased intention to quit smoking and whether these effects differed depending on individuals' personality traits or perceived financial situation. Analyses relied on repeated cross-validated LASSO with stability selection and post-LASSO mixed-effects estimation. The results are consistent with individual-level heterogeneity, with multiple content features and arguments showing interactions with personality traits and perceived financial situation. Model comparison further indicated that tailoring motivational content features to both personality and perceived financial situation provided the best predictive account of intention change. These findings suggest that persuasive impact in tobacco prevention depends substantially on person-specific alignment between motivational cues and recipient profiles, offering a framework for more precise and scalable campaign design.

Keywords

Message tailoring ; persuasive communication ; tobacco prevention ; personality traits ; motivational content features ; smoking cessation intention ; anti-smoking advertisements

1 Introduction

1.1 From targeting to tailoring

Tobacco smoking remains a major global public health issue. In 2019 alone, it was responsible for an estimated 8.7 million deaths worldwide, making it one of the leading preventable causes of mortality (Murray et al., 2020). Despite decades of tobacco control efforts, smoking remains highly prevalent in many countries, and responses to prevention interventions vary widely across individuals. This heterogeneity suggests that there may be scope to improve existing tobacco control strategies by optimizing how messages are designed and delivered. We focus in this article on mass communication campaigns.

Extensive research has focused on identifying the most effective strategies to reduce tobacco use. A recent meta-analysis of 476 studies comparing the effectiveness of major population-level tobacco control policies identified mass communication as one of the four most effective policies alongside tax increases, smoking bans, and health warning labels for reducing tobacco consumption and sales (Akter et al., 2024). Mass communication campaigns offer several distinctive advantages, including greater public acceptability (Diepeveen et al., 2013) and lower levels of saturations (i.e., with more headroom for intensification unlike fiscal and regulatory measures which can face practical ceilings) making them a particularly promising target for further optimization. Besides, evidence further indicates that such campaigns can have spillover effects by shaping the salience of smoking-related consequences (Durkin et al., 2012).

What, then, can be improved? A key success factor in communication is the fit between the message and its audience (Berlo, 1960; Teeny et al., 2021): messages that align with recipients' characteristics are more likely to be understood, remembered, and acted upon (Avenel et al., in press). Achieving such fit, however, becomes increasingly challenging as the scale of the audience expands. While individual-level tailoring can substantially enhance effectiveness, it comes at the cost of scalability due to the need for individual-level assessments and message production for each individual. This trade-off between effectiveness and scalability has led to a continuum of personalization strategies, ranging from generic messaging to fully individualized communication, depending on how precisely audiences are assessed (see **Figure 1.A**; Kreuter et al., 1999).

In practice, most health prevention campaigns adopt *targeted* communication using market segmentation techniques to address large population subgroups sharing common characteristics, such as age, gender or socio-economic status (S. J. Durkin et al., 2009; Terry-McElrath et al., 2007). This approach offers two key advantages for large-scale prevention. First, it is compatible with mass-broadcast media such as television, where messages can reach large audiences but can still be targeted by placing ads on channels or time slots with skewed audience composition (Hyland et al., 2006; Sims et al., 2014; Wakefield et al., 2010). Second, it is grounded in epidemiological realities: smoking disproportionately affects specific population groups (Pasquereau et al., 2023), making socio-demographic targeting a relevant way to direct prevention efforts toward those most at risk.

However, this approach rests on an implicit assumption of within-group homogeneity, that individuals who share the same socio-demographic characteristics will respond similarly to the same messages. This assumption is often violated in practice, as individuals within the same demographic segment can vary substantially in more specific characteristics that shape how messages are perceived, interpreted, and acted upon (Alkış & Taşkaya Temizel, 2015; Kreuter et al., 1999). As a result, demographic targeting may leave a large share of persuasive variance unexploited, potentially limiting the effectiveness of mass communication campaigns.

Addressing within-group heterogeneity requires moving beyond demographic targeting to message *tailoring* (sometimes called 'message matching'), that is, the adaptation of message content to *individual characteristics* (Kreuter et al., 1999). Individualized message-tailoring techniques are now considered among the most reliable and impactful methods in persuasive communication (Joyal-Desmarais et al., 2022; Noar et al., 2007; Rothman et al., 2020; Teeny et al., 2021). Prior research has demonstrated the effectiveness of tailoring across a range of domains, including political opinion (Tappin et al., 2023), product preference (Hirsh et al., 2012), and smoking cessation (M. S. Webb et al., 2005). Although tailoring was historically constrained by issues of scalability, particularly due to the need for individual-level assessments, recent advances in digital technologies offer promising solutions (e.g., real-time data collection, algorithmic content delivery).

Despite strong evidence that message tailoring enhances persuasive effectiveness, a fundamental question remains unresolved: *tailoring which message feature, to which recipient characteristic?* Tailoring can rely on a wide range of individual characteristics, and messages themselves vary along multiple dimensions, yet there is little consensus on which recipient characteristics are most informative, which message features matter most, and how these elements should be matched to maximize smoking cessation intentions. The present study addresses this gap by systematically examining how different message features interact with different individual characteristics to shape smoking cessation intentions. Rather than assuming a single optimal tailoring strategy, we compare alternative tailoring models to identify which combinations of recipient characteristics and message features are most predictive of persuasive impact in mass communication campaigns.

1.2 Dimensions of message tailoring

Tailored communication can take various forms, depending notably on which individual characteristics are used to define recipient profiles. Recent reviews suggest that the most impactful matching variables are those that exhibit high inter-individual variability (Teeny et al., 2021). Importantly, variability alone is not sufficient: recipient characteristics must also be theoretically or empirically linked to the targeted outcome: a characteristic like hair length may vary greatly across individuals, but it holds no relevance in predicting smoking behaviour. Among the wide variety of individual characteristics, two variables are strongly associated with tobacco consumption: perceived financial situation and personality traits.

Socioeconomic position has already been used in anti-tobacco interventions to target specific audiences given its strong associations with smoking behaviour (S. J. Durkin et al., 2009; Guignard, 2018). In France, results from national representative surveys have shown substantial

disparities in smoking prevalence according to different criteria of socioeconomic position such as education level, employment status and income (Pasquereau et al., 2023). When assessed at the individual level, perceived financial situation may therefore serve as a theoretically grounded and practically relevant variable for message tailoring.

Beyond socioeconomic situation, personality represents a promising and underexploited tailoring variable. Personality is commonly conceptualized using the Big Five model (John et al., 2008), a widely used empirical framework describing five dimensions (i.e., Extraversion, Neuroticism, Conscientiousness, Agreeableness, Openness) that capture stable individual differences in psychological reactivity to classes of situations (Nettle, 2009). These traits are known to be associated with smoking behaviour: smokers tend to exhibit higher levels of Neuroticism and lower levels of Agreeableness and Conscientiousness compared to the general population (for meta-analyses see Hakulinen et al., 2015; Malouff et al., 2006). While personality-based tailoring has shown reliable effects on outcomes such as message evaluation, attitude change, and behaviour across domains including politics and consumer choice (Gerber et al., 2013; Halko & Kientz, 2010; Hirsh et al., 2012; Moon, 2002; Stieger et al., 2020; Winter et al., 2021), it has rarely been applied to anti-tobacco mass communications. In the present study, we therefore focus on perceived financial situation and personality traits, both assessed at the individual level, as theoretically grounded and empirically relevant characteristics for tailoring anti-smoking messages.

Tailoring also requires specifying which aspects of the message itself should be varied. Persuasive messages differ along multiple dimensions, and identifying the content features that interact most strongly with individual characteristics is essential for effective message matching.

A large body of research in persuasive communication has examined how message effectiveness varies as a function of various content features, including the type of arguments used (Gerber et al., 2013), the source of the message (Alkış & Taşkaya Temizel, 2015), emotional tone or intensity (Mowen et al., 2004; Schmälzle et al., 2020), framing (Chatterjee & Hunt, 2005; Chen & Lee, 2008; Dodoo & Wen, 2019; Moon, 2002) and stylistic or graphic elements (Matz et al., 2019; Sojka & Giese, 2001). In the context of tobacco prevention, analogous work has identified content features associated with campaign effectiveness at the population level, although results are not always consistent. For example, some studies report stronger effects of messages emphasizing negative health consequences on smoking cessation behaviours (S. Durkin et al., 2012), while others found greater engagement with positively framed messages (Gallagher & Updegraff, 2012; Teeli, 2026; Toll et al., 2007).

In the present study, we tested two taxonomies of message content. The first one concerns the kinds of *arguments* that are presented in anti-tobacco advertisements. Argument type is a central component of message design and often constitutes the primary lever used by prevention practitioners. Drawing on prior literature and existing campaign practices, we identified a set of 19 arguments commonly used in anti-tobacco campaigns (see **Table 1** for a detailed description). These include positive consequences of cessation (e.g., health or financial benefits, social belonging), negative consequences of smoking (e.g., illness, premature death, absence from one's children's lives), and broader collective consequences (e.g., social costs, environmental harm).

