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"Don't vape, nobody uses these poisonous sticks": A content analysis of adolescents' self-generated anti-smoking and anti-vaping messages

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ABSTRACT

Media literacy interventions are promising approaches to mitigate the harmful impact of media on substance use behaviors, including smoking and vaping. Some media literacy interventions adopt an interactive format, involving adolescents in the creation of counter messages that challenge pro-substance media narratives. However, research has largely focused on the impact of media literacy interventions on behaviors, leaving a critical gap in understanding the actual content of messages that adolescents produce. Consequently, this study presents a content analysis of $N = 256$ anti-smoking/vaping messages created by Belgian adolescents during the #Smokefree intervention, which aimed to discourage smoking and vaping by involving adolescents in the planning/design of their own messages. Overall, adolescents mostly focused on vapes in their messages, which reflects a societal trend whereby vaping is becoming more prevalent while smoking is decreasing among adolescents. More importantly, adolescents relied on negative outcome expectations and descriptive norms to discourage smoking/vaping, and they were able to implement basic heuristic cues necessary to enhance message appeal in their messages. These findings suggest that adolescents can apply critical media literacy skills to their own anti-smoking/anti-vaping messages. It also sheds light on which elements of the media literacy intervention resonated with youth, thereby informing the development of future health campaigns and interventions.

Smoking and vaping remain two major public health concerns (World Health Organization [WHO], 2021) (WHO, 2021). Belgium has a rather lenient tobacco policy compared to other countries, allowing the purchase of both products at the age of 18 (European Network for Smoking and Tobacco Prevention, 2019; Global Tobacco Control, n.d.). Notwithstanding, Belgian adolescents initiate smoking and vaping at an average age of 15, after which use continues to increase throughout adolescence and early adulthood (Rosiers et al., 2024). This is alarming as cigarettes and vapes can impair brain development and increase addiction risk (FDA, 2016; WHO, 2021).

One factor contributing to adolescents' smoking and vaping initiation is the media (Hassanein et al., 2022; Rutherford et al., 2023a). Adolescents are intense users of traditional and social media (Vanwynsberghe et al., 2023). Despite regulations that restrict adolescents' exposure to promotional cigarette and vape content (e.g., European Commission, 2024; FDA, 2016; Kong et al., 2024; WHO, 2005), pro-cigarette and pro-vape messages appear to be omnipresent in televised series, movies (Allem et al., 2022; Rath et al., 2020), and on social media (Alpert et al., 2021; Cortese et al., 2018; Engel et al., 2024). Exposure to such portrayals could elicit positive outcome expectations, which could eventually influence the uptake of smoking and vaping (Hassanein et al., 2022; Rutherford et al., 2023a).

Media literacy interventions are effective approaches to mitigate the harmful influence of media on substance use behaviors, including smoking and vaping (Michaud et al., 2025; Vahedi et al., 2018). Interactive media literacy interventions, which not only teach adolescents to critically evaluate content but also to create messages that challenge pro-substance use narratives in the media, enhance engagement and the

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overall effectiveness of such interventions (Austin et al., 2020; Banerjee and Greene, 2006; Hecht et al., 2003).

However, studies investigating interactive media literacy interventions reflect an important limitation. Most studies largely concentrate on the effectiveness of media literacy interventions through self-reported shifts in media literacy skills and substance use behaviors (Austin and Pinkleton, 2016; Xie et al., 2019). These studies thus neglect the core activity of such interventions: the messages generated by adolescents.

Although there are a few notable exceptions that studied youth-generated counter messages (Banerjee et al., 2013; Banerjee and Greene, 2011; Gordon et al., 2018; Krieger et al., 2013; Peña-Alves et al., 2019), these mainly focused on messages targeting alcohol or tobacco, often predating the rise of vaping. Given the rapid rise of vaping and its perception as less harmful than combustible cigarettes (Sharma et al., 2021), adolescents may now require stronger skills to resist pro-vaping messages in the media. Furthermore, these studies centered on U.S. adolescents, where the legal purchase age of cigarettes and vapes is stricter (>21 years; FDA, 2024) than in Belgium. This legal context may influence adolescents' exposure to cigarettes/vapes in the media, and the social acceptability surrounding such depictions, limiting the generalizability of the findings to other regions.

Thus, it is essential to explore how adolescents in a different regulatory context construct anti-smoking and anti-vaping messages. Analyzing the content of youth-generated messages offers valuable insights into how adolescents apply media literacy skills, and which elements of media literacy interventions resonate with them, and were thus implemented in their own messages. This analysis of youth-produced messages could inform the development of future health messages and prevention initiatives. Thus, this study presents a content analysis of adolescents' self-generated messages in the #Smokefree intervention. This intervention is rooted in the theory of active involvement (Greene, 2013), which involved adolescents in the creation of anti-smoking/vaping messages to challenge unhealthy narratives about these substances in the media and delay initiation of these behaviors.

1. Literature review

1.1. The importance of message creation in media literacy interventions

Media literacy encompasses a broad range of skills, including accessing, analyzing, and evaluating media content, sources, and persuasive techniques, but also producing one's own media content (NAMLE, n.d.). While some media literacy interventions solely focus on critical analysis skills (e.g., Scharrer and Zhou, 2022), other, more interactive interventions include activities that focus on producing media content (Banerjee and Greene, 2006). This idea is also central to interventions that are rooted in the theory of active involvement (Greene, 2013).

The Theory of Active Involvement (Greene, 2013) posits that it is crucial to actively involve adolescents in planning/designing counter messages that challenge pro-substance use messages in the media. Such activities would enhance engagement, which increases adolescents' receptivity to intervention messages and enables deeper processing of information about the targeted substance and media's role in promoting it. Through engagement, adolescents are theorized to acquire essential skills like perspective-taking and counter-arguing, eventually enhancing self-reflection and fostering lasting changes in cognitions and behaviors (Greene, 2013).

