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**Enhancing smokers' engagement during Facebook-  
based smoking cessation interventions**

**PhD thesis**

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## List of publications

### List of full papers directly related to the subject of the thesis

- I. **Watti J**, Millner M, Siklósi K, Hamvai Cs, Kelemen O, Pócs D. How to Avoid Lower Priority for Smoking Cessation Support Content on Facebook: An Analysis of Engagement Bait. *International Journal of Environmental Research and Public Health*. 2023;20(2):958. [IF: 4,614, Q1,Q2]
- II. **Watti J**, Millner M, Siklósi K, Kiss H, Kelemen O, Pócs D. Smokers' Engagement Behavior on Facebook: Verbalizing and Visual Expressing the Smoking Cessation Process. *International Journal of Environmental Research and Public Health*. 2022;19(16):9983. [IF: 4,614, Q1,Q2]
- III. **Watti J**, Mohos A, Kelemen O, Pócs D. Actualities in first-line pharmacotherapy for smoking cessation support (A dohányzásleszokás-támogatás első vonalbeli gyógyszeres terápiájának aktualitásai). *Orvosi Hetilap*. 2021;162(40):1610-1618. [IF: 0,707, Q4]
- IV. **Watti J**, Pócs D, Tari G, Kelemen O. Medical support of cessation for pregnant smokers (Dohányzó várandósok leszokásának támogatása). *Orvosi Hetilap*. 2023 Jul;164(30):1194-1203. [IF: 0,600, Q4]

**Cumulative impact factor of papers directly related to the subject of thesis: 10,535.**

### Other full papers

- I. Pócs D, Ovari T, **Watti J**, Hamvai Cs, Kelemen O. How to create social media contents based on Motivational Interviewing approach to support tobacco use cessation?: A content analysis. *JOURNAL OF SUBSTANCE*. 2022.;27(6):591-597. [IF: 0,895, Q3]
- II. Pócs D, Adamovits O, **Watti J**, Kovács R, Kelemen O. Facebook Users' Interactions, Organic Reach, and Engagement in a Smoking Cessation Intervention: Content Analysis. *Journal of Medical Internet Research*. 2021 Jun;23(6): 27853. [IF: 7,077 D1]

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# Summary

## Background and purposes

Our research focused on an internet-based smoking cessation intervention. We analyzed the application of interaction buttons (comments, shares, and Facebook reactions) in response to Facebook posts supporting smoking cessation on a Hungarian Facebook (FB) page called „CigiSzünet” (English name: “Cigarette Break” – used later in the PhD thesis). Engagement expresses the commitment of the participants in the intervention. Through our research, we strive to help public health professionals running smoking cessation Facebook pages to increase their participants engagement.

In our first research, we selected smoker participants based on their comments. We identified the language use pointing towards smoking cessation in their comments applying the psychological approaches of the Transtheoretical Model (TTM) and Motivational Interviewing (MI). The expressions used by the smokers in their Facebook comments (verbalization) were compared to their use of Facebook reaction buttons (visualization). Our aim was to explore the correlations between the verbal and visual expressions of smokers in which they indicated smoking cessation in order to understand and subsequently stimulate engagement.

In our second research project, we dealt with engagement bait, a strategy for creating specific Facebook posts. Facebook imposes sanctions on posts which apply this strategy and reduces their visibility by demoting them (i.e., these posts are moved to the bottom of the News Feed). Sanctioning contents which utilize engagement bait is performed by Facebook's algorithm, but this process is unfamiliar to the users. Our goal was to explore the mechanism of engagement bait and its effects on contents aiming to help smoking cessation, and to find alternative strategies which can circumvent this sanctioning and increase engagement.

## Methodology

In the first research, a total of 821 comments made by smokers were analyzed (N = 821). In the comments analyzed, we identified the processes of change (which are elements of the Transtheoretical Model) and the motivational language (which was assessed as part of Motivational Interviewing). The language use was compared to the application of Facebook reaction buttons.

In the second research, the three-year period following the introduction of sanctions on engagement bait was examined, with a total of 791 Facebook posts (N = 791). The contents

were categorized into three groups: "engagement bait", "alternative strategy," and "control" groups. Interaction data and reach data were compared across the different groups.

### **Key results**

Our first research found that smokers who reacted with the "Haha" button in response to a smoking cessation post were significantly more likely to write expressions indicating their reluctance to stop smoking, than those who reacted with the "Like" button. Smokers who reacted with the "Love" button to comments were significantly more likely to write expressions supporting smoking cessation than those who did not use these reaction buttons.

Our second research revealed that the reach of the Facebook page fans was significantly lower in the engagement bait group than in the control group. No significant difference in reach data was found between the alternative strategy group and the control group. The alternative strategy group had significantly lower rates of negative Facebook interactions (e.g., hide posts or report contents) and significantly higher click rates compared to the control group.

### **Conclusions**

We studied the behavior of smoker participants in real-life conditions in a Facebook-based intervention. The use of the "Haha" reaction button was found to be a negative indicator of engagement. The "Like" reaction was a neutral indicator, whereas the "Love" reaction was a positive indicator. Therefore, if smokers respond to a Facebook post related to cessation with a "Haha" reaction, they presumably do not intend to quit, and if they respond with a "Love" reaction, they are probably inclined to quit. In terms of cessation, the use of the "Like" reaction button was found to show a neutral attitude.

Our second research was the first in literature to analyze the way of sanctioning the Facebook page for engagement bait and understand the Facebook algorithm which is applied to select whether a particular content is shown to more or fewer users. Among those users who had not previously liked the page, no sanction was applied. Regarding the page fan, however, the alternative strategy we compiled helped us avoid sanctioning. Our alternative strategy was to use indirect questions instead of direct instructions to interact. In fact, this strategy resulted in fewer negative Facebook interactions and more clicks in the alternative strategy group than in the control group. Therefore, alternative strategies seem to be suitable to increase engagement.

# **1 Introduction**

## **1.1 Epidemiology**

Smoking is a common risk factor for many diseases worldwide and a major contributor to premature mortality [1-4]. In the United States, more than 435 000 deaths per year, [5] and in England, approximately 82 900 deaths are linked to tobacco consumption. In Hungary, around half of all deaths are attributable to behavioral risk factors. Smoking, including the use of all tobacco products and secondhand smoke, was responsible for 21% of all deaths in Hungary in 2019, which is sadly higher than the European Union average of 17%. Age-standardised prevalence of smoking for adolescents aged 15-34 was 10% higher in Hungary (39 %) than the average smoking rate in Europe (29%) [6]. Age-standardised prevalence of smoking increases gradually, peaks in the 15-34 age group and then slowly declines in older age groups [6]. It is well known that shorter smoking duration is associated with a higher chance of smoking cessation [7, 8].

Gender difference in smoking is an important factor to consider. In Hungary, the proportion of regular smokers in the age group 18–34 years is 35% for men and 27% for women. Although the prevalence of smoking is slightly lower for women, it should be noted that in the population of women of reproductive age, the adverse effects of smoking on the fetus during pregnancy should also be considered [9-12]. In the literature, little attention has been paid to the gender difference in motivational language. One of the current research goals is to shine new light on the association between the Facebook users, gender, and the motivational language.

## **1.2 Nicotine addiction treatment and management**

There are two treatment methods available for nicotine dependence: pharmacological treatment and the technics of the behavioral medicine. The primary goal of pharmacological treatment is to treat physical dependence by reducing nicotine withdrawal symptoms during cessation [13, 14]. For those who do not experience withdrawal symptoms, pharmacological treatment is not required, their dependence can be managed with psychological interventions [15]. Nevertheless, practical experience has shown that smokers who smoke more than 10 cigarettes a day or light up within one hour after waking up in the morning may experience frequent withdrawal symptoms [16]. In such cases, in addition to psychological interventions to promote general behavior change, the use of pharmacological treatment is also justified,

because combining pharmacological treatment with behavioral techniques increases the chance of successful cessation [17]. The choice of pharmacological treatment depends on the degree of nicotine dependence, age (especially in adolescents), pregnancy, and the co-morbidities of the patient [9,14,15].

With regard to the smoking cessation agents, varenicline and nicotine replacement therapy are currently the principal choice, not only in terms of cessation but also in terms of harm reduction. The results of previous studies suggest that the efficacy of low dose varenicline is close to that of standard dosing, with fewer side effects [18]. Regarding nicotine replacement therapy, it should be highlighted that there is growing scientific evidence for the combination of transdermal and oral formulations compared to monotherapy. Low dose varenicline or nicotine replacement therapy can help lower the number of cigarettes smoked per day if the client does not want to quit but would like to reduce the harm of smoking [18]. The role of medications acting in other ways than the nicotinic system has also emerged. A growing number of reviews advocate the treatment of nicotine dependence with antidepressants. [19] Among these, the most widely reported is the use of bupropion, which is known to be combined with nicotine replacement therapy and varenicline [13].

The choice between different medicines is mainly based on comorbidities and the side effect profile of the medicines. The possible side effects do not usually exceed the health risks of smoking [15]. Apart from hypersensitivity to the active substances or excipients, there are no absolute contraindications to the medication itself [17]. It should be emphasised, however, that smoking cessation is not recommended after severe negative life events (e.g., divorce, job loss) or in unstable mental states (e.g., moderate to severe depression) [13].

It should be mentioned that nicotine replacement therapy during pregnancy differs from the general nicotine replacement treatments in the following: 1) Use of oral formulations over transdermal nicotine intake; 2) More cautious titration period; 3) Shorter treatment duration.

It is always recommended to combine pharmacotherapy and behavioral medicine along with interventions to improve adherence. In addition, it is also advisable to include specific therapeutic interventions to get as much help as possible for the patient to quit smoking [13].

There are two evidence-based psychological interventions to support smoking cessation: Motivational Interviewing and Cognitive Behavioral Therapy. Motivational Interviewing answers the question "Why should I quit?" and places the emphasis on motivation. Cognitive Behavioral Therapy focuses on the question "How do I quit?" and helps change mindset and behavior.