Table 1. Description of the arguments used in anti-tobacco advertisements.

Argument	Description of the argument
Health benefits	Individual health improvements resulting from quitting tobacco, such as better cardiovascular functioning, improved respiratory capacity, reduced cancer risk, and increased life expectancy.
Financial benefits	Individual financial gains associated with quitting smoking, including money saved from not purchasing tobacco products and the possibility of reallocating these savings to other meaningful expenses.
Positive life consequences	Broader improvements in quality of life following cessation, such as increased energy, enhanced well-being, improved physical appearance, and greater overall life satisfaction.
Be present for kin	Emphasis on the ability to remain alive, healthy, and emotionally available for one's children, partner, or close relatives by quitting smoking.
Efficacy appeal	Messages highlighting that quitting is achievable and that effective support tools, strategies, or services are available, thereby increasing perceived self-efficacy.
Normative benefits	Social approval and alignment with societal norms, emphasizing that quitting smoking is socially valued and increasingly common.
Dying	Explicit reference to premature death as a direct consequence of smoking.
Get sick or injured	Emphasis on the risk of developing serious diseases or experiencing physical suffering due to smoking.
Not be present for kin	Focus on the risk of dying early or becoming incapacitated, thereby failing to be present for one's family or loved ones.
Setting a bad example for children	Emphasis on the modelling effect of smoking behaviour and the increased likelihood that children may initiate smoking if parents smoke.
Financial loss	Emphasis on the direct and cumulative personal financial losses caused by tobacco consumption, highlighting the individual economic burden of purchasing tobacco products over time.
Negative life consequences	Broader detrimental effects on daily life, including daily reduced physical fitness, decreased attractiveness, social limitations or diminished opportunities.
Get your children sick	Focus on second-hand smoke and the health harms caused to children and close relatives due to exposure.
Health dangers	Emphasis on the individual and general biological harms caused by tobacco use on the body, including physiological damage to organs and bodily systems that occur even before the onset or diagnosis of specific diseases.
Mortality burden	Direct and categorical statement that tobacco consumption leads to death, framed at the populational level rather than the personal risk for the individual smoker.
Social costs	Emphasis on the collective burden of tobacco use on society, including healthcare expenditures, productivity losses, and public health impact.
Industries manipulations	Messages exposing deceptive practices, marketing strategies, and manipulative tactics used by the tobacco industry.
Environmental harms	Focus on the ecological consequences of tobacco production and consumption,

	such as pollution, deforestation, and cigarette waste.
Harms on youth	Emphasis on the vulnerability of young people to tobacco-related harms, including exposure to marketing strategies, increased risk of addiction and long-term health consequences, as well as the exploitation and health risks faced by children involved in tobacco production

In addition to arguments, we introduce a second taxonomy of message content based on motivationally salient *content features* (Sperber & Hirschfeld, 2004). We define content features as stimuli embedded in messages that activate specific motivational systems in the human mind, often through specific emotional responses (Dubourg et al., 2024). Unlike arguments, which provide explicit reasons for quitting smoking (Mercier & Sperber, 2011), content features operate at a more basic level: they consist of psychologically meaningful cues that reliably trigger motivations such as threat avoidance or curiosity. For example, the depiction of bodily fluids or physical decay constitutes a content feature known to activate pathogen-avoidance mechanisms, commonly known (and experienced) as disgust (Oaten et al., 2009; Tybur et al., 2013). Similarly, scenes depicting individuals helping, protecting, or caring for one another activate affiliative motivations (Aktipis et al., 2018; Barclay et al., 2021). Importantly, sensitivity to these motivational cues varies systematically across individuals. Disgust sensitivity, for instance, varies with Neuroticism (Tybur et al., 2009), whereas responsiveness to affiliative cues varies with Agreeableness (Harris & Vazire, 2016). We selected a set of 17 such content features that were identified as the most relevant for promoting smoking cessation (see **Table 2** for a detailed description). Note that, throughout the study, content features are named after the underlying motivational mechanism they activate, rather than after their specific narrative instantiation. For instance, a piece of information that is novel or surprising will be coded as 'Curiosity', bodily fluids or decay will be called 'Disgust', and a norm violation will be coded as 'Indignation'.

Table 2. Core motivational mechanisms and the motivational content features that activate them. Each mechanism corresponds to a recurrent psychological system, and the listed content features describe the cues that are sufficient to trigger it.

Mechanism	Description of the motivational content feature
Curiosity	Content that highlights the presence of unknown information, unresolved questions, surprising facts, or unexplained phenomena.
Resource accumulation	Content that emphasizes gaining, preserving, or losing material or economic resources, including money, goods, or assets relevant to personal stability and long-term security.
Mental time travel	Content that foregrounds long-term planning, future consequences, delayed outcomes, or complex sequences of actions linking present behaviour to future states.
Threat	Content that depicts the presence of danger, aggression, or imminent harm, emphasizing risk, attack, pursuit.
Disgust	Content that evokes aversive reactions related to contamination, bodily degradation, impurity, or biological corruption.
Pain avoidance	Content that highlights physical suffering, injury, or intense discomfort, emphasizing the motivation to avoid bodily harm.

Pride	Content that emphasizes exceptional achievement, personal mastery, self-improvement, or surpassing limits, eliciting feelings of accomplishment and self-worth.
Shame	Content that focuses on negative social evaluation, exposure, or loss of social standing, emphasizing embarrassment, rejection, or degradation in the eyes of others.
Guilt	Content that emphasizes responsibility for harm caused to others, including unintended consequences, moral transgressions, or preventable negative outcomes.
Indignation	Content that highlights wrongdoing, injustice, or norm violations by an agent, often accompanied by calls for punishment, blame, or moral condemnation.
Compassion	Content that emphasizes vulnerability, suffering, or injustice affecting others, eliciting concern, empathy, and motivation to protect or help.
Social bonding	Content that highlights trust, cooperation, mutual support, or the formation and maintenance of close interpersonal relationships.
Humor	Content that frames situations as benign norm violations or playful devaluations, eliciting amusement without serious threat or harm.
Argumentation	Content that emphasizes reasoning, debate, or intellectual confrontation, structured around claims, counterarguments, or logical persuasion.
Group belonging	Content that highlights shared identity, coalition membership, or alignment with a defined social group, emphasizing inclusion versus exclusion.
Romantic love	Content that emphasizes long-term pair bonding, mutual attraction, emotional commitment, or the maintenance of an exclusive romantic relationship.
Parental care	Content that highlights the protection, nurturing, or safeguarding of children or dependents, emphasizing responsibility for their safety and well-being.

1.3 Analytical aims

Our aim is to identify which combinations of individual characteristics and message features are most strongly associated with changes in smoking cessation intention. Specifically, we examine how two classes of individual differences (personality traits and perceived financial situation) interact with two classes of message content (arguments and motivational salient content features) to shape persuasive impact (see **Figure 1.B**).

This approach allows us to move beyond the assumption that tailoring "works" in general, and instead address the more informative question of *what should be tailored to whom*. Using regularized regression and model comparison, we evaluate which theoretically grounded interactions emerge as the most robust and predictive, and which tailoring strategies provide the best balance between explanatory power and parsimony.