Following this logic, theory of active involvement-based interventions use a two-phase approach: analysis and planning/design (Greene, 2013). In the analysis phase, adolescents learn about the determinants of substance behaviors and critically examine pro-substance messages in the media. The subsequent planning/design phase involves using this knowledge to plan and disseminate their own anti-substance messages, thus learning to counter dominant media narratives and apply persuasive strategies in their own messages or campaigns (Greene, 2013).

1.2. The #Smokefree intervention

To fill this gap, this study will analyze anti-smoking/anti-vaping messages created by early adolescents in the #Smokefree intervention. Following the theory of active involvement (Greene, 2013), the curriculum consisted of two phases: (1) critical analysis of pro-smoking/vaping messages in the media and associated risks, and (2) the development and creation of counter messages to challenge media messages and discourage subsequent smoking and vaping.

A key design feature was to teach adolescents to critically analyze both cigarette and vape portrayals within a single intervention. This approach is justified by some similarities. For instance, both substances have comparable negative consequences, such as addiction and brain damage (Banks et al., 2022; FDA, 2016). Furthermore, portrayals of cigarettes and vapes are omnipresent in the media and are mostly depicted in positive contexts, though the extent of positive portrayal differs between the two (Allem et al., 2022; Rath et al., 2020; Rutherford et al., 2023b).

Despite these similarities, there are also differences regarding usage and social acceptance, which may influence adolescents' choices for their anti-smoking/vaping messages. Research in Belgium showed a decline in cigarette use over the past decade, while vapes' popularity has surged (Rosiers et al., 2023). Vapes are often seen as more appealing due to their colorful designs and flavors, features that are restricted in some countries' regulations, and adolescents may not fully understand the associated risks (Sharma et al., 2021; Thoonen and Jongenelis, 2024). This suggests that vapes may resonate more with adolescents' experiences, leading them to focus on vapes in their counter messages. The content analyses of prior adolescent-generated counter messages in media literacy interventions have focused on one substance (Banerjee et al., 2013; Banerjee and Greene, 2011; Gordon et al., 2018). Hence, we pose the following research question.

Research question 1. Which substance (cigarettes vs vapes) was mostly targeted in adolescents' anti-smoking/vaping messages?

In addition, the intervention aimed to help adolescents understand how media influences cigarette and vape cognitions and behaviors. By analyzing scenes from TV series, movies, and social media posts, adolescents learned to identify key determinants, such as social influences and expectations. We used the Prototype Willingness Model (PWM; Gibbons et al., 2020) to explain how cognitions influence smoking and vaping, and how media could influence these cognitions (Donaldson et al., 2022; Vogel et al., 2021).

The PWM outlines two pathways to health-risk behaviors: a social reactive pathway and a reasoned pathway (Gibbons et al., 2020). The social reactive pathway reflects spontaneous behavior driven by prototype perceptions, which are thoughts about attributes related to a typical peer who smokes/vapes, influencing the willingness to engage in these behaviors. This pathway is particularly important in adolescence, as it recognizes that smoking and vaping may be reactions to social cues, such as peer behavior or glamorized media portrayals, rather than a result of deliberate decision-making (Gibbons et al., 2020). In contrast, the reasoned pathway represents a more deliberate decision-making process. Here, attitudes, shaped by positive and negative outcome expectations (i.e., anticipated consequences of smoking/vaping),combined with descriptive norms (i.e., perceptions of how many others smoke/vape) and injunctive norms (perceptions of others' approval of smoking/vaping), predict an individual's intention to use cigarettes and vapes (Gerrard et al., 2008).

After learning about these pathways and media influence, adolescents selected specific determinants to counteract in the counter messages they created. The few content analyses focusing on adolescents' counter messages regarding various substances analyzed outcome

expectations, potentially overlooking other powerful determinants such as social norms (Banerjee et al., 2013; Banerjee and Greene, 2011; Peña-Alves et al., 2019). Adolescence is a key developmental period in which youth seek belonging in broader peer groups (Brown and Larson, 2009). At the same time, they overestimate peers' use prevalence and approval of substances (Perkins et al., 2019). Research has shown that correcting social norms is particularly effective among younger audiences (Das et al., 2016), thus raising questions which factors beyond outcome expectations adolescents would include in their messages.

Research question 2a. Which determinants of behavioral influence were integrated into adolescents' anti-smoking/vaping messages?

Closely related to this research question, we will analyze how adolescents' self-generated anti-smoking/vaping messages address behavioral determinants, particularly positive and negative outcome expectations. Prior research classified consequences by timeframe and domain (Banerjee et al., 2013; Gordon et al., 2018). Short-term consequences, emerging over days or weeks, include yellow teeth and persistent mouth odor/bad breath, while long-term consequences, developing over months or years, encompass illnesses, mood disorders, and impaired brain development (Banerjee et al., 2013; Gordon et al., 2018). Although not mutually exclusive, beyond timeframe differences, consequences can also be categorized by domain: appearance-related consequences (e.g., yellow teeth), health-related consequences (e.g., death or reduced lung capacity), social consequences (e.g., social exclusion), financial outcomes (e.g., poverty) or environmental consequences (e.g., damage to nature; Banerjee et al., 2013; Gordon et al., 2018).