### 1.3 Behavioral medicine

Psychological interventions are the basis of all cessation support methods. They have been shown to be effective complements to pharmacological treatment, but they can also be effective treatment options on their own. Psychological interventions should be the first choice for occasional smokers and they are of particular importance when the use of pharmacological treatment is restricted (e.g., to support smoking cessation in pregnant women, or among young people).

In addition to developing a trusting relationship, psychological interventions are based on behavioral theories and cognitive models, according to which smoking behavior is the result of a complex interaction between an individual and their environment, and this interaction is determined by cognitive and evaluative processes.

Behavioral medicine is based on the assumption that psychological dependence is influenced by learning processes (mainly the operant and classical conditioning). Sometimes (like it is described in pregnancy related smoking cessation literature) [13], this can be complemented by specific tools as self-reward [20] or external incentives [21]. Besides the learning processes smoking behavior is influenced by different cognitive ways that are manipulated by the individual's own personal values, and the imagined functionality of tobacco use [13]. From a cognitive/behavioral perspective – since it is based on experimental psychology – monitoring and evaluation of feedback is certainly a very important part of the treatment [22], and in this case beside the behavioral feedback we can use biological markers as well (for example: expiratory carbon monoxide (CO) concentration; cotinine levels in urine, plasma and saliva; 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL) in urine) [23]. In addition to basic learning processes, the cognitive approach also emphasises stress management and emotion regulation, which are areas of paramount importance in therapy.

One communication strategy developed specifically for addictive disorders at first is Motivational Interviewing, which fits well with cognitive-behavioral models. Another approach widely used in addiction treatment is DiClemente's Transtheoretical Model, which supports behavioral interventions by analyzing processes of change and their stages, and by assessing readiness to change.



### **1.3.1 Transtheoretical Model (TTM)**

The Transtheoretical Model is an integrative theory of different psychotherapies that offers processes of change in order to understand how changes in health behavior happen [24]. The processes of change are particular actions utilized by people in order to change their health behavior [25]. There are two groups of processes. Experiential processes are cognitive, affective, and evaluative actions, which are taken predominantly in the early phase of behavioral change (e.g., "Consciousness Raising", "Dramatic Relief" or "Self-reevaluation"). In contrast, behavioral processes are action-oriented, and used mainly in a later phase of behavioral change (e.g., "Reinforcement management" or "Stimulus Control") [25-27]. The Transtheoretical Model is regularly utilized to design internet-based public health interventions and has been found to result in significant impact on health behavior changes, including smoking cessation [28, 29]. Nevertheless, few studies have conducted quantitative analyses of the relationship between processes of change and engagement on Facebook.

### **1.3.2 Motivational Interviewing (MI)**

Motivational Interviewing is a client-centered, goal-oriented counselling method that aims to help people change their health behavior and integrates different methods used in psychological and psychiatric counselling [30, 31]. This is an evidence-based approach to addiction treatment and prevention during personal interventions, along with other alternative approaches. While the Transtheoretical Model is easy to apply to online interventions, the complex communication strategy of Motivational Interviewing is naturally more difficult to integrate into internet-based cessation support, and therefore the evidence on its effectiveness is conflicting [32].

Motivational Interviewing theorizes that certain verbal utterances can be predictors of health behavior change. These motivational utterances incorporate two major linguistic categories: "change talk" and "sustain talk" [30,33]. The "change talk" linguistic category contains sentences that move someone towards a beneficial behavioral change that is linked to an improvement in behavioral outcomes [34,35]. If the client uses more change talk, this can be a predictor of successful behavior change [35]. On the other hand, the category of "sustain talk" contains sentences that discourage movement towards the goal of change, but support the maintenance of the status quo, which in our scenario is harmful behavior [33,36]. No previous

research has examined the relationship between motivational language and Facebook reaction buttons, which was one of our research objectives.

#### **1.4 Internet-based smoking cessation intervention**

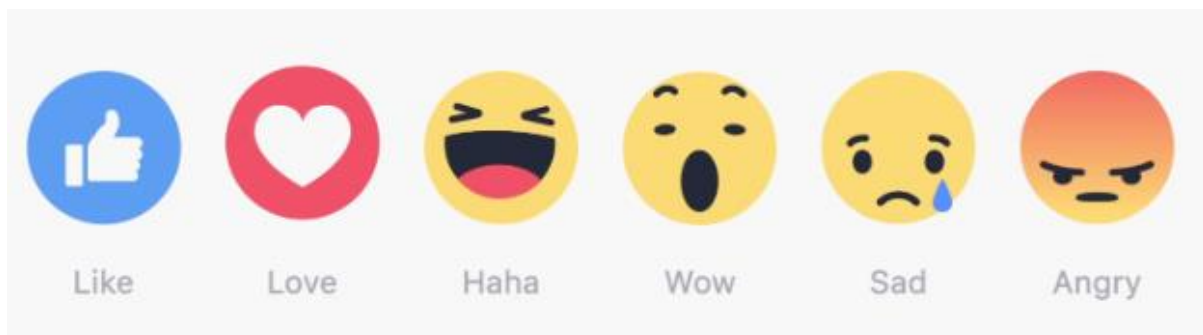
Internet-based interventions can offer new opportunities for smoking cessation, given their easy access and free use. During the COVID-19 pandemic situation, the use of Internet has gained even more importance amongst health care workers and patients as well [37, 38]. Smoking cessation interventions on social media hold promise to help smokers quit [39]. Research shows that it might extend the reach and impact for smoking cessation also among young adult smokers. [40] Therefore, social media has been vividly used in recent decades to quit smoking among different age groups [41-43], as internet users are generally more interactive on social media platforms than on other internet mediums [44]. For example, social media content about the benefits of quitting can provoke interactions among internet users [45, 46]. Therefore, the interactivity of social media can increase the effectiveness of smoking cessation interventions [47-49]. Facebook as a virtual community can be useful in addressing the health problems of Facebook users through social support [50]. Another advantage of the social network is that the sharing of smoking cessation stories can be triggered on Facebook, making smoking cessation a popular normative influence [51, 52]. In order to study the potential benefits of this platform, the present thesis used two psychological approaches in the online space: the Transtheoretical Model and Motivational Interviewing [13].

Creative integration of technology to solve health problems around the world is becoming increasingly important. Digital interventions can be used to stimulate critical behavior change processes that lead to improvements in health behavior [53-55]. „Engagement” with digital behavior change interventions plays an essential role in their effectiveness [53, 56-59]. In behavioral science literature, "engagement as usage" phrase implies that engagement can include the quantity (e.g., frequency, duration) and quality (e.g., use of certain buttons) of usage [41, 53-61]. This perspective can be beneficial in changing health behavior during public health campaigns [62-65]. Both the quantity and quality of usage can be associated with health behavior change, and these may differ in internet-based interventions using different platforms [64, 65].

Facebook is a popular and widely accessible platform that is ideal for public health interventions among adolescents and adults [51,66-68]. The quality of usage on Facebook includes users' interactions, i.e., actions on certain buttons that a person uses in relation to a

particular Facebook post [69-73]. For instance, the "comment" interaction button is used to write text or post an image below the social media content. A high number of comments are associated with a change in health behavior [74-76]. However, the content analysis of comments on public health Facebook posts is a poorly researched area. Other popular interaction buttons are Facebook "reactions". They can give users the opportunity to express their emotions and to play a specific role in public health interventions [69,72]. According to a research on smoking cessation getting one "Like" reaction on an intervention platform can be associated with smoking reduction by approximately one cigarette per week [77]. So far, there have been only a few quantitative analyses of "Love", "Haha ", "Wow", "Sad", or "Angry" reactions in public health interventions [72,73]. (Figure 1).

**Figure 1. Facebook reaction buttons:**



Facebook-based smoking cessation interventions by using reaction buttons or writing comments show engagement [74,77]. In addition to using the reaction buttons, users can also express their opinion by writing comments on the Facebook post. The Facebook reaction buttons marked with icons are means of emotional-visual expression, while comments provide a more cognitive-verbal expression. Both can be considered indicators of engagement, i.e., the degree of involvement in online interventions. This may explain why it is important to understand the relationship between Facebook reactions and comments. So far, there have been only a few quantitative analyses of engagement in response to health interventions.

## 2 Goals of the thesis

### 2.1 Primary focus of the research

Our first research sought to explore the relationship between verbal and visual expressions of smoking cessation by smoker Facebook users in order to understand and subsequently stimulate engagement.

Our second research aimed to reveal the mechanism of engagement bait and its effects on cessation-related content and to identify alternative strategies that can circumvent sanctions imposed by Facebook.

### 2.2 Research questions

#### 2.2.1 First Research

- *How do smokers combine Facebook engagement with verbal expressions from the Transtheoretical Model and Motivational Interviewing?*
- *What is the relationship between smokers' gender and verbal expressions from the Transtheoretical Model and Motivational Interviewing?*

#### 2.2.2 Second Research

- *How does Facebook sanction engagement bait posts that support smoking cessation?*
- *What are the advantages of using alternative strategies over engagement bait in reaching and engaging Facebook users?*

## **3 Methods**

### **3.1 The investigated Facebook-based smoking cessation intervention**

Cigarette Break is an online smoking cessation intervention run jointly by students and teachers at the University of Szeged. The program was launched on March 7, 2017, with contents posted on the Facebook page every day or every other day. The number of users increased steadily during the research period. The primary objective of the Facebook-based intervention was to promote smoking cessation. This Facebook page avoids intimidating and condemnatory content and seeks to support smoking cessation through motivational interviewing counselling approach. Our research identity is transparent on the Facebook page. Users of the Facebook page are kept informed about the current research and its results.