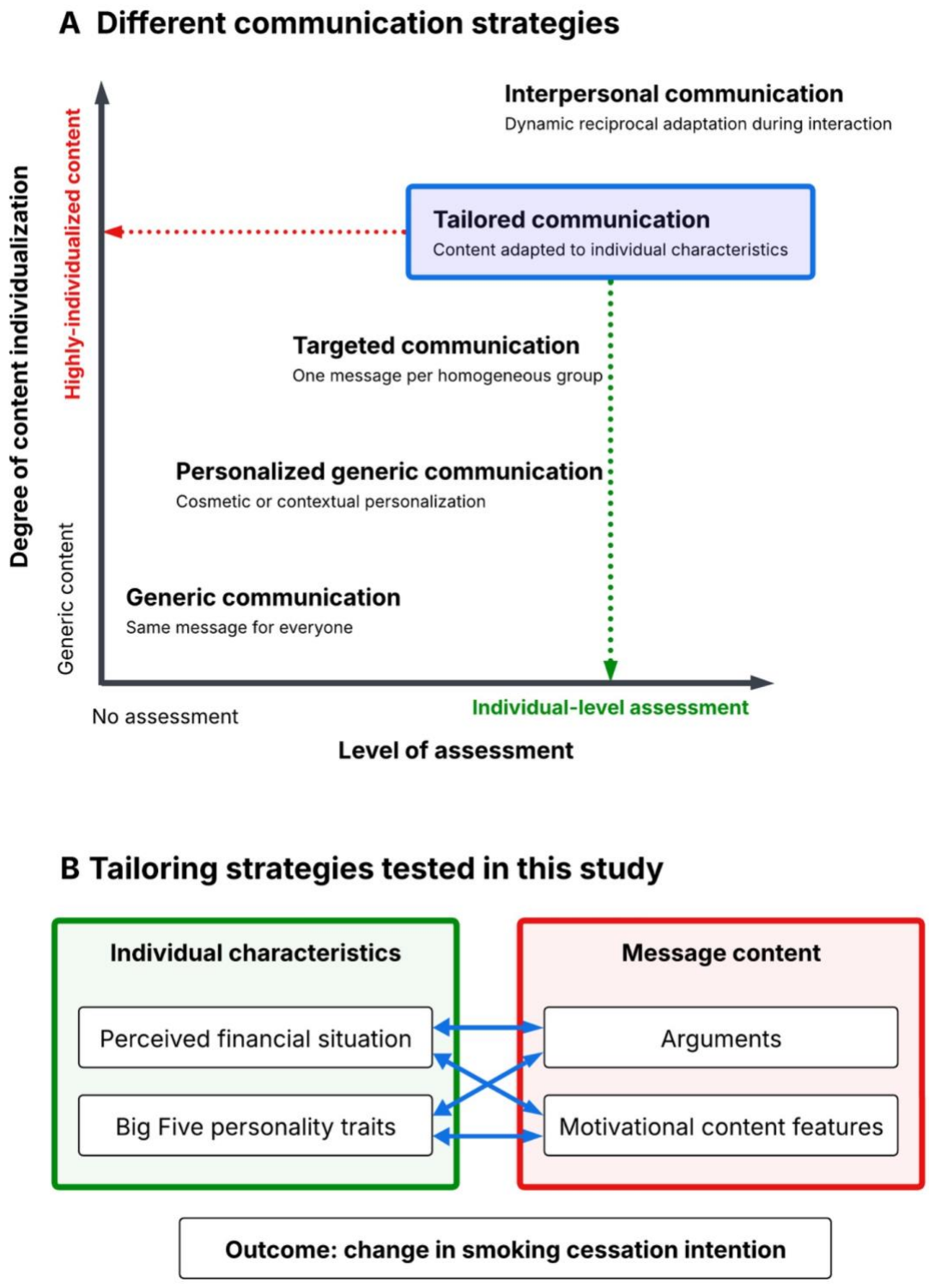

Figure 1. **A. Classification of the different approaches of health communication by level of content personalisation.** Adapted from Avenel et al. (2026), inspired by Kreuter et al. (1999). **B. The four tailoring strategies tested in the study.**

2 Materials and methods

2.1 Study design and participants

The study was pre-registered on the Open Science Framework (https://osf.io/mqwu2). It involved daily smokers recruited from a panel, who participated online. Data collection was carried out by the survey-provider Ipsos-bva. Participants viewed three advertisements, randomly chosen from a pool of 38. After each advertisement exposure, participants rated their change in intention to quit smoking and the perceived effectiveness of the advertisement. Subsequently, participants completed a personality assessment. Given the length of the questionnaire, three attention checks were embedded throughout the questionnaire; participants who failed any were prompted to stay focused. Those failing all three checks were excluded from the study. Upon completion, participants were provided with their personality test results and a brief description of each trait. Data collection took place in June 2024.

The sample included 2622 French adults aged 18-75 (M_{age} = 46.1, SD_{age} = 16.5; 1,326 women, 1,296 men; see **Table 3** for detailed characteristics of the sample, including personality scores), all of whom reported smoking cigarettes daily (manufactured or otherwise). To ensure statistical power, recruitment targeted 200 evaluations per advertisement, using quotas to approximate the demographic composition of the French smoking population. Each participant evaluated three advertisements, yielding a total of 7,866 observations.

Table 3. Characteristics of the participants

Variable	Statistic	Total (N = 2622)	Male (N = 1326)	Female (N = 1296)	18-24 (N=182)	25-3 (N=444)	35-49 (N=865)	50-64 (N=896)	65-75 (N=235)	No intention to quit (N=1116)	Intention to quit within 6 months (N=1131)	Intention to quit within the next month (N=375)
Perceived financial situation												
I'm comfortable		233 (8.9%)	142 (10.7%)	91 (7.0%)	29 (15.9%)	73 (16.4%)	62 (7.2%)	55 (6.1%)	14 (6.0%)	115 (10.3%)	94 (8.3%)	24 (6.4%)
I manage easily		723 (27.6%)	395 (29.8%)	328 (25.3%)	51 (28.0%)	126 (28.4%)	209 (24.2%)	257 (28.7%)	80 (34.0%)	302 (27.1%)	328 (29.0%)	93 (24.8%)
I need to be careful		927 (35.4%)	455 (34.3%)	472 (36.4%)	60 (33.0%)	132 (29.7%)	307 (35.5%)	339 (37.8%)	89 (37.9%)	394 (35.3%)	409 (36.2%)	124 (33.1%)
I manage with difficulty		541 (20.6%)	254 (19.2%)	287 (22.1%)	29 (15.9%)	84 (18.9%)	199 (23.0%)	185 (20.6%)	44 (18.7%)	227 (20.3%)	218 (19.3%)	96 (25.6%)
I cannot survive without debt		185 (7.1%)	80 (6.0%)	105 (8.1%)	12 (6.6%)	27 (6.1%)	85 (9.8%)	58 (6.5%)	3 (1.3%)	73 (6.5%)	77 (6.8%)	35 (9.3%)
Don't wish to answer		13 (0.5%)	0 (0%)	13 (1.0%)	1 (0.5%)	2 (0.5%)	3 (0.3%)	2 (0.2%)	5 (2.1%)	5 (0.4%)	5 (0.4%)	3 (0.8%)
Openness	Mean (SD)	77.7 (10.3)	76.8 (10.0)	78.7 (10.5)	78.1 (11.0)	77.8 (9.65)	76.8 (10.2)	78.2 (10.5)	78.9 (10.5)	77.1 (10.9)	78.2 (9.9)	77.9 (9.6)
Conscientiousness	Mean (SD)	85.8 (11.4)	84.8 (11.6)	86.8 (11.2)	79.3 (10.3)	83.3 (11.2)	85.3 (11.6)	88.2 (10.9)	88.4 (11.2)	85.8 (11.5)	85.8 (11.4)	85.9 (11.5)
Extraversion	Mean (SD)	75.5 (11.8)	76.7 (11.8)	74.3 (11.7)	76.3 (10.8)	77.2 (11.4)	74.6 (12.2)	75.6 (11.8)	74.4 (11.6)	75.0 (12.1)	76.0 (11.5)	75.3 (11.7)
Agreeableness	Mean (SD)	88.1 (11.5)	85.2 (11.6)	91.1 (10.5)	83.6 (13.0)	84.7 (12.5)	87.4 (11.3)	90.2 (10.3)	92.6 (9.38)	88.0 (11.5)	87.8 (11.6)	89.4 (10.7)
Neuroticism	Mean (SD)	68.7 (14.4)	66.6 (14.1)	70.9 (14.4)	74.7 (13.7)	72.2 (13.9)	70.6 (14.4)	65.4 (13.6)	63.6 (14.3)	67.7 (15.1)	69.1 (14.0)	70.7 (13.4)

2.2 Anti-tobacco advertisements

A total of 38 advertisements were used as stimuli; 37 of them were anti-tobacco advertisements, selected from international campaigns. They were drawn from the campaigns realised by different public health agencies or organisations (French National Public Health Agency, Public Health England, US Center for Disease Control, Australian Cancer Institute NSW, British National Health Service, Canadian Ministry of Health, Health New Zealand, Thai Health, Irish Public Health Agency, WHO) or other administrations (US Food and Drug Administration, French cancer institute) and by anti-tobacco non-governmental organisations (Comité National Contre le Tabagisme, Contre Feu (former Alliance contre le tabac), The Truth Initiative, Demain sera Non-Fumeur). The last one was a control stimulus, not tackling a tobacco issue.

The anti-tobacco advertisements all met two criteria: (1) They aimed to encourage smoking cessation (explicitly or implicitly) or provided information on the harmful effects of tobacco. (2) Each advertisement had previously been broadcast as part of an anti-tobacco campaign.

Seventeen advertisements were originally produced in a foreign language and were dubbed into French to ensure comprehension. Two foreign-language advertisements were presented in their original version with French subtitles, as dubbing would have altered key production characteristics (e.g., music lyrics). The diversity of advertisements ensured substantial variation in both content features and arguments.

2.3. Measures

2.3.1 Content of the advertisements

Content features were coded for each advertisement using a predefined list of 17 features (see **Table 2**). Each feature was rated on a scale from 0 (absent) to 3 (essential to the advertisement). Coding was performed by an expert annotator who was not involved in the study and was blind to the study design.

Presence or absence of arguments used to encourage smoking cessation were coded using a list of 19 distinct arguments (see **Table 1**). This coding was conducted independently by two annotators. In cases of disagreement (n = 7), discrepancies were resolved through discussion until consensus was reached.