Research on public service announcements suggests that health campaigns should be tailored toward the target audience (e.g., Masterman and Kelly, 2003). For younger audiences, appearance-related consequences, social exclusions and specific health consequences such as brain damage (e.g., Wackowski et al., 2019) are particularly persuasive. Existing content analyses indicate that adolescents' own counter-messages predominantly highlight short-term consequences (e.g., vomiting because of alcohol use) (Gordon et al., 2018) or appearance related consequences of tobacco (e.g., yellow teeth) (Banerjee et al., 2013), suggesting that these resonate most. Since this evidence is limited, especially for vapes, we investigate.

Research question 2b. Which specific positive and negative outcome expectations for avoiding smoking and vaping are expressed in adolescents' anti-smoking/vaping messages?

Finally, the curriculum also focused on heuristic cues that attract attention and enhance message persuasiveness. These cues are subtle, often visual or auditory, and have been shown to improve attention, retention, and generate positive attitudes toward the message (Padon et al., 2018). Exposure to these cues can heighten the perceived desirability of these messages (Vranken et al., 2023), which is a key indicator for the uptake of these behaviors (Austin, 2007). Accordingly, adolescents in the intervention learned to detect these cues in cigarette and e-cigarette portrayals and to integrate these heuristic cues in their own counter messages regarding cigarettes/vapes.

Following prior research on persuasive cues in advertisements (Padon et al., 2018; Vranken et al., 2023), the #Smokefree curriculum identified three overarching cues: (a) stylistic features, (b) character features, and (c) repetition.

Stylistic features include vibrant colors, filters, music such as jingles or background sounds, and unique settings or locations (Padon et al., 2018; Vranken et al., 2023). Character-features encompass relatable role models, such as peers, and admired figures like celebrities or social media influencers, as well as anthropomorphized characters, such as cartoons or talking animals (Padon et al., 2018). The last heuristic cue is repetition, which involves the repeated display of messages via the same or different media channels (Padon et al., 2018). There is some limited evidence suggesting that adolescents understand certain heuristic cues such as the use of colors and repetition (Banerjee et al., 2013; Gordon et al., 2018). However, we extend these insights to multiple substances, including smoking/vaping, and Belgian adolescents.

Research Question 3. Which type of heuristic cues are integrated in adolescents' anti-smoking/vaping messages?

2. Method

2.1. Overview

This study is part of the #Smokefree project, which tested an active involvement intervention designed to reduce or delay smoking and vaping initiation among Belgian adolescents. The intervention was developed iteratively, incorporating qualitative interviews to assess smoking/vaping determinants and a pretest of the curriculum with adolescents, school principals, and stakeholders (e.g., media literacy organization, student guidance center). A quasi-experimental design was used to evaluate the effectiveness of the intervention and assess changes in behavioral outcomes (e.g., cigarette/vape cognitions) (Vranken et al., 2024). The content analysis of the anti-smoking/vaping messages discussed here was based on substance prevention messages produced by adolescents as part of this quasi-experimental study.

2.2. Recruitment in the #Smokefree project

The quasi-experimental study used three assessments (baseline, immediate post-test, and six-month delayed post-test) comparing an intervention with control group. Participants in the intervention group participated in the #Smokefree intervention (i.e., analysis + planning/design phase) from October to November 2023. For ethical reasons, the control group also participated in the intervention, after completion of the final assessment (February – April 2024).

Adolescents were recruited from secondary schools, with the intervention fully delivered by the first author during school hours. Five randomly selected schools participated, with principals choosing classes from the 2nd (ages 13–14) and 3rd years (ages 14–15). Study objectives and ethical considerations were explained to all students, who provided informed assent. Parents were informed in advance and could opt out, though no one chose to. Passive parental consent was approved by the university's ethics board under G-2020-2267-R6(AMD). Full recruitment and consent details are available in the ISRCTN database (Vranken et al., 2024).

A total of 906 adolescents completed the study (44.42 % control group, 55.58 % intervention group), with an average age of 13.57 years old (SD_{age} = .82). Gender distribution was roughly equal (53.6 % boys, 46.0 % girls, .3 % other) in both groups. Among the participants, 91.7 % indicated they never used cigarettes in the past, while 72.8 % reported never having used vapes.

2.3. Intervention design

The intervention followed the theory of active involvement (Greene, 2013) and consisted of two phases. Both phases were conducted on the same day. In the first phase (analysis, 2 h), students participated in small groups, based on their year and educational track. They critically analyzed pro-smoking and pro-vaping messages in the media, and through this process identified specific behavioral determinants and heuristic cues. They also learned about the risks of smoking cigarettes and engaging in vaping.

In the second phase (planning/design, 40 min), participants were split into smaller groups of 2–8. Following instructions for the development of theory of active involvement interventions (Greene, 2013), participants first completed a step-by-step worksheet to support them in designing their own anti-smoking/vaping campaign. This worksheet guided participants in reflecting on arguments to discourage

smoking/vaping and debunk pro-cigarette/vape portrayals in the media. It also allowed them to identify specific behavioral determinants and heuristic cues to integrate into their own anti-smoking/vaping messages. These behavioral determinants and heuristic cues were components of the content in the first part of the intervention. Hence, they were free to focus on specific determinants and cues they found relevant and were asked to justify how and why they would incorporate components in their messages. This structured approach thus offered guidance without comprising participants' agency, enabling a more thoughtful message development process. Afterward, each group had 20 min to illustrate their anti-smoking/vaping message on a large poster using markers and pencils, allowing for diverse formats such as cartoons or the mockup of a TikTok-style video. We encouraged active participation in the creation of their messages by offering prizes. Specifically, each member of a group whose counter messages best aligned with the content of the intervention received a free cinema ticket, allowing them to watch a movie of their choice at major cinema chains. We also organized a social media competition, where groups with the most likes on their messages won a free breakfast at school.