In addition, the Facebook user's gender was also determined based on his or her Facebook profile. It is important to point out that only the gender binary (female and male) was determined based on the Facebook profile (name and picture). Other classifications of gender (e.g., transgender, non-binary, genderqueer) were not feasible based on the Facebook profile. In a total of nine cases, the gender could not be identified by looking at the Facebook profile (e.g., someone posted a comment on behalf of an organization's Facebook page). From the point of view of data protection, it should be mentioned that only gender was recorded in our database, and no other personal data. The Facebook profile analysis was also used to exclude minors from the current study. However, no Facebook profile was found among the participants that referred to an underage user.

We investigated the distribution of the different comment categories by gender and the usage of reaction buttons.

### **3.2 Participants**

The participants of the present research were Facebook users who viewed the social media contents posted on Cigarette Break. Based on the reach data recorded by Facebook, the research population consisted mostly of young adults aged between 18 and 35 years, generally living in Hungary, with a nearly equal proportion of men and women. Facebook Insights database provided us with aggregated and anonymized demographic data, which were exported on September 14, 2020. These data are subject to the privacy policies of Facebook and is made

available by Facebook to the site administrators with the consent of the users. On that date, the total weekly reach was 11,507 users.

As the Facebook users' smoking status is not recorded in their profiles, an online questionnaire was used to explore the smoking habits of the page visitors. This data collection was conducted between September 09, 2020, and September 30, 2020. The language of the questionnaire was Hungarian, and the participation was voluntary, based on informed consent. We obtained summarised and anonymised data from Google using the "Google Forms" software. A total of 477 Facebook users filled this anonymous questionnaire. Our research ethics license was acknowledged by the Ethics Committee, Albert Szent-Györgyi Health Centre, University of Szeged (reference number: 3805-96/2016-SZTE).

In this chapter these demographic data (gender, age, location) is presented. Of the Facebook users reached, 47% were women and 53% men, 1% were between 13 and 17 years old, 83% between 18 and 35 years old, and 16% were older than 35 years. Furthermore, 96% out of them listed Hungary as their place of residence on their Facebook profile. On September 14, 2020, 10,227 people liked the studied Facebook page. Out of them, 53% were women and 47% men, 2% were between 13 and 17 years old, 84% between 18 and 35 years old, and 14% were older than 35 years. In addition, 96% out of them marked Hungary as their location on their Facebook profile. 59% of the respondents were smokers, 21% ex-smokers, 15% non-smokers, and 5% e-cigarette users. Furthermore, 95% of the smokers smoked daily, and 5% smoked occasionally. The type of tobacco the participants utilized were the following: 73% of the smokers used factory-made cigarettes, 36% hand-rolled cigarettes, 21% IQOS, 8% cigars, 6% smokeless tobacco, 5% pipe or hookah. Nicotine addiction was defined by the "time to first cigarette": 81% of the smokers lit the first cigarette within one hour after waking up in the morning, while 19% started smoking more than an hour later. Ultimately, people who actively utilized tobacco products or who quit smoking within one year were categorized into "cessation stages" as follows: pre-contemplation 15%, contemplation 9%, preparation 35%, action 9%, maintenance 2%. On the whole, based on the questionnaire survey, the majority of the participants in the current research may have been nicotine-dependent, regular smokers. It should also be mentioned that there were as many respondents in the preparation stage, as in the other cessation stages combined.

### **3.3 Analysis of intervention content**

The content analysis of the first research is presented in this section. A total of 1294 pieces of social media content were published between 7<sup>th</sup> of March 2017 and 14<sup>th</sup> of September 2020. Firstly, we excluded 150 contents that were not related to smoking cessation (e.g., Facebook posts by administrators), as we wanted to investigate Facebook users' response to contents which support smoking cessation. Then, 45 contents were eliminated that were not adherent to motivational interviewing or were not image-based. The next step in the exclusion process was to select Facebook posts containing comments on smoking cessation. Of the remaining 1,099 Facebook posts, 621 (57%) obtained no comments, and 300 (27%) had comments which were not connected to cessation.

Overall, 178 Facebook posts were included in the first research. These posts included comments that were cessation-related and non-cessation-related. It is also important to emphasize that only the original Facebook posts published on the investigated Facebook page were included in the research. This was inevitable to evaluate the Facebook users' responses to the same original stimulus. The social media contents shared by the Facebook users were rejected, since in this case the Facebook profile of the given users may have changed the responses of other Facebook users as a new stimulus. For example, a profile of a known person can be a positive or negative stimulus depending on how the user relates to the known person (co-worker, boss, family member, famous person etc.). In summary, the stimuli used for the research were original Facebook posts that matched motivational interviewing, contained an image, and supported smoking cessation. This content analysis can only be interpreted in this context.

### **3.4 Design and procedure**

The research method of the present research was a hypothesis generating, retrospective content analysis. We investigated Facebook users' interactions (comments and reactions) to the same stimuli (Facebook posts under investigation). The interaction data were analyzed on the comment level. A total of 821 Facebook users commented on 178 Facebook posts. All the comments were from different Facebook users. Hence, the number of items was the number of Facebook users who posted a comment (N=821). The 821 Facebook users involved in the research can be divided into 2 groups (page fans and nonfans) depending on whether they previously liked the Facebook page or not. The 821 Facebook users are different and therefore

only included once in the database. In this subsection, we present the aspects of the comment analysis.

Since we wanted to analyze the Facebook users' direct response to a particular content, we investigated only the "first comments". For instance, if a Facebook user wrote "I want to quit" under the original social media content, then this was considered a first comment. If another Facebook user added "I want to quit too", that was a second comment. Second and third comments were not included in the research, because they may have been responses to first comments (as a new stimulus), and not responses to the original Facebook post (as the analyzed stimulus). All the 821 comments were first comments. We also examined the use of Facebook reactions, which were also direct responses to a particular content. We analyzed "first reactions" to Facebook posts, not "second or third reactions" to comments. Thus, the relationship between "first comments" and "first reactions" was evaluated at the same level (post-level). Finally, Facebook users freely and voluntarily posted comments and used the reaction buttons on this public Facebook page, without any external pressure.

We collected whether the Facebook user who posted the comment used any Facebook reaction button associated with the social media content. If the Facebook user used a reaction button to the given cessation support content, we also recorded the type of reaction button utilized: "Like ", "Love ", "Haha ", "Wow ", "Sad ", "Angry ".

The comments were categorized into different groups according to the Transtheoretical Model and the Motivational Interviewing approach. The analyzed comments did not contain personal or sensitive data, and the purpose of the comment analysis was to examine the verbalization of the smoking cessation process. The processes of change are specific actions that are taken by smokers in order to stop smoking. For instance, the sentence "I read about people who have successfully stopped smoking." is an experiential process ("Consciousness Raising"); while the sentence "I reward myself for small quitting steps." is a behavioral process ("Reinforcement management"). Furthermore, change talk utilized by smokers may indicate motivation for tobacco use cessation or action to quit smoking. The phrase "I wish I could quit smoking." is preparatory change talk ("desire"), while the sentence "I bought a nicotine patch." is mobilizing change talk ("taking steps"). On the other hand, sustain talk used by smokers can reflect demotivation for tobacco use cessation or inaction towards tobacco use cessation. Examples of sustain talk are "I like to smoke cigarettes." ("desire"), and "I smoked my friend's cigarette." ("taking steps"). The original wording of the example sentences has been changed to avoid further identification. In summary, these definitions highlight that only smokers' phrases have been classified. Therefore, the strict use of definitions means that Facebook users



who write these sentences can be considered smokers based on the text. The process of comment analysis is presented in the next subsection.

Definitions of "processes of change":

- These phrases are specific actions (experiential and behavioral processes) that smokers take to quit smoking.
- Experiential Processes. Smokers' phrases that express cognitive, affective, and evaluative processes and are used mainly in the early stage of tobacco use cessation. These five processes are "Consciousness Raising", "Dramatic Relief", "Social Liberation", "Environmental Reevaluation", "Self-reevaluation".
- Behavioral Processes. Smokers' sentences that indicate action-oriented processes used predominantly in a later stage of tobacco use cessation. These five processes are "Self-liberation", "Reinforcement management", "Helping Relationship", "Stimulus Control", "Counter Conditioning".

Definitions of "motivational language":

- Smokers' phrases who express motivation/demotivation for tobacco use cessation or action/inaction towards tobacco use cessation (change talk/sustain talk).
- Change talk. These phrases used by smokers who favour movements toward tobacco use cessation. Subtypes of change talk: "Desire, Ability, Reason, Need" (acronym: DARN, "preparatory change talk") and "Commitment, Activation, Taking steps" (acronym: CAT, "mobilizing change talk").
- Sustain talk. Smoker's sentences that favour continuing tobacco use rather than moving toward tobacco use cessation.

### 3.4.1 First Research

Firstly, the content analysis of the first research is presented. At the beginning, the comments were divided into two approximately identical groups based on the topic. A total of 47% of the comments (N=382) dealt with smoking cessation, and this group was further classified. Only smokers' comments were evaluated as a cessation topic. For instance, we excluded comments like "I disagree with this post." or "I really like this post." The comments which were in connection with cessation and were written by non-smokers were categorized as non-cessation topic. For example, "My husband threw away his cigarettes" – from this sentence it is not obvious whether the speaker is a smoker or not. Therefore, this was classified as a non-cessation topic. However, comments like "I threw out my cigarette" were added to the cessation-topics as from these it is clear that the person is a smoker. In summary, while non-smokers do not write comments on the psychological process of their smoking cessation, smokers do.

Ten processes of change were differentiated. A comment could include more than one processes of change subcategories, but only one from each subcategory. A total of 260 processes of change were detected in the analysis, of which 150 (58%) were experiential processes, and 110 (42%) behavioral processes. Therefore, not all comments on cessation contained processes of change. Two raters categorized all the 821 first comments separately into experiential processes, behavioral processes and comments which were not related to cessation (Cohen kappa value of 0.935).