2.3.2 Individual characteristics

Participants completed the 120-item IPIP-NEO personality inventory (Johnson, 2014), which provides scores for all five personality traits. For all 120 statements, respondents have to rate how accurately the statements describe them on a five-point scale, ranging from strongly disagree to strongly agree. The European French version of the questionnaire (Thiry & Piolti, 2023) was used, with minor changes to improve comprehension among individuals from lower socio-economic backgrounds.

Participants reported their perceived financial situation on a five-point scale, ranging from "I am comfortable" to "I cannot survive without debts".

2.3.3 Change in intention to quit smoking

Prior to viewing the advertisements, participants were asked about their intention to quit smoking within the next month, six months or not at all in these delays. Immediately following exposure to each advertisement, declarative changes in intention were measured on a 21-point scale (from –10, indicating a much lower intention to quit, to +10, indicating a much stronger intention).

2.4 Statistical analysis

All analyses were conducted using R version 4.4.1 and independently reproduced in Python by a second researcher.

Prior to data analysis, all explanatory variables were standardized (mean = 0, SD = 1) to ensure that all variables contributed equally to the model and to prevent those with large numerical ranges from disproportionately influencing the results. Given that each participant contributed to three observations, we accounted for within-subject dependency by assigning folds at the participant level during cross-validation.

The analytical strategy relied on a set of large interaction models designed to capture how the effectiveness of message contents varies with personality traits and perceived financial situation. Specifically, four primary model families were estimated, corresponding to the combination of two types of individual characteristics (personality traits or perceived financial situation) and two types of message content (motivational salient content features or arguments). In each model, change in smoking cessation intention was predicted by all main effects and all relevant two-way interactions between individual characteristics and message content. For example, the model combining personality traits and arguments included interactions between the five Big Five traits and the 19 arguments, in addition to their respective main effects. This resulted in high-dimensional predictor spaces, making conventional regression approaches unsuitable due to multicollinearity and overfitting.

To identify the most relevant predictors and interactions while addressing multicollinearity, we employed LASSO (Least Absolute Shrinkage and Selection Operator) regressions with cross-validation. This regularisation technique applies a L1 penalty to shrink some coefficients to zero, effectively performing variable selection (Tibshirani, 1996). We decided to favour LASSO regression over other machine learning methods such as random forest models as they allow for interpretable models with coefficients comparable to those of linear regressions.

To improve the stability of variable selection, particularly given the presence of correlated predictors and repeated measures, we implemented a resampling strategy. Specifically, we generated 1,000 distinct cross-validated LASSO models using 1,000 unique random seeds. For each iteration, a 10-fold cross-validation was performed using folds stratified by participant ID,

and the optimal penalization parameter was extracted. In a second step, 1,000 LASSO models were refitted using the corresponding penalization parameter values from the first step, this time without cross-validation. For each model, we recorded the non-zero coefficients to identify the variables selected by the penalization procedure. We then computed the selection frequency of each variable across the 1,000 models. Only variables (main effects or interactions) selected in more than 50% of the models were retained for interpretation.

Because LASSO does not provide parameter inference, we subsequently fitted a linear mixed-effects model including only the predictors retained by the LASSO procedure, with participant included as a random effect. This model was used to estimate the direction and relative magnitude of the most robust associations. Consistent with the variable-selection framework, p-values are not reported.

We performed this analysis with the four primary models. In addition to these models, we also applied the same procedure to models including joint interactions between personality traits *and* perceived financial situation with message content (content feature and argument, successively), in order to assess whether combining individual characteristics improved predictive performance. Across all analyses, only theoretically motivated two-way interactions, specifically between individual characteristics and message characteristics, were included to preserve interpretability. Additionally, all six models were re-estimated controlling for age and gender.

Finally, to determine which of the six models best predicted the outcome, we compared them using the Akaike Information Criterion (AIC). This criterion assesses the quality of a model by balancing goodness of fit and complexity. Lower AIC values indicate a better balance between goodness of fit and model complexity, allowing us to identify the model expected to achieve the strongest out-of-sample predictive performance.

3 Results

Table 4 reports descriptive statistics for participants' intention to quit smoking prior to the intervention and changes in intention following exposure to the advertisements. While baseline intentions were heterogeneous, exposure was more often associated with increases in intention than decreases, although a substantial proportion of observations showed no change. Nevertheless, these overall patterns do not account for potential differences in how individual respond to different message characteristics. The next sections will examine whether and how the different tailoring strategies (Figure 1.B) influence changes in quitting intentions.

Table 4. Intention to quit smoking before and after exposure to the advertisements.

Participants intention to quit smoking prior to intervention (N=2622)	
No intention to quit	1116 (42.6%)
Intention to quit within 6 months	1131 (43.1%)

Intention to quit within the next month	375 (14.3%)
Evolution of intention to quit after each exposure (N=7,866)	
Decrease in intention to quit	573 (7.3%)
Increase in intention to quit	3375 (42.9%)
No change in intention to quit	3918 (49.8%)

3.1 Personality × Content features

We first report the main effects of personality traits and content features to provide a general overview of responsiveness to anti-tobacco advertisements, before turning to the interaction patterns that are central to our analysis. At the level of main effects, some personality traits were associated with a greater overall increase in smoking cessation intention than others. In particular, Extraversion (selection frequency = 1.00, β = .84) and Neuroticism (frequency = 1.00, β = .73) emerged as the strongest positive predictors of intention change. Several content features also showed consistent positive associations across participants, independently of personality, most notably Disgust (frequency = 1.00, β = .28) and Compassion (frequency = 1.00, β = .19). In contrast, Humor had a negative main effect (frequency = 1.00, β = −.12), suggesting that humorous advertisements were, on average, less effective in increasing quitting intentions. Smaller but consistently negative associations were also observed for Group belonging (frequency = 1.00, β = −.07) and Threat (frequency = 1.00, β = −.03).

Beyond these general tendencies, the effectiveness of content features varied as a function of personality traits. Distinct interaction patterns emerged for each trait, indicating that the persuasive impact of specific content features depends on recipients' psychological profiles (**Figure 3**). For instance, positive interactions were observed between Agreeableness and Romantic love (frequency = 1.00, β = .09), Argumentation (frequency = 1.00, β = .08), and Moral indignation (frequency = 1.00, β = .07). Conscientiousness showed positive interactions with Humor (frequency = .54, β = .11) and Shame (frequency = .78, β = .03), but a negative interaction with Curiosity (frequency = .78, β = −.11). Extraversion interacted positively with Curiosity (frequency = .64, β = .10) and Parental care (frequency = .98, β = .08), and negatively with Social bonding (frequency = .98, β = −.05). Several interactions involving Openness were also robust, notably with Pain avoidance (frequency = .98, β = .07), Curiosity (frequency = .60, β = .05), and Guilt (frequency = .64, β = −.03). Finally, Neuroticism exhibited fewer stable interactions overall, though consistent effects emerged for Argumentation (frequency = .64, β = .07) and Group belonging (frequency = .78, β = −.08). Together, these results indicate that while some content features exert general effects, a substantial share of persuasive impact depends on personality-specific alignment between content features and recipients' psychological profiles.