2.4. Content analysis of anti-smoking/vaping messages

This study analyzed the anti-smoking/vaping messages created during the planning/design phase of the intervention from both the intervention and control group (delayed intervention). Both groups participated in the intervention curriculum, albeit at a different time point in the project. While 906 adolescents completed the study, they were divided into smaller peer groups to create their anti-smoking/vaping messages. This led to a total of 259 anti-smoking/vaping messages generated by the 259 groups. Of these messages, 3 were not considered because they were not completed (e.g., a blank or half-finished page). This resulted in a final *N* of 256 anti-smoking/vaping messages. Of these, 116 (45.3 %) were created by the control (delayed intervention) group, and 140 (54.7 %) by the intervention group. Furthermore, 100 (39.0 %) anti-smoking/vaping messages were created by groups in the general educational track and 153 (59.0 %) by groups in vocational/technical tracks. A total of 5 (2.0 %) anti-smoking/vaping messages were created by groups who did not specify their educational track.

2.4.1. Coding scheme

We developed a codebook to code the anti-smoking/vaping messages. The codebook addressed the type of substance (research question 1) and the behavioral determinants featured in the messages (research question 2). Because positive and negative outcome expectations are uniquely suited for further categorization, we predetermined (a priori) more granular codes relating to their timeframe and domain (research question 2b). Finally, we also coded the specific heuristic cues integrated in the messages (research question 3). We used binary codes for almost all categories, unless otherwise stated. Because adolescents could incorporate multiple behavioral determinants, positive and negative outcomes, and heuristic cues, such binary codes also enabled a comprehensive assessment of the various elements present. Table 1 provides an overview of the coding scheme. If it was unclear which specific determinants or heuristic cues were being used, we used the worksheet that was filled out in the planning phase to confirm the appropriate coding. Hence, the main unit of analysis remained the anti-smoking/vaping messages.

2.4.2. Coder procedures

The third author participated in a 2-h coder training session led by the first author to discuss the codebook, categories, and descriptions, and to resolve uncertainty over code meanings. Afterward, the first and third authors independently coded approximately 10 % of all anti-smoking messages to assess intercoder reliability. Coder reliability was measured by Cohen's Kappa (κ). Only one code (presence of prototype

Table 1
Overview of the codebook, including variables, definition and coding.

Variable	Definition	Variable Coding
Type of substance	Discussion of which specific smoking/vaping behavior was targeted.	1 = Cigarettes 2 = Vapes
Presence of behavioral determinants	Overarching code for the presence of determinants outlined in the PWM (see below)	0 = No (not present) 1 = Yes (present)
Presence of descriptive norms	Subcode PWM – An indication on how many peers engage in smoking/non-smoking or vaping/non-vaping (e.g., through statistical information).	0 = No 1 = Yes
Presence of injunctive norms	Subcode PWM – An indication regarding the approval/ disapproval of smoking/non-smoking or vaping/non-vaping.	0 = No 1 = Yes
Presence Attitudes	Subcode PWM – Information about personal opinions regarding smoking/not smoking or vaping/not vaping (e.g., 'I do not like smoking', 'smoking is not fun')	0 = No 1 = Yes
Presence negative outcome expectations	Subcode PWM – Description or portrayal of negative consequences related to smoking/vaping.	0 = No 1 = Yes
Domain negative expectations	Subcode negative expectations – Description or portrayals related to different domains.	1 = appearance-related consequences (e.g., yellow teeth, wrinkled skin) 2 = physical consequences (e.g., cancer, black lungs) 3 = social consequences (e.g., bullying, exclusion) 4 = Economic consequences (e.g., financial difficulties) 5 = More than one code present
Timeframe consequences	Subcode negative expectations – Differentiation between short- vs long-term consequences.	1 = Short-term (e.g., yellow teeth, being tired) 2 = long-term consequences (e.g., black lungs, financial difficulties, illnesses) 3 = Combination, more than one code present
Presence positive outcome expectations	Subcode PWM - Overarching code for descriptions or portrayals related to the presence of positive consequences of not smoking/ vaping.	0 = No (not present) 1 = Yes (present)
Domain consequences	Subcode for positive consequences – Description or portrayal of positive consequences related to not smoking/vaping, in specific domains such as health or social consequences.	1 = appearance-related consequences (e.g., white teeth, smooth skin) 2 = physical consequences (e.g., lack of diseases) 3 = social consequences (e.g., belonging to peer groups) 4 = Financial consequences (e.g., financial success) 5 = Combination, more than one code present
Timeframe consequences	Subcode positive consequences – Description or portrayal illustrating the short- or long-term consequences of not smoking/ vaping.	1 = Short-term (e.g., white teeth) 2 = long-term consequences (e.g., no illnesses) 3 = Combination, more than one code present

(*continued on next page*)

Table 1 (*continued*)