Comments on cessation (N=382) were also classified into change talk and sustain talk in accordance with Motivational Interviewing. A comment could have change talk and sustain talk separately or both. A total of 778 motivational utterances were detected in the analysis, of which 475 (61%) were change talk and 303 (39%) sustain talk. Thus, all comments on smoking cessation could be classified through the Motivational Interviewing. Two raters categorized the comments studied separately into change talk, sustain talk, and comments which were not relevant to cessation (Cohen kappa value of 0.944). Comments about cessation may include more than one process of change, change talk, or sustain talk. It could happen that the same text fell into both linguistic categories of process of change and change talk, but this combination was rare. This fact shows the similarities between the two psychological theories. Nevertheless, the low number of texts in both linguistic categories did not influence the statistical analysis.

### 3.4.2 Second Research

The second research focused on analyzing the reach data and interaction data of the chosen Facebook posts. It is important to underline that only the original content published by the Facebook page was selected for the analysis. Content shared by others was not reviewed as it may affect the data accession. Facebook introduced the engagement bait in Hungary on June 25, 2018. We investigated Facebook posts over a three-year period starting from that date. A total of 1,026 pieces of social content were published on the Facebook page studied between June 25, 2018, and June 25, 2021. Of these, a total of 791 Facebook posts were shortlisted for the research based on the following exclusion criteria.

We excluded 99 Facebook posts that did not support smoking cessation (e.g., admin posts, posts of ex-smokers, posts related to secondhand smoke). Thus, only Facebook posts supporting smoking cessation were included in the research. This allowed us to discover if pro-quitting engagement bait content is sanctioned by Facebook. If not, Facebook supposedly considers smoking cessation support as "useful for people" and exempts this content from sanctions. We then excluded 10 posts that were not image-based (e.g., containing only a video or link). This was essential since the algorithmic content ranking is influenced by the type of post (e.g., video or image-based post) [72]. Content ranking is also affected by the time of publication, [72] but there was no need to exclude content in this respect as it was published at the same time (17.00 on weekdays and 13.00 on weekends). Besides this, content ranking was also influenced by paid advertising, so this was also an exclusion criteria. We excluded 126 'boosted' Facebook posts, which were promoted by paid Facebook advertising after publication to get more followers. In summary, 791 Facebook posts met the inclusion criteria, i.e., they were image-based, non-paid, they aimed at promoting smoking cessation, and were published at the studied time interval.

In Textbox 1 we report the 5-5 subcategories of the engagement bait and the alternative strategies groups. The five subcategories for engagement bait are: react baiting, comment baiting, share baiting, tag baiting, and vote baiting. In these instances, the text of the Facebook posts or the used image included some instructions that encouraged users to interact. (e.g., "Like this!" or "Share this!"). The subcategory is named in accordance with the interaction to which it is directed (e.g., "Like this!" – react baiting). These subcategories have been designed in line with the engagement bait subcategories defined in the Facebook Community Guidelines. The authors' alternative strategies use questioning strategies that encourage people to interact without engagement bait (without instructions). For instance, the

questions emphasise the emotional background of the Facebook post and use questions about emotions instead of reaction baiting: "This Facebook post illustrates the initial emotions of smoking cessation. What about your feelings? How do you feel in this situation?".

The two raters separately categorized all the 791 Facebook posts into engagement bait, alternative strategies, and control group categories (Cohen kappa value of 0.972). There were seventy-five Facebook posts that met the requirements of the five engagement bait subcategories. In all, 341 contents used alternative strategies without engagement bait. The control group was composed of 375 Facebook posts that did not use engagement bait or alternatives strategies.

The percentage distribution of the five subcategories in the engagement bait group was the following: react baiting – 16%, comment baiting – 65%, share baiting – 1%, tag baiting - 15%, and vote baiting – 3%. A post may include multiple engagement bait subcategories, but only one of each subcategory. The percentage distribution of the five subcategories in the alternative strategies group was the following: questions instead of react baiting – 2%, questions instead of comment baiting – 94%, questions instead of tag baiting – 3%, and questions instead of share/vote baiting – less than 1%. A post may include various alternative subcategories, but only one of each subcategory. Due to the low number of items in the subcategories, the engagement bait and alternative strategies groups were used jointly for statistical analysis.

Textbox 1. Definitions of Facebook post categories used in this research.

### **1) Engagement Bait**

"Engagement bait" is a tactic to create Facebook posts that encourage people to interact, through likes, shares, comments, and other actions, to artificially increase engagement and get greater reach on News Feed.

- a) *React baiting*. Asking people to react to the post (includes "Like", "Love", "Haha", "Wow", "Sad", and "Angry").
- b) *Comment baiting*. Asking people to comment with specific answers (words, numbers, phrases, or emojis).
- c) *Share baiting*: Asking people to share the post with their friends.
- d) *Tag baiting*: Asking people to tag their friends.
- e) *Vote baiting*: Asking people to vote by reactions, comments, sharing, or other means of representing a vote.

## 2) Alternative Strategies in place of Engagement Bait

These asking strategies encourage people to interact without engagement bait. These strategies utilize questions, rather than instructions.

- a) *Questions instead of react baiting.* Emphasis on the emotional background of the content. Using questions about emotions associated with the content. (e.g., "This Facebook post illustrate the initial emotions of smoking cessation. What about your feelings? How do you feel in this situation?").
- b) *Questions instead of comment baiting.* The use of open questions about the topic of the content (e.g., "We are curious about your experience. What is your experience with this aspect of quitting smoking?").
- c) *Questions instead of share baiting:* Emphasis on the benefits of the particular content for the community. Utilizing questions that enable Facebook users to identify themselves with the content (e.g., "This Facebook post helps smoking cessation during pregnancy. Is this aim important to you, too? ").
- d) *Questions instead of tag baiting:* Using questions about people could potentially benefit from the particular content, and who are close to the Facebook user (e.g., "Is there anyone in your environment who can draw strength to quit smoking from this Facebook post? ").
- e) *Questions instead of vote baiting:* Emphasis on the responses of two different communities to the given content. Using questions that enable Facebook users to choose between the featured interactions (e.g., "Smokers and non-smokers can express different emotions because of this Facebook post. What is your response? ").

In the Textbox 2 the reach data and the post-level interaction data are presented. The reach data indicates how many users have seen a particular Facebook post. It is an indicator of algorithmic content ranking. The higher the value, the more users the Facebook post reached, i.e., the higher Facebook ranked the content in users' News Feeds. The contrary is also true. The lower the reach, the fewer users the content reached, and the lower Facebook ranked the post in users' News Feeds. As we excluded advertised Facebook posts from the analysis, we only utilized unpaid reach data. Facebook also gives accession data to the page administrator which identifies the people reached by the Facebook post: fans or nonfans. This allows users to be grouped by their previous activity: whether they have liked the Facebook page before. The fan reach is the number of people who had previously liked the Facebook page and saw the given post on Facebook. The nonfan reach is the number of people who had not liked the Facebook page before, and they saw the particular post. The total reach is the sum of fan reach and nonfan reach. These data show whether Facebook ranked the content higher or lower in the News Feed of page fans or nonfans.

The interaction rates were calculated by dividing the number of people who used any specific buttons or performed other clicks in relation to the given Facebook post (interactions) by the number of people who saw the post (total reach). The use of interaction rates is a correction of interaction data. The problem with the absolute number of interactions is that the reach data has a direct influence on the interaction data, and vice versa. If more Facebook users view the post, they are more likely to use the interaction buttons. If a Facebook post receives more interactions, the Facebook's algorithm ranks that content higher in users' News Feed [72]. Therefore, in the current research we used "interaction rates" to express the frequency of the given interaction at the same reach. Facebook interactions can be an indicator of how social media increases the usage of a Facebook-based intervention (reactions, shares, comments, clicks) or decrease it (negative Facebook interactions). The total number of negative Facebook interactions was used in the analysis, as it was available together and not separately.

Textbox 2. Definitions of post-level data used in the current investigation.

**1) Reach data**

- a) *Fan reach*. The number of people who liked the Facebook page before seeing the specific Facebook post.
- b) *Nonfan reach*. The number of people who did not liked the Facebook page before seeing the specific Facebook post.
- c) *Total reach*. The number of people who saw the given Facebook post. (The sum of fan reach and nonfan reach.)

**2) Interaction data**

- a) *Interaction rate*. The number of people who utilized any specific buttons or performed other clicks regarding to the given Facebook post (interactions) divided by the number of people who saw the post (total reach).
- b) *Reaction rate*. The number of people who used a "Like", "Love", "Haha", "Wow", "Sad", or "Angry" reaction button to express their emotions (reactions) divided by the number of people who saw the post (total reach).
- c) *Comment rate*. The number of people who utilized the 'comment' button to publish a text or an image message (comments) divided by the number of people who saw the post (total reach).
- d) *Share rate*. The number of people who used the 'share' button to send the content to others (shares) divided by the number of people who saw the post (total reach).
- e) *Click rate*. The number of people who utilized any other actions, for instance, to view the Facebook page profile, or to expand photos to full screen (clicks) divided by the number of people who viewed the post (total reach).

- f) *Engagement rate*. The number of people who used reaction buttons, commented, clicked, or shared on the Facebook post (engagement) divided by the number of people who saw the post (total reach).
- g) *The rate of negative interactions*. The number of people who hid the Facebook post, reported the Facebook post as a spam, or unliked the Facebook page (negative interactions) divided by the number of people who viewed the post (total reach).

### 3.5 Statistical analysis

We used a non-parametric statistical test, because neither the number of motivational words (first research), nor the reach and activity data of Facebook posts (second research) were with normal distribution. In the statistical analysis of the first research, Pearson's Chi-square test was used to compare these categorical variables, and the effect size was determined using Cramer's V coefficient. The study groups were identified as the combination of writing comments and using specific reaction buttons. In the comparison group, comments were written without using the reaction buttons. The statistical analysis was conducted once the comments were classified.

In the second research, the Kruskal-Wallis H test was applied in conjunction with the Dunn test. For comparison, the effect size was calculated in each case using eta squared. First, we investigated the reach data for the study groups and the control group. Then we made a comparison of the proportion of different reaction buttons used between the groups. Finally, differences in interaction rates were studied.