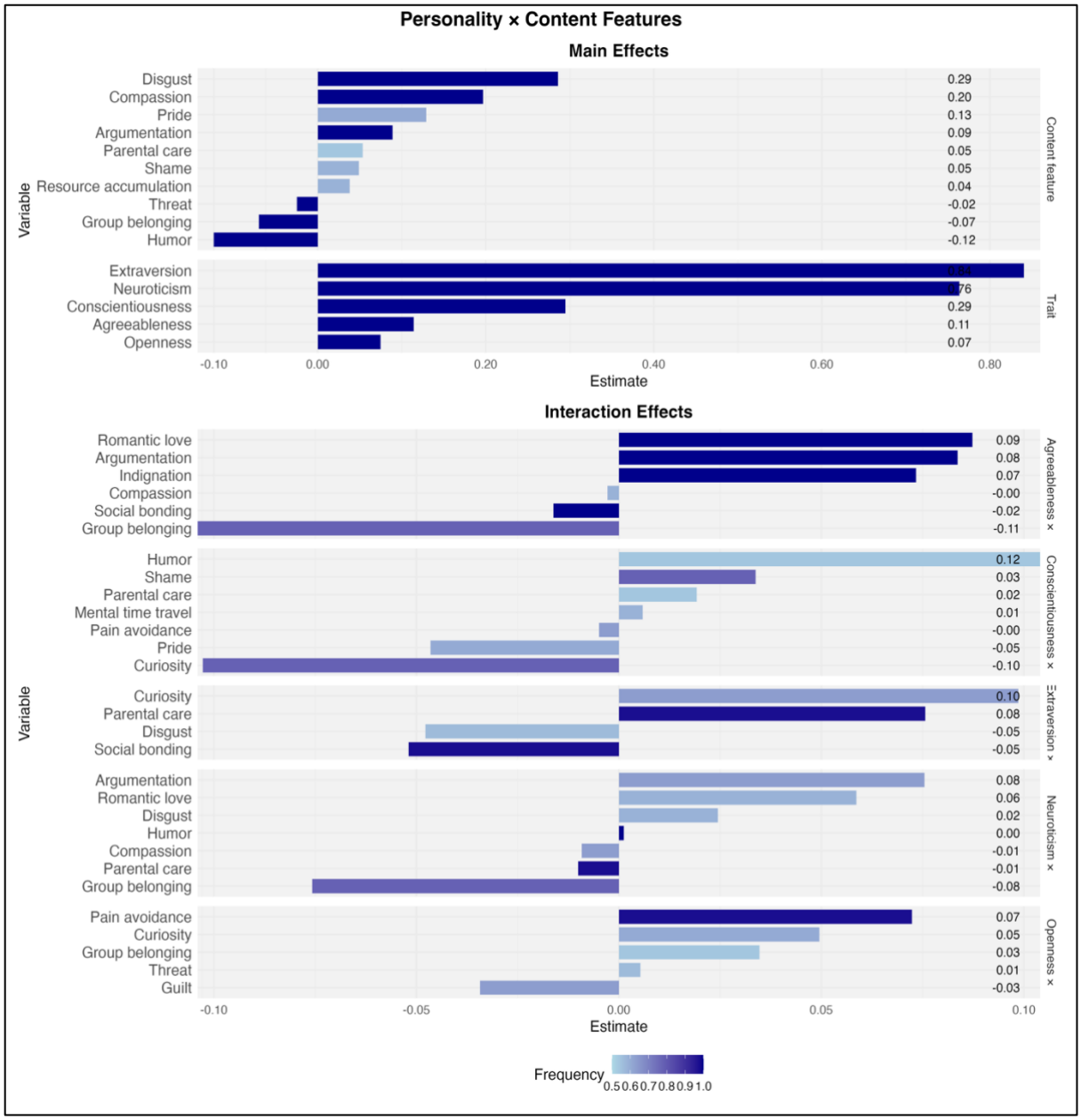

Figure 3. Main and interaction effects selected in at least 50% of the LASSO regressions, with coefficients from a post-LASSO linear model. Colour intensity represents the selection frequency across 1,000 LASSO iterations, and bar length indicates standardized coefficients estimated in linear mixed-effect models including only the selected predictors by the LASSO models.

3.2 Perceived financial situation × Content features

We next examined how perceived financial situation interacts with content features in shaping responses to anti-tobacco advertisements. At the level of main effects, a more favourable perceived financial situation was associated with a greater overall increase in smoking cessation intention. Most of the content features identified in the personality-based model showed associations with intention change. One additional feature, Resource accumulation (selection frequency = .77, β = .03), emerged uniquely in this model, displaying a small positive association.

Beyond these general effects, five content features showed systematic interactions with participants' perceived financial situation (**Figure 4**): Mental time travel (Frequency = 1, β=.06), Parental Care (Frequency = 1, β=.02), Social bonding (Frequency = .82, β=.02), Disgust (Frequency = 1, β=-.03) and Curiosity (Frequency = 1, β=-.05). Taken together, these findings indicate that perceived financial situation systematically moderates the effectiveness of several content features.

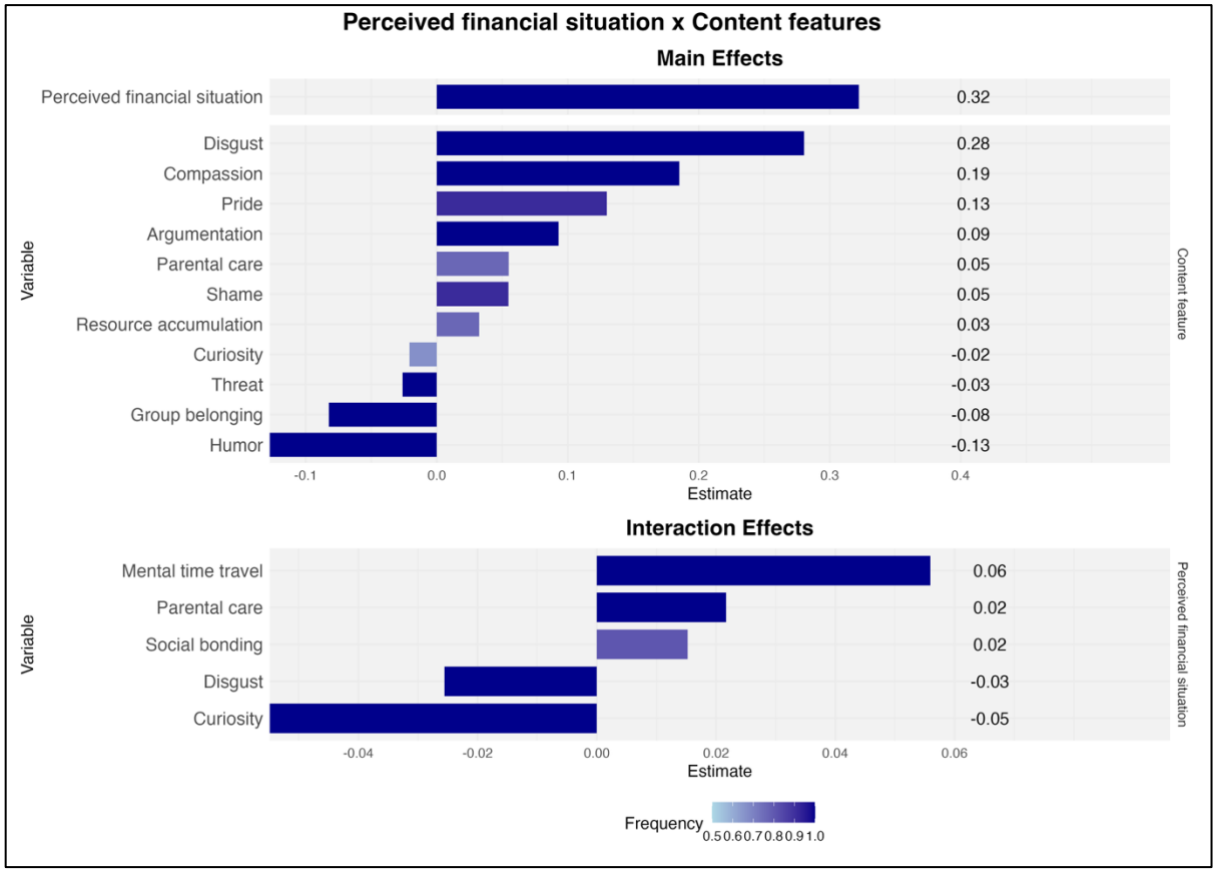

Figure 4. Main and interaction effects selected in at least 50% of the LASSO regressions, with coefficients from a post-LASSO linear model. Colour intensity represents the selection frequency across 1,000 LASSO iterations, and bar length indicates standardized coefficients estimated in a linear mixed-effects model including only the selected predictors by the LASSO models. (Pfs = perceived financial situation)

3.3 Personality x Arguments

We next examined how personality traits interact with argumentative content in shaping responses to anti-tobacco advertisements. At the level of main effects, the pattern for personality traits closely mirrored that observed in previous analyses, with Extraversion and Neuroticism again associated with greater overall increases in smoking cessation intention. Turning to arguments, several showed strong and consistent positive associations across personality profiles. In particular, Health dangers (selection frequency = 1.00, β = .28), Be present for kin (frequency = 1.00, β = .24), and Dying (frequency = 1.00, β = .17) emerged as the most persuasive arguments on average. In contrast, Normative benefits displayed a robust negative main effect (frequency = 1.00, β = −.16), suggesting that appeals emphasizing social norms were, overall, less effective.

Beyond these general tendencies, the effectiveness of arguments varied systematically as a function of personality traits. Distinct interaction patterns emerged for each personality trait, indicating that the same argument can have different persuasive effects depending on recipients' psychological profiles (**Figure 5**). For Agreeableness, positive interactions were observed with Be present for kin (frequency = 1.00, β = .09), Get sick or injured (frequency = 1.00, β = .09), Harms on youth (frequency = 1.00, β = .05), and Health dangers (frequency = 1.00, β = .04), whereas Efficacy appeal was less effective among individuals scoring high on Agreeableness. Conscientiousness showed positive interactions with Get sick or injured (frequency = 1.00, β = .08) and Negative life consequences (frequency = .97, β = .01). Extraversion interacted positively with Mortality burden (frequency = .60, β = .05), Health dangers (frequency = .60, β = .03), and Setting a bad example for children (frequency = 1.00, β = .02), but negatively with Get sick or injured (frequency = 1.00, β = −.09. For Neuroticism, positive interactions emerged with Dying (frequency = 1.00, β = .06) and Negative life consequences (frequency = .86, β = .04), alongside negative interactions with Normative benefits (frequency = 1.00, β = −.04) and Financial loss (frequency = 1.00, β = −.05. Finally, negative interactions were found between Openness and Positive life consequences (frequency = .97, β = −.01), Health dangers (frequency = 1.00, β = −.01), and Not be present for kin (frequency = 1.00, β = −.07). Taken together, these results indicate that, much like content features, the effectiveness of arguments depends on a trait-specific alignment between argumentative content and personality profiles.