Variable	Definition	Variable Coding
Presence prototype perceptions	Subcode PWM - Descriptions or portrayals about characteristics of a person who smokes/vapes or does not smoke/vape (e.g., someone is cool or popular).	0 = No 1 = Yes
Presence of heuristic cues	Overarching code – Description or portrayal of subtle visual or auditory cues such as color, repetition (see below).	0 = Absent 1 = Present
Presence of specific characters	Subcode for heuristic cue – Portrayal of a specific character such as a cartoon, animal, young person or famous person.	0 = No (Absent) 1 = Yes (Present)
Type character	Subcode for presence of character – Identification of a specific character depicted in the anti-smoking campaign.	1 = Young person 2 = Famous person (e.g., celebrity, influencer) 3 = Cartoon/animal 4 = Combination
Presence of color	Subcode for heuristic cue – Portrayal or lack of colors/ filters as a feature.	0 = No (i.e., anti-smoking campaign in black – white) 1 = Yes
Presence of unique locations/ settings	Subcode for heuristic cue – Portrayal or lack of specific indoor/outdoor setting as a notable feature (e.g., hospital, party, nature).	0 = No 1 = Yes
Presence of humor	Subcode for heuristic cue – Portrayal or lack of humor or comedy as a notable feature (e.g., jokes)	0 = No 1 = Yes
Presence of music	Subcode for heuristic cue – Portrayal or lack of background music or sound (e.g., jingle) as a notable feature.	0 = No 1 = Yes
Presence of repetition	Subcode for heuristic cue – Statement about whether the message will be repeated through other channels (e.g., spreading multiple flyers) or the same channel (e.g., someone shares the post on Instagram's feed and stories).	0 = No 1 = Yes

perceptions) had a lower reliability of .63. This was attributable to a low number of instances related to the presence of prototype perceptions in the dataset. Coder reliability of all other variables was excellent (Landis and Koch, 1977). Table 2 provides an overview of the coder reliability.

Table 2
Coder Reliability measured by Cohen's Kappa for Each Variable.

Variable	Intercoder reliability (κ)
Type of substance	1.00
Presence descriptive norms	1.00
Presence injunctive norms	1.00
Presence attitudes	1.00
Presence negative expectations	.78
Type of negative expectations	.90
Timeframe negative expectations	.84
Presence positive expectations	.90
Type of positive expectations	.91
Timeframe positive expectations	.91
Presence prototype perceptions	.63
Presence of characters	1.00
Type of characters	1.00
Presence of colors	1.00
Presence of unique locations	.92
Presence of music	1.00
Presence of humor	.84
Presence of repetition	1.00

Afterward, the third author coded all the remaining anti-smoking/ vaping messages.

3. Results

To answer the research questions, descriptive statistics were calculated using SPSS version 29. The data are available via OSF. Regarding research question 1, analyses revealed that the majority of adolescents' self-generated messages focused on vapes. Specifically, out of 256 messages created by adolescents, 176 (68.8 %) targeted vapes, while only 80 (31.3 %) aimed to discourage cigarette use.

Afterward, we examined the specific behavioral determinants targeted in the anti-smoking/vaping messages, focusing on the constructs of the PWM, namely prototype perceptions, descriptive norms, injunctive norms, attitudes, and outcome expectations (research question 2a). The vast majority of the anti-smoking/vaping messages, 212 of 256 (82.8 %), used negative outcomes to discourage cigarette and e-cigarette use, making this the most frequently targeted determinant. Examples of negative outcome expectations were yellow teeth, hair loss, feeling sick, and environmental damage (mostly for vapes). Descriptive norms were the second most common focus, appearing in 47 (18.4 %) anti-smoking/ vaping messages. In these types of messages, adolescents used statistics to highlight that the majority of their peers did not engage in smoking/ vaping. This determinant was followed by positive outcome expectations in 29 (11.3 %) anti-smoking/vaping messages. These messages focused on positive consequences of non-use, such as flawless skin, white teeth, having social and romantic success. Other determinants, including attitudes and prototype perceptions, were rarely utilized to discourage cigarette and e-cigarette use. Table 3 provides an overview of the prevalence of each determinant across the anti-smoking/vaping messages.

To elaborate on positive and negative outcome expectations, we further explored which specific types of outcomes were addressed (research question 2b) (see Fig. 1). We focused on both the domain (e.g., health, appearance) and timeframe of consequences represented in the youth-produced messages. Among the anti-smoking/vaping messages focusing on negative outcome expectations (n = 212/256), most presented a combination of outcomes (n = 95/212, 44.8 %), commonly mixing health-related consequences (e.g., cancer, blackened lungs) with appearance-related effects (e.g., yellow teeth, hair loss). Fig. 2 provides an example of a message created by adolescents that highlights a combination of these outcomes.

Health-related outcomes alone were the second most frequently depicted (n = 79/212, 37.3 %), followed by appearance-related consequences (n = 24/212, 11.3 %). Other types of negative outcomes, such as economic (n = 9/212, 4.2 %), social (n = 3/212, 1.4 %), or environmental consequences (n = 2/212, .9 %) were less commonly utilized.

For the timeframe of negative consequences, nearly half of the anti-smoking/vaping messages combined short- and long-term consequences (n = 104/212, 49.1 %). For instance, one anti-vaping campaign depicts a dragon using vapes and gradually dying (a long-term consequence), while the e-cigarette itself explodes (i.e., a short-term consequence). Additionally, 65 of 212 (30.7 %) anti-smoking/vaping messages emphasized long-term consequences only, such as illnesses, and 43 (n =

Table 3
Presence of different behavioral determinants.

Variable	Frequency (%)	Frequency (n/total)
Descriptive norms	18.4 %	47/256
Injunctive norms	4.3 %	11/256
Attitudes	1.2 %	3/256
Negative outcome expectations	82.8 %	212/256
Positive outcome expectations	11.3 %	29/256
Prototype perceptions	4.3 %	11/256

Note. Percentages may sum to more than 100 % because the observations could be classified under multiple categories.