All analyses were performed using the Statistical Package for the Social Sciences software. A p-value of less than 0.05 was considered a significant effect, and a p-value of less than 0.001 was considered a highly significant effect.

## 4 Results

### 4.1 First Research

#### 4.1.1 Engagement: comments and reaction button

The number and percentage distribution of comments in the different categories are summarized in Table 1. About 20% of the Facebook users who commented used one of the reaction buttons, whereas the majority (80%) did not combine commenting with Facebook reactions. There was no significant difference between the cessation-related and non-cessation-related comments concerning the combination of comments with the usage of the reaction buttons (20.4%, 20.7%). Because of the low proportion of combinations, statistical analysis of the six different reaction types was not realizable, however, some trends can be perceived. For instance, cessation-related comments were combined with notably fewer "Haha" reactions (3.9%) than comments which were not related to cessation (6.2%). There was no significant difference in the combinations based on the Transtheoretical Model and Motivational Interviewing, nevertheless, we could observe interesting trends in the psycholinguistic categories. People who formulated experiential processes or sustain talk in their comments were less likely to use reaction buttons than the average (14.7% and 15.8%, respectively). In contrast, the proportion of people who used reaction buttons was higher than the average among those who formulated behavioral processes or change talk (26.9% and 22.5%, respectively). As mentioned so far, there was no significant difference between the examined comment categories regarding the combination of comments with the use of the reaction buttons. Nonetheless, this classification did not take into account the number of processes of change or motivational utterances identified in a comment.

Our research also focused on verbal expressions and gender differences. Significant gender differences were observed during the psychological analysis of the comments. There was a clear male dominance among commentators who did not favour cessation (the control group) 63.9% were men and 36.1% women. In contrast, significantly more female Facebook users (46.2%) wrote about cessation ( $\chi^2(1)=8,468$ ,  $P=.004$ , Cramer's  $V: 0.102$ ). We also found significant gender differences in the subgroups based on the Transtheoretical Model and Motivational Interviewing. In contrast to the male dominance of the control group, in the case of comments containing experiential processes, significant female dominance was observed (63.9% female, 36.1% male). However, there was no significant gender difference between the



comments containing behavioral processes and those having experiential processes and behavioral processes together (48.1–51.9% and 50.0–50.0% female–male ratio). Gender differences between the Transtheoretical Model subgroups and the control group were found to be highly significant using the Chi-square test ( $\chi^2(3)=28.965$ ,  $P=.001$ , Cramer’s V: 0.212). Finally, compared to the control group, significantly more women wrote comments containing change talk (57.2% female, 42.8% male), and significantly more men had comments containing sustain talk (79.8% male, 20.2% female). There was no significant gender difference between comments containing change talk and sustain talk together (48.8% female, 51.2% male). Gender differences between the Motivational Interviewing subgroups and the control group were found to be highly significant using the Chi-square test ( $\chi^2(3)=45.081$ ,  $P=.001$ , Cramer’s V: 0.236). Overall, compared to the control group, significantly more women wrote cessation-related comments, using especially experiential processes and change talk, and significantly more men used statements having sustain talk.

**Table 1.** The number (n) and the distribution (%) of comments in different categories in accordance with the Transtheoretical Model and Motivational Interviewing (N=821).

Comments, n (%)										
	Facebook user’s gender		Combination of comment and reaction		Types of the combined Facebook reaction					
	Female	Male	Non-combined	Combined	Like	Love	Haha	Wow	Sad	Angry
<b>Comments by topic</b>										
Cessation Topic										
(N=382)	174 <sup>a</sup> (46.2)	203 <sup>a</sup> (53.8)	304 (79.6)	78 (20.4)	49 (12.8)	10 (2.6)	15 (3.9)	1 (0.3)	0 (0.0)	3 (0.8)
Non-cessation Topic (Control Group)										
(N=439)	157 <sup>a</sup> (36.1)	278 <sup>a</sup> (63.9)	348 (79.3)	91 (20.7)	47 (10.7)	9 (2.1)	27 (6.2)	4 (0.9)	2 (0.5)	2 (0.5)
<b>Comments by “Transtheoretical Model”</b>										
Experiential Processes										
(N=109)	69 <sup>b</sup> (63.9)	39 <sup>b</sup> (36.1)	93 (85.3)	16 (14.7)	13 (11.9)	1 (0.9)	1 (0.9)	0 (0.0)	0 (0.0)	1 (0.9)

Behavioral Processes

(N=78)	37 <sup>b</sup> (48.1)	40 <sup>b</sup> (51.9)	57 (73.1)	21 (26.9)	12 (15.4)	4 (5.1)	4 (5.1)	0 (0.0)	0 (0.0)	1 (1.3)
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Experiential Processes and Behavioral Processes

(N=23)	11 <sup>b</sup> (50.0)	11 <sup>b</sup> (50.0)	17 (73.9)	6 (26.1)	3 (13.0)	3 (13.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
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Non-cessation Topic (Control Group)

(N=439)	157 <sup>b</sup> (36.1)	278 <sup>b</sup> (63.9)	348 (79.3)	91 (20.7)	47 (10.7)	9 (2.1)	27 (6.2)	4 (0.9)	2 (0.5)	2 (0.5)
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**Comments by “Motivational Interviewing”**

Change Talk

(N=204)	115 <sup>b</sup> (57.2)	86 <sup>b</sup> (42.8)	158 (77.5)	46 (22.5)	32 (15.7)	7 (3.4)	5 (2.5)	1 (0.5)	0 (0.0)	1 (0.5)
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Sustain Talk

(N=95)	19 <sup>b</sup> (20.2)	75 <sup>b</sup> (79.8)	80 (84.2)	15 (15.8)	7 (7.4)	0 (0.0)	6 (6.3)	0 (0.0)	0 (0.0)	2 (2.1)
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Change Talk and Sustain Talk

(N=83)	40 <sup>b</sup> (48.8)	42 <sup>b</sup> (51.2)	66 (79.5)	17 (20.5)	10 (12.0)	3 (3.6)	4 (4.8)	0 (0.0)	0 (0.0)	0 (0.0)
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Non-cessation Topic (Control Group)

(N=439)	157 <sup>b</sup> (36.1)	278 <sup>b</sup> (63.9)	348 (79.3)	91 (20.7)	47 (10.7)	9 (2.1)	27 (6.2)	4 (0.9)	2 (0.5)	2 (0.5)
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<sup>a</sup> Significant difference,  $P < .05$  (2-tailed).

<sup>b</sup> Highly significant difference,  $P < .001$  (2-tailed).

**4.1.2 Smokers’ engagement based on TTM**

When analyzing the comments related to smoking cessation, it was obvious that these comments were written by smokers. Using TTM, we compared the number and proportion of psycholinguistic categories with the use of reaction buttons, which is summarized in Table 2. We found that, compared to male smokers, female smokers used more processes of change, including more experiential processes, when reacting to Facebook post which supported smoking cessation. Male smokers used 0.50 (SD: 0.60) processes of change on average, while female smokers used significantly more, 0.74 (SD: 0.57) ( $U=13764$ ,  $P<.001$ ,  $\eta^2=0.036$ ). A similar significant difference was observed in the number of experiential processes. While men had an average of 0.42 (SD: 0.55) experiential processes, women noted 0.60 (SD: 0.65) ( $U=8740$ ,  $P=.018$ ,  $\eta^2=0.015$ ). No significant gender difference was found in the number of behavioral processes ( $P=.109$ ). Finally, we also observed female dominance in relation to the proportion of experiential processes. Compared to all processes of change, 49% of men and 64% of women used experiential processes ( $U=4425$ ,  $P=.028$ ,  $\eta^2=0.019$ ). In general, it seems that the processes of change, particularly experiential processes, are more characteristic of female smokers than male smokers.

Our next research question on the Transtheoretical Model drew attention to the relationship between the processes of change and the use of Facebook reaction buttons. Our results demonstrate that Facebook users who used a specific type of reaction button did not utilize significantly more experiential or behavioral processes than those who did not use Facebook reactions along with their comments. In this analysis, only one significant difference in the total number of processes was found by performing the Kruskal-Wallis H test ( $\chi^2(3)=8.347$ ,  $P=.039$ ,  $\eta^2=0.014$ ). Dunn's pairwise test was applied to identify the significant difference. Hence, we observed that those who combined their comments with "Love" reaction used significantly more linguistic categories expressing processes of change than those who combined their comment with "Haha" reaction, 1.10 (SD: 0.74) and 0.33 (SD: 0.49), respectively. Though the Dunn's pairwise test did not show a significant difference between those who utilized a reaction combination and those who did not. It is worth underlining a trend which is nearly significant ( $P=.066$ ). Compared to all processes of change, smokers using the reaction buttons utilized fewer experiential processes (61% vs. 52-31-20%) and more behavioral processes (39% vs. 48-69-80%) than those who did not utilized Facebook reactions along with their comments. In conclusion, we identified only one noteworthy association between the number of processes of change and the usage of Facebook reactions.

The above results partly answer the question of which psychological model is able to explore the relationship between the verbalization of health behavior change and the usage of Facebook reactions: The Transtheoretical Model or the Motivational Interviewing Approach. The Transtheoretical Model alone cannot be completely applicable for investigating the association between health behavior change and the usage of Facebook reactions.

**Table 2.** The mean and the SD for the processes applied in the Transtheoretical Model by the combination of comments with reactions.