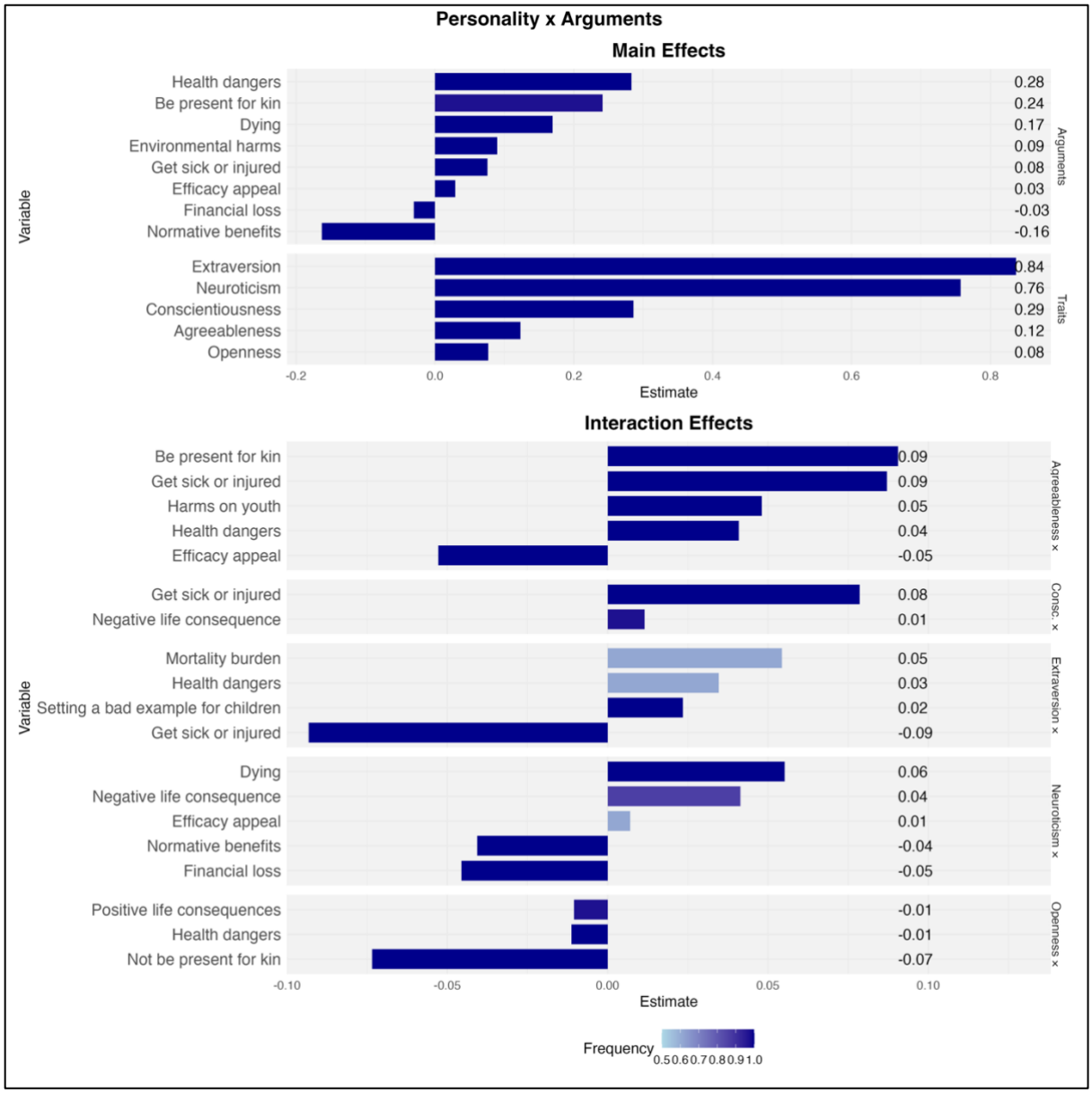

Figure 5. Main and interaction effects selected in at least 50% of the LASSO regressions, with coefficients from a post-LASSO linear model. Colour intensity represents the selection frequency across 1,000 LASSO iterations, and bar length indicates standardized coefficients estimated in linear mixed-effect models including only the selected predictors by the LASSO models.

3.4 Perceived financial situation × Arguments

We finally examined how perceived financial situation interacts with argumentative content in shaping responses to anti-tobacco advertisements. At the level of main effects, the pattern for perceived financial situation was consistent with that observed in the previous section. Most arguments showed similar main effects to those observed in the personality-based model. One additional argument, Social costs, emerged uniquely in this model and displayed a small but consistent negative association (selection frequency =.89 $\beta = -.03$).

Beyond these general effects, several arguments exhibited systematic interactions with perceived financial situation, indicating that their persuasive impact varied depending on smokers' financial self-assessment (**Figure 6)**. Seven interactions were retained in at least 50% of the LASSO replications: Financial benefits (frequency = .82, β = .09), Dying (frequency = .97, β = .05), Financial loss (frequency = .97, β = .05), Get sick or injured (frequency = .98, β = .03), Be present for kin (frequency = .96, β = .02), Health dangers (frequency = .96, β = .01), and Social costs (frequency = .97, β = −.07). Taken together, these findings indicate that perceived financial situation systematically moderates the effectiveness of several arguments.

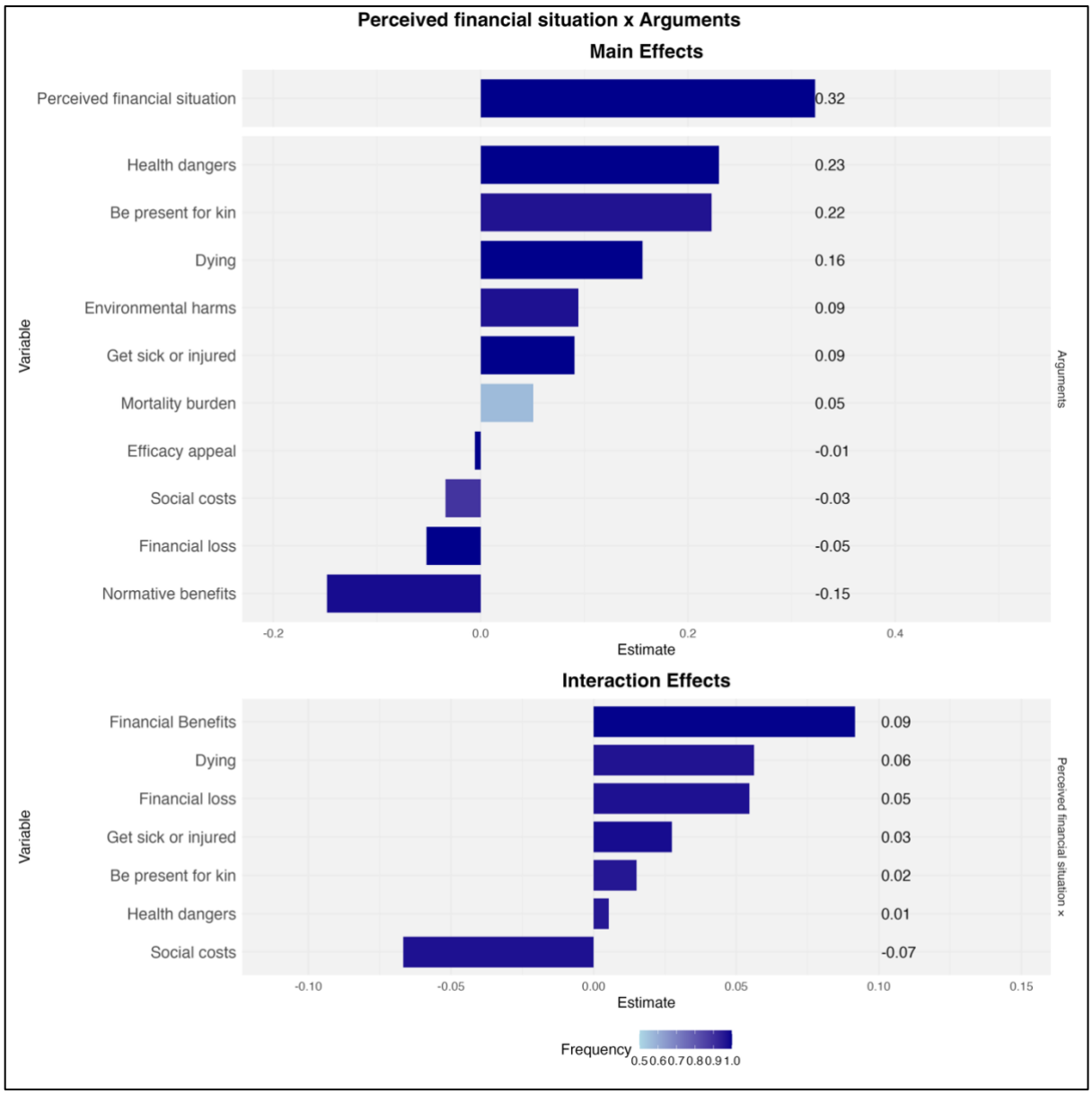

Figure 6. Main and interaction effects selected in at least 50% of the LASSO regressions, with coefficients from a post-LASSO linear model. Colour intensity represents the selection frequency across 1,000 LASSO iterations, and bar length indicates standardized coefficients estimated in linear mixed-effect models including only the selected predictors by the LASSO models.