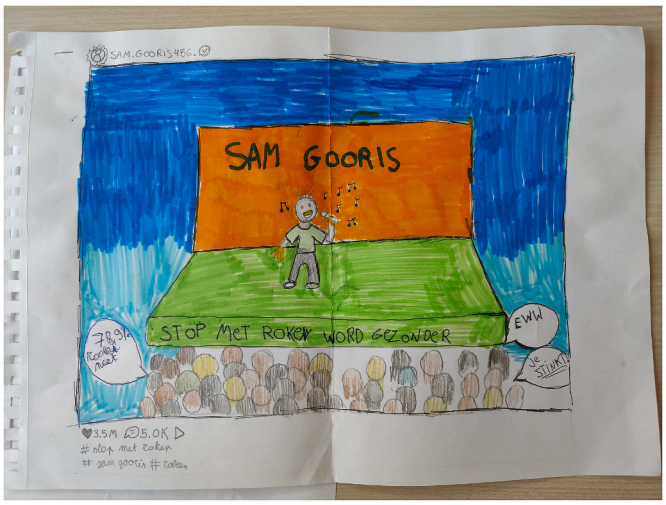

Fig. 1. Example of Anti-Smoking Campaign Addressing Behavioral Determinants

The following anti-smoking campaign features a famous singer from Belgium with yellow teeth and nicotine stains on his hands, illustrating negative outcome expectations. The other people in the audience are non-smokers, and one of them states that 78.9 % of peers do not use cigarettes, highlighting a descriptive norm. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

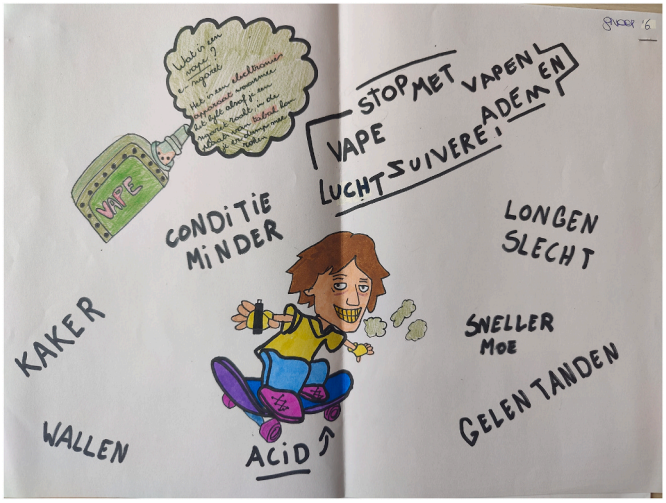

Fig. 2. Example of Anti-vaping Campaign Combining Health- and Appearance-Related Negative Consequences

The following image represents a popular social media influencer (ACID) from Belgium shown vaping. He has yellow teeth, an appearance-related consequence, and shows signs of reduced physical fitness. Surrounding text highlights additional health-related consequences (e.g., cancer, poor lung function). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

43/212, 20.3 %) focused exclusively on short-term consequences.

In addition to examining negative consequences, we also analyzed anti-smoking/vaping messages that highlighted positive consequences in more detail. It should be noted, however, that positive expectations were mentioned in only 29 of 256 anti-smoking/vaping messages (11.33 %). Most of these messages (n = 9/29, 31.0 %) presented a combination of positive outcomes related to non-use. Others focused on targeting social benefits only (n = 8/29, 27.6 %), with messages suggesting enhanced success in finding a romantic partner or having more fun with friends at a party by choosing not to smoke or vape. Health-related benefits appeared in 6 messages (20.7 %) and appearance-related outcomes in 5 messages (17.2 %). The majority of these messages combined short- and long-term positive consequences (n = 21/29, 72.4 %). See Fig. 3 for an example of a message highlighting multiple positive consequences.

For research question 3, we investigated heuristic cues that adolescents integrated into their anti-smoking/vaping messages. Overall, the messages frequently included multiple cues, indicating that adolescents were mindful of the production elements that could enhance attention and appeal. Nearly all messages featured distinctive characters (n = 251/256, 98.0 %), with over 60 % (n = 149/251) of them using a combination of different characters like peers, animals (e.g., dragon, cat, rat) and cartoon figures (e.g., skull), and 26 % focusing on a cartoon or figure only (n = 66/251).

Additionally, vibrant colors appeared in 91.8 % of messages (n = 235/256), repetition in 66.8 % of messages (n = 171/256, 66.8 %), and unique settings such as a party or hospital in 46.5 % of the messages (n = 119/256). Humor was also present in 37.3 % of the anti-smoking/vaping messages (n = 96/256), suggesting that while not the dominant approach, a significant portion of adolescents saw humor as an effective tool for discouraging smoking/vaping. Unsurprisingly, because of the poster format of the message creation setting, music or reference to sound was the least utilized cue. Table 4 provides an overview of the results, and Fig. 4 provides an example of anti-smoking/vaping messages using multiple cues.

4. Discussion

Scholars have suggested that interactive media literacy interventions that involve participants in the creation of counter messages to challenge pro-health-risk behaviors in the media are more engaging and result in long-lasting behavioral changes (Banerjee and Greene, 2006; Greene, 2013; Greene et al., 2021). Although a few notable studies have explored anti-substance use messages generated by participants (Banerjee et al., 2013; Banerjee and Greene, 2011; Krieger et al., 2013; Peña-Alves et al., 2019), the majority of research only focuses on behavioral outcomes, often overlooking the specific messages produced by adolescents in these interventions (for an overview, see Xie et al., 2019). Therefore, this study analyzed anti-smoking/vaping messages generated by adolescents in the #Smokefree intervention to assess how well they applied their media literacy skills and to understand how they