<b>Processes of Change, mean (SD)</b>					
<b>Facebook user's gender</b>		<b>Combination of comment and reaction</b>			
<b>Female</b>	<b>Male</b>	<b>Non-combined</b>	<b>Like</b>	<b>Love</b>	<b>Haha</b>
(n=174)	(n=203)	(n=304)	(n=49)	(n=10)	(n=15)
Experiential Processes (EP)					
0.60 <sup>a</sup>	0.42 <sup>a</sup>	0.56	0.40	0.50	0.11
(0.65)	(0.55)	(0.63)	(0.54)	(0.70)	(0.33)
Behavioral Processes (BP)					
0.32	0.44	0.36	0.37	0.80	0.44
(0.51)	(0.60)	(0.55)	(0.54)	(0.63)	(0.53)
All Processes of Change (EP+BP)					
0.74 <sup>b</sup>	0.50 <sup>b</sup>	0.61 <sup>a</sup>	0.63 <sup>a</sup>	1.10 <sup>a</sup>	0.33 <sup>a</sup>
(0.57)	(0.60)	(0.59)	(0.60)	(0.74)	(0.49)
The Proportion of Experiential Processes [EP/(EP+BP)]					
0.64 <sup>a</sup>	0.49 <sup>a</sup>	0.61	0.52	0.31	0.20
(0.46)	(0.47)	(0.46)	(0.48)	(0.37)	(0.45)
The Proportion of Behavioral Processes [BP/(EP+BP)]					
0.36 <sup>a</sup>	0.51 <sup>a</sup>	0.39	0.48	0.69	0.80
(0.46)	(0.47)	(0.46)	(0.48)	(0.37)	(0.45)

<sup>a</sup> Significant difference,  $P < .05$  (2-tailed).

<sup>b</sup> Highly significant difference,  $P < .001$  (2-tailed).

### 4.1.3 Smokers' engagement based on MI

In the comments related to smoking cessation, we examined the number and proportion of motivational linguistic categories and compared them to the use of reaction buttons, which are summarized in Table 3. Here again, the text of the comments made it apparent that the comments were written by smokers. Our first research question was "What is the relationship between smokers' gender and verbal expressions from the Transtheoretical Model and Motivational Interviewing? "

We found that female smokers wrote significantly more motivational utterances and change talk, while male smokers used significantly more sustain talk under contents supporting smoking cessation. Women wrote significantly more motivational utterances ( $U=12915$ ,  $P<.001$ ,  $\eta^2=0.054$ ), with an average of 2.01 (SD: 1.06), while men had an average of 1.59 (SD: 1.00). A similar significant difference was observed in the number of change talk. Female smokers used 1.60 (SD: 0.95) change talk ( $U=10765$ ,  $P<.001$ ,  $\eta^2=0.112$ ), while male smokers wrote an average of 0.94 (SD: 0.92). In contrast, the number of sustain talk was dominated by males. Men wrote significantly more, 0.66 (SD: 0.65) sustain talk ( $U=13527$ ,  $P<.001$ ,  $\eta^2=0.039$ ), while women used an average of 0.41 (SD: 0.63). Finally, we also observed female dominance in relation to the proportion of change talk. Compared to all motivational utterances, 79% of women and 53% of men used change talk ( $U=12131$ ,  $P<.001$ ,  $\eta^2=0.071$ ). Overall, based on our results, female smokers are characterized by a high number of motivational utterances and change talk, while male smokers are more likely to use sustain talk.

Our second research question, related to the Motivational Interviewing approach, examines how smokers express the motivational language in combination with Facebook reaction buttons. Our findings indicate that Facebook users who wrote high number of motivational utterances and change talk matched their comments with "Love" reactions. We observed a significant difference in the number of motivational utterances among those who utilized reaction buttons performing Kruskal-Wallis H test ( $\chi^2(3)=12.825$ ,  $P=.005$ ,  $\eta^2=0.026$ ). The number of motivational utterances was the highest among those who used the combination of comment and "Love" reaction (mean: 3.10, SD: 1.37). Dunn's pairwise test showed that this value was significantly higher in comparison to the "Haha" (mean: 1.47, SD: 0.74,  $P=.006$ ), and "Like" (mean: 1.69, SD: 1.08,  $P=.006$ ) reaction combination and among those not utilizing the reaction combination (mean: 1.78, SD: 1.03,  $P=.007$ ). We found a similar significant difference in the number of change talk ( $\chi^2(3)=19.243$ ,  $P<.001$ ,  $\eta^2=0.043$ ). The number of change talk was also particularly notable among those who used the combination of comment and "Love" reaction (mean: 2.60, SD: 0.97). Dunn's pairwise test verified that this value was significantly higher in comparison to the "Haha" (mean: 0.67, SD: 0.72,  $P<.001$ ) and "Like"

reaction combination (mean: 1.24, SD: 0.78,  $P=.006$ ), and among those who did not utilize them (mean: 1.24, SD: 0.99,  $P=.001$ ). Overall, the combination of comment and "Love" reaction is characterized by a high number of motivational utterances and change talk.

The proportion of motivational language subcategories was also compared to the usage of reaction buttons. Some significant differences were found ( $\chi^2 (3) = 11.116$ ,  $P=.011$ ,  $\eta^2 = 0.022$ ). In comparison with all motivational utterances, smokers utilizing the "Haha" reaction button wrote a significantly lower proportion of change talk (40%) than those reacted with the "Like" (76%,  $P=.026$ ) or "Love" reactions (89%,  $P=.042$ ). Additionally, this means that those who utilized the "Haha" reaction button wrote a significantly higher proportion of sustain talk (60%) than those who used the "Like" (24%,  $P=.026$ ) or "Love" reaction (11%,  $P=.042$ ). On the whole, the combination of comment and "Haha" reaction is characterized by a high proportion of sustain talk.

Comparing Table 2 with Table 3, we observed more significant associations between motivational language and reactions than processes of change and reactions. Thus, motivational language seems to be more appropriate for investigating the relationship between the verbalization of the smoking cessation process and the usage of Facebook reactions.

**Table 3.** The mean and the SD of change talk and sustain talk by combinations with reactions.

<b>Motivational language, mean (SD)</b>					
<b>Facebook user's gender</b>		<b>Combination of comment and reaction</b>			
<b>Female</b>	<b>Male</b>	<b>Non-combined</b>	<b>Like</b>	<b>Love</b>	<b>Haha</b>
(n=174)	(n=203)	(n=304)	(n=49)	(n=10)	(n=15)
Change Talk (CT)					
1.60 <sup>b</sup>	0.94 <sup>b</sup>	1.24 <sup>b</sup>	1.24 <sup>b</sup>	2.60 <sup>b</sup>	0.67 <sup>b</sup>
(0.95)	(0.92)	(0.99)	(0.78)	(0.97)	(0.72)
Sustain Talk (ST)					
0.41 <sup>b</sup>	0.66 <sup>b</sup>	0.54	0.45	0.50	0.80
(0.63)	(0.65)	(0.62)	(0.77)	(0.85)	(0.56)
All Motivational Utterances (CT+ST)					
2.01 <sup>b</sup>	1.59 <sup>b</sup>	1.78 <sup>a</sup>	1.69 <sup>a</sup>	3.10 <sup>a</sup>	1.47 <sup>a</sup>
(1.06)	(1.00)	(1.03)	(1.08)	(1.37)	(0.74)
The Proportion of Change Talk [CT/(CT+ST)]					

0.79 <sup>b</sup>	0.53 <sup>b</sup>	0.64 <sup>a</sup>	0.76 <sup>a</sup>	0.89 <sup>a</sup>	0.40 <sup>a</sup>
(0.34)	(0.45)	(0.42)	(0.37)	(0.19)	(0.44)
The Proportion of Sustain Talk [ST/(CT+ST)]					
0.21 <sup>b</sup>	0.47 <sup>b</sup>	0.36 <sup>a</sup>	0.24 <sup>a</sup>	0.11 <sup>a</sup>	0.60 <sup>a</sup>
(0.34)	(0.45)	(0.42)	(0.37)	(0.19)	(0.44)

<sup>a</sup> Significant difference,  $P < .05$  (2-tailed).

<sup>b</sup> Highly significant difference,  $P < .001$  (2-tailed).

## 4.2 Second Research

### 4.2.1 Ranking of engagement-enhancing contents

The major focus of the second research was on reach data analysis. The results of the second research on how Facebook limited the reach of "engagement bait" and alternative strategy content are presented. If a given Facebook post type reached fewer users on average, it indicates that the Facebook algorithm placed that content type further down in users' News Feeds. We summarized the results in Table 4. First, the engagement bait group is compared with the control group. Our research question was: "How does Facebook sanction engagement bait posts that support smoking cessation? "

We observed that fan reach was significantly lower in the engagement bait group in comparison to the control group. Nevertheless, no significant differences were found for nonfan reach and total reach. The Kruskal-Wallis H test showed significance only for fan reach ( $\chi^2(2) = 6.930, P = .031, \eta^2 = 0.006$ ). We used Dunn's test to identify significant differences. Posts utilizing the "engagement bait" tactic reached an average of 809.9 people (SD: 428.6), whereas the control group posts reached significantly more, an average of 978.1 people (SD: 555.5), based on Dunn's test ( $P = .049$ ). In conclusion, the usage of the "engagement bait" tactic did not significantly decrease total reach, only fan reach.

Next, we compare the alternative strategies used instead of the "engagement bait" to the control group. Our research question was: "What are the advantages of using alternative strategies over engagement bait in reaching and engaging Facebook users? " No significant differences were observed between the alternative strategies and the control group for fan reach, nonfan reach, and total reach. It is also worth mentioning that there is a downward trend for all three accesses. The average reach was lowest for the engagement bait (e.g., total reach: 1284.3) and highest for the control group (e.g., total reach: 1505.7). The average reach of contents using the alternative strategies was between the other two groups (e.g., total reach:

1401.5). In summary, despite the reach of the alternative strategies was lower in comparison to the control group, it was not significantly different.

**Table 4.** The mean and the SD of fan, nonfan, and total organic reach by engagement bait, alternative strategies, and the control group.