3.5 Supplementary models and model comparisons

All analyses were replicated with age and gender included as control variables. Across models, age and gender consistently emerged as a significant main effect, with younger participants and women showing larger increases in smoking cessation intention following advertisement exposure. Note that many interaction terms disappeared when adding those control variables for all hypotheses. However, some also emerged that were not present in the initial models. In models based on content features, age interacted positively with Shame (Freq=1, β=0.07) implying that older smokers were more responsive to messages emphasizing shame-related cues. In models involving argument, several age-related interactions with arguments were also retained: Health benefits (frequency = 1.00, $\beta = -.06$) and Negative life consequences (frequency = 1.00, $\beta = -.07$) were less effective among older participants, whereas Get sick or injured showed a positive interaction with age (frequency = 1.00, $\beta = .03$), indicating greater effectiveness for older smokers.

Finally, to assess which tailoring strategy provided the best overall account of variation in smoking cessation intention, we compared models differing in the individual characteristics and message content dimensions they incorporated (**Figure 7**). The model combining content features tailored to *both* personality traits and perceived financial situation, while controlling for age and gender, yielded the lowest AIC. This model therefore provided the best balance between goodness of fit and parsimony among the tested tailoring strategies (**Figure 8**). Except for terms involving age and gender, all of the terms (main effects or interactions effects) retained in this last model were also present in the models describes in the sections 3.1 and 3.2. However, this model relies on a more limited set of predictors, suggesting that the robust effects are captured by a more parsimonious specification. Finally, for this model, fixed effects accounted for 5.5% of the variance of change in cessation intention, of which 5.1% were attributable to main effects alone. The contribution of interaction terms is thus modest, explaining an additional 0.4% of the variance.

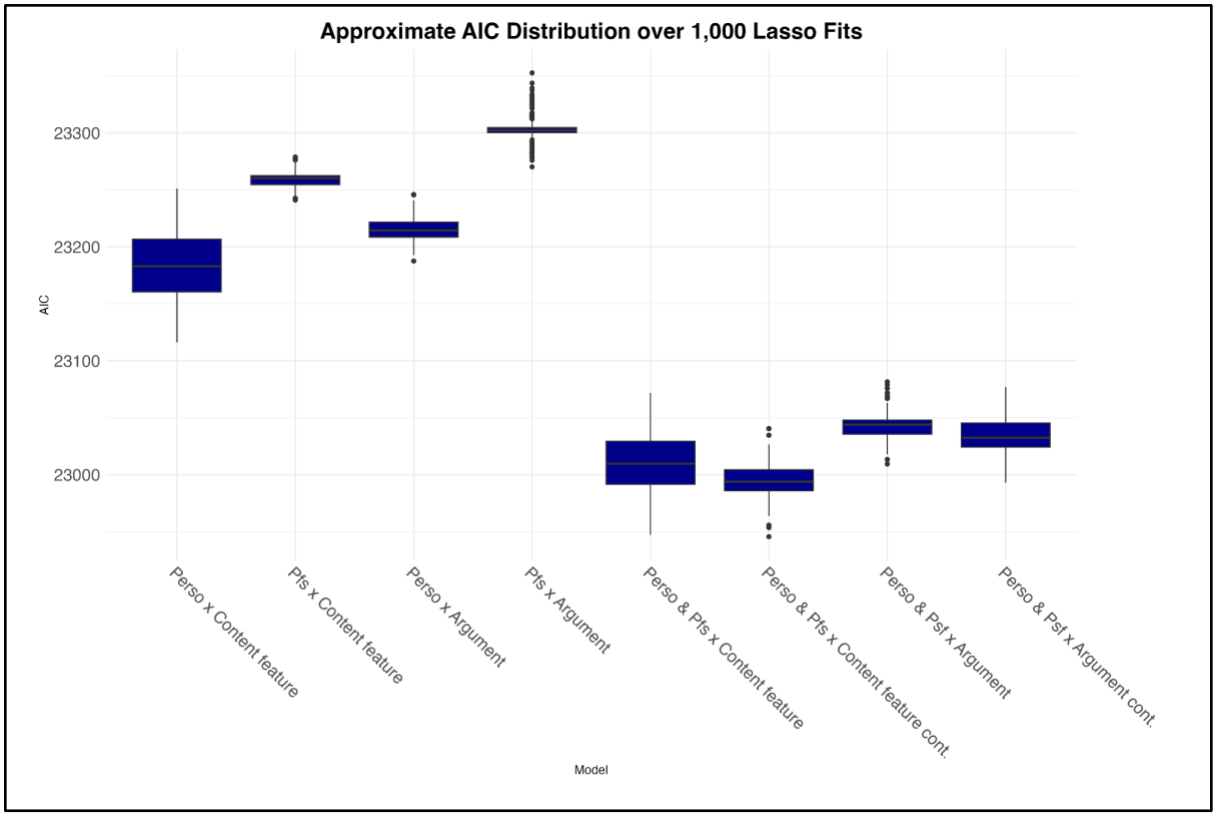

Figure 7. Comparison of tailoring models based on AIC. Lower AIC values indicate a better balance between goodness of fit and model complexity. The model combining content features tailored to both personality traits and perceived financial situation, while controlling for age and gender, achieved the lowest AIC (perso = personality traits, pfs = perceived financial situation, cont. = controlled for age and gender).

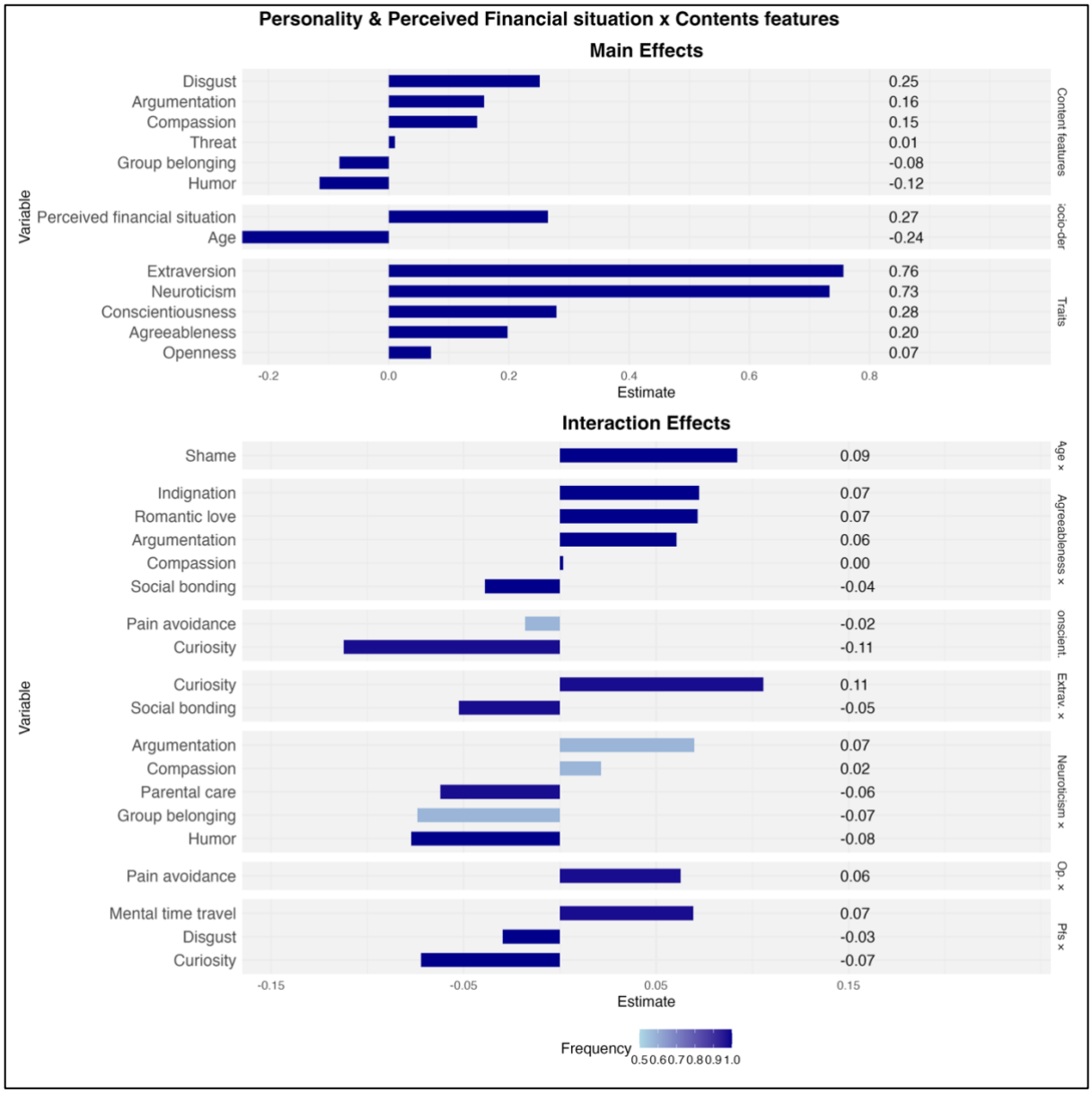

Figure 8. Main and interaction effects selected in at least 50% of the LASSO regressions, with coefficients from a post-LASSO linear model, for the model with the lowest AIC. Colour intensity represents the selection frequency across 1000 LASSO iterations, and bar length indicates standardized coefficients estimated in linear mixed-effect models including only the selected predictors by the LASSO models.