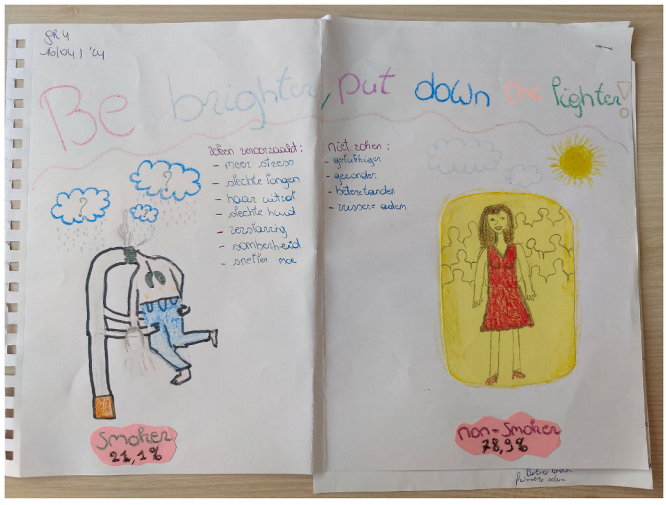

Fig. 3. Anti-Smoking Campaign addressing Positive Consequences of Not Smoking

This anti-smoking campaign addresses both positive and negative consequences of cigarette use. The positive consequences highlighted include white teeth, fresh breath, happiness, and better health.

Table 4
Presence of heuristic cues.

Variable	Frequency (%)	Frequency (*n*/total)
Distinctive characters	98.0 %	251/256
Peers	12.0 %	30/251
Celebrities/influencers	2.4 %	6/251
Cartoons/figures	26.3 %	66/251
Combination	59.4 %	149/251
Colors	91.8 %	235/256
Unique location	46.5 %	119/256
Humor	37.5 %	96/256
Music	14.5 %	37/256
Repetition	66.8 %	171/256

Note. Percentages may sum to more than 100 % because the observations could be classified under multiple categories.

Fig. 4. Example of an Anti-Smoking Campaign integrating multiple Heuristic Cues.
This image depicts an anti-smoking campaign addressing financial loss, appearance-related consequences (e.g., yellow teeth, reproductive difficulties, social rejection, and bad odor/smell due to smoking). It incorporates various heuristic cues such as vibrant colors, animals, people, unique locations, and humor. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

implemented skills developed in the intervention.

First, adolescents' messages mainly focused on discouraging vaping. Their choice to focus on vaping likely reflects the broader social context: vaping is increasingly prevalent among adolescents, while cigarette use continues to decline (Rosiers et al., 2023). In our study, 26.2 % of adolescents indicated prior use of vapes compared to 8.3 % who previously used cigarettes. Moreover, the continued perception of vaping as less harmful than cigarettes (Sharma et al., 2021) and adolescents' lower critical engagement with vaping-related information in media (Park et al., 2019) may further explain the focus. Rather than positioning this finding as a novel contribution, we see it as reinforcing the urgency of addressing vaping in adolescent-focused interventions, a need already underscored by rising prevalence of vapes and persistent misperceptions. To enhance the impact of such interventions, adolescent involvement in message development is key, as peer-created messages are more likely to target relevant determinants and are more likely to resonate (e.g., Banerjee and Greene, 2016; Widnall et al., 2024). In addition, we need more research that develops and tests vaping-based media literacy programs, as well as warning statements that activate when adolescents encounter pro-vaping media content. This has already been widely researched for other substances like alcohol (Hendriks et al., 2023; Russell and Russell, 2008).

The second conclusion highlights the importance of addressing personally relevant negative outcomes of smoking/vaping and correcting descriptive normative perceptions. Adolescents in our study showed a broad understanding of smoking and vaping consequences, particularly short-term and appearance-related effects like yellow teeth and wrinkled skin. They also challenged the misperception that 'everyone' smokes/vapes by incorporating corrective descriptive norms into their messages.

In contrast, prior research on adolescents' self-generated anti-smoking and anti-alcohol messages primarily focused on long-term consequences (e.g., death, severe illness) and utilized fear-based appeals, while neglecting descriptive norms (e.g., Banerjee et al., 2013; Banerjee and Greene, 2011; Peña-Alves et al., 2019). These contrasting findings are not entirely surprising given that certain factors, like social norms, are particularly difficult to shift through interventions (e.g., Byrne and Hart, 2009). The fact that adolescents in our study did incorporate social norms and short-term outcomes may be linked to the specific ways in which the intervention was delivered – possibly through relatable examples and peer discussions. However, we cannot determine this with certainty, as prior interventions were often structured in a similar manner.

Notwithstanding, future health campaigns and interventions should devote specific attention to these components when targeting adolescents. Adolescents are in a crucial period where their emerging identity and appearance are highly important, and they are particularly sensitive to how their behaviors affect others' perceptions (Brown and Larson, 2009). The focus on appearance-related outcomes, such as yellow teeth and wrinkled skin, makes sense given that these are short-term, visible consequences that can directly affect their self-image and perceived social standing. Similarly, adolescents are at an age where belonging to peer groups and "fitting in" is critical (Brown and Larson, 2009).

Social norms, especially the perception of whether other peers engage in smoking/vaping, hold significant weight in shaping adolescent behaviors (Perkins et al., 2019). Adolescents turn to peers to determine what is socially acceptable, which is why correcting these social norms may have been a message focus. The group-based setting of our intervention, where youth created anti-smoking/vaping messages in smaller peer groups, may have been the perfect format for debunking misperceptions about descriptive norms. The collaborative environment may have allowed them to recognize that not all peers smoke/vape, enhancing their collective understanding of descriptive norms (e.g., Greene, 2013).