	<b>Organic Reach; mean (SD)</b>		
	<i>Engagement Bait</i>	<i>Alternative strategies</i>	<i>Control Group</i>
<i>Fan Reach</i>	809.9* (428.6)	908.7 (538.7)	978.1* (555.5)
<i>Nonfan Reach</i>	474.4 (531.9)	493.7 (424.2)	524.4 (752.7)
<i>Total Reach</i>	1284.3 (787.7)	1401.5 (849.9)	1505.7 (1103.3)

\*Significant difference,  $P < .05$  (2-tailed).

\*\*Highly significant difference,  $P < .001$  (2-tailed).

#### 4.2.2 Enhancing engagement in the light of Facebook reactions

In the following, we present how Facebook users utilized reaction buttons for different types of content, which are summarized in Table 5. First, the engagement bait group was compared with the control group. We observed that significantly fewer "Haha" response buttons were utilized in response to the engagement bait techniques than in the control group. However, no other significant differences were confirmed. The analysis showed that out of 1,000 Facebook users, an average of 11.49 (SD: 5.25) had a "Like" reaction to "engagement bait" posts, which is essentially the same as in the case of the control group, where 11.05 (SD: 5.08) gave such a reaction. Likewise, almost identical proportion was observed in the case of the "Sad" reaction. For three response buttons ("Love", "Angry", and "Wow"), the interaction rate was higher in the engagement bait group than in the control group, but the differences were not significant. Performing the Kruskal-Wallis H test, we found a significant correlation only in the "Haha" reaction rate ( $\chi^2(2) = 15.818$ ,  $P < .001$ ,  $\eta^2 = 0.018$ ). Dunn's pairwise test confirmed



the difference between the engagement bait techniques and the control group. Out of 1,000 Facebook users, an average of 1.38 people (SD: 2.91) reacted with "Haha" to engagement bait-type posts, which is significantly more than in the case of the control group, where 2.37 people (SD: 3.71) utilized such a reaction. In summary, a significant difference was only found for the "Haha" response, which was higher in the control group compared to the engagement bait techniques.

Secondly, we compared the alternative strategies with the control group. We found that, even for the alternative strategies, there was only a significant difference in the case of the "Haha" responses. For the reactions "Like", "Love", "Wow" and "Sad", the average interaction rate was nearly identical between the alternative strategies and the control group. The "Angry" reaction rate was higher in the alternative strategies group, although not significantly. As shown earlier, the Kruskal-Wallis H test revealed a significant difference in the "Haha" response ( $\chi^2(2) = 15.818, P < .001, \eta^2 = 0.018$ ). The post hoc Dunn's pairwise test demonstrated a significant difference between the alternative strategies and the control group. Out of 1,000 Facebook users, an average of 1.52 (SD: 2.97) had a "Haha" reaction to posts utilizing alternative strategies, which is significantly more than in the control group, where 2.37 (SD: 3.71) used such a reaction. Overall, the control group had significantly more "Haha" reactions in comparison to the alternative strategies.

	<b>Interaction Rate; mean (SD)</b>		
	<i>Engagement Bait</i>	<i>Alternative strategies</i>	<i>Control Group</i>
<i>"Like" Rate</i>	11.49 (5.25)	10.39 (5.22)	11.05 (5.08)
<i>"Love" Rate</i>	1.34 (3.74)	0.76 (3.03)	0.71 (3.05)
<i>"Haha" Rate</i>	1.38** (2.91)	1.52** (2.97)	2.37** (3.71)
<i>"Wow" Rate</i>	0.92 (3.52)	0.14 (0.74)	0.20 (1.33)

<i>“Sad” Rate</i>	0.15 (0.47)	0.09 (0.39)	0.11 (0.61)
<i>“Angry” Rate</i>	0.04 (0.16)	0.11 (0.75)	0.02 (0.17)

**Table 5.** The mean and the SD of interaction rate by engagement bait, alternative strategies, and the control group.

\*Significant difference,  $P < .05$  (2-tailed).

\*\*Highly significant difference,  $P < .001$  (2-tailed).

### 4.2.3 Enhancing engagement in the light of interactions

In the following, we present what interaction buttons Facebook users utilized for the different types of content, which we summarized in Table 6. First, we compared the engagement bait group with the control group.

No significant difference was found between the engagement bait group and the control group regarding either interaction rate. It is noteworthy that the reaction rate, comment rate, share rate, click rate and engagement rate were slightly higher for the engagement bait in comparison to the control group. However, the rate of negative interactions was practically the same between the two groups. Overall, we did not find any significant difference between the engagement bait group and the control group, which may be a consequence of the artificial back-ranking of engagement bait content.

Secondly, we compared the alternative strategies with the control group. We observed that the alternative strategies had a significantly lower reaction rate and rate of negative interactions, and a significantly higher click rate in comparison to the control group. No significant difference was detected for the other interaction rates. Applying the Kruskal-Wallis H test, significant correlations were found for reaction rate ( $\chi^2(2) = 10.492$ ,  $P = .005$ ,  $\eta^2 = 0.011$ ), rate of negative interactions ( $\chi^2(2) = 6.891$ ,  $P = .032$ ,  $\eta^2 = 0.006$ ), and click rate ( $\chi^2(2) = 8.072$ ,  $P = .018$ ,  $\eta^2 = 0.008$ ). Dunn's pairwise test showed a significant difference between the alternative strategies and the control group in terms of all three interaction rates. Out of 1,000 Facebook users, an average of 13.02 (SD: 7.81) utilized a reaction button for posts along with the alternative strategy and 0.06 (SD: 0.20) a negative Facebook interaction. These values are significantly lower in comparison to the control group, where an average of 14.46 people (SD: 7.76) used a reaction button ( $P = .006$ ) and 0.12 people (SD: 0.34) a Facebook negative interaction ( $P = .028$ ). The click rate was significantly higher in the case of the alternative

strategies group ( $P=.021$ ). Out of 1,000 Facebook users, posts utilizing alternative strategies had an average of 46.16 clicks (SD: 41.48), whilst control content received 37.30 clicks (31.98). No difference was found in the share rate between the two groups. The comment rate and engagement rate were slightly higher in the case of the alternative strategies, but this difference was not significant. In summary, the disadvantage of utilizing alternative strategies might be that they can decrease the reaction rate, however, they have the dual advantage of increasing the click rate whilst reducing the rate of negative interactions.

**Table 6.** The mean and the SD of interaction rate by engagement bait, alternative strategies, and the control group.

	<b>Interaction Rate; mean (SD)</b>		
	<i>Engagement Bait</i>	<i>Alternative strategies</i>	<i>Control Group</i>
<i>Reaction Rate</i>	15.32 (10.10)	13.02* (7.81)	14.46* (7.76)
<i>Comment Rate</i>	2.10 (3.58)	2.19 (3.73)	1.64 (2.84)
<i>Share Rate</i>	1.34 (1.38)	1.25 (1.19)	1.27 (1.20)
<i>Click Rate</i>	45.24 (36.22)	46.16* (41.48)	37.30* (31.98)
<i>Engagement Rate</i>	79.31 (39.78)	75.63 (46.72)	69.13 (38.05)
<i>The Rate of Negative Interactions</i>	0.13 (0.43)	0.06* (0.20)	0.12* (0.34)

\*Significant difference,  $P<.05$  (2-tailed).

\*\*Highly significant difference,  $P<.001$  (2-tailed).

## 5 Discussion

In the first research, our main aim was to evaluate the relationship between the usage of Facebook reaction buttons and the verbalization of the smoking cessation process ("processes of change", "verbal expressions") during a Facebook-based intervention. In the second research, our intention was to assess the impact of engagement bait on content ranking and the Facebook user activity.

Firstly, the findings of the first research are shown. It suggests that smokers can express the process of their smoking cessation using Facebook reaction buttons in addition to psycholinguistic categories. Thus, these verbal and visual ways of expression are linked on Facebook, and they are combined by the users. We found multiple significant associations between the number of motivational utterances and the usage of Facebook reactions. Those who used a combination of the comment and "Love" reaction wrote significantly more motivational utterances and change talk than those who utilized the "Haha" and "Like" buttons, or those who did not use these reactions. Furthermore, those who combined the comment and "Haha" reactions were characterized by a high proportion of sustain talk. Smokers can demonstrate change talk with the "Love" reaction, and sustain talk with the "Haha" reaction, in response to Facebook posts supporting smoking cessation. This appears to be an important outcome in this area, as Facebook-based smoking cessation interventions tend to use reaction buttons as a common indicator of engagement, regardless of their emotional context or meaning [74,77-79].

This assumption could also be supported by a significant correlation of these reactions with the number of processes of change. In this case, the ambivalence of the smoking cessation process may be reflected in a strikingly high and remarkably low number of processes of change. The "Love" reaction was associated with a notably high number of processes of change, while among those utilizing the "Haha" reaction, the processes of change were particularly low. This difference proved to be significant. However, no significant difference was observed between those who utilized the reaction button and those who did not use it, in terms of the number of processes of change. Thus, our results suggest that motivational language is more effective in revealing the relationship between verbalization of the smoking cessation process and usage of Facebook reactions than processes of change.

Hypotheses for future testing regarding to reaction buttons:

- "Love" reaction can be associated with a high number of change talk and a large proportion of change talk during Facebook-based smoking cessation interventions.
- "Haha" reaction can be associated with a large proportion of sustain talk during Facebook-based smoking cessation interventions.

The secondary aim was to explore the gender difference of processes of change and verbal expressions during the Facebook-based smoking cessation intervention. Significant female dominance was observed in the number of comments related to cessation, total processes of change, and total motivational utterances. Based on the Transtheoretical Model and Motivational Interviewing, a significant female majority was observed in the presence, the number, and the proportion of experiential processes and change talk in the various subgroups. Men were characterized by comments which were not related to cessation. Furthermore, we found a significant male predominance in the proportion of behavioral processes, as well as in the presence, the number, and the proportion of sustain talk. It is important to emphasize that this does not mean that the Facebook-based smoking cessation support intervention would be more successful among women than men. Rather, it may be explained by the fact that a public Facebook page makes it easier for female smokers to write about their thoughts and experiences of quitting. In contrast, male smokers may be more inclined to voice their doubts and resistance to cessation, and to deflect the conversation with comments not related to cessation. On the other hand, this male attitude also expresses an interest in the contents which support cessation, as the smoker makes a comment instead of being passive. Since the early stages of cessation are characterized by a high number of sustain talk, it can be assumed that male smokers at these stages express interest in cessation support contents in this way. Therefore, sustain talk expressed in comments, which is typical of men, could be a form of male engagement in a Facebook-based smoking cessation intervention. Overall, our results suggest that men responded to cessation support contents with sustain talk, women with experiential processes and change talk.