4 Discussion

The aim of this study was to examine whether and how smokers' individual characteristics (i.e., personality traits and perceived financial situation) interact with two types of message attributes (i.e., content features and arguments) to influence smoking cessation intention. Rather than asking whether tailoring is effective in general, the study sought to clarify which message features are effective for which individuals, and along which psychological dimensions. Still, the analyses revealed clear *general* patterns of responsiveness to anti-tobacco advertising. Exposure to a single advertisement produced a modest but reliable increase in cessation intention, with higher overall responsiveness among smokers scoring high in Extraversion and Neuroticism, as well as among

those perceiving their financial situation as more favourable. In addition, several content features (e.g., disgust, compassion, argumentation) and arguments (e.g., health dangers, being present for kin, dying) showed broadly positive associations with intention change across participants, whereas others appeared consistently less effective (e.g., humour, group belonging, normative benefits).

Crucially, however, the central contribution of this study lies beyond these average effects. Across all analyses, we observed systematic interactions between individual characteristics and both content features and arguments. These interactions imply that the same message element can increase cessation intention for some smokers while being neutral or less effective for others, depending on their profile. For example, content features evoking Romantic love did not exert a general effect across participants, but were positively associated with intention change specifically among individuals high in Agreeableness (consistent with the idea that affiliative cues are particularly motivating for those who place greater value on close relationships). Together, these findings suggest that a substantial share of persuasive variance in anti-tobacco communication resides in person-specific alignment between message content and individual psychology, rather than in universally effective messages. Importantly, the finding that the full model (with both personality traits and perceived financial situation in interaction with content features) was the best model suggests that considering multiple individual dimensions simultaneously yields a more accurate representation of the processes underlying message-recipient matching (Noar, 2007).

A natural question raised by these findings concerns their generalizability: do the personality–content alignments observed here extend beyond the specific set of advertisements used in this study, beyond video-based communication formats, and even beyond the tobacco domain? This question is central both for theoretical interpretation and for real-world applications of message tailoring. Several aspects of our design and results suggest that they do. First, the design adopted in our study targets mechanisms that are, in principle, transferable across campaigns, policy domains, and media: rather than comparing the effectiveness of individual advertisements, we annotated ads in terms of abstract, psychologically defined content features that recur across multiple stimuli. This approach is explicitly intended to identify stable links between individual characteristics and underlying motivational cues, rather than idiosyncratic properties of particular messages.

Second, several of the interaction patterns identified in the analyses converge with well-established findings in personality psychology. For instance, participants high in Openness were more responsive to content features triggering Curiosity only in our first model, aligning closely with prior work conceptualizing curiosity as the core motivational component of Openness (Dubourg, in prep). Still in the first model, participants high in Neuroticism were more sensitive to cues of Disgust, in line with prior work on threat sensitivity (Oosterhoff et al., 2018). Participants with a more favourable perceived financial situation were more responsive to future-oriented arguments, echoing evidence that socio-economic resources facilitate projection in the future (Martínez & Maner, 2025; Nettle, 2010). We also conceptually replicate the links between personality traits and argument links, notably those involving Agreeableness (e.g., kin-related arguments are effective; Hirsh et al., 2012; efficacy-based appeals are less effective; Halko & Kientz, 2010) and Neuroticism (e.g., financial loss argument is less effective; Hirsh et al., 2012).

Finally, the greater effectiveness of arguments emphasizing the social costs of tobacco use among participants with lower perceived financial situations aligns with research on social class and self-construal (Kraus et al., 2012).

Although these convergences do not constitute direct evidence of cross-domain or cross-media generalization, they suggest that the interaction patterns observed in this study reflect broader psychological mechanisms rather than campaign-specific effects, and therefore plausibly extend beyond the particular stimuli and context studied.

A further theoretical implication of these findings concerns the relative persuasive power of content features compared to explicit arguments. Much of the persuasion literature implicitly assumes that messages are effective primarily because they provide reasons to change attitudes or behaviour (Mercier, 2016). Against this backdrop, the present results are noteworthy: content features (defined as cues that directly activate motivational systems) emerged as more predictive of intention change than argumentative content. One explanation may be that motivationally aligned cues are more effective at generating interest (Maunoir et al., 2026). When a message activates motivations that are already salient, individuals may more readily place themselves in the situation depicted and allow it to influence their intentions, even in the absence of explicit reasons. For example, a smoker strongly motivated by parental care may be affected by seeing children in a scene, without needing arguments about health risks or future outcomes. From this perspective, persuasion may often operate less through the transmission of reasons than through the activation of motivationally meaningful representations that make behavioural change feel relevant and compelling (Braddock & Dillard, 2016; de Graaf et al., 2012; Green & Brock, 2000).

Several limitations of the present study should be acknowledged, which also point to directions for future work. From a design perspective, the library of advertisements was necessarily limited, raising the possibility that some observed effects partly reflect idiosyncratic properties of specific stimuli rather than message features per se. Second, although the study demonstrates the relevance of personality-based tailoring, it relied on an extensive 120-item personality questionnaire, which is unlikely to be feasible in most applied prevention contexts. Future research should therefore test whether comparable tailoring effects can be obtained using a shorter questionnaire.

Third, the effect sizes observed were modest. However, such findings are consistent with prior work on smoking cessation, tailored health communication (Joyal-Desmarais et al., 2022; Noar et al., 2007), and small effects of this magnitude can have meaningful consequences when deployed at population scale (Götz et al., 2022). This is especially true in the context of tobacco prevention, where the substantial burden of tobacco use means that even modest improvements in cessation intention may translate into significant public health benefits. Particularly, as recent advances in digital communication and generative artificial intelligence increasingly enable large-scale implementation of such tailoring strategies (Simchon et al., 2024). Moreover, the present estimates likely underestimates the true impact of tailored communication as repeated exposure is a key driver of effectiveness (Schmidt & Eisend, 2015), and our study design only allowed for a single exposure.

Fourth, some interactions observed in this study diverge from previous findings, underscoring the importance of contextual factors. For instance, whereas openness has been shown to increase responsiveness to positively framed life-benefit arguments in the domain of voting (Gerber et al., 2013), we observe a negative interaction with positive life consequences in the context of smoking cessation. Such discrepancies highlight the need to consider domain-specific motivational dynamics when applying personality-based persuasion frameworks. Future research could examine whether these newly identified interaction patterns replicate in other behavioural domains such as alcohol consumption, physical activity, or diet.

An additional consideration concerns the fact that the present study focused on changes in intention to quit smoking rather than behavioural outcome; future work should examine whether these tailoring effects extend to downstream behavioural outcomes, such as quit attempts or sustained cessation. Indeed the intention-behaviour gap is particularly important in tobacco cessation, where even large intents to change tend only to moderate actual behaviour changes (T. L. Webb & Sheeran, 2006). In particular, randomized field experiments could test whether personality- or context-based tailoring outperforms generic messaging under real-world exposure conditions, including repeated exposure over time. Further research should also assess the feasibility of implementing these strategies using shorter, practical assessments of individual characteristics. Finally, recent advances in digital communication and generative artificial intelligence may increasingly enable the scalable deployment of such tailoring approaches, opening promising avenues for the development of more effective and personalized tobacco prevention interventions.

5 Acknowledgments

Santé publique France, Agence nationale de santé publique; Women's Cancers Institute, Institut Curie, ANR-23-IAHU-0006; Valentin Thouzeau (expert annotator), Institut Jean Nicod, Département d'études cognitives, École normale supérieure, Université PSL, EHESS, CNRS, 75005 Paris, France; Nihel Ben Taleb Institut Jean Nicod, Département d'études cognitives, École normale supérieure, Université PSL, EHESS, CNRS, 75005 Paris, France

6 Declaration of interests statement

The authors report there are no competing interests to declare.

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