The final conclusion highlights adolescents' abilities to integrate basic heuristic cues used in media portrayals to enhance attention and message appeal in their own anti-smoking/vaping messages. Our study found that adolescents used multiple basic cues including colors and distinct characters, with abstract cues like humor being less frequently integrated. This may suggest that more complex cues may be harder for adolescents to grasp or incorporate effectively in their own messages. These findings align with previous studies reporting a focus on simple elements like colors, stick figures, and specific settings in counter messages (Banerjee et al., 2013; Krieger et al., 2013). Additionally, these findings may also be attributable to time and resource constraints during the counter message creation phase. Adolescents only had 40 min for message planning, and 20 min for message creation. Research suggests that when given more time, adolescents can develop more visually engaging content (Peña-Alves et al., 2019). Additionally, humor may be harder to convey in a drawn format, even though participants were encouraged to consider planning audiovisual content (e.g., TikTok videos). Using real video formats might better facilitate the use of more abstract and complex cues. More research is needed to grasp whether it was indeed time- and resource-restraints that explain the lack of more abstract cues, or whether adolescents simply do not grasp the concept of humor or view it as an effective persuasive tool for targeting their peers. While one could argue that humor may not have been coded due to generational differences in its interpretation between the coder and the

participants, this can be ruled out as students explicitly stated the persuasive cue used and its rationale in the checklist accompanying their anti-smoking/vaping message.

4.1. Implications for media literacy interventions and health message designs

Four key implications for future media literacy interventions and health messages can be drawn from this study. First, interventions should focus on emerging substances like vapes, as adolescents may find information about these products more personally relevant. This was reflected in their choice to highlight self-generated messages on vapes despite receiving information about the role of media in promoting both smoking and vaping. Second, media literacy interventions and health messages should address personally relevant consequences, such as appearance-related issues and social disapproval, because tailored content has been shown to increase effectiveness (e.g., Galper et al., 2024; Niederdeppe et al., 2024). Third, group-based settings in interventions could be particularly powerful, because peers can help each other in becoming more media and health literate (Vranken et al., 2023) while also debunking social norms. Peer groups could also be involved in the creation and dissemination of health messages, as adolescents are more likely to accept messages from like-minded peers (Hasel et al., 2016). Fourth, future media literacy interventions should more explicitly focus on abstract heuristic cues, such as humor, or facilitate their integration by using formats that support such cues during the creation activity. Research has shown that humor in anti-smoking messages can more effectively discourage smoking, highlighting the value of this element (Lee and Chen, 2017).

4.2. Limitations

As with all research, this study has limitations. First, time and resource constraints may have led to fewer behavioral determinants and heuristic cues in the messages, potentially limiting insights into the media literacy intervention's full effects. We prioritized the planning phase over the creation phase, as the theory of active involvement (Greene, 2013) suggests that critical thinking and self-reflection primarily occur during planning. Notwithstanding, future studies should consider providing more time for this activity, message refinement, and evaluating the content of messages.

Second, the creativity and visual quality of the counter messages depend heavily on adolescents' artistic abilities. Groups with limited drawing skills may have struggled with the implementation of heuristic cues (e.g., humor) or behavioral determinants, even if they understood them. Computer-based drawing programs and stock images could be utilized in future media literacy interventions to assist with the creation of counter messages, connecting to the time component and incorporating message refinement.

Third, since the messages were group projects, one individual may have led the work, potentially reflecting that student's learning more than the group's perspective. However, this risk was minimized through active supervision by the first author, teachers, and research assistants.

Fourth, we could not collect certain demographic data, such as gender or smoking status in the checklists accompanying the counter messages for ethical reasons and anonymity. Because these factors can influence perceptions of cigarettes/vapes, future research should explore whether such characteristics affect the content of the messages.

Finally, this study was conducted in Belgium, offering unique insights into adolescents in a context with relatively lenient tobacco policies in comparison to other countries, and thus possibly higher social acceptability. However, this may limit generalizability to other settings. Future research across different regions with varying tobacco regulations could identify how cultural differences shape the content of self-generated anti-smoking/vaping messages, allowing media literacy interventions to better tailor interventions across contexts.

5. Conclusion

This study is among the first to analyze adolescents' self-generated anti-smoking/vaping messages that were created as part of an interactive media literacy intervention. Such insights enable us to assess whether adolescents can apply their media literacy skills in their own counter messages and to assess which elements more closely resonate with them, which could inform future media literacy interventions and health messages. Our findings showed that adolescents primarily focused on vapes which reflects a societal trend whereby vaping is becoming more prevalent. More important, adolescents addressed descriptive norms and short-term and appearance-related risks associated with smoking to counter glamorized smoking/vaping portrayals in the media, and demonstrated the ability to integrate basic heuristic cues in their messages that could enhance message appeal. Hence, we argue that future media literacy interventions and health messages should specifically target social norms and personally relevant consequences and enhance knowledge of more abstract heuristic cues.

CRediT authorship contribution statement

Sofie Vranken: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Femke Geusens:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization. **Caroline Christiaens:** Writing – original draft, Data curation. **Kathryn Greene:** Writing – review & editing, Conceptualization. **Kathleen Beullens:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Data curation, Conceptualization.

Ethics approval statement

This study was part of the #Smokefree project, which was reviewed by the Social and Societal Ethics Committee of the KU Leuven (Belgium) under project number G-2020-2267-R6(AMD). For the intervention project, we gained active informed consent from school management and active assent from participating adolescents. Furthermore, we employed a passive parental consent procedure. The IRB approved this since (1) the intervention materials (curriculum) align with the learning goals mandated by the Flemish (Belgian) government, (2) passive consent of parents was evaluated against the background of active consent from the school management who already considered the interest of their students against the benefits of research when deciding to participate. (3) The research entailed no more than minimal harm. (4) The waiver did not adversely affect the rights and welfare of the participants.

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Data availability

The data are publicly available via the Open Science Framework: https://osf.io/5udtj/files/osfstorage?view_only=

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