Secondly, the hypotheses related to gender differences are discussed. Our results suggest that the experiential processes and change talk would be typical of female engagement during Facebook-based smoking cessation interventions. This finding may be relevant for public health professionals who are designing intervention contents to support cessation in female smokers. Facebook posts that deal with experiential processes and use the strategy of

"evoking change talk"; may be more successful in reaching women than men. This hypothesis should be tested in future with randomized controlled trials. Our results on gender differences suggest that sustain talk would be typical of male engagement during Facebook-based smoking cessation interventions. However, this finding may be more useful in moderation work, than in the creation of contents. According to the Motivational Interviewing approach, cessation support contents should not be aimed at generating sustain talks, as this would inhibit health behavior change. However, moderation work in Facebook-based interventions for male smokers should be prepared to handle sustain talks. In this case, the goal of moderation work should be to soften sustain talk and preferably switch to change talk in the chat using "softening sustain talk"; or "sustain talk management"; strategies. A longitudinal study of these moderation strategies is also recommended for the future.

Hypotheses for future testing regarding to female and male engagement:

1. Experiential processes and change talk can be typical of female engagement during Facebook-based smoking cessation interventions.
2. Sustain talk can be typical of male engagement during Facebook-based smoking cessation interventions.

Thirdly, the findings of the second research are presented. Our results indicate that Facebook ranks engagement bait content lower in the fan's News Feed. This is demonstrated by the fact that fan reach was significantly lower in the engagement bait group than in the control group. This may be due to the fact that the fan group is better defined than the nonfan group. Hence, the fan group provides a better opportunity for Facebook to intervene. However, previous research has shown that high rates of page likes can be associated with a high engagement rate for certain content [80]. This implies that limiting fan reach gives Facebook a more vulnerable point of attack to sanction engagement bait content. It can be assumed that by limiting fan reach, engagement rate or other interaction rates can be indirectly better limited. In conclusion, Facebook has sanctioned engagement bait content among visitors of the page. However, this result indicates that Facebook has not exempted content of smoking cessation support from being sanctioned. Therefore, Facebook did not classify this as "benefit to people", despite it is considered socially beneficial content.

The relationship between engagement bait techniques and Facebook users' activity was also investigated. Users pressed significantly fewer "Haha" reaction buttons in response to the engagement bait techniques than in the control group. This could be due to the limitation of fan

reach. We revealed that the "Haha" reaction button is a fan-specific interaction. Moreover, of all Facebook interactions, the "Haha" reaction button correlated most strongly with fan reach [72]. Hence, this reaction button may be the most sensitive to fan reach limitation. Artificially reducing the fan reach of engagement bait content was associated with a decrease in the use of the "Haha" reaction button. This phenomenon underlines the fact that limiting fan reach leads to a reduction in interaction rates. This is due to the fact that in no case was the engagement rate or other interaction rate significantly higher in the engagement bait group in comparison to the control group. Nevertheless, we would expect engagement bait techniques to raise the engagement rate. In summary, it seems that by artificially reducing fan reach, Facebook can assure that interaction rates are not significantly different between the engagement bait group and the control group.

In our second research project, we sought to discover alternative strategies instead of engagement bait that can stimulate engagement without getting lower ranking in users' News Feed. We did not find significant differences between the alternative strategies and the control group in terms of fan reach, nonfan reach, and total reach. This could indicate that Facebook did not perceive this content as engagement bait, and therefore did not rank it lower in users' News Feeds. In other words, alternative strategies appear to be able to circumvent Facebook's engagement bait limitations regarding organic reach. We also found that the alternative strategies had significantly lower rates of negative interactions and significantly higher click rates compared to the control group. Lowering the rate of negative interactions (as a resistance of behavior change) is extremely beneficial, especially in the area of addiction [33,80]. Increasing the click rate can be advantageous for public health campaigns in general [74]. In summary, further studies are required to investigate whether alternative strategies are suitable for stimulating reaction button use.

Hypotheses for future testing regarding to alternative techniques:

- Alternative techniques can stimulate the click rate and inhibit the rate of negative interactions without significantly reducing organic reach.
- Asking strategies that encourage people to interact may result in fewer Facebook reactions, especially "Haha" reaction.

## 5.1 Limitations of our research

Some major limitations of the present work should be considered. In the first research, the sociodemographic data and smoking habits of the participants are not known with precision. Nevertheless, as discussed in the Methods section, the available sociodemographic data were downloaded from the Facebook Insight repository and an online questionnaire was used to assess participants' smoking habits. Secondly, due to the low number of elements, we were unable to analyze the "Wow", "Sad" and "Angry" reaction buttons. The infrequent use of these reaction buttons may be attributed to the fact that the stimuli tested were Facebook posts that promoted smoking cessation based on Motivational Interviewing. Motivational Interviewing is essentially a non-confrontational approach that respects smokers' autonomy, which can result in a low number of such negative emotional responses. It is therefore important to highlight that our results are primarily assessed in relation to the stimulus under research. The examined Facebook posts were based on the Motivational Interviewing approach, which may have influenced the responses of Facebook users (utilizing "motivational language" rather than "processes of change"). Previous research showed that the use of Motivational Interviewing can provoke significantly more "change talk" in smokers [81]. Thus, future investigations should analyze Facebook posts that are not based on the Motivational Interviewing approach.

The primary limitation of the second research is that due to the retrospective nature of the research, there is a disproportionality in the number of items in the subcategories. Engagement bait or the usage of alternative strategies were not taken into account in the preparation of the intervention content. The content was then classified into these groups or subcategories. We corrected this disproportionality by combining the subcategories. In addition, Facebook's Community Guidelines identifies repeated usage of engagement bait as a factor that increases sanctioning. Facebook pages that repeatedly and systematically use engagement bait will be downranked more than individual posts. The Facebook page under study also posted engagement bait content several times during the research period, so the results should be interpreted in this context.



## 6 Conclusions

Regarding our findings in the first research, we observed that the "Like" response may not be a specific engagement indicator for the smoking cessation process. On the contrary, the "Love" and "Haha" reactions may be specific engagement indicators and may visually express the ambivalence of the smoking cessation process. At Facebook post level, smokers who want to quit can use "Love" reaction, while smokers who do not want to quit can utilize "Haha" reaction. These results can be interpreted in the studied online context (smoking cessation support contents as stimuli). This is demonstrated by the fact that the number of change talk, the proportion of change talk, and the number of processes of change were significantly higher among those using the "Love" response, while the percentage of sustain talk was higher and the number of processes of change were significantly lower among those having the "Haha" response. During the motivational interview, the consultant utilizes different communication strategies on the basis of the client's verbal responses (change talk and sustain talk). Our results imply that "Love" and "Haha" reactions, as the client's visual responses, may also be appropriate for the selection of these strategies in this online context. To sum up, from the perspective of health behavior change, the "Haha" reaction may be a negative engagement indicator, the "Like" reaction may be a neutral engagement indicator, and the "Love" reaction may be a positive engagement indicator. Hence, the results of this investigation suggest that measuring and analyzing the processes of change and motivational utterances in Facebook users' comments could be valuable for Facebook-based smoking cessation interventions.

Further inferences can also be drawn about gender differences in engagement, and understanding these differences may be beneficial in editing Facebook posts targeting women or men to support smoking cessation. In our research, female engagement may be characterized by utilizing the terms of experiential processes and change talk. Therefore, Facebook posts that generate experiential processes and change talk can be more successful in increasing female engagement. At the same time, the use of sustain talk may be typical for male engagement. It follows that male engagement can be stimulated by the appropriate use of "softening sustain talk" strategies during moderation work. This suggests that questions targeting such linguistic categories should be avoided when creating Facebook posts to help male smokers quit smoking, and one should be prepared to deal with such utterances when moderating comments. As our research was retrospective in nature, the hypotheses raised are worth testing in future longitudinal studies.

In our second research we succeeded in exploring how Facebook ranks backward engagement bait content in user's News Feeds. Our research also demonstrates that Facebook has not exempted content that supports smoking cessation from the sanctioning of engagement bait. Facebook's Community Guidelines state that it does not sanction socially relevant content (e.g., reporting a missing child). However, our results suggest that, according to Facebook, support for smoking cessation does not fall within this scope. It is therefore proposed to initiate a dialogue between Facebook and international health organizations (e.g., the World Health Organization) with the aim of exempting public health content from Facebook sanctions. The fan reach in post-level may be the intervention point where Facebook's algorithm implements the restriction. As a consequence of this sanctioning, engagement bait content is not able to meaningfully raise the engagement rate or any interaction rate. In summary, engagement bait content is not advisable for Facebook-based public health interventions.

Finally, it is worth pointing out that alternative strategies seem promising for creating Facebook posts supporting smoking cessation. There are some striking conclusions to be drawn from the findings of the investigation on alternatives to engagement baits. The asking strategies we have compiled could help health professionals to avoid sanctioning engagement bait in Facebook-based public health interventions. Alternative strategies may stimulate the click rate and hinder negative interaction rates without significantly reducing organic reach. Increasing the click rate is also an important factor because Facebook sanctions click bait content as well as engagement bait content. Therefore, alternative strategies could be used to avoid sanctioning click bait. In addition, increasing the click rate in public health campaigns in general can also be advantageous [77]. Our future plans include conducting a randomized controlled trial to test these hypotheses.

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